The influence of urban street-side greenery on people's visual preference

J Ernawati [a,1]

[a] Human Settlement and Urban Design Laboratory, Department of Architecture, Faculty of Engineering, Brawijaya University
[1] jenny_ernawati@ub.ac.id
* corresponding author

ARTICLE INFO

Article history
Received September 3, 2022
Revised November 15, 2022
Accepted December 6, 2022
Available online December 31, 2022

Keywords
Urban street
Greenery
Visual preference

ABSTRACT

This study purposed to identify urban street-side greenery's effect on people's preferences towards streets in Malang town, Indonesia. Nine samples of streets were randomly selected based on greenery conditions and street typologies. Thirty participants for each street systematically selected came to a total of 270 respondents. The research instrument was a questionnaire with photos of the nine streets as stimuli to explore people's preferences towards street-side greenery based on six street greenery variables and two street conditions using multiple rating scales. The data analyses employed a descriptive statistic to determine people's preferences and multiple regression analysis to identify street greenery attributes that influence people's visual preference of the street. The results show that all street greenery attributes significantly influence people's preferences ($p < .05$). As a whole, street-side greenery attributes, i.e., plant height, green street median, vegetation arrangement, the distance between trees, tree and vegetation species, and the number of trees, determine around 17.2% of urban street visual preferences. Among those street greenery qualities, the number of trees, vegetation arrangement, and green street median existence have the most influence on people's visual preferences. However, other than street greenery attributes, the street conditions (i.e., street width and the sidewalk width) significantly contribute to people's preference. It accounts for around 49.4% of the visual preference of the street.

1. Introduction

Various cities in many parts of the world experience the same development problem that changes their land use. There is some land use transformation from natural and agricultural areas into built areas. Construction of urban facilities and infrastructure to accommodate development needs often sacrifice the quality of open space and the environment. Due to population growth, city development increases land demand, while residents suffer from air pollution, noise pollution, and a lack of green space (Choumert [1]). In response to this situation, previous studies showed the growth of green facilities' importance for choosing a living environment (Chiesura [2]; Jim [3]; Choumert [1]; Ye et al. [4]).

Urban greenery has long been recognized for its role in improving environmental and aesthetic conditions in urban environments (Jim & Shan [5]; Ye et al. [4]). It is generally known that green space has a positive impact on the environment. At the macro scale, the main factors that influence climate are solar radiation (Henderson-Seller & McGuffie [6]; Hien & Jusuf [7]). Meanwhile, the built environment and its surroundings at the micro-scale, especially buildings and vegetation, affect the earth's surface solar radiation.

The benefits of street vegetation for urban dwellers have received much attention (Todorova et al. [8]). As an essential element in urban planning, green space plays a crucial role in the sustainability of a city (Chiesura [2]; Jim [3]; Choumert [1]). Attention to the sustainability of a city and the quality of life has led to increasing demand for green facilities on a daily basis (Ye et al. [4]; Long & Ye [9]). Green space provides countless benefits for the community, such as facilities for recreational activities, ecological functions, public health, and a healthy environment (Bolund & Hunhammar [10]; Choumert [1]; Li et al. [11]; Tzoulas et al. [12]).

Green space plays an essential role in human health. Previous studies show a positive relationship between health and green space (Lu et al. [13]; Takano et al. [14]; Tzoulas et al. [12]; de Vries et al. [15]). Urban green space can reduce air pollution and urban heat (Whitford et al. [16]). Besides that, green space can also attract people to spend more time outside the home to stimulate physical activity (Lu et al. [13]).

As a natural element, green space also plays a vital role in social health, such as its attachment. It plays an essential role in social interaction in the urban environment (Tzoulas et al. [12]). Conversely, green space that is perceived to be too dense, enclose, or not adequately maintained can also increase the community's sense of insecurity (Taylor et al. [17]). Thus, green spaces' benefits are conditional and cannot be generalized because they depend on green space configuration and the people who use them.

This situation makes policymakers, architects, and urban planners increasingly understand the importance of greenery in cities' regeneration (White & Gatersleben [18]). However, urban planning practice rarely considered the quality of visual street greenery (Ye et al. [4]). Although urban design quality is considered necessary in determining people's preferences (Ernawati et al. [19]), urban streetside greenery has not received special attention. Previous studies have shown that natural scenery is usually preferred and valued as more beautiful than artificial scenery or the built environment. The integration of natural elements in urban areas can also improve people's perception of the area.

