Chinese Pedestrians and Their Walking Characteristics: Case Study in Beijing

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The walking activities and characteristics of Beijing pedestrians, particularly in reference to the use of pedestrian crossing facilities, are highlighted. Walking serves many purposes in Beijing and is popularly used for commuting by the populace regardless of gender and age. A study revealed that although Beijing pedestrians were less enthusiastic about using the overpasses and underpasses than they were about using signalized crossings, mainly because of the ascending and descending movements required, when the safety aspects and other related attributes were appraised, these pedestrians did not favor any type of crossing in particular. Thus, Beijing pedestrians would accept any type of crossing facilities as long as they are appropriate and sufficient.

Because of ongoing policies to curb the use of bicycle ownership in Beijing by implementing bicycle taxes, raising bicycle prices, and imposing higher parking fees, walking plays an even more important role for the mobility needs of the populace. According to the origin-destination (O-D) surveys conducted by the Beijing Traffic Safety Bureau (1) in 1987, it was revealed that among the five major urban transport modes, walking accounted for 13.8 percent of the total trips made in Beijing. Even though bicycles were the most dominant mode of traveling—consisting of 50.3 percent of the total trips made and followed by buses (27.7 percent), institute buses (4.4 percent), taxis (0.6 percent), and others (3.2 percent)—commuters sometimes do not reach their final destinations by bicycle. Often, commuters must walk to reach their final destinations. In fact, they use walking as a means of transport the way Westerners use their vehicles in commuting—not only to work and school but for other social and recreational activities as well.

However, unlike Westerners but similar to people in other developing countries, local commuters do not perceive the need for discipline in using the pedestrian crossing facilities. It may be useful to identify the reasons that Beijing pedestrians are not willing to comply in using the crossing facilities and whether this unwillingness is legitimate. Excuses include improper location, insufficient crossing facilities, lack of safety aspects, and lack of convenience and comfort.

This paper intends to examine the walking activities and characteristics of Beijing pedestrians, particularly in reference to the use of pedestrian crossing facilities. In addition, their attitudes toward and acceptance of the crossing facilities are also scrutinized. It is hoped that the results will pave the way toward improving pedestrian facilities in Beijing.

DATA COLLECTION

To fulfill the desired objectives, questionnaires were used to collect relevant information about pedestrian characteristics and attitudes toward the crossing facilities in Beijing. A total of 1,500 questionnaire forms were distributed randomly to pedestrians in 70 locations. Of these, 1,126 forms were returned; after uncompleted forms were removed, only 930 forms were used for analyses. Table 1 gives the locations of the survey sites and the response rates.

In addition, pedestrian volume counts were also made at two signalized crossings to determine the number of illegal walkers. Detailed descriptions of the two study sites are presented in Table 2. A photographic technique through the use of a video camera was employed to record pedestrian volumes. To avoid any bias results and to obtain the normal walking conditions, data were collected during the off-peak period (2:00 to 5:00 p.m.) and during weekdays at the two study sites.

BEIJING PEDESTRIANS

To ensure the unbiased selection of the interviewed pedestrians, which would represent the typical Beijing pedestrian, demographic characteristics of these pedestrians were first determined. Results of the questionnaires revealed that walking in Beijing has become a common mode of transport among all commuters regardless of gender and age, as shown in Table 3. Female and male pedestrians appeared to be nearly evenly represented by 53 and 47 percent, respectively. Age distinction among various pedestrians' age groups, in particular the groups between 16 and 55 years, is almost undistinguishable. However, the young and the elderly appeared to be the smallest group among Beijing pedestrians.

Compared with another study of nonmotorized transport (NMT) in another major Chinese city (Shanghai) on the demographic characteristics of bicycle users (2), there was a slight difference in the female-male users ratio. It was known that male bicyclists in Shanghai outnumbered women by 20 percent (60 versus 40 percent). Perhaps Chinese men are more active in riding bicycles than women but not in walking. Nevertheless, compared with their income and educational background, the studies of the two cities did not indicate any distinction, as indicated in Table 4. Beijing pedestrians are also quite well educated: 95.7 percent (94.7 percent in Shanghai) of the total pedestrians interviewed received at least a middle school education, and 28.2 percent hold bachelor's degrees. Thus, NMT in China is used by all citizens regardless of educational background.

