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# The Significance of Green Infrastructure Experience to Cognitive Well-Being of Residents in Small Town

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## ABSTRACT:

The paper explored the significance of residents' experience with an array of green infrastructure in Taiping, a small town in central Peninsular Malaysia. It argued that the existence of a composite of greenery and open spaces in a town with pleasing qualities contributes to cognitive performance, through contact and participation. In particular, it examined the relationship of participation in the green spaces to residents' cognitive well-being. Green infrastructure network is greenery and open spaces linked by walkways, streets, waterways and drainage ways around and between urban areas, at all spatial scales. In Taiping, the green infrastructure network consists of the Lake Gardens (town park), river corridors, street plantings, school playfields, neighbourhood open spaces, home gardens and loose-fit spaces such as pocket spaces in between buildings and shop-houses. Ease of access to green infrastructure network, physically and visually facilitates residents to participate in active activities, to socialize and to perform other transactional activities outside their homes. Therefore, the effects from the participation trigger many positive moods such as serenity, cheerfulness, relaxation, calmness, comfort and satisfaction. Questionnaires (n=335) were used to explore frequency of residents' visits to the green infrastructure and the causal relationship to cognitive performances that lead to their well-being. The data showed, regardless of ages, residents frequently visited the green spaces. Results also suggested that there was a modest relationship between frequent visits and cognitive well-being of residents. Hence, they implied the benefits of access to green spaces and implicated that the existence of green infrastructure network such as parks and neighbourhood open spaces are essential land use in an urban fabric that foster sense of well-being to its inhabitants.

Keywords: *Green infrastructure, Small town, Experience, Participation, Cognitive well-being*

## 1. Introduction

Green infrastructure networks are an attempt to overcome the negative effects of the built environment of cities and towns. Urban green infrastructure consists of various types of greenery and open spaces linked by streets, waterways and drainages encircling and connecting urban areas, at all spatial scales (Tzoulas et al. 2007). Parks, home gardens, pocket spaces, courtyards, playing fields, bodies of water, incidental spaces, loose-fit places (Franck and Stevens, 2007) and other residual spaces (Davidson, 1999), and streets, are some of the major green infrastructures in which human interaction with nature takes place. A green infrastructure network is a composite of open spaces linked by walkways, streets and trails, which enable urban residents to experience the outdoors both visually and kinetically. The concept of green infrastructure network stresses on the holistic relationship of outdoor open space with a range of

human experiences in unbroken continuity. It facilitates residents' ability to recreate, socialize and perform other regular transactional activities.

The functions of green infrastructure in towns and cities are manifold—ranging from conservation of natural resources to provision of recreations. In particular, the provision focuses at fulfilling nature needs and human interaction needs. Nature needs are fulfilled from residents' contact with the green infrastructure, from aesthetic experience and from recreational activities. The experience such as encounter plants, landscapes and wilderness, for examples, in parks and neighbourhood open spaces promote beneficial physiologically effects to them. In addition, social interaction and participation in the green spaces fulfill human interaction needs of residents with others, allowing sense of community to flourish.