Although the benefits of street greenery are numerous, aspects of greenery's visual or aesthetic amenity have received less attention (Long & Liu [20]). Literature studies show the critical role of visible street greenery in improving the quality of one's experience in urban areas. Many researchers conducted various studies to examine street greenery's contribution to people's lives and comfort in walking (Ye et al. [4]; Ernawati [21]). The results of previous studies showed that street greenery could help increase public appreciation of the aesthetics of the urban environment (Camaeho-Cervantes et al. [22]; Ye et al. [4]). In the past two decades, many studies examine people's preferences for green space. The results of previous studies indicate that urban greenery increases the perceived quality of life in residential areas and can increase security (Taylor et al. [17]). Some studies also show the importance of utilizing environment aesthetic benefits by arranging vegetation in road corridors in urban areas and other areas that are easily accessible to urban residents (Barau [23]; Lee & Kim [24]; Ye et al. [4]). However, those various studies of people preferences toward tree planting and urban street landscape have been conducted in North America (e.g., Hitchmough & Bonugli [25]; Kaplan & Kaplan [26]; McPherson et al. [27]; Schroeder & Cannon [28]; Sommer & Sommer [29]; Thaiutsa et al. [30]). The studies that conducted cross-national are limited in number (Sommer & Summit [31]; Sommer [32]). Those studies revealed that respondents give high value to the urban green space. The evaluations were based on functional, ecological, social, and psychological attributes (Hitchmough & Bonugli [25]; Sheets & Manzer [33]).

In contrast, in cities in the UK with relatively cold summer climates, the shadows formed by trees are judged by some respondents to be negative attributes. The result of that study means that community support for tree planting in those cities is based more on aesthetic-psychological values than functional values (Hitchmough & Bonugli [25]). This situation also shows that people from different nationalities appreciate green spaces differently. Similar studies in developing countries such as Indonesia are still very limited in number. Because of this, this research means to fill this gap.

In Malang, a small city in the Eastern part of Java Island Indonesia, this situation is quite alarming. The town failed to fulfill the Indonesia Spatial Planning Law requirement to have urban green space covered for 30% of its area. The city only has green space for around 8% of the total city area.

Streets are the main city infrastructures that function to accommodate the city's circulation for vehicles and pedestrians. Streets are the most popular settings for walking, biking, and physically active activities (Rosenberg et al. [34]; Lu et al. [13]). The urban green space arrangement that can be accessed directly by the community and improved quickly is the street-side greenery in neighborhood areas. Unfortunately, some literature reviews show that street greenery received less attention in studies than public space like parks (Kaczynski and Henderson [35]; Lachowycz & Jones [36]; Lu et al. [13]).

Thus, structuring a street's green space that is effective and following the community's conditions requires local community involvement (Shan [37]). Planning and redesigning the street-side greenery as green space in Malang city should involve local people as the street users. Some theories explain human preferences for vegetation. Sommer and Summit [38] reveal that empirical studies of trees' preferences are very consistent. A large number of studies in environmental aesthetics indicated this situation. Community preferences in structuring street-side greenery play an essential role in forming people's attitudes towards the street-side greenery's visual quality. Understanding the green system's characteristics that affect people's preferences is still very much needed. Based on the theory obtained from a general pattern of human preferences, researchers must be aware of differences in social norms and expectations that affect people's response to street trees (William [39]). Cultural or ethnic differences also appear to be the most significant factors concerning these expectations (Fraser & Kenney [40]). Therefore, it is necessary to study people's preferences for street-side greenery cross nationals such as in Indonesia.

2. Method

The research applied a quantitative approach to explore people's visual preference towards the streetside greenery in the Town of Malang, Indonesia. Nine samples of streets were chosen randomly according to the type of road and the street greenery coverage. There were 270 respondents participated in this study. Respondents were selected systematically from residents of the nine streets' samples. For each street, the researcher selected thirty residents as respondents, consisting of 15 respondents for each street side. Respondents were selected based on building units so that only one respondent took for each house/building. The selection of houses is carried out systematically from end to end of each street, between odd and even house numbers alternately so that samples can represent the population.

