

The Study of the Relationships among Psychological Factors, Acceptable Walking Distance, and Reported Walking Distance for Shopping Trips

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Abstract: The purpose of this study is to examine the relationship between psychological factors and walking behavior in order to provide evidence supporting the implementation of measures for behavioral change for the success of urban planning initiatives. The acceptable walking distance is selected as an intermediate variable between psychological factors and actual walking distance. The results indicate that increasing the acceptable walking distance has the potential to stimulate pedestrians to increase the amount of walking. Also, an ordered probit model has indicated that psychological factors have a significant influence on the acceptable walking distance. It is able to identify a sequence of cause and effect where psychological factors would first influence acceptable walking distance and then the acceptable walking distance would influence pedestrian walking distance. A policy of applying soft measures such as psychological strategies to increase the pedestrian output is supported by the findings of this project work.

Keywords: psychological factors, walking behavior, ordered probit model, walking distance

1. INTRODUCTION

Walking is not only a most basic means of transport for people in their daily life but also an indispensable means for completing the whole daily journey. Ideally, people can reach anywhere in the city by walking regardless of age and sex. It is recognized that walking has a specific advantage in terms of accessibility. Other than the accessibility, walking has further advantages as well, such as low cost, zero emission and environmental friendliness. In recent years, walking has played an important role in maintaining personal health as well. Saelens and Handy (2008) argued that walking is a common form of physical activity. Frank, Andresen, and Schmid (2004) also concluded that each additional kilometer walked per day was associated with a 4.8% reduction in the likelihood of obesity. There are more and more studies focusing on the health benefits of walking to date.

What do motivate people to walk? Or, what are the significant correlates with walking? These are essential issues to consider in urban planning. Mehta (2008) pointed out that walking is largely influenced by cultural factors, individual circumstances, preference and characteristics as well as environmental factors. Tsukaguchi, Vandebona, Yeh, Hsia, Jung, and

Tajima (2011) conducted an international comparison among Japan, Korea and Taiwan based on the aspect of cultural comparison. Keegan and O'Mahony (2003) examined a new type of pedestrian waiting countdown timer to influence pedestrian behavior at signalized pedestrian crossings in Dublin. The result showed that individual's behavior is influenced by the change of the specific environmental factor. Saelens and Handy (2008) reviewed 42 studies, published between 2002 and 2006, to point out that attributes of the built environment correlate with walking. They summarized the significant correlates identified in previous studies, such as accessibility or proximity, mixed land use, density, aesthetics, sidewalks, street connectivity, safety, and neighborhood type. There are still many empirical studies examining the effect of environmental factors on walking behavior, such as Humpel, Owen, Iverson, Leslie, and Bauman (2004), Guo and Loo (2013). In addition to the built environment, the social atmosphere and attitudes of individuals toward walking also have effects on walking behavior. Joh, Nguyen, and Boarnet (2012) pointed out that built environment factors and social characteristics have differential impacts on walking trips depending on a person's walking attitudes. They concluded that strategies to promote positive walking attitudes should be pursued in tandem with land use policies to encourage walking within community neighborhoods.

Krizek, Handy, and Forsyth (2009) proposed a different conceptual framework to describe the effects of causal factors on walking behavior. In their conceptual framework, the nonmotorized transportation interventions regarding hard measures and soft measures are introduced. The hard measures considered were infrastructure investments and physical improvements and developments. In the last few decades, central and local governments have invested a lot of time and money in the pedestrian infrastructures in order to provide a good environment for pedestrians. Planning authorities have held the view that "Supply will bring usage". In other words, it has been believed that in theory, behavioral changes result from the improvement of infrastructure (Krizek et al., 2009). However, hard measures have been often very expensive but not quite effective in bringing about the change of behavior. On the other hand, soft measures such as education, encouragement, and enforcement are now believed to be able to change attitudes of individuals based on attitude theory (Eagly and Chaiken, 1993) and then, the change of attitudes can induce the change of behavior based on behavioral science (Ajzen, 1987). Soft measures have the potential to increase the quantum of walking through psychological changes, such as increased motivation or desire to walk and walk longer. Although some studies suggested attitudinal factors may be a stronger determinant of walking than built environment factors, it is unfortunate that, to date, there are only a few studies that have examined the relationship between psychological factors and walking distances.

This study attempts to examine the relationship between psychological factors and walking behavior in order to provide a supporting evidence for the implementation of soft measures. Although it has been known that behavior is influenced by different factors, this study focuses only on the psychological factors. There are many studies discussing the variations in walking distance by trip purposes, for example, Seneviratne (1985), Agrawal and Schimek (2007) and Yang and Diez-Roux (2012). The results of these studies have indicated that the value of acceptable walking distance may differ based on the particular trip purpose. This study demonstrates the proposed concept in the context of shopping trips. The reason for selection of this trip purpose is the observation that large portion of Taiwanese often rides private vehicle to go shopping. Thus, they need to park their cars or motorcycles in a parking place close to their desired destinations and reach the shops on foot. Therefore, acceptable walking distance (AWD, henceforth) for pedestrians in this study has been defined as "the acceptable walking distance from parking place to a desired shopping place when you use a

car or scooter as a transport mode to arrive in". The reported walking distance (RWD, henceforth) of pedestrians in this study has been defined as "the reported walking distance from parking place to a desired shopping place when you use a car or scooter as a transport mode to arrive in". AWD and RWD are both measured by clock time in minutes.