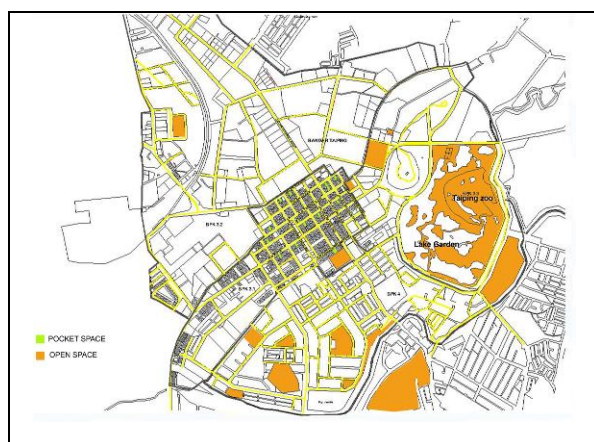
The experience with the green infrastructure includes giving attention to its physical properties and attributes, expressing emotional feeling from the aesthetic experience of its environment and developing social relationships with others, in which the environment acts as a setting within which action takes place and as a venue for carrying out actions and achieving goals (Ittelson et al., 1976, Yuen, 1996). The experience may develop into preference, concern and satisfaction towards the green space. It may even form into a much deeper feeling—sense of attachment. The experiences in the green space allow familiarity and induce frequent visits to the green spaces. Hence, the pleasing green infrastructure's environments to residents are dependent upon features that can satisfy motivational needs, that exhibits fine design and distinctive environmental quality, or that is meaningful in terms of events (Thwaites et al., 2005). The effect from the experiences is cognitive well-being. A considerable body of literature was identified that addresses the relationship between experience with nature and cognitive well-being. For examples, Ulrich et al. (1991) and Ulrich and Parson (1992) found that nature enhances emotional well-being, reduce stress and, in certain situations, improve mental health. Engagement with the natural environment induces pleasurable feelings, including joy, relaxation, comfort and calmness (Korpela, 2002), as well as physiological benefits like higher energy levels and increased ability to relax (Payne et al. 1998). These effects are possible because vegetation and nature engage our spontaneous attention, allow our sensory apparatus to relax, and infuse us with fresh energy. For example, going for a stroll in a garden can actually clear one's head, advancing the beneficial physiological effects in our bodies to psychological effects in our brains.

## **2. Green Infrastructure in Taiping**

Taiping consists of low-rise residential area, low-density commercial area and numerous green spaces. Its greenery consists of the Lake Gardens, a town park, along with hill landscapes, river corridors, and incidental and undeveloped places in the town center, such as courtyards within and among institutional and government buildings, pocket spaces and street landscapes. The residential neighborhoods consist of open spaces with playgrounds, open fields and home gardens.

Green infrastructure network and recreational development cover a total of 90 hectares of land (Figure 1). The Lake Gardens is an 84-acre town park near the town centre, with glorious large rain trees and lakes, recreational amenities and a zoo; it covers 17% of the town area. There are 22 pocket spaces between shop houses within the town centre. Street landscapes consisting of

trees and shrubs connect places within commercial areas to recreational spaces and neighbourhoods. Major roads lie in a rectangular gridiron form which includes Taming Sari Street and Kota Street, which connect the town centre with the Lake Gardens and the neighborhoods. Only 26% of the road system in Taiping, however, is significantly green. The green infrastructure in the neighborhoods, including community parks, playgrounds and home gardens, makes up 13% of green area of the town. The green spaces are situated in a harmonious arrangement among a variety of buildings—old public, institutional and commercial—with Larut Hill as a backdrop. The Lake Gardens stores and provides water supply to the town, harbours wildlife, and affords residents a large outdoor place for recreation activities. The loose spaces and street planting in the town area allow people to enjoy the greenery and permit shoppers to move around in unregulated, relaxed and free manner. Kota Street, Taming Sari Street and Pasar Street are the major routes connecting the town park with a few street plantings and scattered pocket spaces located between shop-houses. The streets are meeting place for residents to trade and buy produces, and to eat in cafes.



**Figure 1:** Distribution of green and pocket spaces in Taiping

### 3. Research Gap and Aim of Study

A considerable body of research shows that contact with nature, passive viewing or participating in nature can generate progressive effects to well-being. Literature on symbiotic human-green infrastructure relationship was selected from different disciplines, including urban ecosystem, landscape architecture, arboriculture and forestry, urban and environmental planning, environmental psychology, and preventive medicine, community health and health promotion. They addressed that contact with the green environments give opportunities for urban residents to improve everyday well-being. For example, the field of health promotion views sense of well-being as a dynamic transaction between individuals and groups and their sociophysical milieu (Stokol, 1992). Therefore, experience in the green infrastructure such as passive viewing or active participation gives direct physical exposure and induces psychological processes that benefit physical, psychological and social health (Maller et al, 2005; Groenewegen et al, 2006) of urban residents.