2.1. Data Collection

The data collection conducted observations and tracing maps of google satellite imagery to identify streets with much greenery, streets with an average number of greenery, and streets with a lack of greenery, based on the street typologies. Measurement of the estimated amount of greenery by tracing on google maps was intended to select a sample of streets. Therefore, as a consequence, the area covered by the green layout is more determined by the area of the green coverage. Then the streets are grouped into three groups as follows:

- Street with much street-side greenery (>66% of the street-side area)
- Street with a moderate number of street-side greenery (which covers around 33%-66% of the streetside area)
- Street with a lack of street-side greenery (<33% of the street-side area)

Based on the street's function, there are three types of streets in Malang, i.e., Arterial road, collector road, and neighborhood street. Table 1 shows the type of streets and its street-side greenery based on observation and map tracing conducted.

Table 1. Type of streets and street-side greenery

Type of Street	Number of Streets with Street-Side Greenery (SSG) Condition		
	Much SSG (Number of street)	*Moderate SSG (Number of Street)*	*Lack of SSG (Number of Street)*
Arterial Road	4	16	7
Collector Road	7	14	8

Neighborhood Street	9	27	18
	20	57	33

In each type of street, three samples were randomly selected using a research randomizer. So there are nine samples of streets, which represent the type of streets in Malang City. The nine chosen samples are:

- Merdeka Barat Street (the arterial road with much SSG)
- Kauman Street (the arterial road with lack of SSG)
- Tumenggung Suryo Street (the arterial road with lack of SSG)
- Soekarno-Hatta Street (collector road with much SSG)
- Tlogomas Street (collector road with lack of SSG)
- Muharto Street (collector road with lack of SSG)
- Melati Street (neighborhood street with much SSG)
- S.Parman III Street (neighborhood street with lack of SSG)
- Mulyorejo Street (neighborhood street with lack of SSG)

Those nine selected streets were then photographed and printed in 4R sizes (Figure 1). The photos are used as stimuli in the questionnaire that were evaluated by the community.

a.Melati Street b.S.Parman III Street c. Merdeka Barat Street

d. Tumenggung suryo Street e. Mulyorejo Street f. Kauman Street

g.Soekarno-Hatta Street h. Tlogomas Street i.Muharto Street

Fig. 1. Stimuli of the Study

The questionnaire used photos as stimuli to make respondents easy to remember the place and give respondents an idea of the assessed street. Therefore, even though only one photo was used in each corridor, it did not cause bias. This condition is because respondents filled out the questionnaire on-site. Furthermore, respondents are residents of the street, so they are very familiar with visual street greenery in the study location.

Although some researchers are accustomed to replacing actual street vegetation with photographs, some researchers prefer to survey residents about the actual trees outside their homes (Williams [39]).

This research applied both photos to recall memory and on-site field surveys as residents of the street.

2.2. Research Instruments

The main research instrument is a self-administered questionnaire that consists of two parts. The first part means to record respondents' characteristics such as gender, age, length of stay in Malang, and the household economic condition to provide a homogeneity or heterogeneity of all respondents. The second part means to explore people's preference for urban street-side greenery. Respondents rate their preference to two street conditions variables and six street-side greenery attributes based on previous studies. The street condition consists of the width of the street and the width of the sidewalk while the street-side greenery attributes consist of the number of trees (1); the existence of green street median (2); the distance between trees (3); the vegetation arrangement (4); tree and vegetation species (5); and plant height (6).

Respondents were given a questionnaire to assess their visual preferences for the street-side greenery in their surroundings, as presented by photographs. Respondents evaluate the street-side greenery using five-point multiple rating scales ranging from "least preferred to the street-side greenery condition of Street X" (value 1) to "most preferred to the street-side greenery condition of Street X" (value 5). Respondents only needed to circle one of the five preference scales, which corresponds to their opinion.

The questionnaire also provided a section to explore respondents' visual preferences of the street.

2.3. Data Analysis

This study employed descriptive statistics to identify people's preference for street-side greenery. The research applied multiple regression analyses in revealing the influence of street-side greenery on people's visual preferences. In the regression analysis, the street-side greenery and street design acted as independent variables, and people's visual preference acted as a dependent variable. As a whole, the data analyses using SPSS software.

