Biophilia: Residents' Connection with Green Infrastructure in a Town

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ABSTRACT

Green infrastructure is urban nature consisting of greenery and green spaces distributed in and around town. It facilitates residents' contact with natural environment that may fulfil their needs for nature in urban places. Human's inherent affiliation with the natural environment or Biophilia has been long hypotesised. The paper draws the findings of a case study exploration on the connection between residents with green infrastructure in Taiping, a small colonial town in Peninsular Malaysia. Biophilic tendency of residents to green infrastructure in the town was elicited using questionnaire survey (n=335) and semi-structured interviews (n=33). The results show that residents who participated in activities within the greenery and open spaces in the town experienced various benefits that fulfil their needs for nature. Physically, participating in activities provided the residents active living. Physical and visual experience afforded relaxation, comfort and calmness. More social interactions were experienced resulting in community satisfaction. The study concludes that existence of matured green infrastructure extends beyond aesthetic enjoyment. It provides urban residents with a connection to nature that induces affiliation with green infrastructure in a town. Thus, planning and provision of green infrastructure with care by urban planners and designers are essential in the urban fabrics.

Keywords: Biophilia, Experiential Contacts, Connection; Green infrastructure, Town Residents, Taiping

INTRODUCTION

In the past forty years, particularly in environment-behaviour studies, researchers have explored the idea that there is a link between human evolution, connection and affiliation for nature (e.g. Appleton, 1975; Wilson, 1984; Kaplan and Kaplan, 1989). This is because human's responses to greenery and forests are so strong and consistent that some researchers have suggested that humans have evolved instinctive preferences for a certain type of natural environment. One of the most prominent theories on humans' relationship with nature originates from the 'love of nature theory' referred as *Biophilia*. The theory postulates that humans have an innate tendency to focus on life and life-like processes (Wilson, 1984; Kellert and Wilson, 1993). Therefore, it implies that the desire for contact with nature is something that humans inherit and act on instinctively without realising or appreciating the underlying evolutionary reasons. This innate bond with nature may also imply that certain kinds of contact with it may directly be beneficial to our well-being. Researchers believe that this natural instinct is affiliated with humans' genetic fitness and competitive advantage. As such, experiential contact with nature is found to be essential to physical and psychological well-being (Heerwagen and Orians, 1993; Frumkin, 2005). In other words, our relationships with nature are a fundamental component of building and sustaining good health. Consequently, the factor underpins people's ethic of care for green environment and the growing concerns for conservation of the natural environment.

LITERATURE REVIEW

Western researchers have proposed that humans basic needs for nature do not differ from our original ancestors. This is because it is believed that humans have lived with forests and grasslands since ten million years ago (Appleton, 1975; Orians, 1986; Kellert and Wilson, 1993; Sullivan, 2005). Thus, humans have spent such a long time within close contact with nature rather than being disengage from it. In other words, humans have an instinctive need for nature—biophilic tendency. The humans need is parallel to the Islamic worldview. In Islam, there is no denying on the importance of nature as resources of enormous benefits for human to survive, thus must warrant respect. The Glorious Qur'an mentions the functions of nature such as plants as sustenance and a source of aesthetic (e.g. Sura 'Abasa (80), 24-32). The Qur'an clarifies the functions of nature to humans as objects of beauty since peace of mind is a religious requirement which needs to be satisfied (Ahmad Bakadar *et al.*, 1997). Thus, Allah has made plants and animals which can provide joy and wonder to human soul, so that man can satisfy his peace of mind. In short, this perspective affirms that natural environment is essential for humans' functioning.

However, as the environment evolves over time, the current habitat is unrecognisable because of its transformation by human ingenuity. Therefore, the phenomenon diminishes people's contact with the natural environment. Researchers believe that the disengagement from the natural environment has started since 2,500 years ago due to humans' activities on earth (Sullivan, 2005). For example, the shift away from this intimate, daily contact with the natural world can be seen most profoundly during the Industrial Revolution which has brought with it the construction of large cities and towns. Structures and paved-over land dominate the urban landscapes resulting in more urban environment becoming devoid of green space and proper street landscape. In addition, current lifestyle of urban residents reduces their interaction with the natural environment, while increasing their immersion in the artificial human-made environment (Katcher and Beck, 1987). Being in urban environment exposes them to too much artificial stimulation and sedentary indoor activities. Thus, lifestyles in urban areas are now characterised by increase in sedentary behaviour, obesity problems, stress and mental ill-health (e.g. studies by Barton *et al.*, 2009; Grahn and Stigsdotter, 2010). In fact, physical inactivity in towns and cities is prevalent among Malaysian. The inactivity is because urban residents spend little time on recreational activities in parks and gardens (The Star, 2010). As a result, it reduces the protective factors of nature for health improvement. Excessive artificial stimulation as well as the sedentary indoor activities increase stress, cause exhaustion and loss of vitality and health (Hartig *et al.*, 2003; Van den Berg *et al.*, 2007). Thus, urban residents have suffered from the urbanisation and industrialisation.