Considering the monthly income of all pedestrians interviewed in Beijing, it is seen clearly from Table 4 that the majority of the Beijing pedestrians earned less than 300 yuan (U.S. $66) per month, represented by 83.2 percent of the total respondents. Although 77.2 percent of the Shanghai bicyclists interviewed earned

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TABLE 1 Questionnaire Survey Sites

Locations of Survey Sites	No.	No. of Forms Distributed	No. of Returns	Respond Rates	No. of Effective Forms	Effective Rates
Factory	17	400	264	66.0%	193	73.1%
Government Office	20	400	279	69.8%	248	88.9%
Private Company	6	60	35	58.3%	16	45.7%
University	3	120	87	72.5%	72	82.8%
School	6	120	101	84.2%	90	89.1%
Hospital	2	50	34	68.0%	21	61.8%
Department Store	4	50	36	72.0%	18	50.0%
Residential Area	5	230	223	97.0%	212	95.1%
Survey Site	7	70	67	95.7%	60	89.6%
Total	70	1,500	1,126	75.1%	930	82.6%

less than 300 yuan, most (71.2 percent) earned between 100 and 300 yuan (U.S. $22 to 66). Only 56.5 percent of the Beijing pedestrians earned between 100 and 300 yuan, and the other 26.7 percent received less than 100 yuan per month. Nonetheless, according to the official statistics (*3*), the average annual income of Beijing citizens in 1991 was 2,877 yuan, or 240 yuan per month. Because of the low income of the people and the government's restrictive policies on the use of automobiles, NMT in China will probably remain as a significant means of transportation in the country.

WALKING CHARACTERISTICS IN BEIJING

To reinforce other studies' findings on the vital role of walking trips in China, this study also inquired about the trip purposes and average walking time of Beijing pedestrians. It was known that various types of trip were completed through walking. In many Western countries walking is used mainly for recreation, exercise, or commuting to and from transit stations. In Beijing, however, Chinese pedestrians walk not only to transit stations (15.1 percent) and for recreational activities (9.8 percent), but also to work (22.7

TABLE 2 Descriptions and Dimensions of Selected Signalized Crossings

Name of Site	Description	Length of Crossing, meter	Allocated Crossing Time, seconds
Xidan Intersection	1) Located on Changan Street which is one of the important arterial roads in Beijing 2) Close to Xidan CBD 3) Medians with 0.5 m. height fence at the center of the road 4) More vehicles with relatively high speed	37.8	Average Green Time: 32 Average Red Time: 68
Dongsi Intersection	1) Located in Dongsi commercial area 2) Medians with 0.5 m. height fence at the center of the road 3) Residential areas nearby 4) Moderate vehicles with relatively low speed	22.08	Average Green Time: 32 Average Red Time: 75

TABLE 3 Distribution of Pedestrians in Beijing and Cyclists in Shanghai by Age and Gender

		Age Groups (Years)								Total
		<15	16-20	21-25	26-35	36-45	46-55	56-65	>65	
Male	Beijing	36 41.9%	64 41.6%	69 52.7%	86 42.0%	64 44.8%	80 54.4%	23 50.0%	11 61.1%	433 46.6%
	Shanghai	17 68.0%	59 59.0%	132 53.2%	403 55.5%	561 58.4%	215 63.4%	166 86.9%	16 69.6%	1,569 60.0%
Female	Beijing	50 58.1%	90 58.4%	62 47.3%	119 58.0%	79 55.2%	67 45.6%	23 50.0%	7 38.9%	497 53.4%
	Shanghai	8 32.0%	41 41.0%	116 46.8%	323 44.5%	400 41.6%	124 36.6%	25 13.1%	7 30.4%	1,044 40.0%
Total	Beijing	86 9.2%	154 16.6%	131 14.1%	205 22.1%	143 15.4%	147 15.8%	46 4.9%	18 1.9%	930 100.0%
	Shanghai	25 1.0%	100 3.8%	248 9.5%	726 27.8%	961 36.8%	339 13.0%	191 7.3%	23 0.9%	2,613 100.0%

percent), school (15.2 percent), and, surprisingly, to shop (22.8 percent). These three trip purposes accounted for nearly 61 percent of the total responses, reflecting the vital role of walking in Beijing. Moreover, considering the walking time and the trip purposes as shown in Table 5, even though nearly 60 percent of the interviewees responded that they walk fewer than 20 min, still a considerable amount of pedestrians walked more than 30 min not only to work or to school but to shop as well. In fact, about 19 percent of those pedestrians who went shopping must spend at least 45 min walking, as shown in Table 5.