The aim of the paper is specifically to explore the significance of the green infrastructure experience to one aspect of sense of well-being—cognitive. Cognitive well-being (or mental and

emotional well-being) is attained when an individual has the ability to use his emotional capability; that is, to think rationally and logically in order to function and meet ordinary demands of everyday life. Studies have found that nature and green space promotes positive cognitive well-being of people. Perceptual theories including evolutionary and cultural theories underpinned most of the studies. Evolutionary theories such as Landscape Preference by Kaplan and Kaplan (1989), biophilia (Wilson, 1984; 1993) and prospect and refuge theory (Appleton, 1975) postulate that preference towards natural environments are shaped by our common evolutionary history (Appleton, 1975), therefore it is inherent. Hence, there exist a common set of landscape features perceived as positive and negative for all humans. On the other hand, cultural preference theories such as topophilia (Tuan, 1974) posit that preference of nature is predominantly dependent on the cultural background and personal attributes of individuals. Table 1 summarizes the findings from various disciplines and authors that contributed to studies on green infrastructure and cognitive well-being.

**Table 1: Studies on cognitive outcomes from green infrastructure**

Author	Concern of Research	Parameter
Ulrich (1986) Ulrich (1984); Ulrich et al. (1991) Kuo (2001); Kuo and Sullivan (2001)	<ul style="list-style-type: none"> <li>Emotional stress mitigation.</li> <li>Natural views increase positive self-reported emotions and recovery from stress.</li> <li>Green views increase the effectiveness of people in facing major crises, and lessen aggression by reducing mental fatigue.</li> </ul>	Relief negative emotion
Parsons, 1991; Ulrich et al., 1991b Rohde and Kendle (1994)	<ul style="list-style-type: none"> <li>Exposure to natural environments enhances the ability to cope with and recover from stress and cope with subsequent stress.</li> <li>Viewing nature reduces anger and anxiety, sustains attention and interest and enhances feelings of pleasure.</li> </ul>	
Lohr et al. (2004); Ulrich (1984); Ulrich et al. (1991) Takano et al. (2002); Tanaka et al. (1996); Payne et al. (1998); de Vries et al. (2003) Kaplan and Kaplan, 1989; Cordell et al., 1998 Korpela (2002), Ulrich (2002), Cooper-Marcus (2000)	<ul style="list-style-type: none"> <li>Natural views provide relaxation.</li> <li>Better self-reported health, better general perceived health, more physical activity and relaxation, hence, longevity.</li> <li>Having nature in close proximity, or just knowing it exists, is important to people regardless of whether they are regular 'users' of it.</li> <li>Outdoor engagement affords feelings of pleasure including enjoyment, being relaxed, and comfort and calms.</li> </ul>	Relaxation, comfort and calm
Kaplan and Kaplan (1989); Kaplan (1992a); Lewis (1996); Leather et al. (1998) Kaplan and Kaplan (1989)	<ul style="list-style-type: none"> <li>People have a more positive outlook on life and higher life satisfaction when in proximity to nature.</li> <li>People with access to nearby natural settings have been found to be healthier overall than other individuals – increased levels of satisfaction with one's home, one's job and with life in general</li> </ul>	Satisfaction
Gearin and Kahl (2006), Everheart (1983), Wolch et al. (2002). Korpela (1989, 1992); Korpela and Hartig (1996); Korpela et al. (2001); Newell (1997) (Dwyer et al. 1996); Schroeder (1988), Dwyer et al. (1991) Korpela (1989;1992); Korpela and Hartig (1996); Newell (1997), Korpela et al. (2001)	<ul style="list-style-type: none"> <li>Sense of escape from fast-paced urban life and a place for solitude and contemplation</li> <li>People visit favourite places, often natural settings, for regulation of self-experience and feelings.</li> <li>Symbolic values of greenery.</li> <li>Favorite settings are serene, peaceful and restful.</li> <li>People's visit favorite places for regulation of their feelings.</li> <li>Natural places relates to favorite places.</li> <li>Visual contact with greens reduces mental fatigue.</li> </ul>	Solitude and contemplation Favourite place, calm and comfort
Ryan (2005) Kim and Kaplan (2004)	<ul style="list-style-type: none"> <li>Public attachment to urban parks and natural areas</li> <li>Nature/open spaces as role in residents' feelings of attachment towards the community, and their interactions with other residents.</li> </ul>	Attachment
Brown et al. (2003); Cooper-Marcus (1995); Lalli (1992); Rivlin (1987); Ahlbrandt (1984)	<ul style="list-style-type: none"> <li>Personal meaning and cultural values linking to restoration and psychological well-being</li> <li>Residents' preferences and emotional feelings to greenery</li> </ul>	

