An Experimental Comparison of the Effectiveness of Cool Colors as Environmental Stimulus on the Elderlies in High-rise Condominiums of Kuala Lumpur

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The rapid urban spatial expansion and population growth in recent years has resulted in the development of numerous high-rise condominiums in Kuala Lumpur. Many of these buildings include general relaxation and recreational facilities for the occupants. However, the majority of these spaces are designed to cater for the basic needs of typical residents, with less attention to the expectations of the elderlies. As a result, elderlies residing in such condominiums predominantly prefer to stay in their flats, and this phenomenon can negatively impact their overall health and quality of life. While with an appropriate consideration of shared facilities this occurrence can be solved. In this study, cool colours in fifteen intensities were tested (10 minutes as the test duration for each intensity) on 64 elderly occupants in a 3m×2m test room based on the Quasi-experimental method to evaluate the impacts of cool colours as environmental stimulus in common indoor facilities of condominiums. The participants were the residents of two high-rise condominiums in Kuala Lumpur, and they were all above 60 years old. Their blood pressure, heart beat rate and skin temperature as dependent variables were measured by sphygmomanometer and infrared thermometer as two required instruments and analysed to evaluate their relationship with cool colours and time spent. There are three significant results: Firstly, the lightest intensity of blue-green and green colours have decreased dependent variables with strongest relationship. Secondly, violet has negative impacts by increasing dependent variables. And thirdly, green colour, in general, has decreased dependent variables with positive impact as environmental stimulus while lightest blue-green colour affects the dependents variable faster than the other intensities. Higher rate of dependent variables associated with arousing feeling, while lower rate of dependent variables associated with calm and relaxation feeling. The study concludes that particular cool colours embrace promising potentials to be taken into consideration during the design of indoor spaces, particularly for the elderlies, by architects and interior designers.

Keywords: Elderly Residents, Cool Colours, Common Indoor Facilities, High-rise Condominiums, Environmental Stimulus

1. INTRODUCTION

Perverse dependence of the contemporary human on technology is constantly changing the daily lifestyle (Dociu, 2013). While this might be contributive to enhancing the quality of life regardless of its challenges, it might be unpleasant for the elderly as it might be difficult for them to adapt themselves to these changes (Blažun, et al., 2014). As a result, in many occasions, the elderlies might be

disengaged from the communities and their surroundings, which can negatively affect their health and well-being (Gabriel, et al., 2014). This neglection can commonly lead to the isolation of the elderlies (Iliffe and Manthorpe 2014). Recent studies demonstrate that three challenges of "neglect, isolation and fear" are always connected to each other in the context of the well-being of elderlies (Kurt and Jellinger, 2014). These challenges can get more intensified once being intertwined with the feeling of boredom or idleness (HelpAge India, 2011).

Kuala Lumpur as the most populous city in Malaysia is no exception from this phenomenon. According to the Kuala Lumpur City Hall in 2015, 9.8% of the overall 1.67 million population of the city are elderlies. They are struggling with some physical and psychological issues as a result of disengaging from the communities and their surroundings, which can affect their quality of life and wellbeing (Ainoriza et al., 2016, Lim et al., 2014). Following a personal observation conducted by the researcher as the preliminary study with a focus on 300 elderlies in Kuala Lumpur high-rise condominiums, it has been proven that the elderlies over 60 years old spend the majority of their time at home compared to the other age groups (Ogundele, 2010). The study also reported that approximately 150 to 280 elderly occupants depending on the buildings population live in such condominiums in Kuala Lumpur. In general, most condominiums in Kuala Lumpur have standard facilities for relaxation and entertainment of residents. Nevertheless, the majority of these shared amenities are designed with considerably less attention to the expectation of elderlies (Ogundele, 2010). Referring to the rapid population growth and numerous constructions of high-rise condominiums in Kuala Lumpur (Stella, 2015), the aim of this study is to investigate the quality of typical indoor facilities in these buildings from the elderlies' preferences. To achieve this aim, the objectives are to examine the impacts of cool colors: to explore the spectrum of cool colors; and to test their effectiveness as environmental stimulus on elderlies to get the most relaxation level within standard indoor facilities of high-rise condominiums.

1.1. ELDERLY VISUAL ABILITY

Ageing changes human body physiologically and accordingly (Lord, 2006; Sturnieks et al., 2008), affects the optical system. With ageing process, our eyes struggle with several issues such as: gradual reduction in accommodation; reduction in pupil diameter; yellowing pigmentation of the lens; and boost absorption and scatter of light in the ocular media (Shariful et al., 2012). Suffering with one of these issues effects visual performance for elderlies. They will face with a number of visual difficulties such as: poor night vision, lack of colour perception, reduce visual acuity, reducing the contrast sensitivity, the loss of visual field and the continuity of light and dark interference (Lord, 2006; Veiel et al., 2006; Sturnieks et al., 2008). Elderlies are not sensitive on detecting temporary objects. They need to spend more time on detection (Blake et al., 2008) and this issue effects the colour detection on them as well (Ho et al., 2001). Therefore, the visual effect of colour on elderlies is different to the other age group, which needs a comprehensive investigation accordingly (Dijkstra et al., 2006).

Within the years a few studies investigates the visual impact of colours on elderlies. Birren (1961) identified that colour affects elderlies body physiologically and psychologically, where colour influence mood and personality as well as close relationship with emotion. Tate and Allen (1985) conducted a study about colour impact on elderlies. They realized that elderlies do not prefer dark colours and they are more interested on light colours instead. They also found that light green is the most preferred colour. There were no any significant different between men and women. Dittmar (2001) mentioned that ageing increases the popularity of blue colour on elderlies, while

paradoxically the dark colours popularity decrease gradually.

1.2. COOL COLOURS AGAINST WARM COLOURS

Colour gives life to our environment through the fibers, finishes, surfaces, and sculptures in architecture and enhances the impacts of architectural expressions (Naseri and Tamizi 2011). Dijkstra et al. (2006) and Ulrich et al. (2004) showed that the psychological effect of an environment could release stress and increase the feel of relaxation. Previous researchers classified the comparison of colour emotions. Warm colours associated with aroused feeling and cool colours associated with calm and relaxation feeling (Kaya & Epps, 2004). Dijkstra et al. (2006) mentioned the primary environmental stimulus is the colour of the walls in an environment, which will change the feeling of the place to get an appropriate result in human health. They added, colours in an indoor environment could be a beneficial effect on patients as the first healing factor in a healthcare system. They also identified that warm colours including red, yellow and orange in an indoor place will arouse human feeling while cool colours including blue and green associates with relax and calm feeling. Dijkstra et al. (2006)_ further stated that many researchers have investigated the role of colours and the possibilities of their optimal use for the enhancement of the quality of the built environments. Dijkstra et al. (2006) analyzed the impact of cool and warm colours through survey studies and proved that warm colours in an indoor environment arouse human feeling while cool colours like blue and green result in the sense of relaxation and calmness. They tested the wall colours (white vs. green) as a stimulus based on 89 participants who were students with an average age of 20.4 years. The result showed that the green walls have a significant impact on the reduction of stress on low-screeners (p=0.05). Ross et al. (2013) evaluated the visual impact of colours through a Quasi-experimental study and realized that warm coloured lights affect the human nerves negatively. She tested 117 participants, 28 men and 89 women who were divided into two locations randomly. The average age of the participants was 43, and three types of coloured light were projected to an interior environment to evaluate the psychological impact of coloured light as environmental stimulus. Elliot and Maier (2014) analyzed colour aesthetics to assess the relation between color and human psychological behavior. They similarly found that each color has a particular impact on the elderly feeling.