Considering the walking time by gender as shown in Table 6, the findings clearly revealed that walking in Beijing is influenced neither by gender nor by walking time. Unlike the riding time of bicyclists in Shanghai (*2*) as shown in Table 6, which indicated the declining trends of the female riders toward the longer trips, Beijing female pedestrians place less concern on their walking distances. The same trends, in which women slightly outnumber men, can be noticed on any walking time except for the range of 21 to 30 min, as shown in Table 6. Furthermore, considering the average walking time among various age groups of Beijing pedestrians, results also revealed that walking time has no effect on any age group. Regardless of their ages—young, adult, or even elderly—they all walk with about the same average walking time, as shown in Table 7. Moreover, when questioned about their maximum tolerable walking time, most age groups reflected the same endurance—they could walk for an average of 36.5 min. However, the elderly (older than 65) could tolerate only 26.7 min of walking time, but the young generation (under 20) could manage up to 41 min of walking.

The ability of Chinese pedestrians to walk longer distances can be noticed especially if compared with Westerners. Taking into account the average walking time of Beijing pedestrians of 22.5 min and the average walking speed of 73 m/min found in other Asian countries (*4,5*), the average walking distance of the Chinese would be 1,643 m. This average walking distance is much longer than that of their Western counterparts. The average walking distances of New Yorkers and Calgary citizens were 523 and 335 m, respectively (*6*). Not only do the Chinese spend more time walking than Westerners, but even compared with one of their Asian counterparts, they also walk much longer distances. In Riyadh, Saudi Arabia, for example, the average walking distance was found to be only 859 m (*7*). The endurance of the Chinese reflects not only the versatile roles of walking in China but also a significant means of NMT in the country.

ATTITUDES TOWARD CROSSING FACILITIES

Like other developing countries, discipline in crossing the roads according to law is not generally observed in Beijing. Pedestrians normally must be forced to use the crossing facilities by law enforcers or through some barriers. However, it would be appropriate to verify the legitimacy of this statement, so this study employed the pedestrian volume counts at two signalized crossings, namely, Dongsi and Xidan. These two crossings are located in bustling areas (detailed descriptions can be found in Table 2). Results of the volume surveys indicated that there is a considerable number of pedestrians who crossed the roads illegally—particularly at the Xidan crossing. (Illegal crossings are defined in this study as crossing the road during the red signal.) During the 3-hr observation period, approximately 30 percent were illegal crossings at the Dongsi crossing and 43 percent were illegal at the Xidan crossing, as presented in Table 8. The high percentages of illegal crossings reflect the impatience of pedestrians and perhaps the lack of effective enforcement.

Despite the shorter red time of 68 sec regulated at the Xidan crossing compared with 75 sec at Dongsi, a still higher percentage of illegal crossings was noticed at Xidan. This may be because more pedestrians were using the Xidan crossing and they became more daring to cross illegally as the group grew. Therefore, it is imperative to impose strict law enforcement and to provide information on how to use the roadway facilities properly. Doing so

TABLE 4 Comparison of Monthly Income and Level of Education of Pedestrians in Beijing and Cyclists in Shanghai