Hence, there is a pressing need for contact with nature in urban areas. Urban green infrastructure in the form of recreational park and green spaces are setting for urban residents to attain this contact in urban areas. Parks, playing fields, bodies of water, hill forests, pocket spaces, courtyards, loose-fit places, neighbourhood open spaces and home gardens are green places in a town or a city where urban residents can have access and connection with the natural environment. The experiential contacts of the residents may occur through viewing and by actively engaging in physical-kinetic activities such as walking and exercising in the spaces (Pretty *et al.*, 2005; Maller *et al.*, 2005). Studies conducted on people's experience with outdoor environments have revealed that visual and kinetic contacts with natural features and greenery fulfil humans' biophilic tendency. This experience ultimately improves human functioning and well-being (e.g. studies by Hartig and Staats, 2003; Irvine and Warber, 2003; Grinde and Grindal Patil, 2009). Accumulating studies in urban design

discipline provides evidences on the interrelated aspects of relationship between green infrastructure and positive well-being functioning of urban residents (e.g. studies by Takano, 2007; Jamil, 2002; Newton, 2007). For example, Zube (1984) found that preference for different types of landscapes has consistently demonstrated that most people of different ages, socio-economic class, education, cultural background prefer natural environments, such as treed parks, over built-up urban environment. There has been a substantial studies too that suggest green infrastructure is actively pursued by people to restore themselves from stresses of everyday lives (e.g. studies by Jamil, 2002; Newton, 2007). Jamil (2002) suggests that Malaysian parks are important for urban residents to get away from noise of urban places, by taking refuge and relax to a pleasant landscape. The activities such as strolling, jogging and sitting under trees afford them relaxation and comfort.

Other researches particularly relating to environmental psychology and behaviour disciplines are being studied separately, which explored the specific emotional responses from contact with nature such as social, cognitive, behavioral, anxiety, stress, confidence and stamina (e.g. Kaplan *et al.*, 1998; Grahn and Stigsdotter, 2010). For example, studies in environmental psychology and behaviour found that physical and visual interactions with urban open spaces can induce pleasurable feelings, including joy, relaxation, comfort and calmness, as well as physiological benefits like higher energy levels and increased ability to relax (e.g. studies by Payne *et al.*, 1998; Kaplan *et al.*, 1998; Van den Berg *et al.*, 2007). Consequently, parks and gardens are ideal places for activities specifically to foster restorative experience and as settings for recovery from mental fatigue (Kaplan and Kaplan, 1982; Hartig *et al.*, 2003). Engagement with green infrastructure such as parks and encountering plants, landscapes or wilderness promote beneficial physiologically effects that include higher levels of activity and ability to relax faster (Parsons, 1991; Payne *et al.*, 1998). In addition, researches have shown that an outdoor activity provides scope for relaxation, refreshment, escape from the everyday worries and a chance to form social relationships (e.g. studies by Kim and Kaplan, 2004; Maas *et al.*, 2009). Thus, access to urban nature has been shown to contribute to enhanced mental well-being that fulfil psychological needs of nature. According to Burns (2006), this is because the natural environment operates as a reciprocal inhibitor of depression by providing attributes that stimulate pleasurable input.

This research is a case study exploration that identifies town residents' connection with nature in Taiping, an old town in northern Peninsular Malaysia. Nature in Taiping consists of an array of green infrastructure such as the Lake Gardens (a town park), a large open playfield, hill forests, various small green pocket and loose-fit spaces, neighbourhood spaces, home gardens and green networks (tree-lined streets, street planting and river corridors). Physical contact with nature, aesthetic needs, and recreational and play are the experiential contacts that may fulfil nature needs of the residents. Fulfilling this need is particularly important in the context of urban experience which is known to limited in terms of its natural places. This study is essential because the experiential contacts and needs for parks, riversides and gardens in urban areas are obvious. However, why the places are needed and what is the meaning of experiencing the places are less explored in research. As a result, little is known on how urban residents view for instance a park, a treed street or a small neighborhood park. Therefore, this study seeks to explore residents' biophilic needs and their tendency to affiliate with natural environment in a town. It asks the following questions:

1) What are the types of green infrastructure that afford contacts of residents with nature in the town?
2) How does the green infrastructure fulfil residents' need for nature?

MATERIALS AND METHODS

Case Study Area

Taiping is a small town in northern part of Perak, Peninsular Malaysia. The old colonial town of 402 km² is the wettest place in tropical climate Malaysia with high rainfall. The temperature is generally high and shows little variation during the course of the year. Therefore, the plants and greenery consisting of tropical vegetations thrive. Once, the tin mining activities have greatly modified the natural tropical landscape in the town creating lakes and small ponds that are converted into a town park (the Lake Gardens). It becomes the main recreational green infrastructure in the town. Land uses in Taiping consist of low-rise residential area, low-density commercial area, institutional and public districts with various small green pocket spaces and compounds located within the land uses.

