A Study on the Identification of Influential Walkability Correlates of the Physical Environment

Balasooriya B.A.D.R.C. [1)],Jayasundara K.M.P.R.[2)],Chamara W.K.J.[3)], Gunasinghe, W.M.M.T.[4)] and Jayasinghe, C.S. [5)]

Abstract

Aims of increasing non-automated transportation and increasing rates of obesity have increased the interest in promoting walking resulting in many research works investigating about influence of physical environment on walkability. Since most of such works are based on pedestrian environment of developed countries, there is a need to have similar investigations for countries like Sri Lanka which have fairly poor pedestrian infrastructure. This research attempts to cover such gap of identifying walkability correlates, through three psychological experiments. Firstly, a set of 130 potential correlates were proposed by analyzing 220 walking decisions. Secondly, this set was filtered to 55 based on degree of influence. Using those, 60 streetscape photos were evaluated to identify 14 walkability correlates. Further, using principal component analysis, six components (Traffic safety in walking area, Design comfort of walking area, Environmental appearance, Illegal Invasion of Pedestrian space, Shade and Sense of Space) were identified.

1. Introduction[1]

There is always plenty of literature, design guidelines on the problems of car traffic but hardly about the pedestrians and their needs. But walking is one the commonly used mode of transportation in Sri Lanka. Transportation related walking can reduce vehicle usage. Modal shift to walking is a key strategy in attaining sustainability in transportation. This research thus is an attempt to identify the elements of the physical environment which encourage walking behavior in Sri Lankan context. In identifying the physical environmental correlates to walkability many researchers tend to investigate individual elements such as pedestrian infrastructure, greenery, space to walk or destinations. Influences arising from the presence of better pedestrian infrastructure such as sidewalks have been studied by Hess at al. (1999)[1], Some researchers have investigated the influence of the physical environment in terms of amenities such as safety from traffic (Foster et al., 2004)[2], aesthetic appearance Ball et al. (2001)[3] convenience of access to destinations (Ball et al., 2001) [3] and crime safety (Foster et al., 2004) [2]. Ewing et al. (2006)[4] have argued that perceived amenities mediate between

[1] are with the Faculty of Engineering, University of Ruhuna.
[1]chamara_balasooriya@yahoo.com;[2]jayasundararanga@yahoo.com;[3]janitha.su.eng@gmail.com; [4]malmigunasinghe@yahoo.com

physical features and walking behavior. What influences a walking decision is not the mere presence of physical elements but perceived psychological impact from such elements. Thus a proper study should identify the physical elements that influence walking and also evaluate mediating amenities influencing the walking. Based on such concept, this research attempts to identify walkability correlates in terms of physical elements and amenities.

2. Methodology

The research work was carried out through three psychological experiments done with the participation of university students. In Experiment 1, 20 participants were taken along one of the 20 predefined routes consisting of different streetscapes. While walking, they commented about the suitability of different street segments for walking. The resultant 200 descriptions were analyzed carefully to pick up key descriptor phrases describing the walking spaces. To increase the comprehensiveness, the list was enriched by introducing descriptors from previous research work related to walkability and affective environmental appraisals. After adjusting for the similarity in meaning, a list of 151 environmental descriptors was finalized. Secondly, a questionnaire survey was conducted to select those exerting higher influence on walking decision.Each of the 151 scales was rated on an 11-point scale for their degree of influence for a walking decision. 79 subjects rated each of the given scales for their influence on walking decision. Whenever they had serious difficulties to understand the meanings of scales they marked it off with a "?" mark.For each scale, rating values were averaged over the 60 respondents. Three criteria were used to filter out less influential descriptors. Those had (1)a median value less than 5 or (2) an inter quartile range of 5 or more or (3) 6 or more "?" marks were eliminated. After elimination the list had 73 items. 79 Students participated in third experiment which used 60 representative street images as stimuli. Respondents viewed the individual images projected on to a screen and rated those for walkability using a 7 point Likert scale of –3 to +3. Also they narrated the reasons for their decision. The resultant decision descriptions were analyzed using the 73-descriptor code. Each descriptor was defined as a 3 point Likert scale of –1 to +1. Parts of each description were divided in to substantive component and valance component. The substantive component was coded in terms of the 73 Likert scaled descriptors. After selecting the most suitable Likert scale for the substantive component, the valance component was checked to see how the subjects perceived the condition as being positive, neutral or negative to take a walk. Based on that, values were assigned for the relevant Likert scale as +1, 0 or –1 for positive, neutral or negative conditions to walk. Value of 0 was assigned for each of the other Likert scales not mentioned in the decision description.

In order to judge the influence of each descriptor on walkability, rated walkability values were correlated to values of 73 descriptors. Considering that correlation coefficient below 0.1 reflect the absence of even a small correlation, 14 descriptors (Table 1) having correlation coefficients above 0.1 were selected for further analysis. In order to a clear understand the most important parameters to walkability, a multiple regression analysis was conducted introducing the above selected descriptors as dependent variables and walkability as the independent variable. In order to understand the components underlying the 14 correlates, a Principle Component Analysis (PCA) was conducted and the model which explained the higher variance and having Eigen values above 1 was selected. In order to assess the validity of the model, the walking decisions were coded again by using the 6 selected components. Further a multiple regression analysis was conducted to identify the relative contribution of the parameters. (Table 1).

3. Results and Discussion

According to the results of the PCA and multiple regression analysis, traffic safety in walking area is the most influential factor on Sri Lankan walkers. They are particularly sensitive to the presence of a means of separation between them and the vehicles. Previous studies done in developed countries have found similar results. At the next level of importance is the environmental appearance which is created through the feeling of beauty, cleanliness and presence of muddy pot holes. While studies done in other countries have observed similar tendencies parameter about muddy pot holes are unique to this study.

Next important parameter is the Sense of Space which highlights the importance of having more wider space for both vehicles and pedestrians. The parameter Illegal Invasion of Pedestrian Space has not been observed in previous studies. This emphasizes the need to have more operational control in road environment.

4. Conclusions

The six components and 14 correlates highlight the factors influencing Sri Lankan walkers. While some correlates observed in previous studies were also observed here, the outcomes depicted some specific requirements for the Sri Lankan walkers. The results can be utilized to understand applicable design treatments in the process of creating better pedestrian spaces. Further these form a good starting point for the development of indicators to measure the walkability of existing streets.

Table 1: Results of the Principle Components Analysis & Standardized Regression Coefficients of Multiple Regression Analysis using six principle components

Variables	Component					
	Traffic safety in walking area	Sense of Space	Environmental appearance	Illegal invasio of Pedestrian space	Design comfort of walking area	Shade
Presence of sidewalk separation	.733					
Safe - Unsafe	.697					
Amount of space of the sidewalk		.780				
Magnitude of road space		.763				
Presence of muddy potholes			.707			
Clean Dirty			.663			
Beauty - Ugly			.492			
Disorderly parked vehicle				.744		
Having to walk in the middle of the road				.739		
Presence of well-built road					.772	
Comfortable - Uncomfortable					.679	
Shady - Sunny						.932
Eigen value	1.26	..24	1.20	1.13	1.12	1.01
Percentage of variance [c]	10.48	0.34	10.02	9.41	9.35	8.45
Standardized Regression Coefficients	0.379	170	0.253	0.150	0.168	0.078
Extraction Method: Principal Component Analysis. ; Rotation Method: Varimax with Kaiser Normalization; a- Rotation converged in 6 iterations; b- Only loadings above 0.3 are shown; c- Cumulative variance captured by 6 components = 58.05%						

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