Education Level		Monthly Income (Yuan)																Total	
		<100		100 - 200		201 - 300		301 - 400		401 - 500		501 - 600		601 - 750		751 - 900		>900			
P.S.	B	20	8.1%	5	2.5%	6	1.8%	9	7.8%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	40	4.3%
	S	3	1.9%	26	3.3%	15	1.4%	10	2.6%	2	2.7%	7	9.9%	0	0.0%	5	16.1%	0	0.0%	68	2.6%
M.S	B	110	44.4%	77	38.9%	119	36.4%	37	32.2%	6	26.1%	2	50.0%	1	20.0%	3	60.0%	2	40.0%	357	38.4%
	S	52	33.3%	218	27.3%	243	23.1%	101	26.7%	17	22.7%	11	15.5%	7	23.3%	7	22.6%	1	33.3%	657	25.3%
H.M	B	72	29.0%	55	27.8%	94	28.7%	34	29.6%	3	13.0%	1	25.0%	1	20.0%	1	20.0%	1	20.0%	262	28.2%
	S	42	26.9%	294	36.8%	429	40.7%	128	33.9%	28	37.3%	23	32.4%	5	16.7%	8	25.8%	1	33.3%	958	36.9%
B.D	B	41	16.5%	52	26.3%	99	30.3%	30	26.1%	8	34.8%	1	25.0%	2	40.0%	1	20.0%	1	20.0%	235	25.3%
	S	57	36.5%	232	29.0%	344	32.6%	117	31.0%	24	32.0%	22	31.0%	17	56.7%	10	32.3%	0	0.0%	823	31.7%
A.B.D	B	1	0.4%	7	3.5%	8	2.4%	4	3.5%	6	26.1%	0	0.0%	1	20.0%	0	0.0%	0	0.0%	27	2.9%
	S	0	0.0%	26	3.3%	21	2.0%	22	5.8%	4	5.3%	7	9.9%	1	3.3%	1	3.2%	1	33.3%	83	3.2%
O	B	4	1.6%	2	1.0%	1	0.3%	1	0.9%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	20.0%	9	1.0%
	S	2	1.3%	3	0.4%	2	0.2%	0	0.0%	0	0.0%	1	1.4%	0	0.0%	0	0.0%	0	0.0%	8	0.3%
Total	B	248	26.7%	198	21.3%	327	35.2%	115	12.4%	23	2.5%	4	0.4%	5	0.5%	5	0.5%	5	0.5%	930	100.0%
	S	156	6.0%	799	30.8%	1054	40.6%	378	14.6%	75	2.9%	71	2.7%	30	1.2%	31	1.2%	3	0.1%	2597	100.0%

Legend :

P.S. - Primary School
M.S. - Middle School
H.M.S. - High Middle School
B.D. - Bachelor's Degree
A.B.D. - Above Bachelor's Degree
O - Others
B - Beijing
S - Shanghai

TABLE 5 Trip Purposes and Walking Time of Beijing Pedestrians

Walking Purposes	Average Walking Time, Min.								Total
	1-5	6-10	11-15	16-20	21-25	26-30	31-45	>45	
Work	9 4.3%	33 15.6%	44 20.9%	36 17.1%	20 9.5%	28 13.3%	22 10.4%	19 9.0%	211 22.7%
School	8 5.7%	14 9.9%	29 20.6%	25 17.7%	21 14.9%	20 14.2%	10 7.1%	14 9.9%	141 15.2%
Shopping	6 2.8%	26 12.3%	32 15.1%	36 17.0%	18 8.5%	24 11.3%	30 14.2%	40 18.9%	212 22.8%
Business	1 8.3%	1 8.3%	0 0.0%	2 16.7%	2 16.7%	1 8.3%	2 16.7%	3 25.0%	12 1.3%
To/Fr Transit Stations	9 6.4%	30 21.4%	29 20.7%	26 18.6%	9 6.4%	15 10.7%	7 5.0%	15 10.7%	140 15.1%
Returning Home	2 6.9%	7 24.1%	3 10.3%	4 13.8%	3 10.3%	4 13.8%	4 13.8%	2 6.9%	29 3.1%
Recreation	1 1.1%	4 4.4%	11 12.1%	11 12.1%	11 12.1%	17 18.7%	13 14.3%	23 25.3%	91 9.8%
Social Activity	1 3.7%	4 14.8%	5 18.5%	6 22.2%	2 7.4%	1 3.7%	2 7.4%	6 22.2%	27 2.9%
Others	5 7.5%	18 26.9%	13 19.4%	9 13.4%	3 4.5%	5 7.5%	4 6.0%	10 14.9%	67 7.2%
Total	42 4.5%	137 14.7%	166 17.8%	155 16.7%	89 9.6%	115 12.4%	94 10.1%	132 14.2%	930 100.0%

not only will ensure the safety of the pedestrians but may promote greater use of NMT in Beijing.

