Corresponding Characteristics of Pedestrian awareness and attitudes in Taiwan

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Abstract: This study is an extension to a project that explores pedestrian behavior in Taiwan with an emphasis on impacts of socio-cultural attributes. Data collection for this study was carried out by conducting an interview questionnaire survey in four Taiwanese cities. The structural relationship among pedestrian attitudes and multiple variables was examined by using multiple correspondence analysis. The main purpose in this study is to use correspondence analysis to discover and visualize the structural relationship among attributes of citizens and pedestrian awareness and attitudes. The result shows that pedestrian awareness and attitudes are associated with stage of life and life style.

Key Words: pedestrian travel culture, multiple correspondence analysis, EASTS IRG05, life style and stage of life.

1. INTRODUCTION

The sustainable development has been a well-known concept in urban planning and transportation planning since last decade. Most of urban planners and transportation planners devoted to make a plan which can drive the urban development toward sustainable (Calthorpe, 1993). In recent years, “low carbon emission” and “green sustainable development” have also become a new trend in urban planning and transportation planning. Planners and researchers focus on how to provide useful strategies to restrain people from using private motorized vehicles and encourage people to use the public transport more in daily life. In transportation planning field, the measure of transportation (or travel, traffic) demand management, such as road pricing and car pooling, have a significant role in decreasing the use of private motorized vehicles. However, it is not enough to “encourage” people to use public transport since the public transport is not so convenient for people to conduct their activities. Therefore, the measures of TDM should coordinate with the ways of spatial planning, such as transit malls and pedestrian facilities, transit oriented development and so on, to increase the level of convenience of public transport. That is a better way to
push people to use public transport and sustainability may be realized in real world.

Under this circumstance, planners have gradually paid more attention to the pedestrian facility planning. A comprehensive understanding of pedestrian preferences and behavior is thus necessary when planners make a pedestrian plan. The work covered in this paper attempts an exploratory statistical analysis of pedestrians over four Taiwanese cities in order to have a better understanding of the corresponding characteristics of pedestrian image. This study is based on the framework that proposed by Tsukaguchi et al. (2007). This paper attempts to use a simplified but statistical way to visualize and explore the relevance of personal characteristics and walking image of citizens in different 4 cities in Taiwan.

Pedestrian travel behavior is a composite and complex outcome of individual characteristics, interpersonal characteristics and physical environmental characteristics (Krizek et al., 2009). However, the past research also demonstrated that the effect of physical environment improvement is relatively small (Krizek et al., 2009). It is necessary to examine what influence pedestrian travel behavior based on different perspectives and approaches. In recent year, one new approach considering the effect of the societal perspective toward walking behavior has emerged. Not only the effect of investment of infrastructure, but the effects of natural environmental conditions and attributes of citizens are taken into consideration when analyzing pedestrian behavior. Tsukaguchi et al. (2007) named this new approach “pedestrian travel culture” and drew a conceptual outline as shown in figure 1. Follow-up publications have attempted to investigate relationships within the pedestrian travel culture framework. Tsukaguchi et al. (2009) have reported the relationship between awareness toward walking and attributes of citizens. Tanaka et al. (2009) have investigated the relationship between level of service of public transport and pedestrian attitudes. Hsia et al. (2009) have examined the difference of walking image among life stages. This paper incorporates past research experiences with new thoughts available from the members of international research team in attempt to investigate pedestrian attitudes. The purpose of this study is to investigate the relationships among pedestrian attitude and the multiple attributes of citizens in the same time by using correspondence analysis.

In the sequential section, the study framework of pedestrian travel culture is introduced briefly. Section 3 represents the composition of data and correspondence analysis method. Section 4 displays the results of multiple correspondence analysis. Some interesting findings are also interpreted in this section. The implication and conclusions is in the final section.