The town centre of Taiping is an old commercial area with rectangular gridiron layout on ten shophouse-sized blocks originated from the British colonial in 1880s (JPBD, 2005). Intersecting perpendicular to the main streets of Taming Sari Street and Kota Street are a number of crossroads (e.g. Chung Thye Phin Street, Lim Teong Chye Street and Tupai Street) that form the gridiron layout of the town. The commercial area consists of mostly of old commercial shophouses—convenience, hardware, groceries electronic, apparel shops, kopitiam (coffee shops) and barbershops, among others, mixed with new buildings such as hotels, banks, fast food restaurants and medium-sized shopping complexes. Institutional and public districts consist of museum, hospital, municipal office and schools. Within close proximity of the town centre (to the northeast side) are the Esplanade, the Lake Gardens and Larut Hill—three main green infrastructures in the town. To the north, south and southeast sides are the residential neigbourhoods of terraced-type and village-like houses. Old residential areas lay near the town centre such as Kampung Jambu and Kampung Tupai.

Green Infrastructure in Taiping

Overall the landscape in Taiping is considerably green. Green infrastructure in Taiping covers 161 square kilometres of land or 40% of its land uses (Taiping Municipal Council, 2004) (Figure 1). The natural environment that includes lakes, hill forests and waterfalls are among the best natural green infrastructures that bestow Taiping scenic beauty and charms. The distribution of recreational green infrastructure is concentrated towards the northeast side of the town centre, being the Lake Gardens and Larut Hill as the main recreational areas. The main recreational green infrastructure is the Lake Gardens. Larut Hill is a walking distance from the Lake Gardens. The top of the hill is 13 km away and is reachable by four-wheel drive or by foot. The Esplanade is a big open playfield within the area of the Lake Garden for active sports and community gatherings. Other green open spaces are public building and institutional grounds, small pocket spaces, neighbourhood spaces and home garden, existing private land and undeveloped land. Green network in Taiping is the transport corridors which include tree-lined streets, scenic main road and smaller routes. Others are such as river corridors and linear green spaces along the commercial shophouses and five-foot walkways of old shophouses.

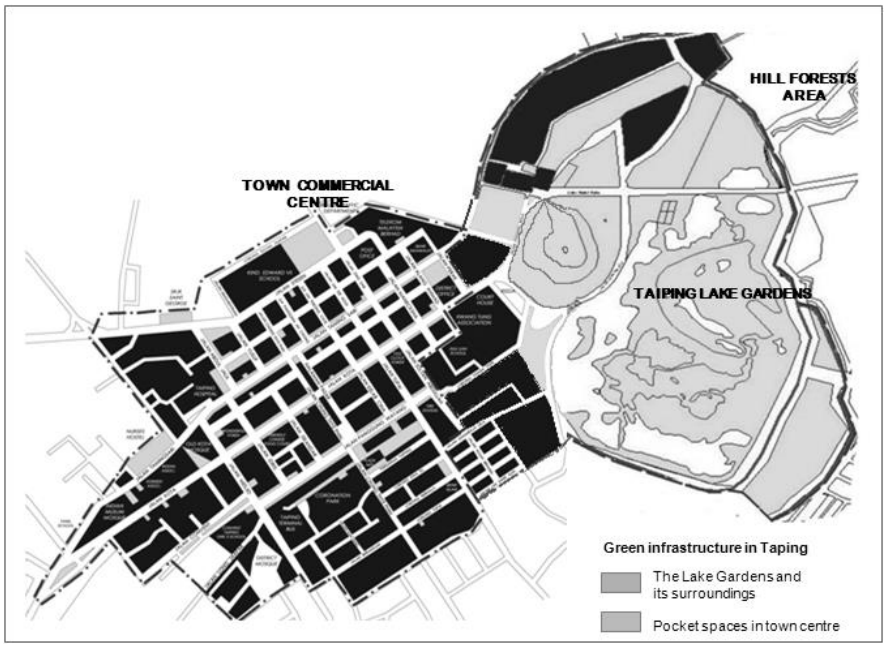

Figure 1 Green infrastructure in Taiping

*(**Source:** Mazlina, 2010)*

The Lake Gardens is an 84-acre town park near the town centre, with glorious large rain trees and lakes, abundant natural features, recreational amenities and a zoo. Naturally, it becomes the major patch as well as a major landmark for the town. Inside the gardens, a variety of smaller spaces, flourishing greenery, attractive lakes form a landscape with a serene and panoramic environment which provide opportunities for leisure and recreational activities to residents and visitors. This environment was highly natural with meandering roads around the lakes laced by rows of beautiful 100-year-old rain trees (*Enterolobium saman*). Lakes and small ponds, winding paths within the gardens, expansive manicured green lawns and undulating topography engulfing the lakes enhance the splendour that provide breathtaking views of the town park. Three main streets encircle the Lake Gardens, namely Taman Tasik Street, Sultan Mansor Street and Pekeliling Street offer spectacular views to the lakes, hills and sky. Larut Street connects the Lake Gardens to Larut Hill. Larut Hill is a forest reserve as well as a retreat. At the foot of the hill, water recreational areas such as the Burmese Pool originate from rivulets trail down to form various favourite spots for water recreations.