Finally, there are two proposed hypotheses in this study. 1) RWD is influenced by AWD. 2) AWD is influenced by pedestrian psychological factors. In the next section, the outline of questionnaire survey including data collection method and contents of questionnaire has been introduced. Then, the above two hypothesis has been examined by different statistical methodologies as explained in section 3 and 4. The implications of the analysis and results are outlined in section 5 before leading to the final section to present the conclusions.

2. OUTLINE OF THE QUESTIONNAIRE SURVEY

2.1 Data Collection Method

This study is continuation of a series of research projects related to pedestrian travel culture. The goal of the overall series of projects is to establish the concept of pedestrian travel culture and to identify the directions for pedestrian planning (Tsukaguchi, Vandebona, Sugihara, and Yeh (2007)). Unlike other studies of the series, this study does not conduct an international comparison but focuses on the relationship between psychological factors and walking distance properties of different cities within one country, Taiwan. This study introduces psychological aspects of residents to supplement the body of work created about the concept of pedestrian travel culture.

Questionnaire surveys were conducted in four Taiwanese cities, i.e. Kaohsiung, Taichung, Tainan, and Chiayi in February 2006 and July 2008. The population values for the cities according to Hsia, Yeh, Vandebona, and Tsukaguchi (2010) were about 1.5 million, 1.1 million, 0.8 million, 0.3 million for Kaohsiung, Taichung, Tainan, and Chiayi respectively. The selection of cities was influenced by the proximity to the National Cheng Kung University where members of this research team were based. The characteristics of each city were taken into consideration as well. Kaohsiung and Taichung were second and third largest cities in Taiwan in terms of population at 2008. Tainan has the longest history among these cities and currently well known for educational institutions and the Tainan science park. Chiayi is a relatively small city and supports a large agricultural hinterland. Each city represents different characteristics of Taiwanese cities partially.

Quota sampling method was implemented for the survey sample selection. First, the category variables of age and administrative district were used to make a cross-tabulation. Next, the proportion in each cell became a basis for sample selection. Interviewers were asked to find suitable respondents to satisfy the requirement of proportions in each cell. The questionnaires were administered on weekends by interviewer visiting individual homes. As shown in Table 1, approximately similar number of questionnaires was administered in each city. The least number was done in Kaohsiung, 296, and the highest number was in Chiayi, 329 questionnaires. It is noted that this method was convenient and easy to handle in the field conditions although it is not a random sampling method.

There are total 1243 samples in this database as Table 1 shows. All respondents answered the questions about psychological factors of pedestrian toward walking. However, some of the respondents did not answer the question of AWD. This subset with missing data was excluded from the subsequent analysis. After screening the data, there were 981 useful samples. Sample sizes for the survey cities are shown in the two columns at the right hand

side edge of Table 1.

Table 1 Distribution of questionnaire counts from the four cities

City	Total number of samples		The number of usable samples	
	Frequency	Proportion (%)	Frequency	Proportion (%)
Kaohsiung	296	23.8	222	22.6
Taichung	300	24.1	233	23.8
Tainan	318	25.6	257	26.2
Chiayi	329	26.5	269	27.4
Total	1243	100.0	981	100.0

2.2 Contents of questionnaire

In order to clarify the effect of psychological factors of pedestrian on their AWD, 10 statements associated with the psychological factors of pedestrians toward walking were asked in this questionnaire survey. The following ten statements include general attitude toward walking in the first four statements, characteristics of preferred routes in the next four statements and personal reflection of the individual's walking behavior in the last two statements. The details of the ten questions are listed in Table 2.

Table 2 The psychological factors of pedestrian toward walking

Category	Statement
Attitude	(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
Preference	(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
Personal reflection	(i) I walk faster than others
	(j) I usually cross a road during a red signal if there is no traffic

The 10 statements were originally devised by the research team for the purpose of international comparison and were classified into 3 categories of psychological factors, such as attitude, preference, as well as personal reflection. This study did not carry out the international comparison but employed the data to examine the effect of psychological factors on walking distance of different Taiwanese cities. Respondents were asked to answer these questions in a five points scale. Complete agreement with a statement was indicated by a value of 5.0, while strong disagreement with the statement was indicated by a value of 1.0.

Other than the psychological factors of pedestrian toward walking, AWD is selected as a relevant variable which depicts respondent's tolerance to walking distance. AWD has been measured by clock time and divided into six ordered ranges as shown in Table 3. In this case, the order sequence number is meaningful and useful in establishing an order probit model. The bigger the sequence number of order is the longer the AWD is.