As shown in the table, the studies were mostly carried out in western settings. Very few were found in non-western countries with tropical climate, with the exception of Singapore (e.g. Yuen, 1996; Tan, 2006) and Indonesia (Ady, 2008). In Malaysia, the studies mostly directed

towards experience, use and post occupancy evaluation of the green spaces (e.g. Suhardi, 2002; JPBD, 2006), but hardly focused on the causal effects of the experience to users, in particular to sense of well-being. Hence, little is known on how residents especially in small towns experience the green infrastructure and how it affects their cognitive well-being. Thus, this study attempts to fill in the gap by investigating the relationships between frequent visits to the green infrastructure and cognitive well-being from ways town residents use and perceive the green spaces. The study is set to answer two main questions: (1) Do residents frequently visit the green infrastructure in the town? And (2) Does experience in the green infrastructure influence their perceived cognitive well-being? The parameter for experience is frequent visit that lead to familiarity of various green infrastructure in the town. Cognitive well-being dimensions are comfort, relax, calm, emotional relief, privacy, safety, satisfaction, favourite place, meaningful place, care and concern.

#### **4. Methods**

The study employed quantitative method using survey questionnaire to capture the perceived experience of town residents. The field survey was conducted in 2008 that measured frequent visits of residents (n=335) and relationship to cognitive well-being. The questionnaires mainly consisted of closed choice questions with a few of open-ended questions. The sections in the questionnaire contained the background information of the respondent and the experiences of residents with the green infrastructure. Closed-ended response using multiple response scale, categorical and ordinal scale elicited most of the responses of residents. The ordinal scale consisted of a positive five-point Likert format; 5 meant strongly agree, 1 meant strongly disagree and 3 was neutral. The neutral option ensured that respondents were able to provide honest answers to the items. Open-ended questions were included to obtain more information about residents' favourite green spaces, to expand on the responses made in the closed-ended questions.

The unit of analysis was 335 residents living in Taiping town and in some parts of Kamunting, Tupai and Assam Kumbang towns. Administration of survey using a variation of the drop-off method (Kamarul Zaman, 2007) was carried out in two ways: (1) dropping off survey door-to-door in the neighborhoods and government offices, and (2) intercepting passers-by in public spaces in town centre and green spaces. The door-to-door drop-off method, used in twelve neighbourhoods, required the researchers to explain the questionnaires, and if necessary, leave the questionnaire for the respondent to complete at his or her leisure. In this case, the deadline for completion was indicated on the questionnaire, and the researchers returned and collected the questionnaires on that date. This method was administered for two days on a weekend, when residents were most likely to be at home. The public space intercept method required the researchers to distribute the questionnaire to passers-by, business owners in the town and users in the Lake Gardens. The questionnaires were explained to the respondents and they filled out the survey in the presence of the researchers. The completed questionnaires consist of 57% female and 43% male respondents. 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. Majority of the respondents (68%) have resided in Taiping between 11 to 50 years.

The analyses of the questionnaires applied Statistical Product and Services Solutions (SPSS) Version 12 that elicited residents' experiences of the green infrastructure from frequent visits and familiarity. Descriptive statistics such as percentage and mean of score described the data and compared the experience of using different types of green infrastructure. Test of difference between groups deduced the association between frequent visits and age groups of residents. Correlation analyses measured the strength of relationship between frequencies of visits to cognitive well-being of residents.