2. STUDY FRAMEWORK OF PEDESTRIAN TRAVEL CULTURE

The conceptual framework of pedestrian travel culture in this study is proposed by Tsukaguchi et al. (2007). In this framework, authors have assumed that the pedestrian behavior is influenced by system characteristics referred to here as regional characteristics. Three main elements were considered as regional characteristics. They are (A) level of service of the urban infrastructure (B) regional environment and (C) citizen attributes. Past related studies showed that there are interrelationships between elements of the regional characteristics and pedestrian characteristics. Those interrelationships have been proved by Tsukaguchi et al. (2007) and Tanaka et al. (2009) as well as Hsia et al. (2009). However, those studies mentioned above only focused on the relationship between pedestrian attitudes and another single factor, such as age of the level of service of public transport. There is no study to discuss the relationship between pedestrian attitudes and several pedestrian attributes.
simultaneously. Thus, the purpose of this paper is to investigate the corresponding characteristics of pedestrian awareness and attitudes toward walking.

3. DATA AND METHOD

The correspondence analysis is famous in France and Japan. Clausen (1988) has described the brief history of the development of correspondence analysis in his book. This method does not assume any underlying theoretical distribution. That means it is likely to be a kind of model-free method. The method has been used as a technique for exploratory data analysis because of its features.

Kim and Yamashita (2008) have indicated that multiple correspondence analysis has two main features. The first one is the multivariate treatment of the data through simultaneous consideration of multiple categorical variables. That means it can display the relationships among multiple variables simultaneously. The second feature is the graphic presentation of the multivariate data in a map. It is helpful to discover the structure inherent in the data.

Golob and Hensher (2007) employed multiple correspondence analysis to examine the corresponding characteristics of the trip chaining activity of Sydney residents. In their paper, the advantage of multiple correspondence analysis that can deal with the causality of nonlinear and non-monotonic relationship between social economic descriptors and measures of travel behavior was emphasized. In addition, this method can be used for forecasting future demand based on different scenarios.

The goal of this study is to discover the relationship among pedestrian attitude toward
walking and other variables which are personal characteristics, life style and stage of life by using multiple correspondence analysis. Therefore, the method of multiple correspondence analysis is adopted to discover the inherent structure of data. Data from a questionnaire survey of pedestrian awareness and attitudes in four cities in Taiwan was used and the distribution of questionnaire counts can be found in table 1.

<table>
<thead>
<tr>
<th>City</th>
<th>Frequency</th>
<th>Relative frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taichung city</td>
<td>300</td>
<td>0.24</td>
</tr>
<tr>
<td>Kaoshiung city</td>
<td>296</td>
<td>0.24</td>
</tr>
<tr>
<td>Tainan city</td>
<td>318</td>
<td>0.26</td>
</tr>
<tr>
<td>Chiayi city</td>
<td>329</td>
<td>0.26</td>
</tr>
<tr>
<td>Total</td>
<td>1243</td>
<td>1</td>
</tr>
</tbody>
</table>

The pedestrian attitude includes the following statements.
(a) I like walking.
(b) Walking is smart (clever).
(c) I am willing to walk for a short distance in daily life.
(d) I like to walk and stroll.
(e) I prefer a street with good scenery for walking.
(f) I prefer a street with good surroundings (neighborhood), even if a little detour is necessary.
(g) I prefer a street with some people, even if a little detour is necessary.
(h) I prefer the shortest route when the surroundings (neighborhood) are not pleasant.
(i) I walk faster than others.
(j) I usually cross a road during a red signal if there is no traffic.

The Likert scale (Meyer and Miller, 2001; Dawes, 2008) was used in evaluating the level of agreement. Complete agreement with a statement was indicated by a value of 5, while strong disagreement with the statement was indicated by a value of 1. The particular value of this format is the unambiguous ordinality of response categories (Babbie, 2000).

For the purpose of stage of life one relevant variable is the ‘age’ of respondents. The respondents have been grouped into age groups designated as ‘below 20 years (younger)’, “20 – 40 years (young adult)”, “40 – 60 years (adult)” and “above 60 years (elder)” old. This classification is sufficient to reflect the stage of life. The basic composition of data is listed in table 2. Note that the sample distributions based on different grouping variables do not be agree fully with the distributions of population because of the sampling error. A correction could be applied by using a weighting technique to bring the distribution in line with real population breakdowns. As we do not intend to compute indices such as overall averages from the sample, such corrections are not required in the current analysis.