The other variable covered is RWD. RWD has been measured by clock time as well. The ordered sequence as adopted in AWD have been employed to represent respondent's revealed behavior.

Table 3 The measurement of AWD and RWD

Order	Range
0	Less than 2 minutes
1	2 to 5 minutes
2	5 to 10 minutes
3	10 to 15 minutes
4	15 to 20 minutes
5	More than 20 minutes

3. RELATIONSHIP BETWEEN ACCEPTABLE WALKING DISTANCE AND REPORTED WALKING DISTANCE

The purpose of this section is to explore the relationship between AWD and RWD. It is assumed that RWD is influenced by AWD in this study. Therefore, the first step is to examine whether RWD is independent of AWD or not. The χ^2 test has been carried out to examine the hypothesis of independence. The value of χ^2 is 644.03 (with degree of freedom 36). The result is significant as this value is larger than the critical value of χ^2 test at significance level $\alpha=0.05$. The hypothesis of independence between RWD and AWD has been rejected.

The second step is to explore the interaction between them. The X-axis represents the categories of AWD and Y-axis represents the expected values of RWD as Figure 1 shows. Expected value is computed using multiplication of the probability in each category of reported walking time and the mid value of the particular time range.

5 minutes appears to be the critical value in terms of RWD. On the other hand, 10 minutes is likely to be a critical value in terms of AWD. In general, people who respond the AWD is 10 minutes at most (i.e. in one of the three categories of “less than 2 minutes”, “2 to 5 minutes”, and “5 to 10 minutes”) are likely to tolerate 5 minutes of RWD at most in practice. By contrast, people who respond the AWD is 10 minutes at least (i.e. in one of the three categories of “10 to 15 minutes”, “15 to 20 minutes”, and “more than 20 minutes”) are likely to tolerate 5 minutes of RWD at least in practice.

The above results indicate that, as expected, the increase of AWD is likely to increase RWD as well. However, the peak has occurred at the category of 15 to 20 minutes. It implies that RWD is likely to be influenced by AWD to a certain degree. That also implies people may agree to accept longer walking distance in their mind but cannot tolerate such long distance in practice possibly due to the heavy loads of shopping and, presents or inclement weather or poor street environment.

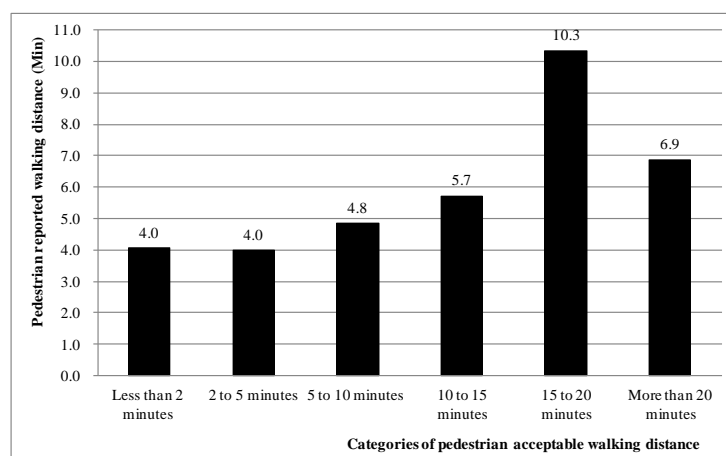


Figure 1 Reported walking distance (RWD) against acceptable walking distance (AWD)

4. RELATIONSHIP BETWEEN PEDESTRIAN ATTITUDES TOWARD ACCEPTABLE WALKING DISTANCE

4.1 Methodology: the ordered probit model

The objective of the ordered choice model is to model the ordered responses as functions of explanatory variables (Boes and Winkelmann, 2006). The modern form of the ordered probit model was proposed by McElvey and Zavoina (1971, 1975) for the analysis of ordered categorical outcomes. The basic model structure is an underlying random utility model or latent regression model (Greene and Hensher, 2010).

$$y_i^* = \beta'x_i + \varepsilon_i, \quad i = 1, 2, \dots, n \quad (1)$$

where

x_i denotes a set of K covariates which are assumed to be independent of ε_i .

β denotes a vector of K parameters which is the object of estimation and inference.

ε_i is the disturbance term.

y_i^* is observed in discrete form through a censoring mechanism. That means

$$y_i = \begin{cases} 0 & \text{if } \mu_{-1} < y_i^* \leq \mu_0, \\ 1 & \text{if } \mu_0 < y_i^* \leq \mu_1, \\ 2 & \text{if } \mu_1 < y_i^* \leq \mu_2, \\ \dots & \\ J & \text{if } \mu_{J-1} < y_i^* \leq \mu_J, \end{cases} \quad (2)$$

where

i denotes the number of sample. The n samples are labeled $i = 1, 2, \dots, n$.

Several normalizations are needed to identify the model parameter (Greene and Hensher, 2010).