The Esplanade is a big green open playfield near the Lake Gardens and town centre. It is a civic space for community gathering and frequently used for playing soccer and other active sports. At least twenty-two pocket spaces between shophouses are located in the town centre which collectively cover 9% of the town area. Small pocket spaces and undeveloped spaces in between commercial shophouses are scattered in and around town. However, there are very few well-designed small pocket spaces and vegetated pockets gardens in the town centre such as those that can be found in front of the marketplace and the clock tower. A well-designed green space of public and institutional grounds can be found at Municipal District building, mosques, hospitals and schools.

The residential neighborhoods consist of open spaces with playgrounds and playlots, open fields, home gardens, wastelands and streets. They make up 14% of green areas of the town. Most of the neighbourhood green spaces consist of small playlots and some consist of open playfields. The neighbourhoods such as Taman Suria, Taman Sentosa, Kampung Tupai, Kampung Jambu and Kampung Birch are resided by at least three main

ethnics, the Chinese, the Malays and the Indians. As such, the home gardens of the residents are characterised by different choices of plants and garden ornaments based on the residents' culture and belief.

DATA COLLECTION

Findings for this study are based on mixed-methods approach. It involves collecting and analysing both quantitative and qualitative data in a single study. Two types of primary data were collected: survey (n=335) and semi-structure interview (n=33). Self-administered survey questionnaire is the major method on getting responses of residents living in Taiping. Self-administered questionnaire is carried out by asking the respondents to complete the questionnaire themselves (Babbie, 2004). A detailed semi structured face-to-face interview was carried out involving the exploration with a few residents as the participants (n=33). The questionnaire was designed to measure responses of residents living in Taiping from their experience and feeling that they have towards an array of green infrastructure distributed in Taiping. Responses of residents are not directly observable hence according to Dawes (1972) strategies that include inferred cues and interrogation as in the survey questionnaire have always been the most appropriate measure. In addition, surveys are widely used as a mean of making descriptive assertions about preferences and attitudes of the sample of a population (Akbar *et al.*, 2003).

Semi-structured face-to-face interviews were carried out involving the exploration with 33 numbers of residents. The interview was semi-structured, in which a basic structure of the questions was developed as a guide during the interview administration, thus the same questions were asked to the interview participants. The participants consist of users in the Lake Gardens, and residents in neighbourhood terrace housing and in the town centre. The interview was used to obtain more information on residents' responses and feelings towards the green infrastructure. It consists of the participants' responses on their experience including types of visits, feeling on the spaces and attributes of the green infrastructure. Each interview lasted between 20 to 30 minutes. In addition to the primary data, sources that include government publications and reports such as local and structure plans, books and maps were also content analysed to explore the characteristics of Taiping and study the types of green infrastructure in the town.

ANALYSES

Quantitative and qualitative analyses were used to describe the data. Measures on parameters of the survey questionnaire were analysed using the SPSS (Statistical Product and Services Solutions) tool. Descriptive statistics presented discrete data and ordinal data (which were measured using Likert scale format) in percentage.

The qualitative data of the interviews was analysed using content analysis. Data from the interviews is transcribed verbatim in Malay language with a few participants using English to interact with the researcher. Nevertheless, the final transcripts were translated into English to assist in presentation of results. The responses were recorded and transcribed in a summary describing participant's answer to assist in content analysis. The transcripts were edited using categorical analysis. The analysis was selected because of the semi-structured manner of the interview questions, in which the category headings were defined by the questions. In this case, categorising what participants say was based on the responses of the parameters asked to the participants, and other additional responses that reveal underlying dimensions from the words described by them. The qualitative data of the interviews was then described using percentage of frequency. Furthermore, reviews and content analysis of

publications provided extensive information on the town's characteristics and details on types of green infrastructure.

RESULTS AND DISCUSSION

The Residents

The survey questionnaire consisted of 335 respondents (n). 52% of the survey responses came from the residents living in twelve neighborhoods in Taiping. The neigbourhoods consist of two residential types—terrace housing and village-like neighbourhood. The respondents that live in terrace housing neighbourhoods were from Taman Suria, Taman Sentosa, Taman Aun Say, Taman Perak, Taman Panglima, Taman Saujana, Taman Marissa and Taman Saujana Jaya. The respondents that live in the village-like neigbourhoods were from Kampung Jambu, Kampung Birch, Assam Kumbang and Kampung Tupai. 23% of the survey responses consist of officers from Taiping Municipal Council, town users, and business owners. 25% of the respondents were park users in the Lake Gardens. 57% male and 43% female respondents answered the survey questionnaire. The Malays represented the ethnic majority of the respondents. The largest percentage of respondents (86%) was adults between the ages of 19 to 55 years old. The majority of them (68%) have resided in Taiping between 11 to 50 years, suggesting that they are familiar with the green infrastructure of the town.