## 5. Findings and discussion

### 5.1 Frequency of visits and familiarity

The regularity of visits to the green infrastructure determines the familiarity of residents with the various types of such infrastructure in the town. Results suggested that the largest percentage (77%) of residents visited various green spaces in Taiping at least once in two weeks (Table 1). Thus, the intensity of use of the green infrastructure was high, indicating that residents responded positively towards participation in the green spaces. The preference for activities in the spaces took place most regularly with families (81%), friends (61%) and significant others (53%). On the other hand, responses on social encounters with neighbours and other residents were low (30%). Responses on being alone (21%) in the green space suggested that most respondents prefer not to be alone in the green spaces.

**Table 1:** Frequency of visits to green space

Measure	Scale	Agreement		N=335
		%	No. of case	
1) Do you frequently visit the green space?	1=Yes	79%	266	335
	2=No	21%	69	
2) Frequency of visit	1=Once or less/month	23%	76	334
	2=Once/fortnightly	22%	73	
	3=Once or more/week	55%	185	
3) Frequent visit by age group*				334/335
• Adolescent	Yes – 27; No - 1	96%	28	
• Adult and older adult	Yes – 227; No - 64	78%	288	
• Elderly	Yes – 15; No - 4	79%	19	
4) Frequent visits with individual/group to green spaces	1=With family	81%	267	331
	2=With friends	61%	203	331
	3=With my loved ones	53%	174	330
	4=With other local residents	22%	73	330
	5=Like it alone	21%	70	329
	6=With neighbours	20%	66	331

\*Kruskal-Wallis Test on comparison of scores across group– (Chi-square=1.294; df= 2; p=0.523); mean rank – adolescent=185.29, young and older adult=165.73, elderly=168.08

Cross tabulation result between age groups and frequent visits indicated high agreement for all ages (adolescent = 96%, adult and older adult = 78%, elderly = 79%). The test for difference in scores resulted in significant value of more than 0.05 (p=0.523), whereby an inspection on the mean ranked across all ages were found more or less equal. In other words, the

finding suggested that there is no difference in frequency of visits to green spaces across the three groups of respondents. Hence, the result revealed that residents frequently visited the green infrastructure regardless of their ages. It appears that residents at all ages recognized the presence and functions of the green spaces that enable them to engage in various experiences.

The results offer insights into the ways that various group of residents used the green infrastructure. Young and old residents preferred natural environment, which suggests that it is innate. Adolescent visited the green space probably because it supports their social lives. It is a place to be comfortable with friends, to socialize and to have freedom. For older people, the green spaces give opportunities for them to be healthy through getting active participation, maintaining social network and being with children in a playful environment. Usually, meeting other people, having fresh air, walking, feeling healthy and enjoying scenery are things that they mostly enjoy (Ward Thompson, 2007). Yuen (1996) suggested that respondents consistently associate green space as a convenient place for exercise, play, recreation, socialization and contact with nature. To summarize, in the green infrastructure, children can explore, learn and play together safely with adult supervision, adolescent can have their freedom to socialize with friends, and adults can escape from stress when socializing with others.

The study elicited residents' level of familiarity on eight types of green infrastructure: the Lake Gardens, hill sites, the zoo, the river corridor, open space in town, open spaces between buildings, pocket spaces and street landscapes. Table 2 shows that 91% of residents most frequently visited the Lake Gardens and 68% visited the hill sites, suggesting that residents are familiar with spaces that have distinctive physical properties and attributes such as large open space and naturalness. The main hill site is Larut Hill, which is a familiar backdrop to the town. At the foot of the hill, Burmese Pool (a waterfall site) provides residents a space for leisure activities with family and friends. The District Officer's Residence hill is a parcel of land in the Lake Gardens which residents usually utilize for physical activities such as jogging and walking.