- 1) $\mu_j \geq \mu_{j-1}$. This condition keeps the positive signs of all of the probabilities.
- 2) $\mu_{-1} = -\infty$ and $\mu_J = +\infty$. This condition ensures the support is to be the entire real line.
- 3) To assume the $\text{Var}[\varepsilon_i|x_i] = 1$ in the probit case and $\pi^2/3$ in the logit case.
- 4) Let $\mu_0 = 0$ if we assume x_i contains a constant term.

The latent regression model would describe an underlying continuous preference for the legislation as y_i^* . In practice, y_i^* is unobserved. A censoring of y_i^* into J different ranges, one of which is closest to their true preference. By the laws of probability, the probabilities associated with the observed outcomes are represented as Eq. (3).

$$\text{Prob}[y_i = j|x_i] = [F(\mu_j - \beta'x_i) - F(\mu_{j-1} - \beta'x_i)] > 0, \quad j = 0, 1, \dots, J \quad (3)$$

where $F(\cdot)$ is the distribution function. In this study, $F(\cdot)$ is designated as a standard normal distribution function which yields the ordered probit model. Therefore, Eq. (3) can be re-written as Eq. (4) for the purpose of easy understanding.

$$\text{Prob}[y_i = j|x_i] = [\Phi(\mu_j - \beta'x_i) - \Phi(\mu_{j-1} - \beta'x_i)] > 0, \quad j = 0, 1, \dots, J \quad (4)$$

It is worth noting that this model describes probabilities of outcomes as other discrete choice models do. This model is not like the conventional regression model so that the relationship between a y_i and the covariates x_i does not be described directly.

The likelihood function for estimation of the model parameters is based on Eq. (4) which calculates the likelihood for one observation. The model parameters can be estimated by using maximum likelihood estimation method. Here, the log likelihood function for all observations is as Eq. (5) shows.

$$\log L = \sum_{i=1}^n \sum_{j=0}^J m_{ij} \log [\Phi(\mu_j - \beta'x_i) - \Phi(\mu_{j-1} - \beta'x_i)] \quad (5)$$

where

$$m_{ij} = 1 \text{ if } y_i = j \text{ and } 0 \text{ otherwise.}$$

One issue always appears after the estimation of the model parameters. The issue is the interpretation of the model result. Greene and Hensher (2010) mentioned that interpretation of the coefficients in the ordered probit model is more complicated than in the ordinary regression setting. It is fact that there is no conditional mean function, $E(y|x)$ to analyze. In this case, the partial effects in the ordered probit model are calculated by Eq. (6).

$$\delta_j(x_i) = \frac{\partial \text{Prob}(y=j|x_i)}{\partial x_i} = [\Phi(\mu_{j-1} - \beta'x_i) - \Phi(\mu_j - \beta'x_i)]\beta \quad (6)$$

It is recognized that neither the sign nor magnitude of the coefficient are informative for the computation of partial effects, so the direct interpretation of the coefficients is not correct and clear. In the case where the variable with a positive coefficient, it is recognized that the increase in the variable will increase the probability in the highest cell and decrease the probability in the lowest cell. At the meantime, the sum of all the changes will be zero according to the probability law. It is noteworthy that the single crossing which is the feature of the model. The single crossing means the effects will begin at $\text{Pr}(0)$ with one or more negative values and later change to a set of positive values. There is only one sign change. When the variable with a negative coefficient, the situation is reversed but still keep the feature of single crossing.

4.2 The Empirical study

The primary aim of this section is to examine relationships among the psychological factors and AWD. The independent variables have been shown in Table 2. On the other hand, the dependent variable is AWD which is represented in an ordered form. On the basis of the classification of the dependent variable and on the data for variables described above, the ordered probit analysis was carried out. The dependent variable is ordered according to the pre-determined definitions in Table 3. In this case, the multinomial probit model would fail to account for the ordinal nature of the dependent variables. The ordered probit models have come into wide use as a framework for analyzing such a response (Tsuiji and Choe, 2004).

The second purpose of this section is to examine the city specific differences in terms of the relationships among pedestrian psychological factors and acceptable walking distance. Therefore, the ordered probit analysis has been carried out for four cities. Then, the comparison among models is conducted. The model estimation results of four cities are shown in Table 4. From Table 4, we find that the statement (a) is a common significant determinant of acceptable walking distance among four models. This result illustrates that attitude has a strong effect on forming the level of pedestrian acceptance. The more the pedestrian likes walking, the longer the acceptable walking distance is. The hypothesis that

psychological factors have effects on AWD has been supported by this result to some extents.

There are several specific variables which are significant in different models except for the statement (a). In *Kaohsiung* model, the statement (j) is significant. In *Taichung* model, the statement (h) is significant. In *Tainan* model, the significant determinant includes statement (j). In *Chiayi* model, the statement (g), (h), (j), and constant are significant determinants. In terms of cultural comparison, the statement (a) can be treated as a common culture of Taiwanese pedestrian to some extent. The specific variables which are significant in different models can reflect the local cultures or features of pedestrians who live in different cities. However, some variables are not significant in the models. It is unclear why other variables have no effects on AWD here. This situation may have been caused by the colinearity among variables or the misspecification of model. The further research is necessary to clarify the unclear problem.