In addition to those crossing the road illegally at the designated crosswalks, some may totally ignore the crossing facilities and cross the roads where they wish. It is necessary to identify their reasons for not using such crossing facilities. One reason could be the insufficiency of crossing facilities. According to the *Beijing Statistics Year Book* (*3*), in 1991 there were 1,818 crossing facilities in Beijing, including 1,287 zebra crossings, 371 signalized crossings, 53 overpasses, and 107 underpasses. Although it is not the intention of this paper to verify whether these 1,818 crossing facilities are adequate to handle 10 million Beijing pedestrians, 52.7 percent of the pedestrians interviewed stated that crossing facilities in Beijing are not adequate, as given in Table 9. Only 10.2 percent agreed that there are enough crossing facilities; the other 37.1 percent could not decide. Despite the higher number of signalized crossings than of overpasses and underpasses combined, pedestrians still preferred to have more signalized crossings, according to 34.5 percent of the total respondents (Table 9). Pedestrians also demanded other types of crossing facilities but selected the zebra crossing as their last choice, according to only 15.3 percent of the respondents. Further analyses about the adequacy of each type of crossing facility also revealed similar results, as indicated in Table 9. Those who claimed that crossing facilities in Beijing are inadequate ranked signalized crossings as their first choice.

The main reason that more people preferred signalized crossings may be convenience and faster crossing compared with the overpasses and underpasses, which require ascending and descending movements. This hypothesis is further reinforced by the findings on the willingness of pedestrians to use such facilities. Among the three types of crossing facilities, Beijing pedestrians are more willing to use signalized crossings than the other two types (Table 10). About 75 percent of the pedestrians interviewed were willing to use signalized crossings, whereas only 50.7 percent and 52.5 percent expressed their willingness to use overpasses and underpasses, respectively.

In addition to the insufficient number of crossing facilities, it is more appropriate to identify other reasons that Beijing pedestrians ignored the crossing facilities. Those pedestrians who exhibited their unwillingness to use the crossing facilities were asked to state their reasons for refusal. For signalized crossings, they complained mainly about the location of the crossing ("too far away to use") and the long waiting time to cross the streets. These two reasons accounted for 60 percent (Table 11). Sixteen percent expressed that the crossing time is inadequate, and another 15 percent did not appreciate having to cross the roads in a hurry. These two reasons prompted them to avoid using the signalized crossings. Judging from these two comments, along with the previously mentioned complaints about crossing lengths of the two selected signalized crossings, these complaints should not be totally overlooked. Although the crossing length of the selected signalized crossing at

TABLE 6 Walking Time of Beijing Pedestrians and Riding Time of Shanghai Bicyclists by Gender

Beijing Pedestrians									
	Average Walking Time, min.								Total
	1-5	6-10	11-15	16-20	21-25	26-30	31-45	>45	
Male	19 45.2%	65 47.4%	71 42.8%	64 41.3%	46 51.7%	66 57.4%	41 43.6%	61 46.2%	433 46.6%
Female	23 54.8%	72 52.6%	95 57.2%	91 58.7%	43 48.3%	49 42.6%	53 56.4%	71 53.8%	497 53.4%
Total	42 4.5%	137 14.7%	166 17.8%	155 16.7%	89 9.6%	115 12.4%	94 10.1%	132 14.2%	930 100.0%
Shanghai Cyclists									
	Average Riding Time, min.								Total
	1-5	6-10	11-15	16-20	21-25	26-30	31-45	>45	
Male	16 43.2%	121 55.8%	198 51.8%	279 53.8%	208 61.5%	255 60.4%	229 68.2%	255 73.5%	1,561 60.1%
Female	21 56.8%	96 44.2%	184 48.2%	240 46.2%	130 38.5%	167 39.6%	107 31.8%	92 26.5%	1,037 39.9%
Total	37 1.4%	217 8.4%	382 14.7%	519 20.0%	338 13.0%	422 16.2%	336 12.9%	347 13.4%	2,598 100.0%

TABLE 7 Average Walking Time and Maximum Tolerable Walking Time by Age in Beijing

Age	Average Walking Time (Min.)	Max. Tolerable Walking Time (Min.)
<15	19.62	38.84
16-20	23.98	41.04
21-25	21.92	35.80
26-35	21.13	35.10
36-45	22.63	35.14
46-55	24.33	35.68
56-65	24.35	35.22
>65	22.62	26.67
Average	22.5	36.5