Face-to-face semi-structured interview involved 33 residents in Taiping (n). 52% male and 48% female participated in the interview. The Malay represented the majority of the participants (79%). They consisted of participants in the Lake Gardens, terrace housing and in the town centre. Adults, elderly and adolescent were chosen for the interviews as representatives of users of various green infrastructures in Taiping. 55% of them were adults and the elderly. Most of the participants live in the town (i.e. in the terraced houses in the town and the commercial shophouses). However, there were participants that came from Bukit Gantang and Kamunting, which are some ten kilometres away from Taiping. These participants were included in the interviews because they consider Taiping as a main town for their necessary and voluntary activities.

Visited Green Infrastructure

The study suggests that at least eight types of green infrastructure are significant to the residents' experience (Table 1). The survey responses indicate that there are eight types of green infrastructure that the residents were familiar with and visit: (a) the Lake Gardens, (b) hill forests, (c) Taiping zoo, (d) river corridor, (e) open playfield, (f) open spaces between buildings, (g) pocket spaces, and (h) street landscapes. The interview suggests that the residents were most familiar with five types of green infrastructure: (a) The Lake Gardens including the Esplanade, (b) hill forests, (c) small green spaces and green corridors in town centre, (d) neighbourhood green open spaces, and (e) home gardens.

Table 1 Percentage of visitations to green infrastructure

Types of data	Measures	Type of place *No. of case (%)*				Respondents/ participants (n)
		Green infrastructure		*Non-green Infrastructure*		
1) Survey questionnaire	1 = The Lake Gardens	304	91%	-	-	335
	2 = Hill forests	227	68%	-	-	
	3 = Zoo	174	52%	-	-	
	4 = River corridor	75	22%	-	-	
	5 = Open playfield (Esplanade)	64	19%	-	-	
	6 = Green space of buildings in town	53	16%	-	-	
	7 = Streets in town	37	11%	-	-	
	8 = Pocket space in town	37	11%	-	-	
2) Interview*	1 = The Lake Gardens	33	100%	-		33
	2 = The hill forests & vicinity (Bukit Larut top and the foot, water recreations i.e. Burmese pool, Tmn Suria)	25	75%	-	-	
	3 = Neighbourhood open space and home gardens	10	30%	-		
	4 = The town (The Store, Panggung Wayang Street, Shophouses, restaurant)	3	9%	15	45%	

*Participants of the interview identified more than 1 type of green infrastructure

Results suggest that residents visited various types of green infrastructure in Taiping. Large recreational green spaces such as Taiping Lake Gardens and the hill forests were frequently visited. As well, small green spaces such as neighbourhood open spaces, home gardens and pocket spaces were also favourable places for residents' visits. In other words, there is a variety of green spaces distributed in the town which offered experiential choices to the residents. According to Bonnes and Secchiaoli (1995), this diversity presents opportunity for regular visitation that satisfies residents' perceptual and kinetic needs. Hence, the green infrastructure in Taiping provides opportunity for residents' contact with nature. For example, the diversity of spaces in the Lake Gardens enables participation in physical-kinetic activities such as jogging, walking, exercising and playing sports. Highly natural environment such as lakes and matured vegetation in the park provides opportunities for leisure, recreational and nature appreciation activities that allow residents' connection to urban nature.

Generally, the residents were familiar with small green spaces in the town and in the residential neighborhoods. However, the spaces had low percentage of visits as compared to the Lake Gardens and the hill forests. It appears that the residents barely recognised the smaller spaces (e.g. spaces in between shophouses) as one type of green infrastructure in the town because these spaces were separated by buildings. There is also lacked of naturalness quality of the space, making it difficult for the spaces to be perceived as a part of green infrastructure. In order to make these pocket spaces and compounds more recognisable and usable, they need to be linked to one another, both physically and visually, via corridors such as tree-lined walkways or streets. Such links are essential in urban planning in order to form a network or fabric of greenery that residents can easily recognise in terms of location, direction and transition of each open space in relation to the others. This link facilitates sequential experience of people in a space (Thwaites and Simkins, 2007).

Residents' Needs of Green Infrastructure

Figure 2 shows results derived from the survey questions. The results on parameters for residents' feeling towards green infrastructure in Taiping are categorised into three domains of 'nature needs': (i) physical needs, (ii) psychological needs, and (ii) social needs. Physically, results found that connection with the green infrastructure benefits the residents in ways that they feel more active (74%) whenever they participate in activities such as exercising, strolling and walking in the green spaces. In cognitive aspect, the green infrastructure afforded the residents relief from negative emotions (84%) such that it helps them to forget worries, relieve stress, clear minds of distractions and has comforted, relaxed and calmed them (75%). The green infrastructure is a place for the residents to attain privacy (64%). Furthermore, 69% of the residents' agreed that their favourite places consist of green infrastructure. Hence, at a personal level, the green spaces are meaningful to them (53%) thus the residents feel concern for the conditions of the green infrastructure (75%). Thus, a large percentage of the residents (82%) agreed that the town's green infrastructure should be protected and conserved.

