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Measuring Visual Pollution Threshold along Kuala Lumpur Historic Shopping District Streets Using Cumulative Area Analysis

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MEASURING VISUAL POLLUTION THRESHOLD ALONG KUALA LUMPUR HISTORIC SHOPPING DISTRICT STREETS USING CUMULATIVE AREA ANALYSIS

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ABSTRACT
Visual pollution significantly affects public appreciation of the urban environment. Sources of visual pollution such as wastes, energy infrastructures, and advertising boards can cause discomfort towards one's ability to enjoy a scene or view. Although visual pollution is prevalent in the urban environment, less is known regarding public acceptance and tolerance towards different levels of pollution. Therefore, from our point of view, determining the threshold level of visual pollution is essential in achieving visual quality in the urban environment. In this research, we have chosen a popular urban street in Kuala Lumpur as a case study to help us understand how people respond towards visual pollution within a historic shopping district. The study employed cumulative area analysis and photo booklet survey, and it was tested with students in the landscape architecture program at Universiti Putra Malaysia. Results show that the respondents have higher tolerance towards the level of visual pollution than what we had anticipated. Although we have thought that landscape architecture students should be more sensitive towards visual pollution, regular exposure towards pollutants in the urban environment probably has increased their level of tolerance. Nevertheless, this study has provided us with insight on demographic variables such as gender, education level and residential location, which may be meaningful for future research in identifying visual pollution threshold among the public in cities.

INTRODUCTION AND STUDY BAKGROUND
Visual pollution is a combination of elements causing people's discomfort for a particular view. This is due to an increase or deterioration of elements, objects, infrastructures and waste that can be typically found in the landscape (Falchi et. al., 2012; Chalkias et al.; 2006, Lamb and Purcell, 1990; Ribeiro and Barao, 2006). It can also be further impacted by other graphic objects that are found in the urban environment such as outdoor billboards and signage (Chimlewlski, 2015). Historically, concerns regarding outdoor advertisement pollution can be traced back in the 40s and 50s due to the growth of automobile traffic and construction of interstate highways in the United States. These concerns evolved into public and political movements that aimed to control the growth of outdoor billboards leading to the Highway Beautification Act in 1965(Smardon, 1992).

Nevertheless, in today's urban environment, signage and advertisement billboards are becoming more prevalent due to the advancement of printing and digital technologies that allow bigger, cheaper and a longer period of displayed advertisement. These issues somehow have and continuously affect the physical and social quality of urban spaces. For instance, a study by Bakar et al. (2018) towards visual distractions on urban highways stated that billboards are the primary cause of distractions that can lead to driving problems. On the other hand, the extreme use of billboards in terms of targeting a specific type of public was also highlighted by Kwate and Lee (2007). They argued that billboards were sometimes intentionally placed at a location where people at risk were highly vulnerable to distraction. This approach may lead to adverse effects, such as the populations' future mental health. The same notion was highlighted by Thomas (2015) who considered billboards as pollutants that contribute towards psychological disorders. These Iinclude "diabetogenic" eating behaviors, dysphonia and compulsive buying (Mikołajczak-Degrauwe & Brengman, 2014).

Besides the technologies, the rapid growth of advertisement boards in the city center can also be associated with the pressures faced by the local authorities to increase their yearly revenues. Fees charged to obtain outdoor advertising permits may include billboards, panels, bulletins and frames, window dressing, showroom design, car and bus carding that can be a highly profitable source of income that can be economically critical for the local authority. The same notion agreed by Kwate and Lee (2007) within the context of a neighborhood. They stated that "outdoor advertising reflects tensions between the accrual of revenue for cities and the aesthetic and public health imperatives of neighborhoods" (Kwate and Lee 2007 p.7). Meanwhile, according to the Malaysia Investment Development Authority (MIDA, 2012) currently, there are 179 local authorities in Malaysia, which are responsible for approving signboard licenses. In fact, since the requirements to obtain the license may vary according to the conditions set by each local authority, their understanding in term of controlling visual pollution caused by the advertisement may also differ.