In the conventional regression model, the partial effect of the variable can be computed and interpreted easily. The coefficient of the specific variable represents the effect of one unit change of the variable on dependent variable in the conventional regression model. However, as mentioned before, the interpretation of coefficients of variables is not straightforward in ordered probit model. The sign and magnitudes cannot be interpreted directly to gain the meanings of the one unit change of specific variable.

The partial effects of variables can be computed by Eq.(6) and have been shown in Table 5. The implication of the result listed in Table 5 is that the effect of a change in one of the variables in the model relies on all the model parameters, the data, and which probability is of interest. It is noted that the partial effects have been computed only for the significant coefficients of variables in each model.

The characteristic of single crossing indicate that 5 minutes of AWD seems a psychological threshold for Taiwanese citizens. It is recognized that it always occurs between the states of $Y=1$ and $Y=2$ in each model from Table 5. The positive coefficient sign denotes the partial effect would decrease in the case of $Y=0$ and $Y=1$ first and increase in the case of $Y=2$ and other cases after. On the other hand, the negative coefficient sign indicates the direction of change in partial effects would reverse.

The partial effects represent the impacts on the specific probabilities per unit change in the variable. In order to deeply examine the partial effect of statement (a) in each model, the impacts of partial effects on the specific probabilities have been illustrated. The results are drawn from Figure 2 to Figure 5.

The results show that all six probabilities have changed in every model. The two at the left end of distribution have decreased while the four at the right have increased. As the level of statement (a) increases one unit, the expected value of AWD has also been increased. It implies that pedestrians are likely to accept longer walking distance while they more like walking. The result matches the concept of cognitive resonance in psychology. On the other hand, it also implies the soft measures, e.g. education, may have the potential to motivate people to walk longer. It is noteworthy that "education" implies that individual's behavior can be changed by education based on attitude theory and relevant behavioral theories rather than educate people to like walking. However, the impacts of soft measures on personal psychological factors still need further research.

Table 4 Model estimation results in terms of different cities

—	<i>Kaohsiung</i>		<i>Taichung</i>		<i>Tainan</i>		<i>Chiayi</i>	
Variable	Coef.	<i>t</i> -value	Coef.	<i>t</i> -value	Coef.	<i>t</i> -value	Coef.	<i>t</i> -value
(a)	0.212*	1.862	0.412**	3.987	0.165*	1.786	0.206**	2.004
(b)	0.081	0.788	-0.133	-1.290	-0.149*	-1.897	-0.055	-0.669
(c)	0.033	0.288	0.008	0.064	0.005	0.047	0.123	1.149
(d)	0.029	0.258	0.006	0.061	0.070	0.885	0.016	0.198
(e)	-0.147	-1.106	-0.060	-0.560	0.150	1.468	-0.187	-1.633
(f)	-0.025	-0.266	-0.080	-0.973	0.042	0.490	-0.076	-0.738
(g)	0.096	1.236	-0.021	-0.260	0.103	1.353	0.148*	1.919
(h)	0.005	0.062	0.228**	2.731	0.053	0.708	-0.242**	-3.252
(i)	0.005	0.068	-0.012	-0.153	-0.124*	-1.824	0.034	0.355
(j)	-0.191**	-3.092	-0.013	-0.198	0.004	0.074	0.127*	1.917
Constant	1.051	1.621	0.269	0.437	-0.143	-0.318	1.067**	2.143
μ_1	1.453		1.416		1.290		1.042	
μ_2	2.432		2.274		2.031		1.650	
μ_3	3.040		2.914		2.369		2.665	
μ_4	3.375		3.234		2.512		2.818	
Samples	222		233		257		269	
<i>LL</i> (0)	-299.563		-340.847		-390.487		-421.718	
<i>LL</i> (β)	-289.405		-327.007		-377.605		-409.850	

- Not relevant; ** Significant at 5% level; * Significant at 10% level. *LL*(0) Initial log-likelihood; *LL*(β) Final log-likelihood

Table 5 The partial effects of significant coefficients of variables in different models

