On-Street Pedestrian Surveys of Pedestrian Crossing Treatments

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ABSTRACT

On-street pedestrian surveys were used to obtain the perspectives of pedestrians with regards to their experiences and needs at pedestrian crossing locations. Seven sites with five different treatments were ultimately selected for study. These treatments consisted of two marked crosswalk treatments, an in-roadway warning light treatment, a Hawk treatment, two Split Midblock Signal treatments, and a countdown pedestrian signal treatment at a signalized intersection. The survey was administered at the selected locations where pedestrians could be approached after they crossed at the study site. It was found through this study that as the control at a pedestrian crossing increases through the addition of signs, flashing lights, and/or signals, the pedestrians' perception of safety also increases. Based on the responses of the survey participants, the factors that have the greatest influence on the pedestrian responses were: traffic volume, turning traffic, presence of disabled pedestrians, traffic speed, and the availability of an alternate crossing. The unpredictability of drivers remains the number one concern to the pedestrians no matter what type of pedestrian treatment is utilized. Even at highly controlled crossings where all traffic is required to stop, determining whether a vehicle will obey the signal is one of the major concerns of the pedestrians surveyed. Also, the perception of a pedestrian can be greatly influenced based on their own abilities.

BACKGROUND

On-street pedestrian surveys were used to obtain the perspectives of pedestrians with regards to their experiences and needs at pedestrian crossing locations. A large sampling of crossing sites was identified from phone interviews and on-site visits. Seven sites with five different treatments were ultimately selected for study. Sites were selected based on pedestrian traffic volumes, pedestrian crossing treatment, and roadway characteristics. The selected sites reflected a wide range of crossing treatments in order to obtain greater perspective of pedestrian experiences.

The five treatments included in the study were two marked crosswalk treatments, an in-roadway warning light treatment, a Hawk treatment, two Split Midblock Signal treatments, and a countdown pedestrian signal treatment at a signalized intersection. Table 1 lists the selected sites, where they were located, and a summary of key characteristics of the site.

SURVEY DESIGN

The on-street pedestrian survey was divided into three different sections. The first section was to obtain pedestrians' opinions of the crossing treatment. The second section asked general questions for demographic purposes only. The questions used were:

Section 1

1. On a scale of 1 to 5 (with 1 being very safe and 5 not safe) how safe did you feel crossing this street?
2. Is there anything at this street crossing that was confusing or that you had a hard time understanding? If yes, explain.

TABLE 1 Treatment Characteristics

Site #	Site Location	Pedestrian Treatment	Number of Lanes	Median Present	Distance to Nearest Signalized Intersection
1	Austin, TX	Marked Crosswalk	Four	TWLTL	200 ft (61 m)
2	Tucson, AZ	Marked Crosswalk	Six	Raised	600 ft (183 m)
3	Austin, TX	In-Roadway Warning Lights	Four	Raised	550 ft (168 m)
4	Tucson, AZ	Hawk	Four	Raised	1000 ft (305 m)
5	Tucson, AZ	Split Midblock Signal	Six	Raised	3200 ft (975 m)
6	Tucson, AZ	Split Midblock Signal	Six	Raised	950 ft (290 m)
7	Lauderdale by the Sea, FL	Countdown Display at Signalized Intersection	Two and Four	None and Raised	Not Applicable

3. What is the maximum amount of time a person should have to wait to cross this street? <30 sec, <1 min, <2 min, <3 min
4. Do you think this (name of crosswalk treatment) is safe and effective? Why or why not?
5. Is there any thing else that could be added to improve the safety of this street crossing? If yes, explain.
6. (If at an uncontrolled crossing) If this crossing was not here, would you walk to that next intersection (point to intersection of interest)? Why or why not?