Kuala Lumpur (KL), the capital city of Malaysia, is considered as one of South East Asia's most important financial centers and a very attractive tourist destination. The study area is located within a popular section of Jalan Tuanku Abdul Rahman (JTAR) starting from the intersection of Jalan Dang Wangi towards the intersection of Jalan Tun Perak. This section of the street was selected due to its historical significance and known as one of the most thriving shopping district in the Klang Valley (Figure 1). According to Mahalingam (2014), JTAR is famous for textile arcades, and the shop lots are categorized as the "most expensive real estate" amongst shopping districts in KL. Thus, it is not surprising that the majority of the historical buildings' facade in JTAR were cluttered with different sizes of signage and billboards (Figure 2). The importance of JTAR as one of the shopping attraction sites in Kuala Lumpur is further strengthened by the government decision to engage with the traders along the street regarding their plan to close off the road to private vehicles. The move will promote-pedestrian friendly environment to the shoppers and provide the opportunity to the local authority to enhance the existing urban landscape in the area. A recent online survey by the local authority found that 65% of more than 3000 respondents agreed with the idea (Lim, 2019).

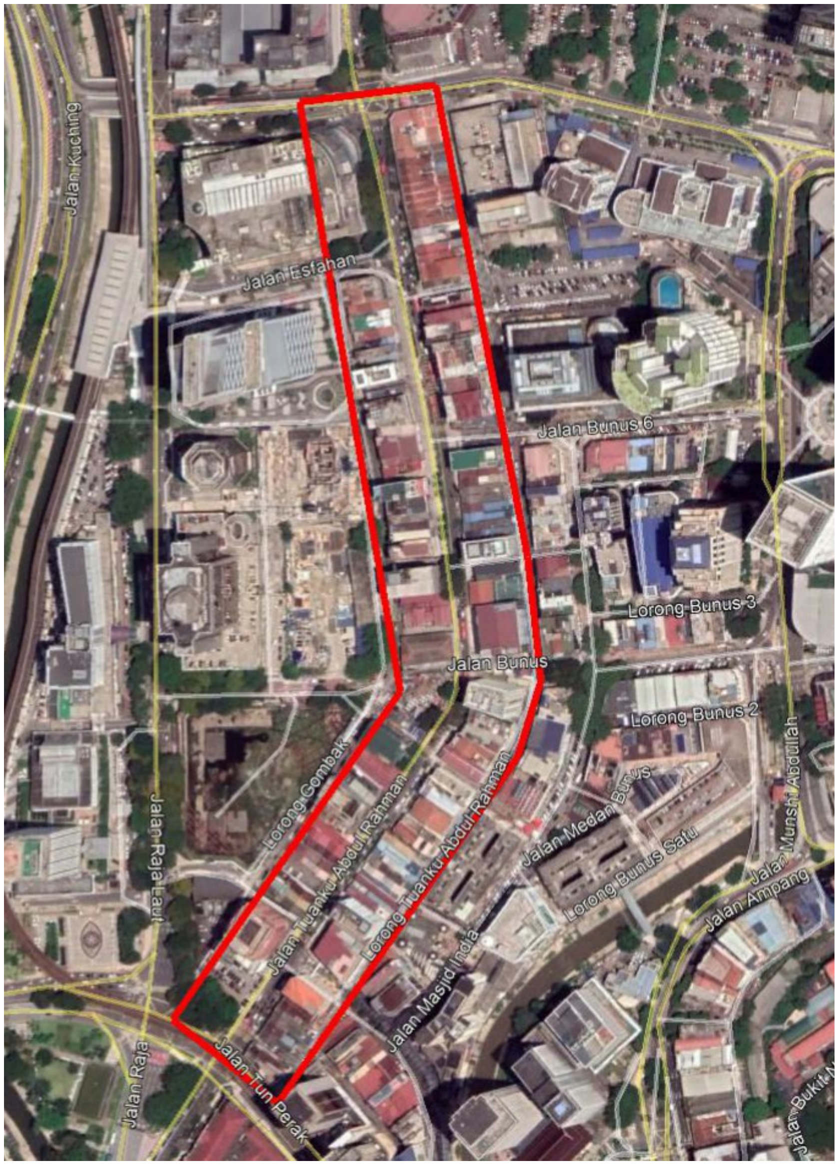

Figure 1: Location map of the study area in Kuala Lumpur. Source: Google Earth

GOALS AND OBJECTIVES

The goal of this study is to identify the potential threshold of visual pollution that can be accepted by the public within the historic shopping district. These objectives support the research goal: -

- To investigate the current level of visual pollution (advertising boards) exposure at JTAR;
- To determine the acceptance level of pollution among the public; and
- To identify factors affecting public acceptance towards visual pollution at JTAR.