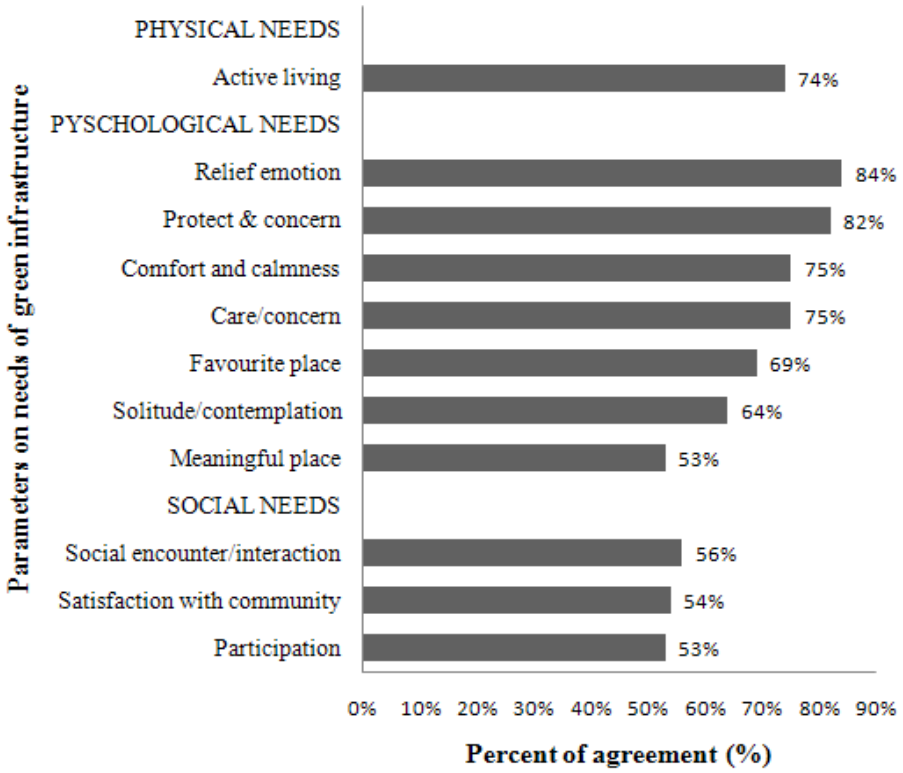

Figure 2 Residents' need of green infrastructure: survey results

Socially, the findings suggest that the green infrastructure contributed to the residents' social needs through residents' participation in physical-kinetic, leisure and social activities. Residents agreed that green infrastructure is an arena that allows them to interact with other residents (56%) and to participate in activities with others (53%). Thus, they feel satisfy with the community that they live in as a whole (54%). In other words, the green infrastructure enables residents to expand their social network. Hence, the availability of green infrastructure in the town has also increased the amount and improved the quality of social interactions among the residents. These social interactions result in a sense of satisfaction towards the community as well as feeling of being happy living in Taiping.

Content analysis of interview has revealed several underlying dimensions on the residents' needs of green infrastructure in Taiping. The summary of results and examples on residents' responses from the interviews are shown in Table 2.

Table 2: Dimensions revealed from content analysis of interviews on the needs of green infrastructure