On the other hand, green spaces in the town, in particular the Esplanade and building compound, were barely visited by the residents (19%). The pocket spaces and the streets were also seldom visited (11%). It appears that residents favour the town park over the small incidental spaces that are distributed within the town. The Esplanade received a low response due mainly to its specific use—i.e., for sports or occasional community gatherings. An open-ended question indicated that residents used the neighbourhood green spaces and home gardens, but the percentage of use was low (6%) among respondents. According to open-ended answers, the green infrastructure network is more visited (90%) than place that is not a green space, such as shopping areas and buildings (10%). The Lake Gardens are the most frequent place that residents mentioned (79%) and the answers are in accordance with the closed-ended response.

**Table 2:** Results on place of visits

Place of visit	Measure	Type of space		Total N
		GI	NGI	
1) Survey questionnaire (closed ended)	1 = The Lake Gardens	91%	-	335
	2 = Hill sites	68%	-	
	3 = Zoo	52%	-	
	4 = River corridor	22%	-	
	5 = Open space in town	19%	-	
	6 = Green space of buildings	16%	-	
	7 = Streets in town	11%	-	
	8 = Pocket space in town	11%	-	
2) Survey questionnaire	1 = The Lake Gardens	79%	-	257



(open-ended question)	2 = Place with water (Burmese pool, Tmn Suria)	4%	-
	3 = Neighbourhood and home garden	6%	-
	4 = Esplanade	1.25%	-
	5 = Shopping areas- Giant, Tesco, Fajar	-	4%
	6 = Town centre - Kota road	-	3.5%
	7 = Building – museum, library	-	1.25%
	8 = Eating places	-	1%

*GI = green infrastructure, NGI = not a green infrastructure, N = total respondents*



**Figure 2:** The environment in the Lake Gardens and the foot of Larut hill

The preference towards the Lake Gardens as compared to the town environment suggested that residents favour natural setting than the built environment. The finding implies that people have an innate preference for nature as compared to built or mix-built environments whereby it deduces that human emotional response is in part at least, evolutionary driven. The Lake Gardens was highly recognized as place that owns special qualities, hence frequently visited by all. The garden has variety of smaller spaces, flourishing greenery, expansive lawns and attractive lakes form a landscape that is serene and panoramic. The naturalness quality such as rows of beautiful 100-year-old rain trees with some of their branches overhanging the roads and some stretching across the roads and dipping into the lake's waters (Figure 2), winding paths within the gardens, expansive manicured lawns and undulating topography engulfing the lakes attracts frequent visits to the gardens, increasing their familiarity and preference towards the spaces. In the gardens, residents can enjoy private conversation with their significant others, sit while watching children in the playground or find a quiet place to sit and relax. In sums, the park pulsates with life and activity and yet it gives the impression of calm, peace and harmony as compared to other spaces.

## 5.2 Cognitive Well-being Outcomes

Cognitive well-being is measured in terms of outcomes achieved from mental process of perceiving the green spaces—the state of being comfortable, relax, calm, relief of emotions, obtain privacy, sense of safety and satisfaction. Cognitive response is also expressed from the attachment, which includes favourite green space and meaningful, care and concern over the green infrastructure.

**Table 3:** Cognitive outcomes from green infrastructure experience

Cognitive well-being	Dimension	Agreement*	N=335
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		No. of case	%	
1) Effect of GI-direct question	Strolling, sightseeing and relaxing in the green space generate beneficial effect	325	97%	335
2) Cognitive effects	Comfort, relaxation and calmness	250	75%	333
	Relief emotion s( forget worries, relief stress & clear random thoughts)	278	84%	333
	Solitude and privacy	213	64%	333
	Safe	193	58%	333
	Satisfaction	227	68%	334
3) Attachment	Favourite place	228	69%	331
	Meaningful place	175	53%	331
	Protected and conserved	272	82%	332
	Care and concern	249	75%	331

\*5 – strongly agree; 4 – agree; 3 – neutral; 2 – disagree; 1 – strongly disagree

Table 3 shows the dimensions for cognitive well-being outcomes from the green infrastructure and their responses. It shows almost all respondents agreed that the green infrastructure benefits them. More than half (>58%) showed positive responses to all cognitive dimensions measured such as feeling comfortable, relaxed and calmed. Cognitive feeling also involved being attached to the spaces, therefore, favourite and meaningful place, care and concern, and protection of the green infrastructure measured the degree of attachment of residents. More than fifty-three per cent felt that they have attachment to the spaces.