This threshold hopefully will serve as a balance indicator between the protection of public mental health while allowing the local authority to capitalize on advertisement fees as their source of revenue to provide better infrastructure for the city.

Figure 2: Jalan Tuanku Abdul Rahman in the early 50s(top) and early 2000 (bottom). Source: https://web.facebook.com/mohdradzi.jamaludin

METHODS: DEMOGRAPHIC AND VISUAL SIMULATION SURVEY

The survey was divided into two major sections, namely the demographic and the visual simulation sections. Questions included in the demographic sections are gender, age, hometown location, education level, frequency of visit, and existing knowledge. These items are used as independent variables to identify significant factors that affected the overall public preference.

Meanwhile, images used for the visual pollution survey were taken at 20 different locations along both sides of the JTAR walkways (10 locations for each side). Distance for each location was roughly 70 meters apart and covered roughly 700 meters stretch of the street. Three pictures were taken at each location covering the street view and the camera lens was tilted at a pedestrian level angle to ensure the best collection of scenes that reflects the presence of elements in the street foreground, middle ground, and background. A total of 60 images were collected on-site.

These images were further reviewed and unsuitable images were eliminated from the main list due to the presence of unnecessary elements such as big trees or buses that blocked the street view. From this process, a final total of 14 images from 14 different locations were selected for the photo simulation survey (Figure 3).

Figure 3: Examples of the images captured during the site visit

The images were further analyzed to identify the existing level of visual pollution caused by the advertisement boards. By using Autodesk AutoCAD 2016, the images were rastered, and the visible area of these advertisement boards were digitized to calculate its cumulative amount of exposure (Figure 4). Table 1 reveals that the total amount of exposures for each scene varies from 0.82% (lowest) to 21.34% (highest) from the total scene area. The images then were assigned specific alphabetical codes for further image manipulation.

Table 1: Existing level of pollutions exposure in %

Picture	Code	Existing level of exposure %
1	A1	16.27
2	B1	17.28
3	C1	11.79
4	D1	10.65
5	E1	11.08
6	F1	21.34
7	G1	10.13
8	H1	14.66
9	I1	1.42
10	J1	2.16
11	K1	0.82
12	L1	7.00
13	M1	6.85
14	N1	3.68

Digitized scene (Code: A1)

The existing level of advertisement boards exposure (%)

= 16.27% from total pictorial area.

Figure 4: Example of area cumulative analysis for one of the scenes.

In addition, larger areas of advertisement boards were added to the original images to increase the pollution exposure. Each image received two levels of pollution increment (1st = **+/-** 5% and 2nd = additional **+/-** 5%) from the total pictorial area (Figure 5). For each level of addition, a new code was assigned based on the scenes' parental coding (Table 2 and 3). The final group of scenes (n=42) was arranged in a random sequence. This was followed by questions that asked the respondents to rate each of the images using a Likert scale rating: 1-highly pleasant, 2-pleasant, 3-moderately unpleasant, 4-unpleasant, 5-highly unpleasant. The ordered scale allowed the respondents to choose the best answer that aligns with their views easily.

Original image: B1

Existing level of exposure = 17.28%

Duplicated image: B2

1st level of addition (5.11%) = 22.39%

Duplicated image: B3

2nd level of addition (5.03%) = 27.43%

Figure 5: The additions have been made to the original pictures to simulate different levels of exposure (yellow represents the first addition = +/- 5%, blue represents the second addition = +/- 5% and red represents the actual existing pollutants = advertisement boards).

Table 2: Summary of percentage of added pollution exposure

Image code	Existing level of pollution %	1st addition %	New code	Total % of pollution after 1st addition	2nd addition %	New code	Total % Pollution after 2nd addition	Overall % of additions
A1	16.27	4.96	A2	21.23	4.86	A3	26.09	9.82
B1	17.28	5.11	B2	22.39	5.03	B3	27.43	10.14
C1	11.79	4.90	C2	16.69	4.89	C3	21.59	9.79
D1	10.65	4.89	D2	15.55	5.01	D3	20.56	9.90
E1	11.08	5.00	E2	16.08	4.89	E3	20.98	9.89
F1	21.34	4.97	F2	26.32	4.89	F3	31.21	9.89
G1	10.13	5.12	G2	15.26	5.12	G3	20.38	10.25
H1	14.66	5.00	H2	19.67	4.96	H3	24.64	9.97
J1	1.42	5.03	I2	6.45	5.13	I3	11.59	10.17
H1	2.16	4.85	J2	7.02	5.01	J3	12.03	9.87
K1	0.82	4.97	K2	5.79	4.88	K3	10.67	9.85
L1	7.00	5.02	L2	12.02	5.12	L3	17.15	10.15
M1	6.85	5.01	M2	11.87	5.07	M3	16.94	10.08
N1	3.68	4.97	N2	8.65	5.10	N3	13.76	10.08

Note: All numbers mentioned are up to two decimal numbers but the total addition percentages represent the summation of numbers with more decimals.