Dimensions	Examples of interview responses	n=33	Green infrastructure
PHYSICAL NEEDS			
1) Active living; 2) Healthy feeling	• The Lake Gardens and Larut Hill are training place; physical activity (jogging). Gaining athletic and swimming skills at waterfall areas in Larut Hill and Burmese pool. • Various physical activities participated in the Lake Gardens, play football in the Esplanade, jog and climb Larut Hill and swimming in Burmese Pool. • Feels good/Like the feeling of being active - like to exercise in the Lake Gardens; jog in the Lake Gardens in the morning; walk in town, and play sports at the Esplanade; like to cycle around town on the streets every weekend with friends; enjoyed cycling to school on the streets in the Lake gardens; play football in the afternoon at the Esplanade.	12 5	Lake Gardens; D.O. Hill; Larut Hill; Burmese Pool; town and the Esplanade
3) Being active while acquiring social skills	• Various activities with friends, e.g. play all kinds of sports including skating, play football and badminton in the Lake Gardens. Walk, jog and exercise with friends around the lakes and take breaks under big "Rain trees". • Train football in the Esplanade and hike to the top of Larut Hill with friends. • Jogging and play football with friends and neighbours in neighbourhood green space. • Participate in taichi, and learn *wushu* from Chinese friends. • Swimming in Burmese pool with friends during school holidays/weekends.	7	The Lake Gardens; the neighbourhoods
4) Recuperative effect	• Visit the Lake Gardens to recuperate from illness (stroke) – regular walking activity in the Lake Gardens and neighbourhood open spaces.	1	Lake Gardens; the neighbourhoods
PSYCHOLOGICAL NEEDS			
1) Amaze with green infrastructure's attributes	• Enjoy amazing views of the scenery, lakes, lovely matured rain trees, greenery, flowerings trees, fish in the lakes, hills and sky of the gardens – e.g. five layers of scenery i.e. the ground (lawn), water (lakes) , greenery (composition of trees), hills and sky). • Beautiful views of the hills' environment with cloud or clear sky; Larut Hill gives character to the town. Amazing landscape—a sight to ponder. • Beautiful fruit trees with aesthetic quality in home gardens	33	Lake Gardens; Larut Hill; Hill forests; Home gardens
2) Cool, shaded and comfortable place	• It rains almost daily in Taiping, hence the place is cool. A cool place at all times, fresh air and cool even at noon time. • Shaded places: enjoying shade under big "Rain trees". • Shades and fruit gardens at home. • Comfortable walking and riding around the Lake Gardens.	22	Lake Gardens; Larut Hill: Hill forests; Home gardens
3) Calm and peaceful place	• The environments always look calm and peaceful; a quiet place, peaceful places especially in the Lake Gardens and peaceful town.	16	Lake Gardens; Larut Hill and hill forests; town
4) Attachment & pride	• No other place can match the Lake Gardens and the town; Lake Gardens is a favourite place; feel proud of the matured rain trees-interesting trees and unique. Valuable old trees and buildings in town. • Feel attach to the places due to experience and memories.	15	Lake Gardens; Larut Hill and hill forests; The town.
5) Relax and rest; 6) Relief stress 7) Clear mind from distraction and worry	• Relaxing place; relax mind a place for rest; a relaxing life in Taiping. • A place to feel better- Relief stress and feeling better. • A place to be if encountering personal problems - can sit in the Lake Gardens for hours without worry; Clear minds from so tasks and problems; clear minds or thinking what to do.	11 2 5	Lake Gardens; town; hill forests
8) Privacy/place for retreat; 9) Place to view people and scenery	• Privacy in many spaces inside the Lake Gardens –e.g. ponds, near water and playground, privacy when reading in secluded area, school's work in the Lake Gardens with friends. • A place that one's want to disappear from the busy world. • Larut hill induced feeling of being far away from civilization; green environment in Larut Hill and Lake Gardens like being immerse totally with natural environment. • The Lake Gardens is a place to sit and observe others or see crowds-photography sessions for wedding, watching children play and quietly viewing the lakes.	8 9	
10) Satisfaction; 11) Happy; 12) Freedom	• Feel satisfied with the gardens, hills and town. • Happy to be in the spaces-ability to vies and participate in activities. • The nature places provide space to feel free to perform leisure and social activities at any time.	10 3 2	The Lake Gardens; Larut Hill and hill forests; Home gardens

** total n my represent more than one response (case) from interview participants*

Four dimensions on physical needs of green infrastructure were obtained for residents' responses: a) active living (n=10), b) healthy feeling (n=5), c) being active while acquiring social skill (n=7) and d) recuperative effect (n=1). The residents expressed at least 12 cognitive needs of green infrastructure from activities with nature in Taiping: (a) amazed with the green infrastructure's attributes (n=33), (b) cool, shaded and comfortable place (n=22), (c) calm and peaceful place (n=16), and (d) attachment and being proud of Taiping's green infrastructure (n=15). Other distinct dimensions emerged from the interview analysis are: being relaxed and rested (n=11), satisfied (n=10), place to view people and scenery (n=9), privacy/a place for retreat (n=8), clear mind from distractions and worry (n=5), feeling happy (n=3), free (n=2) and relief stress (n=2). Among the green infrastructure that afforded the most number of cognitive responses were the Lake Gardens and the hill forests.

Triangulation from both survey and interview findings shows that more dimensions on residents' biophilic needs of green infrastructure in Taiping surfaced from the interview data. The dimensions emerged from the interview findings support the parameters measured in the survey questionnaire. As such, the findings on significance of nature to residents in Taiping become richer and more meaningful. As a result, the findings reveal an understanding of various physical, psychological and social parameters on residents' needs of green infrastructure. Physically, connecting with nature in Taiping provided the residents opportunity to feel healthy and active. Residents perceived the Lake Gardens as a spacious place to participate in various physical activities with family, friends and other residents. At the hill forests, residents hiked to the hilltops. In the residential areas, for example in Kampong Jambu, residents practiced gardening, that is planting fruit trees, vegetables, herbs and flowering shrubs. According to World Health Organization (1997), these low-intensity and long-duration activities such as walking, cycling and gardening are crucial in combating the serious health problems of an increasingly sedentary urban lifestyle.

Cognitively, the green infrastructure in Taiping affords natural environments for active and passive activities that generate relief from negative emotions, help residents to forget worry, relieve stress and clear their minds of distraction. The cognitive needs are attained by physical and visual encounters with matured greenery (such as the 100 years old *Enterolobium saman* trees) and undulating topography of the hill forests and the Lake Gardens. The places offer beautiful scenery and exciting panoramic lookouts over the town's landscape. Macnaghten and Urry (2000) assert that access to outdoor activities in such spaces provide relaxation, refreshment, an escape from everyday life and a chance to form social relationships. So much so that even passive viewing of the natural environment especially after negative antecedent conditions such as attention fatigue or psycho-physiological stress can produce stress-ameliorating effects which may ultimately confer health benefits (Ulrich, 1984; Kaplan and Kaplan, 1989).