1.3. COLOUR AND CULTURE

Jiang and Lu (2014) stated that personal experience and cultural background strongly affect the impact of colour on human psychological perception. They added that the religious beliefs could influence the effect of colours. For instance, white colour represents death in China and India while black is a colour of death in many other countries (Barbara, 2011). In many European countries and the United States, green is sometimes the sign of devil, sickness and death (Heller, 2009). Blue is a symbol of immortality in China and in contrary; it is a symbol of sadness in most of the European countries (Barbara, 2011). Regardless of the historical and cultural impacts of colours on humans, each colour with a different rate of intensity encompasses basic emotional brunt on the human body through the visual sense (Elliot and Maier, 2014; Shariful et al., 2012).

1.4 COLOUR AND INDOOR ENVIRONMENT

Colour affects how people interpret the environment. Of the most effective stimulus of an indoor space are the interior walls. They affect the way people feel and behave (Dijkstra et al., 2006). Willard et al. (2008) mentioned that colour is the most effective architectural and environmental stimulus in an indoor space impacting the human body psychologically. Colours impact human body psychologically

through, blood pressure, heart rate, respiration, digestion, body temperature, and brain activity (Ross et al., 2013). Babin et al. (2003) realized that the colour of the walls plays the main role in users' judgment about space. He tested the impact of wall colour as an environmental stimulus on consumers' behaviour in a different type of stores. The study realized that the stores with blue interior are more associated with desirable appraisement while the store with orange interior are more associated with ill effects on consumers.

The opposite effect of warm and cool colours in the interior environments has been proven over the years (See Table 1). Hidayetoglu et al. (2011) tested 102 participants to find the bright/blurry, attractive/unattractive, navigable/unnavigable and inviting/repellent of an indoor corridor (way-finding). The result demonstrated that warm colours were more appealing colours for participants, if, the cool colours were more attractive for them. They also realized that the females preferred brighter colours range for indoor corridors. Ross et al. (2013) tested 117 participants, 28 men and 89 women who were divided into two locations randomly. Their average was 43, and three types of coloured light were projected into an interior environment to evaluate the psychological impact of glowing light as an environmental stimulus with the similar research approached used by Ulrich (1984) and Wong (2001). Blood pressure, heart beat rate, and skin temperature were measured while the Profile of Mood States (POMS) test was used to get the effect of colour on the sensation and mood of respondents. The study revealed that coloured light could be utilized as a chromotherapy approach (A quasi-experimental method as a correlational study considered in analyzing the data). The result shows that lighter colours have the most negative correlation with all variables.

Table 1: Key findings of the core studies with focus on the impacts of colours

Reference		Area of study	Key findings
Bailey (2006)		Warm colours, cool colours	Warmer colours appearing nearer in depth to viewers than cooler colours
Cooper et al.(1991)			The staffs in the warm environment were less cheerful than the other office
Dijkstra(2006)			- Warm colours like red, yellow, orange in an indoor place will arouse human feeling, while cool colours like blue and green will associate with relax and calm feeling - Wall colour cause people to verdict about that place. It affects the way people feel and behave
Hidayetoglu et al.,(2011)			- Warm colours were more attractive colours for participants, in the event that, the cool colours were more positive

			- They also realized that the females preferred brighter colours range for indoor corridors
Huchendorf (2007)			Warm colours could help people to remember
Elliot and Maier (2014)		Colour emotions, mood and behavior	Each colour has a particular consequence on human feeling
Kaya and Epps (2004)			- Warm colours associate with aroused feeling and cool colours associate with calm and relaxation feeling
			- Most positive feeling by green colour
Wexner (1954)			- Warm colours associate with aroused feeling and cool colours associate with relaxation
			- Green colour is more related to the relaxation, comfortable and calm
			- Orange colour has the effect of upset, excitement and distress on human
Jacob and Suess (1975)			Red and yellow colour gets more discomposure feeling
Mehrabian, (199)			Cool colours associate with calm and relaxation
Knez (2001)			Colour effects mood
Gifford (1988)			Colour effects behavior
Babin et. al. (2003)		Wall colour in an indoor environment	Colour on walls play the main role in people judgment in a place
Dijkstra (2006)			The green room, experienced less stress than the white room
Willard et al. (2008)			Colour is the most effective architectural environmental stimulus in an indoor place,
Tsunetsugu et al. (2013)		Greenery vs urban	Forest views had more positive score on human feeling
Ulrich (1984)			Patients who were looked to the greenery were more influenced positively

Myers (2006)		Elderly, colour and health	Red and yellow can, treat Alzheimer disease on elderlies
Deanne (2000) Shariful et al. (2012)			Increasing physical health of elderly residents by relaxation and spiritual healing
Wong (2001)			More beneficial effect on the physical health by viewing the garden
Jiang and Lu (2014)		Colour vs. culture and historical background	Personal history and cultural background strongly affect colour impact
Tofle et al. (2004)			Cultural and historical background influence the impact of colour

Each cool colour impact elderlies differently and any intensities of each colour has different impact as well. While, Visual impact of colour as environmental stimulus on any intensity can significantly measure through blood pressure, heart beat rate and skin temperature (Ross et al., 2013). Consequently, Cool colours in deferent intensities have not been tested; especially on elderly participants as environmental stimulus and it is a gap in previous studies.