TABLE 8 Number of Illegal Crossings During Red Time Signal

Survey Time	No. of Pedestrians (pedestrians/hour)					
	Dongsi Signalized Crossing			Xidan Signalized Crossing		
	Legal	Illegal	Total	Legal	Illegal	Total
2:00 - 3:00 P.M.	1,233 70.1%	527 29.9%	1,760 29.6%	1,879 54.3%	1,579 45.7%	3,458 30.8%
3:00 - 4:00 P.M.	1,417 69.7%	616 30.3%	2,033 34.2%	2,152 57.8%	1,572 42.2%	3,724 33.2%
4:00 - 5:00 P.M.	1,527 70.9%	627 29.1%	2,154 36.2%	2,351 58.2%	1,686 41.8%	4,037 36.0%
Total	4,177 70.2%	1,770 29.8%	5,947 100.0%	6,382 56.9%	4,837 43.1%	11,219 100.0%

TABLE 9 Attitudes Toward Crossing Facilities

Crossing Facilities	Attitudes Toward the Sufficiency			Total
	Enough	Not Enough	Not so Sure	
Zebra Crossing	20 21.0%	72 14.7%	50 14.5%	142 15.3%
Signalized Crossing	22 23.2%	168 34.3%	131 38.0%	321 34.5%
Overpass	22 23.2%	120 24.5%	67 19.4%	209 22.5%
Underpass	31 32.6%	130 26.5%	97 28.1%	258 27.7%
Total	95 10.2%	490 52.7%	345 37.1%	930 100.0%

TABLE 10 Willingness To Use Crossing Facilities

Type of Crossing	Willingness to Use the Facility		Total
	Yes	No	
Signalized Crossing	697 74.9%	233 25.1%	930 100.0%
Overpass	471 50.7%	459 49.3%	930 100.0%
Underpass	488 52.5%	442 47.5%	930 100.0%

TABLE 11 Reasons for Unwillingness To Use Crossing Facilities by Gender

Reasons for their Unwillingness to Use the Crossing Facilities		Signalized Crossing			Overpass			Underpass		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
Common Factors	Too far away to use	32 45.7%	38 54.3%	70 30.0%	52 55.9%	41 44.1%	93 20.3%	35 47.9%	38 52.1%	73 16.5%
	Too crowded	11 52.4%	10 47.6%	21 9.0%	10 55.6%	8 44.4%	18 3.9%	7 63.6%	4 36.4%	11 2.5%
Specified Factors	The stairway is too steep	-	-	-	4 36.4%	7 63.6%	11 2.4%	3 33.3%	6 66.7%	9 2.0%
	Too tired to walk up and down	-	-	-	110 38.1%	179 61.9%	289 63.0%	61 37.4%	102 62.6%	163 36.9%
	Inconvenience to use	-	-	-	23 47.9%	25 52.1%	48 10.4%	1 50.0%	1 50.0%	2 0.5%
	Need to wait for red time	36 51.4%	34 48.6%	70 30.0%	-	-	-	-	-	-
	Crossing time is inadequate	16 43.2%	21 56.8%	37 16.0%	-	-	-	-	-	-
	Must cross in a hurry	16 45.7%	19 54.3%	35 15.0%	-	-	-	-	-	-
	Fear of Criminal	-	-	-	-	-	-	5 13.9%	31 86.1%	36 8.1%
	Bad Ventilation, Lighting and Cleaning	-	-	-	-	-	-	60 40.5%	88 59.5%	148 33.5%
Total		111 47.6%	122 52.4%	233 100.0%	199 43.4%	260 56.6%	459 100.0%	172 38.9%	270 61.1%	442 100.0%

Xidan intersection is longer than the Dongsi crossing (37.8 versus 22.08 m), their allowable crossing (green) time was 32 sec each. One may wonder why these two crossings had identical crossing times when their crossing lengths differed. Perhaps the authorities should pay more attention to designing the appropriate crossing time for pedestrians. This would not only ensure the safety and convenience in crossing but also would boost the confidence among pedestrians.

Among those who disliked using the overpasses, nearly two-thirds (63 percent) expressed their reasons about the ascending and descending movements required ("too tired to walk up and down"). Another 20.3 percent also complained about the location of the overpasses. These complaints, however, were not expressed strongly by those who disapproved of the underpasses. Instead, they were concerned about the conditions of the underpasses—in particular the ventilation, lighting, and hygienic conditions—as responded by 33.5 percent. Nevertheless, still another 36.9 percent complained about the ascending and descending movements needed. Only 8.1 percent were concerned about the safety aspects, particularly the criminal risks involved. This could perhaps reflect either the low crime rate in Beijing, the fact that only a few criminal cases occurred in the underpasses, or both.