Statement	Y=0	Y=1	Y=2	Y=3	Y=4	Y=5
<i>Kaohsiung</i>						
(a) I like walking	-.0387	-.0442	.0408	.0251	.0082	.0089
(j) I usually cross a road during a red signal if there is no traffic	.0349	.0399	-.0367	-.0226	-.0074	-.0080
<i>Taichung</i>						
(a) I like walking	-.0614	-.1031	.0518	.0601	.0218	.0308
(h) I prefer the shortest route when the surroundings (neighborhood) are not pleasant	-.0340	-.0570	.0287	.0333	.0120	.0171
<i>Tainan</i>						
(a) I like walking	-.0325	-.0328	.0194	.0134	.0053	.0272
(b) Walking is smart (clever)	.0295	.0297	-.0176	-.0121	-.0048	-.0247
(i) I walk faster than others	.0244	.0246	-.0146	-.0100	-.0040	-.0205
<i>Chiayi</i>						
(a) I like walking	-.0362	-.0437	.0031	.0453	.0063	.0252
(g) I prefer a street with some people, even if a little detour is necessary	-.0260	-.0314	.0022	.0325	.0045	.0181
(h) I prefer the shortest route when the surroundings (neighborhood) are not pleasant	.0425	.0514	-.0036	-.0532	-.0074	-.0297
(j) I usually cross a road during a red signal if there is no traffic	-.0223	-.0269	.0019	.0279	.0039	.0155

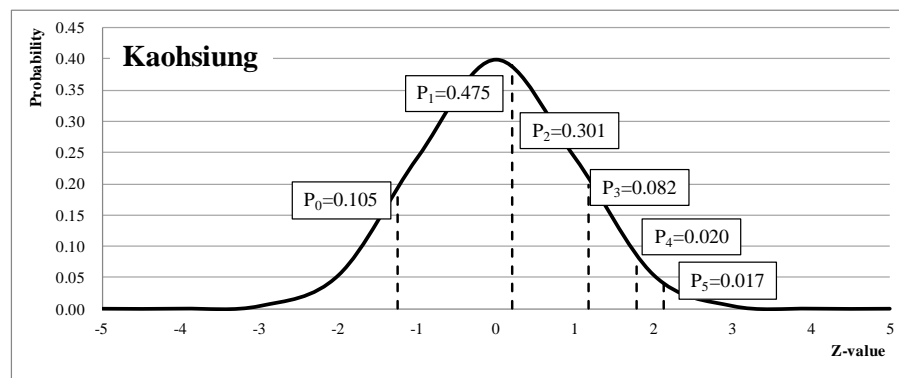
The results of expected values for AWD are shown in Table 6. The expected value is computed using multiplication of the probability in each category of acceptable walking time (P_j or P'_j) and the mid value of the particular time range (y_j^*). It is noted here that P_j means $\text{Prob}(y=j)$ at variable means where $j=\{0,1,2,3,4,5\}$. On the other hand, P'_j means $\text{Prob}(y=j)$ considering the effect of one unit *ceteris paribus* increase in statement (a).

The result shows the rank of the expected value among four cities is Chiayi > Tainan > Taichung > Kaohsiung. If the level of statement (a) increases one unit, the rank of the expected value among four cities change to Chiayi>Taichung>Tainan>Kaohsiung. The value of difference changes from 0.74 to 1.70 minutes as the level of statement (a) increases one unit. Assuming the average walking speed of general Taiwanese citizens is 75 meters per minute, the value of difference would change from 55.5 to 127.5 meters in terms of spatial distance.

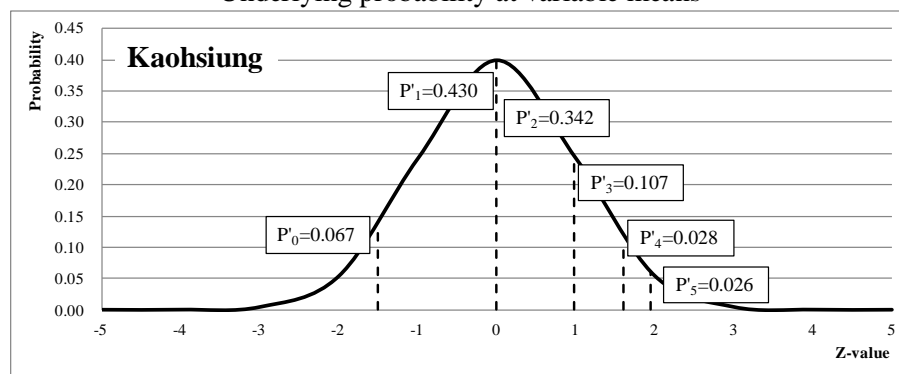
Table 6 The expected value of AWD

(unit: Min)

City	<i>Kaohsiung</i>	<i>Taichung</i>	<i>Tainan</i>	<i>Chiayi</i>
Expected vale of AWD				
(1) $\sum_j(P_j \times y_j^*)$	5.74	6.67	6.85	7.98
(2) $\sum_j(P'_j \times y_j^*)$	6.48	8.37	7.66	8.98
(3) = (2) - (1)	0.74	1.70	0.81	1.00