2. RESEARCH METHOD

This study investigates the effectiveness of cool colours as an environmental stimulus on the elderly occupants residing in high-rise condominiums in Kuala Lumpur, as the reason of warm colours associates with aroused feeling and cool colours associates with calm and relaxation feeling (Kaya and Epps, 2004). Literature presented that the visual environmental stimulus affects human body through 4 main parameters (Tsunetsugu et al., 2013). This includes maximum blood pressure (systolic), minimum blood pressure (diastolic), heart beat rate (beats/min) and skin temperature (C°) as similarly considered by previous studies (Willard et al., 2008; Thompson,

2011; Tsunetsugu et al., 2013; Ross et al., 2013; Noonan and Nguyen, 2013). Following a similar approach, this study utilizes the Quasi-experimental method as a correlational study to measure the impact of cool colours including green, blue-green, blue, blue-violet and violet with three levels of intensities, namely light, medium and dark. To correctly run the experiments, preliminary consultations were carried out with two psychologists to increase the researcher's awareness and capabilities for the experimental process.

2.1. LOCATION AND PARTICIPANTS

There are approximately 957 high-rise condominiums in Kuala Lumpur and among these buildings, 689 (71.99%) are categorized as the middle-income group (Ismail, 2014). Approximately all of the middle-income condominiums have standard facilities with different levels of design quality. Meanwhile, in about 150 to 280 elderly occupants reside in each condo depending on home population based on personal observation in the preliminary site study. Higher elderly residents, more residential floors, units and facilities as well as new constructed buildings were considered as criteria to choose the case studies. To experiment our hypothesis in this

research, the D'Alamanda, and Connaught Avenue condominiums were selected (See Figure 1). Table 2 demonstrates the collected information about these two locations.

Figure 1. D'Alamanda (left) and Connaught Avenue (right)

	D'Alamanda	Connaught Avenue
Number of floors	20	20
Number of Blocks	5	2
Residential floors	7th to 20th	3rd to 20th
Number of units per floor	12	12
Residents in each block	672	944
Total population	3360	1888
Elderly population	280	185

Table 2: Statistics of the selected condominiums

Cultural and the historical background play a significant role in the visual impact (Deanne, 2000). In general, Kuala Lumpur is the home of three races: Malay, Chinese and Indian. Approximately, 67.9% of the Malaysian population is dominated by the Malay race (Jabatan Perangkaan Malaysia, 2013) with the elderly population of 9.8%. This study is limited to the Malay participants only. All participants were selected from the elderlies at the age of 60 and above, which is following the approximate retirement age of Malaysian employees (Randstad Workmonitor, 2015).

All participants were primarily screened to be in good health and all were trained and prepared for the test accordingly.

2.2. SAMPLE SIZE AND INSTRUMENTS

G-power was used for sample size calculation (Faul et al., 2007; 2009). Total sample size was calculated, and the results of power analysis indicated that the minimum required sample size was 64 respondents. The power of the test was considered 0.8 (as a common value for power in the research in human science) and $\alpha = 0.05$ with medium effect size. Table 3 represents the results of power analysis using G-Power version 3.1.9.2. Likewise, Figure 2 shows the result of T-tests for sample size extracted from G-power software.

Table 3 Results of power analysis using G-Power version 3.1.9.2

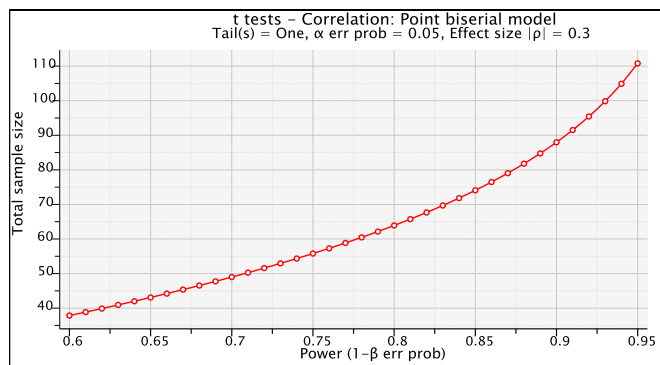| Tests - Correlation: Point biserial model	
Analysis: Compute required sample size	
Input: Tail(s)	One
Effect size $|\rho|$	0.3
α err prob	0.05
Power (1-β err prob)	0.8
Output: Noncentrality parameter δ	2.5158836
Critical t	1.6698042
Df	62
Total sample size	64
Actual power	0.8005036

Figure 2. Result of T-tests for sample size extracted from G power software

A sphygmomanometer for measuring blood pressure and heart beat rate and a thermometer for recording skin temperature was required in conducting this study. According to the consultations with the psychiatrists, it was compulsory to run the experiments without any physical contact with the participants. As a result, an 'iHealth' device (Model BP5) was chosen for measuring the blood pressure and heart beat rate with pressure accuracy of ± 3 mm Hg and pulse rate accuracy of $\pm 5\%$ (iHealthLab, 2016). Furthermore, an 'Infrared Thermometer' device (Model IT-903) was chosen for measuring the skin temperature with $\pm$ 0.5 degree Celsius accuracy (Globalsources, 2016) (See Figure 3). As running the experiments and the operations of instruments required necessary skills, a cardiothoracic nurse provided sufficient training to increase the examiner's awareness and expertise for such operation.

Figure 3. iHealth, model BP5 (left), Infrared Thermometer, model IT-903 (right)

2.3 PROTOCOL STUDY

The other environmental elements such as light, furniture and shadows affect the colour impact in an indoor environment as well. Therefore, in order to get the pure colour impact on participants, projecting the colours individually considered according to the psychiatrists' advice. A 3000 mm (L) * 2000 mm * 3000 mm (H) room located in the selected condominiums was selected as the test room during the experiment. 3 of the four interior walls were completely covered with a black fabric with an acceptable thickness and a white fabric covered the interior front wall as the screen for the colour exposure. The black fabric also covered the entrance door located behind the
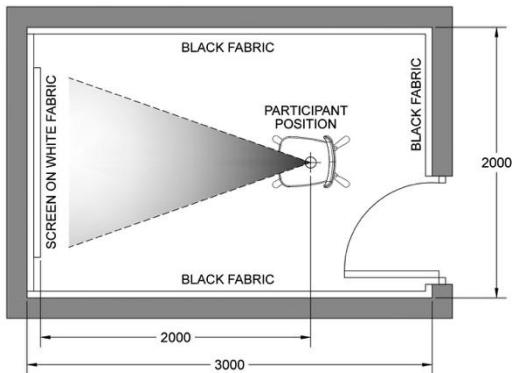
Figure 4. Layout of the experimental platform

Figure 5. Preparations at the test room before data collection

The respondents were located 2000 mm away from the screen, in the middle of the room. Figure 4 shows the plan layout of the test room. Figure 5 demonstrates the preparations in the test room before the initiation of the data collection.