With respect to the gender of those who disapproved of the crossing facilities, as shown in Table 11, it can be clearly seen that female and male pedestrians voiced different opinions especially about the overpasses and underpasses. Men are generally stronger physically, therefore fewer male pedestrians complained about the ascending and descending movements compared with their female counterparts. On the contrary, women were more concerned than men about their safety in using the underpasses. Nonetheless, despite the differing viewpoints, their comments should not be totally overlooked, particularly those involving the safety aspects. After all, it is a policy to encourage pedestrians to cross the roads properly as walking will perhaps continue to remain one of the major means of commuting in Beijing. Would it not be worthwhile to provide appropriate and sufficient crossing facilities that would not only minimize the accident rates but also ensure public confidence in using such facilities?

To provide further information about the preference of Beijing pedestrians toward each type of crossing facility, pedestrians were asked to rate the five given attributes of each crossing facility: convenience in crossing, safety, faster crossing time, condition of supporting facilities (lighting, cleanliness, etc.), and appearance (architectural design and compatibility with the environment). Pedestrians were requested to rate those attributes on a scale of 1 to 6, with 1 representing very poor conditions and 6, excellent conditions. Results of the analyses (Table 12) revealed that pedestrians respond differently to the attributes of each crossing facility. In other words, these three types of crossing facilities were graded differently depending on each attribute. As far as the convenience in crossing and crossing time, signalized crossings ranked first in both categories because no ascending or descending movements were required, followed by underpasses and overpasses, respectively. However, with regard to the safety aspect, Beijing pedestrians selected the overpasses and underpasses to be far superior to the signalized crossings. This expected result is obvious because this method involves fewer risks in crossing the roads. Although the weighted averages of both overpasses and underpasses were almost even (4.57 versus 4.47), overpasses are relatively superior because some pedestrians may fear the criminal risks involved in using the underpasses. For the remaining two attributes, supporting facilities and appearance, Beijing pedestrians also ranked overpasses and underpasses ahead of signalized crossings.

A consideration of all these five attributes together and the assumption that each carries the same weighted average suggest that underpasses (3.54) and overpasses (3.53) would be slightly superior to signalized crossings (3.42). Judging from these results and the previous findings on pedestrians' unwillingness to use the crossing facilities, one may conclude that unless safety is improved, Beijing pedestrians will not favor any type of crossing in particular. In other words, they would accept any type of crossing facility as long as the facility is appropriate and sufficient.

ACCIDENTS INVOLVING PEDESTRIANS

Even though there were fewer pedestrian casualties (83 victims) and only 374 injuries reported in Beijing in 1988 the safety of pedestrians in using the crossing facilities cannot be ignored. As

TABLE 12 Weighted Average of Each Crossing Facility in Beijing

Attributes	Type of Crossing Facilities		
	Signalized Crossing	Overpass	Underpass
Convenience in Using	3.85	3.23	3.34
Safety Aspect	3.50	4.57	4.47
Faster Crossing Time	3.55	3.01	3.13
Conditions of Supporting Facilities	3.09	3.18	3.16
Appearance	3.13	3.64	3.61

Note: 1 means "very poor" and 6 being "excellent".

TABLE 13 Frequency of Accidents from Crossing

Crossing Frequency	Accident Experienced				Total	
	Have		Have Not			
	No.	%	No.	%	No.	%
1 time or less	1	0.8%	127	99.2%	128	13.7%
2 times	4	2.2%	176	97.8%	180	19.4%
3 times	7	6.5%	101	93.5%	108	11.6%
4 times	14	7.8%	166	92.2%	180	19.4%
5 times	14	17.5%	66	82.5%	80	8.6%
At least 6 times	60	23.6%	194	76.4%	254	27.3%
Total	100	10.8%	830	89.2%	930	100.0%

such, Beijing pedestrians were questioned directly about their opinions of the safety aspects. Among the five provided opinions on safety, pedestrians responded positively: 90.3 percent of the respondents mentioned that walking in Beijing is either safe (46.5 percent) or not safe, but not dangerous either (43.8 percent). On the other hand, Shanghai residents had less faith in riding their bicycles, as only 7.4 percent claimed that riding bicycles is safe and another 64 percent responded that it is not safe, but not dangerous either for the same five given opinions. Nevertheless, it would be unfair to conclude that walking in Beijing is safer than riding bicycles in Shanghai. Among those who experienced accidents in these two cities, similar percentages of these victims were noticed (10.8 percent in Beijing and 11.6 percent in Shanghai). However, despite the low number of victims in both cities, the safety aspect of these two NMT modes cannot be overlooked.