3. Results and Discussion

Respondents in this study consisted of 63% male and 37% female, with the majority (80%) aged 20 to 49 years, and 80% of them are local people. Looking at the length of stay in Malang, 71.5% of respondents had settled in Malang for more than 20 years. Most respondents, around 90% of them, belong to middle-low income residents. These situations show that this study's participants are relatively homogenous and have been quite familiar with their surroundings.

Results indicated two streets most favored by the community, five streets with a moderate level of preference, and two streets that the local people least preferred. The value of the mean preference considers these categories. Streets with Mean preference > 4 on a five-point scale indicate most preferred by the community. Mean preference between 3 and 4 indicates a moderate level of preference, and Mean preference < 3 indicates the least preferred by the people. Among those streets favored by the community, the mean preference analysis, as shown in Table 2, show that the most preferred streets are the Soekarno-Hatta Street (Mean=4.06) and the Merdeka Barat Street (Mean=4.04). Whereas the most unpopular streets, according to the community, are the S. Parman III Street (Mean=2.25) and Muharto Street (Mean=2.59). The rest are five streets with moderate mean preference, i.e., Kauman Street (Mean=3.79), Melati Street (Mean=3.72), Tumenggung Suryo Street (Mean=3.56), Mulyorejo Street (Mean=3.50), and Tlogomas Street (Mean=3.46).

Table 2. Mean preference of street-side greenery

Sample of Streets	Mean	Standard Deviation
Melati Street	3.72	0.561
S. Parman III Street	**2.25**	0.758
Merdeka Barat Street	**4.04**	0.551

Tumenggung Suryo Street	3.56	0.561
Mulyorejo Street	3.50	0.638
Kauman Street	3.79	0.625
Soekarno-Hatta Street	**4.06**	0.662
Tlogomas Street	3.46	0.648
Muharto Street	**2.59**	0.843

Overall, The results show that streets preferred by respondents are streets that have much street-side greenery. These research findings are in line with previous studies. Previous research has shown that people usually respond to vegetation and natural elements more positively than those without vegetation and natural elements. White and Gatersleben [18] summarize previous studies' findings that show four things that distinguish areas with natural elements and vegetation compared to those without vegetation. The results of their literature review show that areas with vegetation and natural elements: (1) have a higher preference than built areas; (2) aesthetically more beautiful; (3) generate more positive emotions; (4) and more restorative.

However, analyses of this study are going further. Results of community preferences towards the street greenery attributes and street conditions, as presented in Table 3, show that among the seven streets with high mean preference and moderate preference, the sidewalk's width has evaluated as having a negative to moderate level of preference. In contrast, the street greenery attributes have moderate to high preference. Meanwhile, people evaluate street-side greenery in Muharto Street and S. Parman Street as the least preferred streets. In those two streets, the six street greenery attributes and the two street conditions variables have a low mean preference.

Table 3. People's preferences on the attributes of street greenery and street conditions

Street	The Width of The Street	The Width of The Sidewalk	The Number of Trees	The Existence of Green Street Median	The Distance Between Trees	Vegetation Arrangement	Tree and Vegetation Species	Plant height
Melati	3.66	2.75	3.80	3.47	3.41	3.50	3.56	3.40
S.Parman III	**2.61**	**2.09**	**2.04**	**2.37**	**2.34**	**2.28**	**2.51**	**2.33**
Merdeka Barat	4.11	3.81	3.94	3.45	3.69	3.69	3.73	3.54
Tumenggung Suryo	3.79	3.57	3.32	3.17	3.22	3.26	3.46	3.38
Mulyorejo	3.50	2.57	3.44	3.05	3.33	3.36	3.60	3.46
Kauman	3.92	3.85	3.70	3.27	3.53	3.44	3.65	3.49
SoekarnoHatta	4.01	3.96	3.96	3.89	3.66	3.90	3.89	3.57
Tlogomas	3.53	2.94	3.42	3.11	3.40	3.30	3.49	3.34
Muharto	**2.87**	**2.39**	**2.64**	**2.62**	**2.51**	**2.77**	**2.99**	**2.93**