All of the participants sat in a position to clearly see the screen during the projection of the colours. The duration of each test was 10 minutes. During the entire experiments, the room temperature was set to 23° C following the satisfactory healing standard for elderly indoor temperature (David & Watkins, 2011). The study concentrated on 15 cool colours, which were categorized into five main classifications (See Figure 6). Each primary colour was divided into three different intensities (high, medium, low). Since the projection done through the computer, the colour mode, which was considered for this study, was RGB (Red, Green, and Blue), refers to a universal system for displaying the colours on a computer device. Red, green, and blue can be combined in various proportions to obtain any colour in the visible spectrum. Levels of R, G, and B can provide each range from 0 to 100 percent of full intensity (Sharma, 2004). The value of each parameter was identified in Adobe Photoshop software version CS6. Table 4 shows the RGB values for all color intensities.
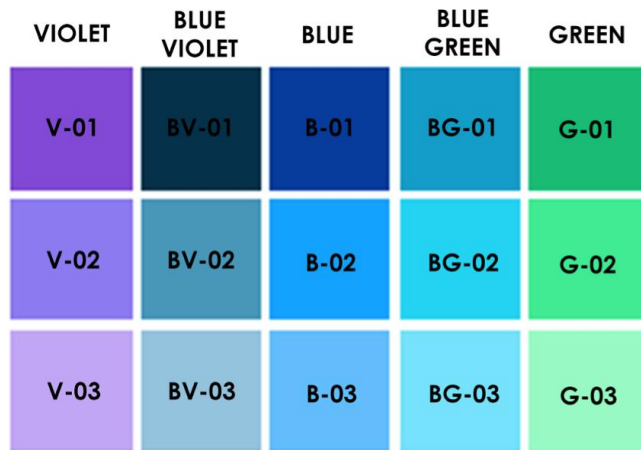
	VIOLET	BLUE VIOLET	BLUE	BLUE GREEN	GREEN
	V-01	BV-01	B-01	BG-01	G-01
	V-02	BV-02	B-02	BG-02	G-02
	V-03	BV-03	B-03	BG-03	G-03

Figure 6. Demonstration and Classification of the fifteen cool colours
in 5 groups

Table 4. RGB values with reference to the colour groups

	G1	G2	G3	BG1	BG2	BG3	B1	B2	B3	BV1	BV2	BV3	V1	V2	V3
R	1	71	166	1	29	132	1	0	115	0	87	164	149	158	206
G	196	235	249	173	219	231	82	179	203	66	168	206	101	146	184
B	136	164	207	211	245	252	173	254	253	92	198	228	221	244	248

2.4 DATA COLLECTION AND ANALYSIS

According to the calculated sample size, the experiments were carried out on the participants to obtain a total of 64 acceptable test results. According to the psychiatrists' advice, every exposure from one colour intensity to another required a 10-minute resting time for each participant. During the resting time, the participants are advised to walk out from the testing room into another room with a minimal interior design where they can enjoy a cup of tea while having a conversation with others. Each participant was tested three times: one color spectrum with three ranges of intensity. Figure 7 presents an example of the data collection process for a male respondent from Connaught Avenue condo.
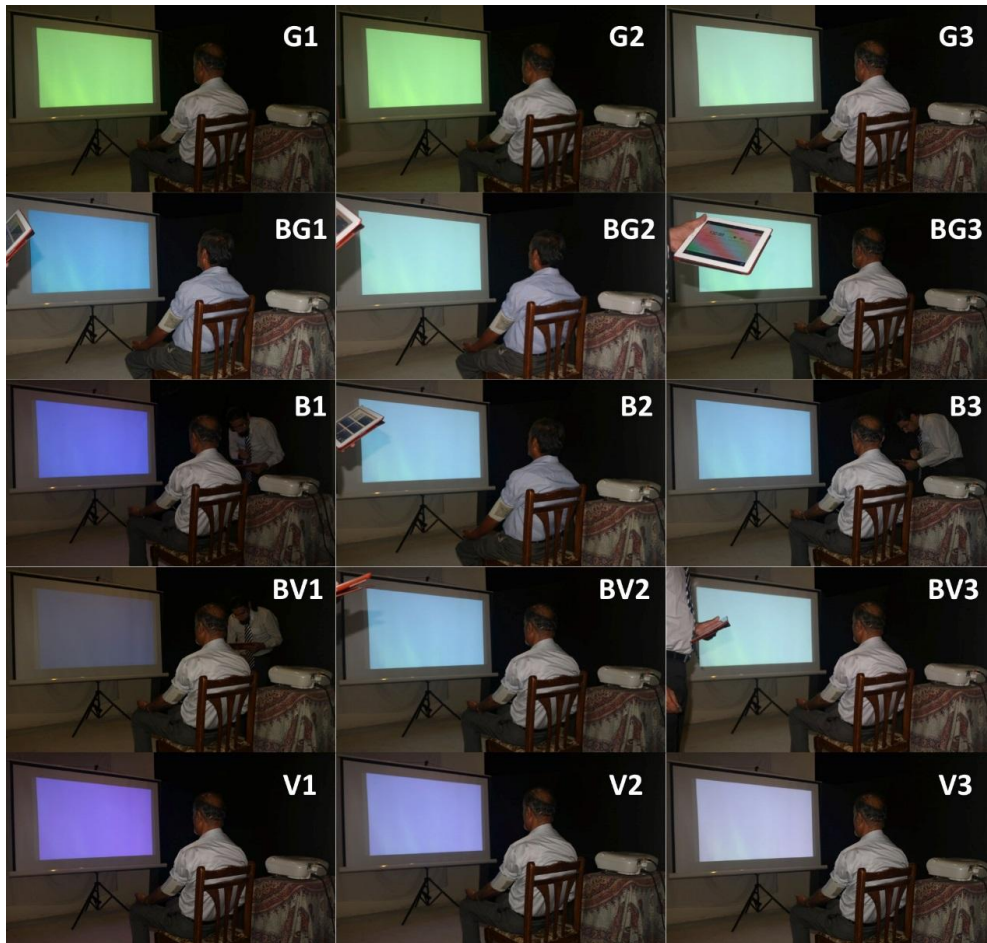
Figure 7. Sample of the data collection phase: A male participant from Connaught Avenue condo

The data entry was done in IMB SPSS software, version 22 under Windows 8 operating system. The statistical analysis involves two phases: Firstly, descriptive and secondly, Bivariate Statistics. Three steps of analysis were applied including Pearson Correlation, Means and ANOVA test.

3. RESULTS AND ANALYSIS

To ensure the reasonable description of the variables, all the variables objected to the normality test, using Skewness and Kurtosis (Bachman, 2004) and Kolmogorov-Smirnov, Shapiro-Wilk (Ruppert, 2004; Rovai et al., 2013). As shown in Table 5, the low value of skewness and kurtosis confirmed that systolic blood pressure, diastolic blood pressure, heart beat rate and skin temperature are statistically average considering that the acceptable range should be between "-2 ~ +2" (Bachman, 2004). The normality of the variables was proved in Kolmogorov- Smirnov and Shapiro-Wilk

test as well (Table 5). Furthermore, Q-Q plot and box plot confirmed the standard distribution of the variables of this study.