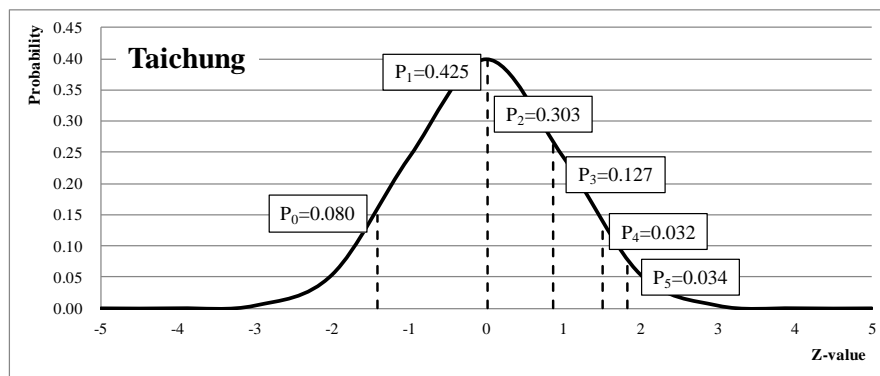


Underlying probability at variable means

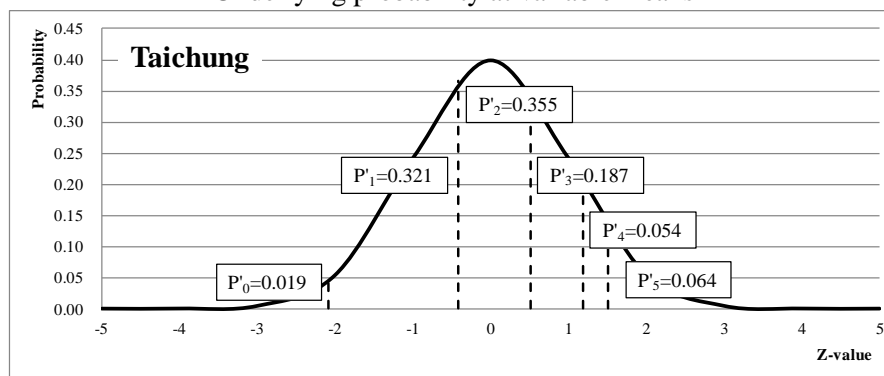


Probability considering the partial effect of statement (a)

Figure 2 The partial effect of statement (a) in *Kaohsiung* model

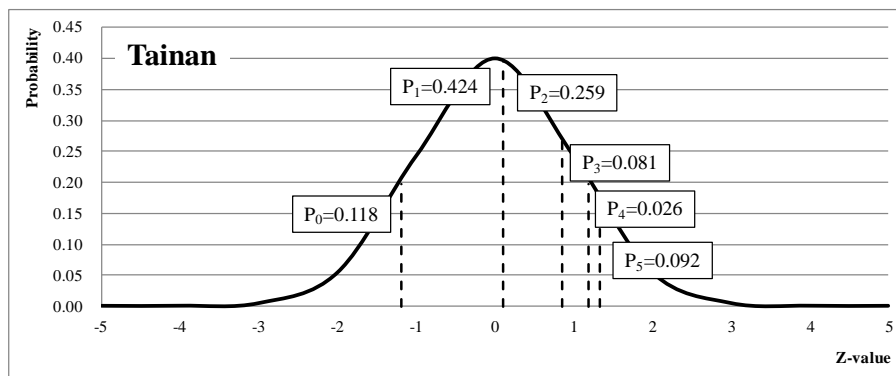


Underlying probability at variable means

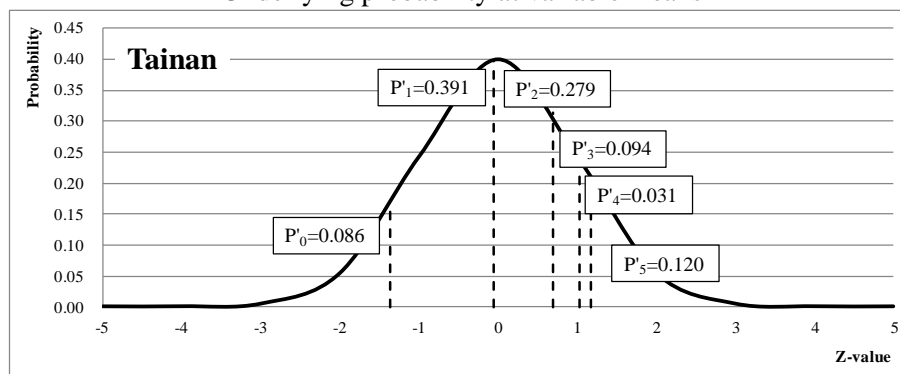


Probability considering the partial effect of statement (a)

Figure 3 The partial effect of statement (a) in **Taichung** model



Underlying probability at variable means



Probability considering the partial effect of statement (a)