Furthermore, this study employed a multiple regression analysis to reveal attributes that affect the street's visual preference. Results of the regression analysis (see Table 4) show that the street conditions, i.e., the width of the street and the width of the sidewalk, influence people's visual preference significantly ($p < 0.01$). Their effect on street visual preferences accounts for 49.4% of the variance (see the R Square value in Model 1 = 0.494), which shows a strong influence. In Model 2, the six attributes of the street greenery, i.e., plant height, green street median, vegetation arrangement, the distance between trees, tree and vegetation species, and the number of trees, are included in the regression model. As a result, the R Square value increases to 0.666. This increasing value means total variance in the community's preference for the street greenery increase to 66.6%. This condition means that the six attributes of the street-side greenery affect 17.2% of people's visual preference

Table 4. Model summary The influence of street-side greenery on people's visual preferences.

R	Change Statistic

Model		R Square	Adjusted R Square	Std.Error of the Estimate	*RSquare Change*	*F Change*	*Df 1*	*Df2*	*Sig.F Change*	Durbin - Watson
1	.703[a]	.494	**.494**	.626	.494	1185.151	2	2427	.000	1.817
2	.816[b]	**.666**	**.664**	.509	.171	206.889	6	2421	.000	

[a.] predictors : (Constant), the width of the side-walk, the width of the street, plant height, the existence of green street median, vegetation arrangement, the distance between trees, tree,and

[b.] dependent variable : people's visual preference

The analysis results indicate that people's impression of the street condition as the greenery location might affect people's street-side greenery preferences. The possible reason is that street conditions, such as the street and sidewalk width, provide a wide range of views. Therefore, those street conditions influence visual preferences stronger compared to the condition of the greenery itself.

Looking at the comparison between the R Square with the Adjusted R Square in Model 2, as shown in Table 4, the difference in value is relatively small, which is 0.002 (around 0.2%). In this situation, although the research only studied 270 respondents, the results can be generalized into the population. When the study involves the entire population of Malang city, the difference in variance is only about 0.2% from the 270 respondents' survey. It can be generalized that the street-side greenery attributes in the model are significantly ($p < .01$) influence visual preference.

In sum, people preferences for street-side greenery is 66.6% determined by street conditions, i.e., the street width and the sidewalk width, and the six attributes of the street-side greenery itself, i.e., plant height; the existence of green street median; vegetation arrangement; the distance between trees; tree and vegetation species; and the number of trees. Table 5 presents the contribution of each attribute as a predictor of visual preference.

Table 5. Multiple regression analysis: The influence of street conditions and street-side Greenery on visual preference[a]

Sample of Streets	B	SE B	*β*
(Constant)	.948	.053	
The width of the street	.501	.017	.507*
The width of the sidewalk	.229	.014	.279*
(Constant)	.022	.054	
The width of the street	.279	.016	.283*
The width of the sidewalk	.111	.012	.135*
Number of trees	.190	.017	.208*
The existence of green street median	.051	.015	.051**
Distance between trees	.101	.016	.106*
The vegetation arrangement	.142	.017	.147*
Tree and vegetation species	.070	.019	.065*
Plant height	.075	.016	.075*

[c.] . Dependent Variable: People's Visual Preference

[d.] *Note: $R^2 = .49$ for Step 1, $\Delta R^2 = .67$ for Step 2 ($p < .01$). *$p < .01$. **$p < .05$.*

Table 5 shows that all attributes of the street-side greenery and street conditions significantly influence people's preferences ($p < .05$). The magnitude of the value of β shows the order of each attribute's relative contribution to people's preferences. Results indicate that the street's width is the most influential variable in people's visual preference ($p < .01$). This contribution then followed by the number of trees ($p < .01$), vegetation arrangement ($p < .01$), the width of the sidewalk ($p < .01$), and the distance between trees ($p < .01$). Although all attributes have a significant influence on people's visual preferences, the effects of plant height ($p < .01$), tree and vegetation species ($p < .01$), and the green street median ($p < .05$) on visual preference are relatively small. Among those six greenery attributes, the number of trees is the most influential attribute for people's visual preferences. This situation means that the community would likely love streets with a lot number of trees. The vegetation

arrangement and the distance between trees are also considered to have a relatively high impact on people's visual preferences.