Table 5. Result of Kolmogorov - Smirnov and skewness - kurtosis tests

	Kolmogorov- Smirnov			Shapiro-Wilk				
	Statistic	df	Sig.	Statistic	df	Sig.	Skewness	Kurtosis
Blood pressure (sys)	0.084	165	0.006	0.969	165	0.001	0.063	-1.154
Blood pressure (dia)	0.045	165	0.200*	0.99	165	0.304	0.174	-0.526
Heart beat rate	0.062	165	0.200*	0.983	165	0.044	0.867	1.238
Skin temperature	0.093	165	0.001	0.958	165	0	-0.257	0.412

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

2.5 CORRELATION TEST OF RESEARCH VARIABLES

2.5.1 AGE AND DEPENDENT VARIABLES

In the first phase of the correlation tests, the relationship between age and the dependent variables was examined. The analysis intended to demonstrate the effect of age on each dependent variable and showed that the correlation is significant at 0.01 levels. It confirmed that through the increase of age of the elderly occupants, the maximum blood pressure (systolic), minimum blood pressure (diastolic) and heart beat rate (beats/min.) moderately increased while the skin temperature (C°) weakly increased. In particular, maximum blood pressure (systolic) increased more significantly compared to the other dependent variables (See Table 6).

Table 6. Result of Pearson Correlation test between age and dependent variables

		Blood pressure (systolic)	Blood pressure (diastolic)	Heart beat rate	Skin temperature
AGE	r	0.478**	0.449**	0.431**	0.211**
	p-value	< 0.001	< 0.001	< 0.001	< 0.001

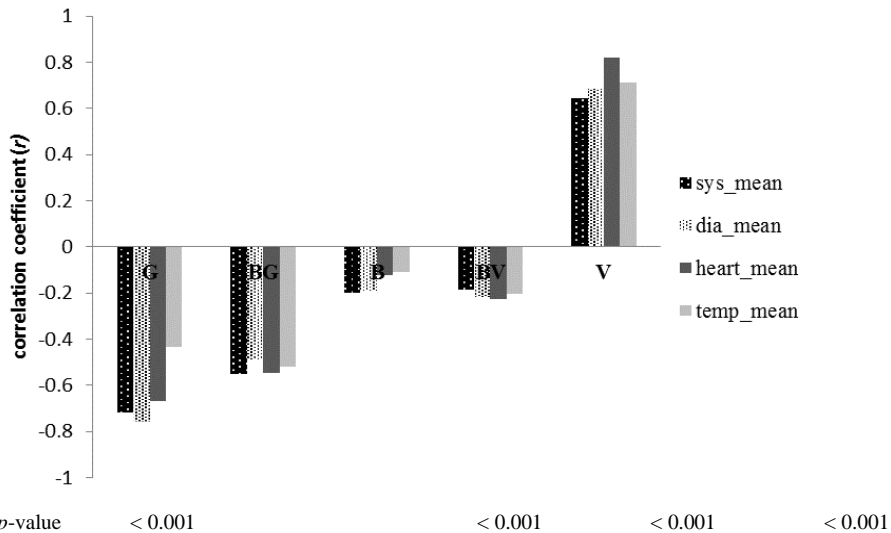**. Correlation is significant at the 0.01 level (2-tailed)

2.5.2 MAIN COOL COLOURS AND DEPENDENT VARIABLES

In this phase, the study explored the relationships between time and the dependent variables for each particular colour. The study targeted to identify which main colors, regardless of the intensities, embrace the most impact on the elderly occupants (See Table 7).

Table 7. Pearson Correlation test between time spending and research dependent variables for each main colour

Colors		Blood pressure (systolic)	Blood pressure (diastolic)	Heart beat rate	Skin temperature
G	r	-.719**	-.760**	-.669**	-.435*
	p-.	< 0.001	< 0.001	< 0.001	0.012
BG	r	-.552**	-.488**	-.546**	-.522**
	p-.	0.001	0.004	0.001	0.002
B	r	-0.2	-0.192	-0.123	-0.107
	p-.	0.265	0.284	0.495	0.554
BV	r	-0.185	-0.219	-0.226	-0.203
	p-.	0.303	0.221	0.207	0.257
V	r	.645**	.684**	.822**	.711**

*** Correlation is significant at the 0.01 level (2-tailed).*

** Correlation is significant at the 0.05 level (2-tailed).*

Figure 8. Correlation coefficient (r) of each dependent variable and the main colour spectrums

Table 7 shows the most positive impact on participants belonged to green (G) colour while blue (B) colour resulted in relatively less impact. It is evident that green (G) color has the strongest relationship with maximum blood pressure (r = -0.719), minimum blood pressure (r = -0.760), heart beat rate (r = -0.669) and skin temperature (r = -0.435) with a negative direction. Figure 8 shows that green color (G), followed by blue-green (BG), blue violet (BV) and blue (B), resulted in the most significant impacts on the reduction of dependent variables as a positive evidence of elderly occupants. On the other hand, violet embraced the most significant impact on increasing the dependent variables as the evidence of negative impact on participants.

2.5.3 CORRELATIONS OF ALL COLOR INTENSITIES

In the second phase, the study intended to measure separately the linear correlations between all cool colours based on their three levels of intensity (resulting in 15 colors) and the dependent variables to identify the eventual impact of each cool colour. Table 8 summarizes the finding of the Pearson correlation test for all fifteen intensities of cool colours. Likewise, Figure 9 shows the average of the dependent variables trend line for each colour on time spending. Meanwhile, Table 9 shows the correlation coefficient (r) between all colors and each particular dependent variable, sorted from lower to a higher value.