Another variables used for the purpose of the current analysis is the ‘public transport usage’ and ‘car ownership’. Indeed, the term lifestyle has a broad meaning and “public transport usage” as well as ‘car ownership’ covers one aspect of lifestyle. The variable shown by public transport usage has been recorded as a frequency of usage where the respondent stated how often per month he or she has used public transport. For the purpose of this study, a respondent who claims to use public transport more than once a month is considered as a public transport user (henceforth PT user). A person who claims public transport usage is equal to one time or less than one time per month is termed ‘PT non-user” in the analysis presented later. The variable shown by car ownership has been recorded as an index that indicates whether respondents have a car or not. A person who has at least one car is termed
‘car owner’. On the other hand, a person who does not own a car is considered as ‘no car’.

<table>
<thead>
<tr>
<th>Variable</th>
<th>category</th>
<th>Frequency</th>
<th>Relative frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Below 20 (younger)</td>
<td>363</td>
<td>0.29</td>
</tr>
<tr>
<td></td>
<td>20-40 (young adult)</td>
<td>567</td>
<td>0.46</td>
</tr>
<tr>
<td></td>
<td>40-60 (adult)</td>
<td>207</td>
<td>0.17</td>
</tr>
<tr>
<td></td>
<td>Above 60 (elder)</td>
<td>106</td>
<td>0.09</td>
</tr>
<tr>
<td>Total</td>
<td>1243</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Public transport usage</td>
<td>PT user</td>
<td>320</td>
<td>0.26</td>
</tr>
<tr>
<td></td>
<td>PT non-user</td>
<td>923</td>
<td>0.74</td>
</tr>
<tr>
<td>Total</td>
<td>1243</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Car ownership</td>
<td>Car owner</td>
<td>901</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>No car</td>
<td>342</td>
<td>0.28</td>
</tr>
<tr>
<td>Total</td>
<td>1243</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

4. RESULTS AND FINDINGS

The process of analysis includes two steps. The Kruskall-Wallis test (KW test) is used to find whether the difference exists between different groups in the first step. The comparison of pedestrian attitudes among different groups was conducted in this step. The grouping variables include age, public transport usage and car ownership. The variable of age represents the stage of life. Both public transport usage and car ownership are used to represent life style. To conduct KW test is a preceding step toward the multiple correspondence analysis because it can reduce the unnecessary information caused by the unrelated variables.

By using KW test, we can find where the difference of pedestrian attitudes significantly exists among groups under different grouping variables (please see table 3). For example, pedestrian attitude shown by the statement ‘I like walking’ has significant difference among different age groups, public transport usage groups and car ownership groups respectively. Therefore, the multiple correspondence analysis method is used to illustrate the relationship among pedestrian attitude toward statement ‘I like walking’, age, public transport usage and car ownership in the same time. The result is shown in figure 2.

In order to display relationships among pedestrian attitude toward walking and other variables simultaneously, statements with only one significant influential variable will not be analyzed in the following work.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Age</th>
<th>Public Transport Usage</th>
<th>Car Ownership</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) I like walking</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>(b) Walking is smart</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>(c) Willing to walk a short distance daily</td>
<td>Yes*</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>(d) I like a leisurely walk</td>
<td>No</td>
<td>Yes*</td>
<td>No</td>
</tr>
<tr>
<td>(e) Prefer good scenery en-route</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>(f) Prefer good neighborhood en-route</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>(g) Prefer busy routes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>(h) Prefer shortest route</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>(i) Fast walker</td>
<td>Yes*</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>(j) Regular signal violator</td>
<td>Yes*</td>
<td>Yes*</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Note: ‘No’ indicates failed to show a statistically significant difference. * indicates difference is significant at 5%. All others have a difference significant at 1%.
The corresponding characteristics of the statement ‘I like walking’ are drawn in figure 2. The figure shows that pedestrians who disagree with the statement ‘I like walking’ are in young generation, using public transport frequently and do not have a car. Pedestrians who agree with statement ‘I like walking’ are older than 20, not using public transport frequently and own a car. It is obvious that the stage of life plays an important role in pedestrian attitude toward walking. A similar situation can be found again in figure 3. When people are old enough, they will regard walking as a smart thing in their daily life. However, young generations find it difficult to agree that walking is smart.