Table 3: Total scene number and classifications based on cumulative % of pollutions for each stage of additions (existing, after the first addition of +/- 5% and second addition of another +/-5%, a total of +/-10%).

Level of pollution classification	Number of existing scene	Cumulative number of scene after the 1st addition	Cumulative number of scene after the 2nd addition
0.00- 4.99 %	4	4	4
5.00 - 9.99 %	2	6	6
10.00 -14.99%	5	7	10
15.00 - 19.99%	2	5	10
20.00 - 24.99%	1	3	8
25% and above	-	1	4
Total	14	28	42

Sampling

For the purpose of the survey, postgraduate and undergraduate students at the Department of Landscape Architecture in Universiti Putra Malaysia were selected as the respondents to represent the public views. The group was selected primarily due to their current understanding and exposure towards the research issue.

RESULTS

A total of 22 postgraduate students (Master of Landscape Architecture Program) and 37 undergraduate students (Bachelor of Landscape Architecture Program) had volunteered for our survey (n=59). The respondents' age varied from 20 years to 34 years old, and a majority of them were female (61%) and the rest male (39%). The number of respondents who hailed from urban areas is 52.5 % (n=31) while 48% (n=28) are from suburban/rural areas. Malaysian students made up the majority of the group (79.7%; n=37) while the rest (20.3%; n=12) are foreign students. For the visual simulation survey, Cronbach's alphas tested for the 42 items shows a higher degree of reliability (42 items; α = 0.908).

Analysis of the least and most unpleasant scenes

Based on the mean scores, which ranged from M=3.56 to M=3.80, the four most unpleasant scenes (F3, F2, G3, M3) were identified. The range of pollutions exposure is from 31.21% to 16.94%. High mean scores for scene F3 (Figure 6) was predictable since the scene has the highest cumulative area of visual pollution. Mean scores for other scenes, however, do not show any association with the amount of pollution that they received. On the other hand, the least unpleasant scenes (Figure 7) rated by the respondents were (N2, H1, J1, N1), which ranged from M=2.80 to M=2.59. Meanwhile, the visual pollution exposure ranged from 8.65% to 3.68% and the results again show no clear association with the mean scores that they received (Table 4)

Table 4: Mean scores for most and the least unpleasant scenes.

Most unpleasant

Code	N	Mean	Std. Deviation

F3	59	3.80	1.256
F2	59	3.66	1.226
G3	59	3.59	.893
M3	59	3.56	.970

Least unpleasant

Code	N	Mean	Std. Deviation
N2	59	2.80	.996
H1	59	2.75	1.154
J1	59	2.73	1.080
N1	59	2.59	1.100

Figure 6: The most unpleasant scene (M=3.80)

Figure 7: The least unpleasant scene (M=2.59)

Mean analysis for level of visual pollution was performed to identify how the respondents rated their preference towards gradual increment of pollutions. The results (Table 5) somehow show clear association between increments of pollution and the respondents rating. The lowest mean score (M=2.84 for 0.0 to 4.99% pollution level) gradually increase to the highest (M=3.58 for > 25% level of pollution). In general, it can be stated that higher level of visual pollution will likely trigger a higher level of unpleasant feeling to the respondents.