Table 8. Summarized results of the Pearson correlation test for all fifteen intensities of cool colour

Color		Blood pressure (systolic)	Blood pressure (diastolic)	Heart beat rate	Skin temperature
G1	r	-.974**	-.971**	-.944**	-.915**
	p value	< 0.001	< 0.001	< 0.001	< 0.001
G2	r	-.969**	-.942**	-.986**	-.961**
	p value	< 0.001	< 0.001	< 0.001	< 0.001
G3	r	-.976**	-.984**	-.975**	-.991**
	p value	< 0.001	< 0.001	< 0.001	< 0.001
BG1	r	0.033	-0.221	-0.403	-.804**
	p value	0.923	0.515	0.219	0.003
BG2	r	-.977**	-.986**	-.984**	-.978**
	p value	< 0.001	< 0.001	< 0.001	< 0.001
BG3	r	-.990**	-.995**	-.991**	-.984**
	p value	< 0.001	< 0.001	< 0.001	< 0.001

B1	r	.983**	.982**	.981**	.978**
	p value	< 0.001	< 0.001	< 0.001	< 0.001
B2	r	-.922**	-.966**	-.956**	-.950**
	p value	< 0.001	< 0.001	< 0.001	< 0.001
B3	r	-.980**	-.979**	-.987**	-.980**
	p value	< 0.001	< 0.001	< 0.001	< 0.001
BV1	r	.960**	.830**	.956**	.910**
	p value	< 0.001	0.002	< 0.001	< 0.001
BV2	r	-.973**	-.980**	-.966**	-.948**
	p value	< 0.001	< 0.001	< 0.001	< 0.001
BV3	r	-.978**	-.955**	-.899**	-.846**
	p value	< 0.001	< 0.001	< 0.001	0.001
V1	r	.958**	.972**	.985**	.960**
	p value	< 0.001	< 0.001	< 0.001	< 0.001
V2	r	.972**	.984**	.983**	.984**
	p value	< 0.001	< 0.001	< 0.001	< 0.001
V3	r	.968**	.987**	.985**	.958**
	p value	< 0.001	< 0.001	< 0.001	< 0.001

** Correlation is significant at the 0.01 level (2-tailed).
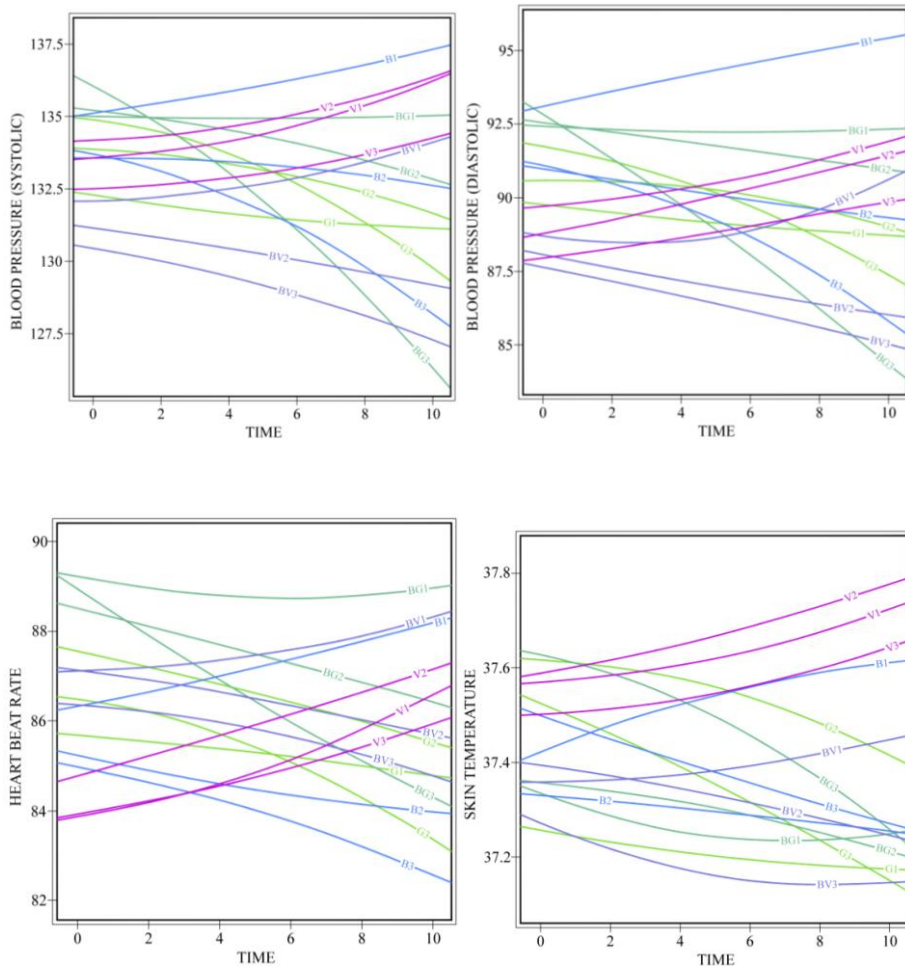** Correlation is significant at the 0.05 level (2-tailed).*

Figure 9. Average of dependent variables trend line for each colour on time spending

Table 9. Correlation coefficient (*r*) of all colours on each dependent variable, sorted from lower to higher value

Blood pressure (systolic)		Blood pressure (diastolic)		Heart beat rate		Skin temperature	
BG3	-0.99	BG3	-0.995	BG3	-0.991	G3	-0.991
B3	-0.98	BG2	-0.986	B3	-0.987	BG3	-

							0.984
BV3	-0.978	G3	-0.984	G2	-0.986	B3	-0.98
BG2	-0.977	BV2	-0.98	BG2	-0.984	BG2	-0.978
G3	-0.976	B3	-0.979	G3	-0.975	G2	-0.961
G1	-0.974	G1	-0.971	BV2	-0.966	B2	-0.95
BV2	-0.973	B2	-0.966	B2	-0.956	BV2	-0.948
G2	-0.969	BV3	-0.955	G1	-0.944	G1	-0.915
B2	-0.922	G2	-0.942	BV3	-0.899	BV3	-0.846
BG1	0.033	BG1	-0.221	BG1	-0.403	BG1	-0.804
V1	0.958	BV1	0.83	BV1	0.956	BV1	0.91
BV1	0.96	V1	0.972	B1	0.981	V3	0.958
V3	0.968	B1	0.982	V2	0.983	V1	0.96
V2	0.972	V2	0.984	V1	0.985	B1	0.978
B1	0.983	V3	0.987	V3	0.985	V2	0.984

Findings revealed that BG3 and G3 embraced the strongest (negative) relationships with the dependent variables (p-value = -0.99). This indicates the lightest blue-green and the lightest green have the highest correlation with the relaxation of elderly occupants through significantly decreasing the maximum blood pressure (systolic), minimum blood pressure (diastolic), and heart beat rate (beats/min). In contrary, B1, V3, and V2 encompassed the strongest (positive) relationships with the dependent variables (p-value = 0.983 ~ 0.987) demonstrating that the darkest blue and the two lightest violets have the lowest correlation with the relaxation of elderly occupants via increasing the dependent variables.