Respondents who own a car are likely to have a positive attitude toward walking, also shown in Figure 3. In contrast, respondents who do not have a car are less likely to have a positive attitude toward walking. Respondents who have a car are likely to drive a long way to the city center and only walk a short distance to his destination in his journey in their daily life. However, respondents who do not have a car tend to regard walking as the necessary mode. More precisely, walking is an indispensable mode for them. They may need to walk a long distance to find a public transport or arrive to their destination by feet. Walking becomes a reluctant activity for them and walking always makes them tired. Thus, it is not amazing that respondents who do not own a car have negative attitudes toward walking.

The age and car ownership are considered as corresponding characteristics of the statement shown by ‘prefer good neighborhood en-route’. The result of multiple correspondence analysis is as figure 4. The figure 4 shows that the elders whose age is above 60 years old are less likely to take a little detour even the street is with good surrounding. The younger population whose age is below 20 years old is also likely to have a negative attitude toward statement ‘prefer good neighborhood en-route’. The result implies that detour is less likely to
be accepted by respondents who often go to their destinations by their feet. Figure 4 also shows that the young adult and adult who own a car are grouped in the agree side.

Figure 3  Multiple correspondence analysis of age, car ownership, public transport usage and pedestrian attitude shown by the statement ‘walking is smart’

Figure 4  Multiple correspondence analysis of age, car ownership and pedestrian attitude shown by the statement ‘prefer good neighborhood en-route’
The figure 5 shows that elders disagree with that they walk faster than others. The stage of life somewhat represents the vigor of respondents in this study. The result indicates when the vigor of respondents is low, they have negative attitudes toward walking.

The figure 6 shows the corresponding characteristics of the regular signal violator. The result indicates that the elder and younger age groups are likely to cross the road during a red signal if there is no traffic. Adults who own a car and do not use public transport frequently are less likely to violate the signal.

There are two dimensions in each figure presented above. The name of each dimension can be given by the consideration of data distribution on each figure. In some research the names of dimensions are important element. However, the names of dimensions are not so important in this paper since the focus is on the result of appearance of data clustering. Briefly speaking, the dimension 1 represents stage of life and life style in each figure. On contrast, the dimension 2 represents respondents’ attitudes toward specific statements.

Figure 5 Multiple correspondence analysis of age, car ownership, and pedestrian attitude shown by the statement ‘faster walker’
Figure 6 Multiple correspondence analysis of age, car ownership, public transport usage and pedestrian attitude shown by the statement ‘regular signal violator’

5. CONCLUSIONS

This study is based on the concept of pedestrian travel culture and uses the multiple correspondence analysis in attempts to visualize the relationship among pedestrian attitudes and other variables including personal characteristic, life style and stages of life. Although it is only an exploratory study, it still provides an easy way for people to understand the relationship among pedestrian attitudes and personal characteristics, life style and stage of life.

The results show that the stage of life does play a significant role in forming pedestrian attitudes toward walking. From the viewpoint of physiology, the vigor of pedestrian is different in their stage of life. Therefore, they are likely to hold different attitudes toward walking in different stage of life. In general, the generations of young adults and adults are likely to give high evaluations to walking. In contrast, those in younger and older age groups are less likely to have good evaluation to walking.

Does life style affect the pedestrian attitudes toward walking directly? In this study, the life style was measured through the proxy variables of car ownership and public transport usage of respondents. The result shows respondents who own a car and do not use bus frequently are likely to have positive attitudes toward walking because walking is an ancillary activity for their daily trip. However, those who do not have a car and use bus frequently are likely to have negative attitudes toward walking because their capability of moving is limited. It implies that life style may affect individual’s attitude toward walking.

This study uses multiple correspondence analysis in attempts to discover the structural relationship among life style, stage of life and pedestrian attitudes toward walking. The
graphical presentation provides an easy way for people to read and understand the data structure. Although all associations discovered in this study need to be validated using other statistical methods, the methodology has provided a viable direction for future research work on pedestrian travel culture.

REFERENCES
Dawes, J. (2008) Do data characteristics change according to the number of scale points used? An example using 5-point, 7 point and 10-point scales, International Journal of Market Research, Vol. 50, Issue 1, pp. 61-77.