### 5.3 Relationship between frequent visits and cognitive well-being

Chi-square Test of independence and Spearman Rank Order correlation explained the causal relationships between frequent visits to the cognitive dimensions. Several cognitive dimensions were tested for correlation with frequent visits and the results of the correlation are shown in Table 4. Results from test of independence indicated that all dimensions obtained the significant value of Chi-square below 0.05 ( $p < 0.05$ ). This means, the cognitive well-being of residents is influenced by frequent visits to the green spaces. The correlations analyses between the two aspects of study revealed low to modest correlation strength for all dimensions. In other words, even though the causal relationship exists; other aspects that contribute to the strength of the relationships need to be observed. As Thwaites et al., 2005 suggested the preferable environments for people are dependent upon features of the environment that can satisfy residents' motivational needs, that exhibits fine design and distinctive environmental quality, or if it is meaningful in terms of events. The greenery and undulating topography of the town park and hill sites afforded natural environments for active and passive activities that generated relief from negative emotions, helping them to forget worry, relieve stress and clear their minds of distraction. Thus, experience with the green infrastructure network did contribute to the cognitive well-being of residents.

**Table 4:** Spearman's rho correlation coefficients-  
Relationship between frequent visits and cognitive well-being

Cognitive Dimension	Frequency of visit		N=335
	Sig. (2-tailed) - p	Correlation coefficient (r)	
2) Relief emotion s( forget worries, relief stress & clear mind of distraction)	0.016	0.132*	332

3) Solitude and privacy	0.004	0.159**	332
4) Safe	0.000	0.226**	332
5) Satisfaction	0.005	0.155**	333
6) Favourite place	0.000	0.236**	330
7) Meaningful	0.035	0.116*	330

Note: Test of independence showed Significant value  $p < 0.05$  for all dimensions

\* Correlation is significant at the .05 level (2-tailed).

\*\* Correlation is significant at the .01 level (2-tailed).

## 6. Conclusion

Provision and maintenance of open spaces at all spatial scales, from home garden to large town park, afford the urban residents place for relaxation from stress, trigger positive emotions, relaxation, comfort and calm. Larger open spaces such as the town park offer sense of belonging in which residents feel that they have favourite and meaningful places. Results suggested that residents perceive the green infrastructure as space where they have contact with nature and fulfill their interaction needs with others. Much of the engagement happened in large green infrastructure that is, the Lake Gardens, some in the hill sites with forest scenery and waterfalls. Very few residents preferred leisure activities in the incidental and loose spaces in the town. The plurality of characteristics of spaces in the Lake Gardens enables residents to engage in variety of leisure activities that afford them cognitive well-being. In addition, the naturalness quality offered residents frequent contact with nature and interactions with others in a peaceful environment. It appeared that residents barely recognized the smaller spaces within the town because these were separated by buildings and lacked of the quality of naturalness, making it difficult to perceive them as elements of the green infrastructure. The spaces were mainly functions as places to sit for a while, to pass through to another area, to meet friends or to mingle for a while. Residents scarcely had a chance to experience qualities of the spaces that may psychologically benefit them. Nonetheless, the small spaces are also important open spaces that bind the fabric of the town together and make the environment in Taiping more coherent. In order to make these pocket spaces and compounds more recognizable and usable as green space, 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, to form a network or fabric of greenery so that residents can easily recognize the location, direction and transition of each open space in relation to the others, facilitating a sequential experience of comfort and safety (Thwaites and Simkins, 2007).

In summary, the green infrastructure network is crucial part of urban fabric that is highly perceived by residents contributing to their cognitive well-being.

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