The analysis illustrated that in general, green (G) color has the most negative correlation with all dependent variables. In particular, green color has a strong relationship with blood pressure systolic (r = -0.719), blood pressure diastolic (r = -0.760) as well as heart beat rate (r = -0.669), while it has a moderate relationship with skin temperature (r = -0.435). The result showed that blue-green 3 (BG3) and green 3 (G3) had the most positive impact on three dependent variables as a result of negative direction, BG3 on blood pressure systolic (r = -0.99), blood pressure diastolic (r = -0.995), heart beat rate (r = -0.991) and G3 on skin temperature (r = -0.991). Furthermore, B1, V3, and V2 had the most negative impact following the correlation coefficient (r) values of dependent variables, as a result of having a strong relationship in a positive direction. The result also shows

the lighter colour has a more positive impact on relaxation. However, the darker colour has, the less positive impact, which means in each color, intensity number 3 received a more positive impact, and intensity number 1 obtained a lower impact. Figure 10 graphically represents the p-value of each colour intensity on dependent variables.
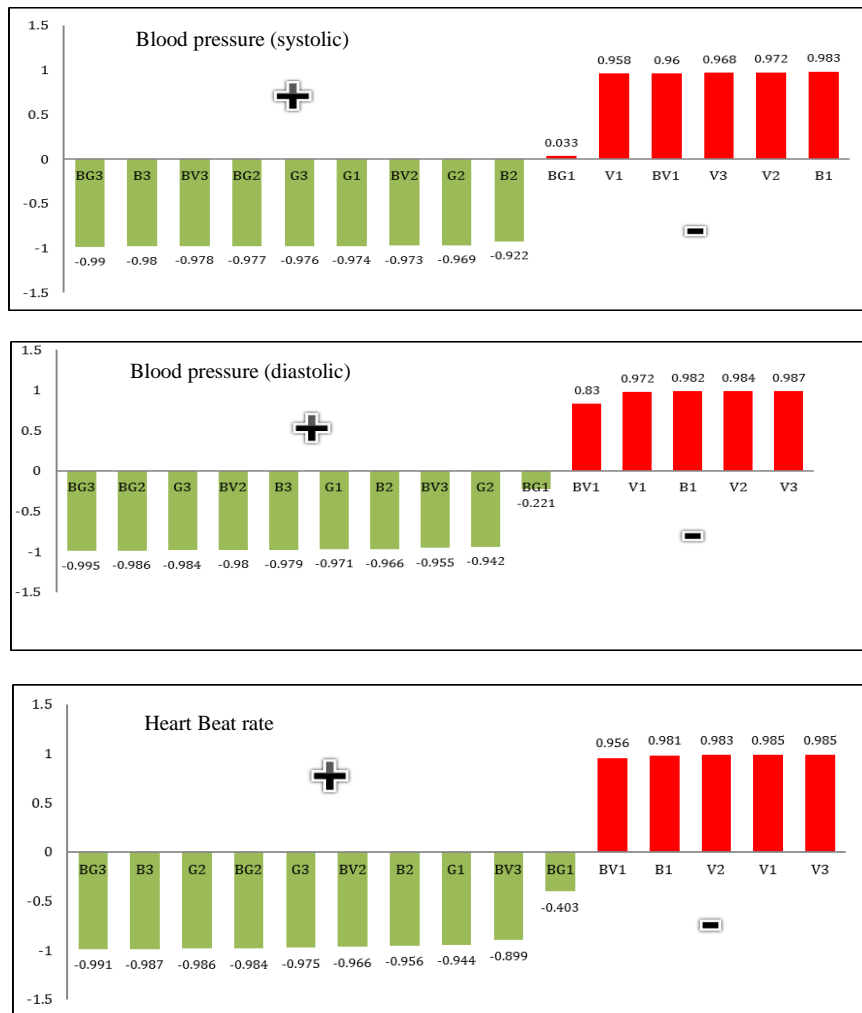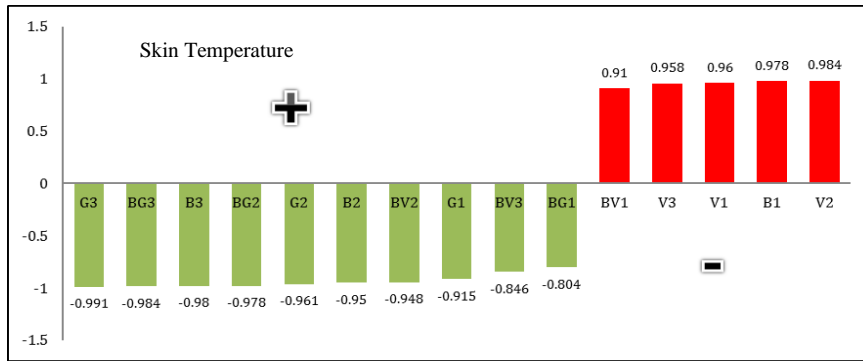
Figure 10: p-value of each colour intensity on dependent variables