The research also reveals the attributes of street-side greenery that affect people's preferences for each street type. Among the nine streets, the most preferred street-side greenery is the green space at Soekarno-Hatta street. The street is a collector road with much street-side greenery. People also like Merdeka Barat Street, an arterial road that also has many greenery. Moreover, its location is adjacent to the urban park. The results indicate that people's preferences are also affected by street design. SoekarnoHatta Street, for example, is a broad collector road consisting of two lanes in the form of a boulevard decorated with green median and a lot of street-side greenery (The green space covers more than 66% of the area).

In conclusion, there are six attributes of urban street-side greenery and two street conditions that influence people's visual preferences. Looking at the magnitude of the influence, the highest effect to the least effect on the visual preference of the street is as follows: the width of the street, the number of trees, vegetation arrangement, the width of the sidewalk, the distance between trees, plant heights, tree and vegetation species, and the green street median. The six attributes of street-side greenery and two street condition variables contribute 66.6% to people's visual preferences. Therefore, around 33.4% of other influential factors of people's visual preferences have not been revealed in this study.

4. Conclusion

This study found six attributes of urban street-side greenery, i.e., the number of trees; vegetation arrangement; the distance between trees; plant heights; tree and vegetation species; and green street median have a significant influence on people's visual preference. They determine around 17.2% of urban street visual preference. Among those six greenery attributes, the number of trees affects people's visual preferences the most. The study also found the two variables of street condition, i.e., the street's width and the sidewalk's width, significantly influencing people's visual preference. They account for around 49.4% of the visual preference. All attributes of street-side greenery and street conditions all together contribute 66.6% to people's visual preference. Therefore, 33.4% of other influencing factors of people's preferences have not been revealed in this study. Future research needs to reveal those other influencing factors.

Acknowledgment

This author acknowledges the Human Settlement and Urban Design Laboratory, Department of Architecture, Faculty of Engineering, Brawijaya University, for its support.

Declarations

Author contribution. All authors contributed equally to the main contributor to this paper. All authors read and approved the final paper.
Funding statement. None of the authors have received any funding or grants from any institution or funding body for the research.
Conflict of interest. The authors declare no conflict of interest.
Additional information. No additional information is available for this paper.

References

[1] Choumert J 2010 An empirical investigation of public choices for green spaces *Landuse policy* **27** pp 1123-1131

[2] Chiesura A 2004 The role of urban parks for the sustainable city *Landscape and Urban Planning* **68** pp 129-138

[3] Jim C Y 2004 Green space preservation & allocation for sustainable greening of compact cities *Cities* **21** pp 311-320

[4] Ye Y et al. 2018 Measuring daily accessed street greenery: a human-scale approach for informing better urban planning practices *Landscape and Urban Planning* https://doi.org/10.1016/j.landurbplan.2018.08.028

[5] Jim C Y and Shan X 2013 Socioeconomic effect on perception of urban green spaces in Guangzhou, China *Cities* **31** 2 pp 123-131

[6] Henderson-Seller A. and Mc Guffie K 1987 *A climate model primer* New York: Wiley

[7] Hien W N and Jusuf S K 2008 An Assessment method for existing greenery conditions in University campus *Architectural Science review* **51** 3 pp 212-222

[8] Todorova A et al. 2004 Preferences for and attitudes towards street flowers and trees in Sapporo, Japan *Landscape and Urban Planning* **69** 4 pp 403-416

[9] Long Y and Ye Y 2016 Huam-scale urban form: Measurements, performances, and urban planning & design interventions *South Architecture* **8** 5 pp 39-45

[10] Bolund P and Hunhammar S 1999 Ecosystem services in urban areas *Ecological Economics* **29** pp 293-301

[11] Li X et al. 2016 Environmental inequities in terms of different types of urban greenery in Hartford, Connecticut *Urban Forestry & Urban Greening* **18** pp 163-172

[12] Tzoulas K et al. 2007 Promoting ecosystem and human health in urban areas using green infrastructure: a Literature review *Landscape and Urban Planning* **81** pp 167-178

[13] Lu Y. et al. 2018 The effect of street-level greenery on walking behavior: evidence from Hong Kong *Social Science & Medicine* **208** pp 41- 49

[14] Takano T et al. 2002 Urban residential environments and senior citizens' longevity in megacity areas: the importance of walkable green space *Journal of Epidemical Community Health* **56** 12 pp 913-918

[15] de Vries et al. 2003 Natural environment – healthy environments? An exploratory analysis of the relationship between green space and health Environment and Planning **35** 17-31

[16] Whitford V et al. 2001 City form and natural process-indicators for ecological performance on urban areas and their application to Merseyside, UK *Landscape Urban Planning* **57** 2 pp 91103.