Further consideration of those who experienced accidents by crossing frequency and by age showed that those pedestrians who need to cross the roads very often are more likely to experience accidents (Table 13). Among those pedestrians who must cross the roads at least six times a day, nearly 25 percent had experienced an accident compared with only 1 percent of those who cross once a day. On the other hand, among those pedestrians who experienced an accident in Beijing, teenagers (16 to 20 years old) appeared to be the most reckless group in crossing the roads compared with other age groups. However, as they grow older, they became more aware of the danger involved, reflected by the decreasing trend in accidents, as shown in Table 14. Among those pedestrians who are 15 years of age or younger, only 8 percent experienced accidents. These youngsters normally were primary school students. They were often requested to cross the roads as

TABLE 14 Frequency of Accidents by Age Group

Age Groups (Years)	Accident Experienced				Total	
	Have		Have Not			
	No.	%	No.	%	No.	%
<15	7	8.1%	79	91.9%	86	9.2%
16 - 20	28	18.2%	126	81.8%	154	16.6%
21 - 25	16	12.2%	115	87.8%	131	14.1%
26 - 35	22	10.7%	183	89.3%	205	22.1%
36 - 45	14	9.8%	129	90.2%	143	15.4%
46 - 55	11	7.5%	136	92.5%	147	15.8%
56 - 65	2	4.3%	44	95.7%	46	4.9%
>65	0	0.0%	18	100.0%	18	1.9%
Total	100	10.8%	830	89.2%	930	100.0%

a group where they can help guide each other in abiding by the traffic regulations. This reflects the importance in having proper knowledge to educate the pedestrians.

CONCLUSION AND RECOMMENDATIONS

One can never deny the vital role of NMT, particularly of bicycles and walking, in providing mobility to all citizens in China. Findings of this study revealed that walking serves many purposes in Beijing and is being widely used for commuting by the populace irrespective of gender and age. However, despite the significant role of walking in Beijing, a number of pedestrians ignored crossing the roads according to the laws. Many pedestrians intentionally cross the roads illegally. There were numerous reasons for their unwillingness to use the crossing facilities: some complained about the inadequacy of the crossing facilities, others worried about their safety and had to rush when crossing, some disliked the ascending and descending movements, some disapproved of the locations of the crossing facilities, and so on. Even though Beijing pedestrians were less enthusiastic about using the overpasses and underpasses than they were about using the signalized crossings, mainly because of the ascending and descending movements required, when appraising the safety aspects and other related attributes, these pedestrians did not favor any type of crossing in particular. In other words, Beijing pedestrians will accept any type of crossing facility as long as it is sufficient and appropriate.

As long as the government encourages the Chinese to continue commuting through walking, then certain recommendations may require attention. First, crossing time at all signalized crossings should be examined to be compatible with the crossing lengths and average walking speed of the Chinese pedestrians. Moreover, local commuters' average walking speed should also be used in designing the crossing time in Beijing.

Second, to ensure a proper crossing attitude that could help maximize the safety of pedestrians, immediate measures may be required, such as strict law enforcement and physical barriers. On the other hand, it is essential to provide proper knowledge to road users, particularly pedestrians, on how to use the roads properly and according to the law.

Currently, the government is imposing penalties on those pedestrians who violate the regulations. Each violation penalty fee is 1 to 5 yuan. This measure appears to be effective when there are adequate enforcers. However, as mentioned earlier, in reality pedestrians were still found to cross the roads illegally. Instead of the penalty tactic, would it be worthwhile considering another tactic, such as the incentive approach? For example, those pedestrians who have not had a violation in a specified period would receive a certificate of appreciation. This certification would be presented when seeking employment, or for deductions in medical fees, or perhaps to receive extra benefits in other social areas. Although this incentive approach seems to be better in theory than in practice, especially considering the Beijing population of 10 million, would it be worthwhile to scrutinize this tactic in detail if other measures failed to provide the satisfactory results?

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