Essentially, these feelings also trigger preference to the green infrastructure. The preference is associated with theories on humans' relationships with natural environments including those being explored in Biophilia (Wilson, 1984), Prospect-refuge (Appleton, 1975) and Landscape Preference Theory (Kaplan and Kaplan, 1989). For example, when given a choice, the residents preferred to be in the natural environment—places with water features, mature trees, lawns, and minimal human influence such as in the Lake Gardens as compared to town commercial centre (such as incidental spaces and courtyards in town). Hence, this preference supports Biophilia theory, where certain landscape features consisting of nature were found to be aesthetically pleasing to people. In addition, the spaces inside the Lake Gardens offer privacy, comfort, relaxation, freedom and opportunity to observe the

views and activities. In various secluded spaces, park visitors are able to rest without intrusion of others and allow them to view greenery, hills, water and sky and ability to observe others. Therefore, the park offers 'refuge' to the users but at the same time enables them 'prospect' to view and observe others. This favourable environmental setting and behavioural preference in nature are described in detail in the Prospect-refuge Theory posited by Appleton (1975).

Socially, residents enjoy activities with family and friends in the green spaces. The green infrastructure allows more social encounters with other residents too. For instance, the Lake Gardens and hill forests are places for gathering and community social events, especially during weekends. Playgrounds in the Lake Gardens and in residential neighbourhoods allow children to engage in various types of creative play and to gain social skills. Streets and comfortable pedestrian spaces in neighbourhoods permitted residents to meet and converse with one another. These social interactions result in a sense of satisfaction towards the community, as well as feelings of being happy living in Taiping. Thus, connecting with nature allows the residents to interact and transact business with fellow human beings. As such, urban green infrastructure in fact can strengthen the social fabric in the town by providing opportunities for residents to participate in activities and socialise with one another.

CONCLUSIONS AND RECOMMENDATIONS

Green infrastructure in a town is a place for residents' contact and connection with urban nature. It is where many residents spend their time doing daily or weekly activities—to exercise, seek leisure, to be alone or to meet friends and observe people. Hence, provision of ample green infrastructure in any town affords opportunities for urban residents to participate in various voluntary activities which physically can act as preventative and curative measures. The relationships between green infrastructure and its users are symbiotic. It means that a well-designed and maintained green infrastructure becomes lively with activities, and in turn residents obtain physical, psychological and social benefits from their active participation in the green infrastructure. Ward Thompson and Travlou (2007) assert that a healthy green infrastructure that is accessible to all is becoming critical in light of the increasing levels of heart disease and obesity because of more sedentary urban lifestyles. As such, mitigating and adapting to these human-induced activities by promoting greener infrastructure may benefit environment and reduce urban residents' morbidity and mortality associated with a sedentary lifestyle. In short, green infrastructure acts as a *salutogenic* environment—an environment in which one would be able to cope well with stress and hence engage in healthier behaviour.

Thus, the findings of this study offer several insights on the significance of green infrastructure as nature in a town and its functional values to the residents' physical, psychological and social needs:

1) For an effective connection to urban nature, the study suggests that a town should have at least one large recreational green infrastructure, one big open playfield, a semi-natural area consisting of hilly forests, water body and a variety of small green spaces (designed and incidental) in town centre, neighbourhood open spaces and home gardens.
2) The cognitive needs of the residents indicate that matured greenery and green space in an old town such as Taiping are vital for residents' biophilia. Hence, a town should

compose of a considerable amount of greenery, the availability of water elements and openness to scenic views as the main attributes of an urban natural place.

3) In social terms, green infrastructure affords residents social interactions with other residents. Thus, provisions of green open spaces that are connected to a proper green network such as tree-lined streets are important for the residents to socialise and achieve social well-being.

Provision and maintenance of open spaces at all spatial scales, from home gardens to a large town park fulfil residents' needs. As such, green infrastructure is an essential amenity in a town. The wide appeal on residents' needs of nature in terms of physical, behavioural and social as shown in this study makes the green infrastructure an asset to a town. This is because parks and urban green spaces offer urban residents positive emotional states and make available favourite places that are serene, peaceful and restful. These are the places of solitude and contemplation that give meanings to people such as personal place memories. These places are niches that permit urban residents to form social interactions, offer a sense of belonging to residents and a place identity to the town. Thus, planning and provision of green infrastructure with care by urban planners and designers will ensure that the needs of urban residents to experience physical and social contacts are fulfilled. It means that experiential contacts can be induced by an improved and well-designed network of green spaces by environmental designers and urban planners who have some degree of control over it. Consequently, by providing people a connection with nature in urban environment, the green infrastructure extends beyond aesthetic needs to include various other well-being benefits. Thus, the study may prove useful for those working with issues of environmental design and urban planning where it suggests that urban residents need green infrastructure, and by implication it may help reduce urban residents' burden of urban living.

ACKNOWLEDGMENT

This paper presents a small part of findings from the author's PhD research. The author is grateful for the financial support from International Islamic University Malaysia.

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