[17] Taylor A F et al. 1998 Growing up in the inner city: Green spaces as places to grow *Environment and Behavior* **30** 1 pp 3–27

[18] White E and Gatersleben B 2011 Greenery on residential buildings: Does it affect preferences and perceptions of beauty? *Journal of Environmental Psychology* **31** 1 pp 89-98

[19] Ernawati J et al. 2018 People's preferences of urban design qualities for walking on a commercial street *IOP Conference Series: Earth and Environmental Science* **126** 012206

[20] Long Y and Liu I 2017 How green are the streets? An analysis of central areas of Chinese cities using Tencent Street View *PLlos One* **12** 2 e0171110

[21] Ernawati J 2016 Dimensions underlying local people's preferene of street characteristics for walking *Procedia Social and Behavioral Sciences* **234** pp 461-469

[22] Camaeho-Cervantes M et al. 2014 How do people perceive urban trees? Assessing likes and dislikes in relation to the trees of a city *Urban Ecosystems* **17** 3 pp 761-773

[23] Barau A S 2015 Perceptions and contributions of households towards sustainable urban green infrastructure in Malaysia *Habitat International* **47** 285-297

[24] Lee J S and Kim J W 2016 South Korea's urban green energy strategies: Policy framework and local responses under the green growth *Cities* **54** 2 pp 20-27

[25] Hitchmough and Bonugli 1997 Attitude of residents of a medium sized town in South West Scotland to street trees *Landscape research* 22 3 pp 327-337

[26] Kaplan & Kaplan 1989 *The experience of nature: a psychological perspective* New York: Cambridge University press.

[27] McPherson E G et al. 2010 Million trees Los Angeles canopy and benefit assessment *Landscape and urban planning* **99** pp 40-50

[28] Schroeder and Cannon 1983 The aesthetic contribution of trees to residential streets in Ohio Towns *Journal of Arboriculture* **9** pp 237-243

[29] Sommer and Sommer 1989 The factor structure of street tree attributes *Journal of Arboriculture* **15** pp 243-246 Reprinted in D Neely Ed. 1994 Journal of Arboriculture: A compendium. Vol. 6: Social Aspects of Arboriculture, pp 92-95. Savoy IL : International Society of Arboriculture.

[30] Thaiutsa B et al. 2008 Urban green space, street and heritage large tree assessment in Bangkok, Thailand *Urban Forestry & Urban Greening* **7** pp 219-229

[31] Sommer R and Summit J 1996 An evaluation of tree descriptions in a popular garden guide *Journal of Arboriculture* **22** 3 pp 155-159

[32] Sommer R 1997 Further cross-national studies of tree form preference *Ecological Psychology* **9** pp 153-160

[33] Sheets & Manzer 1991 Affect, cognition, and urban vegetation: some effect of adding trees along city streets Environment and behavior **23** pp 285-304

[34] Rosenberg M et al. 2010 Physical activity levels Western Australian adults 2009: Findings from the physical activity taskforce adult physical activity survey The University of Western Australia, Perth.

[35] Kaczynski A T and Henderson K A 2007 Environmental correlates of physical activity: a review of evidence about parks and recreation *Leisure Sci.* **29** 4 pp 315-354

[36] Lachowycz K and Jones A P 2011 Greenspace and obesity: a systematic review of the evidence *Obes. Rev.* **12** 501 pp e183-e189

[37] Shan X 2012 Attitude and willingness toward participation in decision-making of urban green space in China *Urban Forestry & Urban Greening* **11** pp 211-217

[38] Sommer R and Summit J 1995 An exploratory study of preferred tree form *Environment and Behavior* **27** 4 pp 540–557 https://doi.org/10.1177/0013916595274005

[39] Williams K 2002 Exploring resident preferences for street trees in Melbourne, Australia Journal of Arboriculture **28** 4 pp 161-170

[40] Fraser E and Kenney W A 2000 Cultural background and landscape history as factors affecting perceptions of the urban forest *Journal of Arboriculture* **26** 2 pp 106-113