Figure 4 The partial effect of statement (a) in **Tainan** models

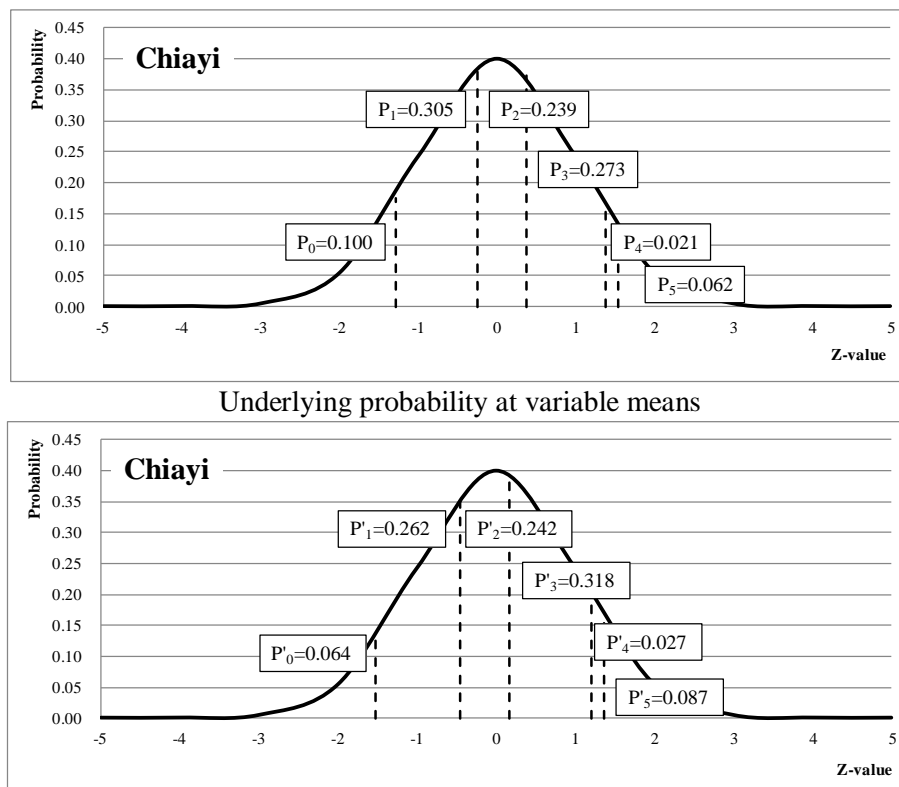


Figure 5 The partial effect of statement (a) in *Chiayi* model

5. CONCLUSIONS

This study attempts to examine the relationship between psychological factors and walking distance. Two proposed behavioral hypotheses have been explored using statistical methods. The result has shown that the person's psychological factors are likely to influence his or her acceptable walking distance. In turn, the AWD is likely to influence his reported walking distance, RWD. It implies the possibility that the attitude change stimulates behavioral change. The partial effect of statement (a) is also examined based on the different cities. The results show that the value of difference is from 0.74 to 1.70 minutes as the level of statement (a) increases one unit. Assuming the average walking speed of general Taiwanese citizens is 75 meters per minute, the value of difference would be from 55.5 to 127.5 meters in terms of spatial distance.

For a long time, the thought of development based on hard measures has dominated the professionals engaged in planning practice. However, maintaining the existing infrastructure and enhancing the frequency of use through the soft measures has received many attentions in recent years. Soft measures as a distinct way of thinking from the reliance on hard measures for development has been proposed mainly because of cost considerations. This concept is based on the belief that an individual's behavior can be changed through the interventions of soft measures or psychological strategies. The discussion about soft measures or psychological strategies is not the scope of this paper, it is however important to discuss the relationship between this paper's results and the extent to which it can influence policy or practice. The results of this study has demonstrated the causal sequence as psychological factors influence acceptable walking distance, and then, influence reported walking distance. Therefore, planners can employ soft measures to influence individual's psychological factors

first and expect the positive change of individual's behavior. It is recognized that needs for further research for the intervention of soft measures are required.

Comparison of models among four cities has indicated that statement (a) has a common impact on AWD. Policy implications of this finding would be a supportive concept for the intervention of soft measures. Furthermore, the comparison of models among four cities also has shown that each model has its own significant variables. Policy implications of this finding would be that the policy making have to consider different pedestrian psychological needs in different cities. Another conclusion that can be derived from these findings is the possibility of exploring a culture-oriented planning. However, the concepts related to practice of culture-oriented planning remain to be investigated in the future.

Some Limitations of this study and suggestions are addressed to point out the direction for future researches.

- 1) The value of acceptable walking distance may differ based on the particular trip purpose. The further study can extend the scope to examine the value of acceptable walking distance based on different trip purposes.
- 2) This study only examines the effect of psychological factors on acceptable walking distance. Apparently, many factors are not discussed in this study, such as built environment, social environment, and personal characteristics. All the overlooked factors can be taken into consideration in future studies.
- 3) The series of pedestrian travel culture projects had paid many attentions to conduct the international comparison of pedestrian attitude, preference, and personal reflection. However, the discussion of planning issue from the aspect of pedestrian travel culture is still lack. This study introduces psychological aspects of residents to supplement the body of work created about the concept of pedestrian travel culture. The future studies can apply the concept proposed by this study to Japanese, Korean, and Australian cities to establish the concept of pedestrian travel culture and to indicate the appropriate direction to pedestrian planning from the aspect of psychological factors.

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