Table 5: Mean value according to level of pollution

Level of pollution %	Mean score
0.00- 4.99 %	2.84
5.00 - 9.99 %	3.00
10.00 -14.99%	3.15
15.00 - 19.99%	3.16
20.00 - 24.99%	3.41
25% and above	3.58

Further investigation towards factors affecting respondents preference towards different level of visual pollution were conducted for variables such as gender, resident location, and the respondents' education level. Independent T-test was used to test these variables and the group statistics results are shown in Table 6, 7 and 8. For gender, the male mean preferences were consistently higher than the female for level of pollution 10.00 to 14.99% onwards. Nevertheless, the male (M=3.18, SD = .23) reported significantly higher level of unpleasant than female (M=3.34, SD = .86), t (3.35) = 56.08, p < .05 for pollution level more than 25%. Meanwhile, for the resident location variable, respondents living in the sub-urban/rural area consistently rated their level of unpleasant higher than people living in the urban area (M=2.86 to M=3.77). On the other hand, postgraduate students rated the pollution level higher than the undergraduate students for a pollution level 15.00-19.99% onwards. The results for these two variables, however, show there is no significant difference in term of their mean preferences.

Table 6: Gender and mean value for level of pollution

Pollution level	Gender	N	Mean	Std. Deviation
0.0- 4.99%	male	23	2.6957	.60282
	female	36	2.9375	.73527
5.00 - 9.99%	male	23	2.9058	.61304
	female	36	3.0602	.72062
10.00 -14.99%	male	23	3.1826	.46967
	female	36	3.1361	.57379
15.00 - 19.99%	male	23	3.1870	.23607
	female	36	3.1389	.68547
20.00 - 24.99%	male	23	3.4420	.50903
	female	36	3.3935	.74871
25% and above	male	23	3.9348	.47803
	female	36	3.3472	.86453

Table 7: Residents location and mean value for level of pollution

Pollution level	Reside	N	Mean	Std. Deviation
0.0- 4.99%	urban	31	2.8226	.62648
	semi-urban	28	2.8661	.76824
5.00 - 9.99%	urban	31	2.9516	.59503
	semi-urban	28	3.0536	.76987
10.00 -14.99%	urban	31	3.1032	.44006
	semi-urban	28	3.2107	.62143
15.00 - 19.99%	urban	31	3.0742	.34638
	semi-urban	28	3.2500	.71102
20.00 - 24.99%	urban	31	3.3172	.45817
	semi-urban	28	3.5179	.82694
25% and above	urban	31	3.3952	.65757

	semi-urban	28	3.7768	.88018

Table 8: Education level and mean value for level of pollution

Pollution level	Education	N	Mean	Std. Deviation
0.0- 4.99%	bachelors	`37	2.9392	.60210
	postgraduate	22	2.6818	.80984
5.00 - 9.99%	bachelors	37	3.0541	.49699
	postgraduate	22	2.9091	.91537
10.00 -14.99%	bachelors	37	3.2378	.41657
	postgraduate	22	3.0136	.67138
15.00 - 19.99%	bachelors	37	3.1541	.52153
	postgraduate	22	3.1636	.61377
20.00 - 24.99%	bachelors	37	3.3468	.54345
	postgraduate	22	3.5227	.82503
25% and above	bachelors	37	3.4324	.75840
	postgraduate	22	3.8182	.79501

CONCLUSIONS

In general, we can conclude that the respondents are likely to feel more unpleasant when the level of visual pollutions gradually increases. The result is something that we predicted. Nevertheless, it came to our surprise that although the highest level of pollution for scene (F3) was 31.21%, the rating was only moderately unpleasant (M=3.80). Technically, the pollution exposure occupied almost the entire facade of the building, and we have used almost all areas that are available to add the advertisement boards. Thus, we assume that the respondents were more tolerant towards higher levels of visual pollution than predicted.

Meanwhile, results from factors affecting the mean preference show significant understanding of how gender, education level, and resident location might affect public judgments in our future studies. Other variables affecting visual pollution, such as building height, scales, colors, and lighting conditions are also worth investigating. Finally, the overall results are disturbing since we had previously anticipated that the landscape architecture students should be more sensitive to visual pollution while the results indicate otherwise. This phenomenon can be further investigated to identify underlying reasons associated with their judgments.

This study is motivated by the desire to improve the physical and psychological well being of Malaysia's capital city, Kuala Lumpur. Although many studies have been conducted to investigate other environmental issues such as air, noise, and water pollution; the impact of visual pollution towards people's experience in Kuala Lumpur is still unclear. Unfortunately, the concept of urban visual quality in Malaysia is at the infancy stage. Lack of understanding and awareness among the City's stakeholders; in particular, have somehow affected the formulation of needed policies to properly manage its urban visual quality. If not addressed adequately, visual pollution may jeopardize Kuala Lumpur's charms as one of the most vibrant multicultural cities in Asia and turn into a neglected mental issue unconsciously faced by city dwellers.

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