The impact of color on elderly physiological parameters have strong correlation relationship with time spent (the time participants spent looking at each colour), which means by time spent; color has more impact on elderly. Two ways ANOVA test has identified the fastest impact color on participants. Figure 11 shows that all the colors start to affect dependent variables, mostly on third minute while blue-green 3 (BG3) starts to impact at the beginning of second minute. The trend line, which shows the average of colors impact on dependent variables has the downwards highest slope on BG3 and G3 in comparison with the other colors. It is undeniable to say that BG3 and G3 (lightest blue-green and lightest green color) has the most positive impact on elderly. Furthermore, BG3 has the fastest positive impact on dependent variables (See Figure 11). Finding also shows that the lighter intensities have more positive impact on dependent variables than the darker intensities
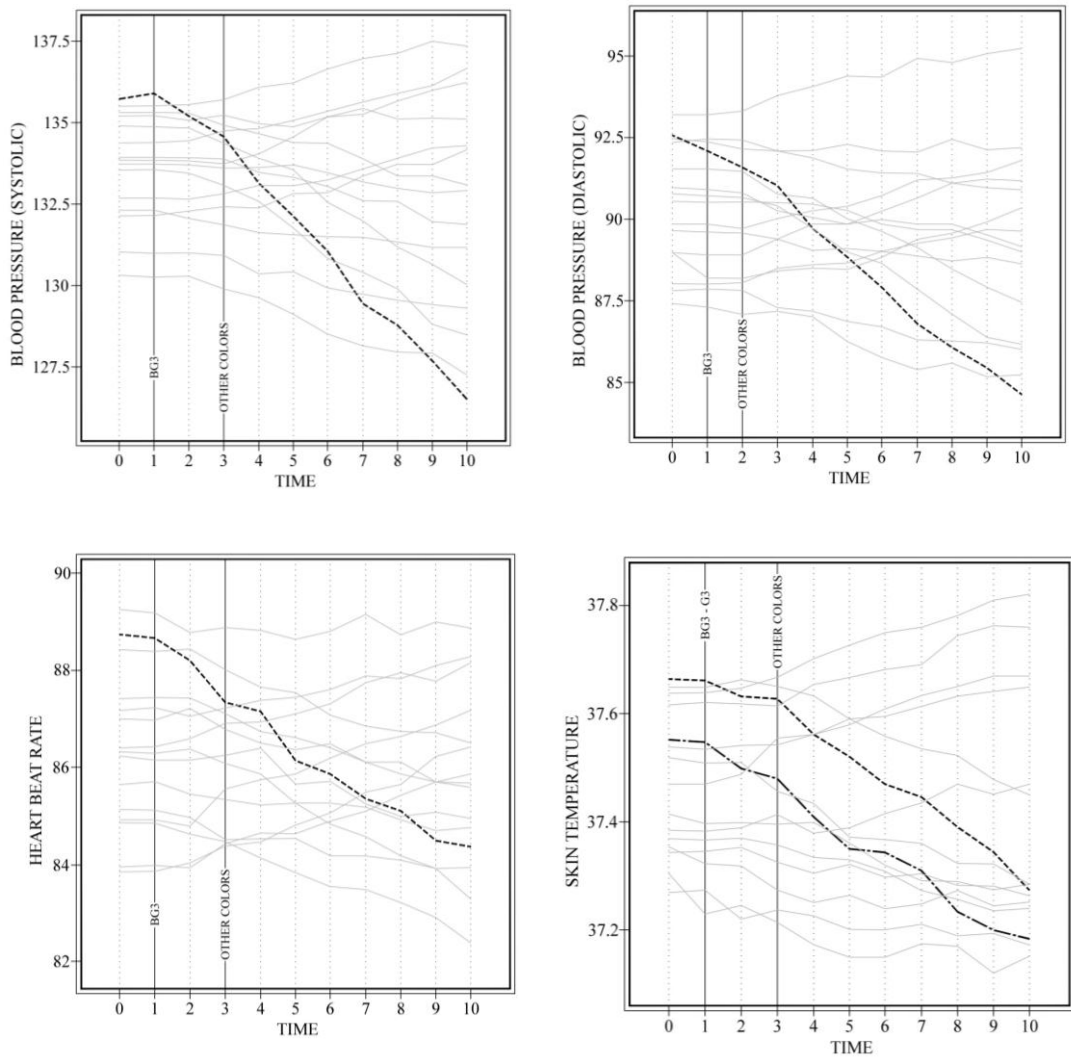
Figure 11. Result of two ways ANOVA test

—·— G3
----- BG3
—— OTHER COLORS

4.0 DISCUSSIONS

This study experimented the effect of cool colours on the elderly occupants of high-rise buildings in Kuala Lumpur to identify their most positive impact as environmental stimulus in common indoor facilities. Despite the fact that the result shows green color has more impact on elderly in comparison with other colors, the lightest spectrum in each colour have the most positive impact. Results of this study are in

line with the findings of Knez (2001), Leather et al. (2003), Dijkstra (2006), and Elliot and Maier (2014) that proves that colour as environmental stimulus encompasses potentials to influence elderlies` mood and feeling. This study supports the previous studies, which were analyzed warm colors associated with aroused feeling and cool colors associated with calm and relaxation feeling (Kaya & Epps, 2004; Elliot and Maier, 2014). However, violet and dark blue that were categorized under cool colors have not associated with calm and relaxation feeling.

Green and blue colors in most intensity have a positive impact on relaxation feeling while dark blue spectrum does not have any correlation with that feeling in comparison to the others with the dependent variables (p-value = 0.98). This supports findings by Dijkstra et al. (2006) that blue and green colours have the most positive impact, and that green colour offers less stress. . The result of this study also has some parallels with Kaya and Epps`s work (2004). They also discovered that green color has a more positive impact. There is no doubt that green color associated with nature and greenery. As a result, people get influenced by the history of nature on their unconscious (Kaya and Epps. 2004), which support Wexner`s (1954) conclusion that green color has the most positive impact as environmental stimulus. This study also strongly supports results by Ulrich (1984), Wong (2001), Ross et al. (2013) and Tsunetsugu et al. (2013) that the visual impact of environmental stimulus effect blood pressure (systolic, diastolic), heart beat rate and skin temperature.

5. CONCLUSION

The study covers elderly residents above 60 years old of Kuala Lumpur high-rise condominium to test the effectiveness of cool colours in order to develop the general relaxation and recreational facilities, with more attention to the expectations of the elderlies. The elderlies limited to Malay, as Malaysian population is dominated by this race (Jabatan Perangkaan Malaysia, 2013). The case studies have limited to middle-income condominium as the majority of the existing condominiums are under this group (Ismail, 2014).

This study put forward that the majority of common indoor facilities of these condominiums in Kuala Lumpur are not entirely under the expectation of elderlies. Colour is one of the most effective environmental stimulus. While other studies have proven the positive impact of cool colours on human, this study identified the impact of each cool colour in fifteen intensities on Malay elderly residents of Kuala Lumpur high-rise condominiums. This study realized the lightest blue-green and the lightest green has the most positive impact on Malay elderlies. This study recognized that B2 had no significant impact on them, while B1, V3, and V2 have an adverse impact on the participants. It is essential to choose the appropriate colours in accordance with the function of the indoor environment. Finally, the findings demonstrated that BG3 and G3 colours could have significant positive impact on the residents` quality of life and mental health on the long-term. It helps them to feel safe and satisfy from the environment when most of their issues come from mental diseases.

The study draws attention to the following concluding remarks:
- The majority of common indoor facilities of high-rise condominiums in Kuala Lumpur are not entirely by the expectation of elderlies;
- Regardless of the different intensities, in general, green color

has more relaxation on Malay elderlies residents;

- Looking at the different intensities, the lowest blue-green and the lowest green have the most positive impact on Malay elderlies residents;
- B2 has no significant impact on Malay elderly;
- B1, V3, and V2 have negative impact on Malay elderly.

Each colour in different intensities impact elderlies differently. While, Visual impact of colour as environmental stimulus on any intensity can significantly measure through blood pressure, heart beat rate and skin temperature (Ross et al., 2013), measuring the effectiveness of other colour intensities such as warm colours recommended for future studies. There are other stimulus that could be effective in relaxing psychologically to increase the elderlies mental health, such as light, texture, and form. These aspects demand further studies as well. Marital status may affect the visual impact of color on elderly, which were not possible to test it in this study. Testing the effect of color on single or married elderly is recommended for future studies.

6. ACKNOWLEDGEMENTS

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