Section 2

7. Did your trip today start with a bus ride, car or walking?
8. In a typical week, how many times do you cross the street at this location?
9. How many streets do you cross in a typical day? 1 to 5, 6 to 10, 11 to 15, 16 to 20
10. Do you have a current driver's license? Yes No
11. Do you consider yourself to be visually disabled/impaired? Yes No
12. Is your age category between: 21-40 41-55 56-64 65+

The third section consisted of recording several demographic characteristics that were observed only for comparison purposes. These observations included the pedestrian's gender and ethnicity, observed disabilities, and whether the pedestrians walking speed was affected. In addition, researchers observed the crossing behavior of the pedestrian at the study location to record if they used the designated crossing, jaywalked, crossed at a near-by intersection, or did something else.

A tally was also kept of those pedestrians refusing to participant in the survey and why. Reasons given for refusing the survey included that they did not speak English, were in a hurry, or simply preferred not to participate. This information was recorded to determine the level of participation at each location.

SURVEY PROTOCOL

The survey was administered at the selected locations where pedestrians could be approached after they crossed at the study site. The potential participants were approached and asked if they would be willing to complete a survey about pedestrian crossings that would take about five minutes. If willing to participate, the surveyor would read the questions to the participant and record their responses. Upon completion of the survey, the researcher would record the observational data on the survey form.

At each site, the researchers interviewed at least 40 pedestrians to obtain their opinions on the pedestrian crossing treatment. Between 4 and 12 hours were spent at each site. Typically between 75 and 90 percent of those approached would participate; however, at one location, only about half of those asked agreed to answer the questions. Each site had between 40 and 44 completed surveys for the evaluation.

PEDESTRIAN CROSSING TREATMENT DESCRIPTIONS

Marked Crosswalk Treatment

Two marked crosswalk treatment sites were selected (See figure 1). They consisted of high visibility, laddle-syle pavement markings on the roadway to delineate the crossing area. Pedestrian crossing warning signs were present and faced in each direction.

Site 1 was a two-way, four lane roadway with a two-way left turn lane (TWLTL). The posted speed limit was 35 mph (56 km/hr) and the crosswalk was located about 200 ft (61 m) from a signalized intersection (see Figure 1a). There were transit stops on both sides of the street with benches and bus shelters. Figure 1b shows the location that a pedestrian would cross to the transit stop if crossing the road at the bus stop. The nearby land use consisted of a grocery store, a strip mall, an elementary school, and a medical building. The population surveyed consisted of transit-dependent individuals, disabled pedestrians, and college students.

Site 2 was a six-lane roadway with a raised median and left-turn bays in each direction (see Figure 1c). The posted speed limit was 35 mph (56 km/h) and the marked crossing was about 600 ft (183 m) from a signalized intersection. Transit stops were located on both sides of the major street, however the transit stop located on the south side is located approximately 150 feet (46 m) from the crossing in front of a strip mall, while the transit stop on the north side was about 400 feet (122 m) from the crosswalk. Site 2 was in a commercial area with nearby residential neighborhoods (see Figure 1d). The pedestrian population was primarily local residents who were utilizing the transit system.

(a) Site 1

(b) Site 1

(c) Site 2

(d) Site 2

FIGURE 1 Marked Crosswalk Treatments at Sites 1 and 2.

In-Roadway Warning Lights Treatment

Site 3 had pedestrian-activated in-roadway warning lights, diagonal (zebra) pavement markings, pedestrian crossing warning signs with flashing beacons, and a median refuge island (see Figure 2). This site was located between a large office complex and a parking garage and was primarily used by employees of the large office complex. The roadway at Site 3 had four-lanes with a raised median. The speed limit was 35 mph (56 km/h), and the crosswalk was located midblock.

FIGURE 2 In-Roadway Warning Lights Treatment at Site 3.

Hawk Crossing Treatment

The crosswalk treatment referred to as a “Hawk” is a pedestrian crossing signal that is activated by the pedestrian. Before activation the signal is dark. After activating the signal light progression is: flashing amber ball, solid amber ball, solid red balls, flashing red balls (wig-wag signal heads). The flashing red balls would permit stop and go vehicle operations during the flashing don’t walk interval if no pedestrians are in the crosswalk.

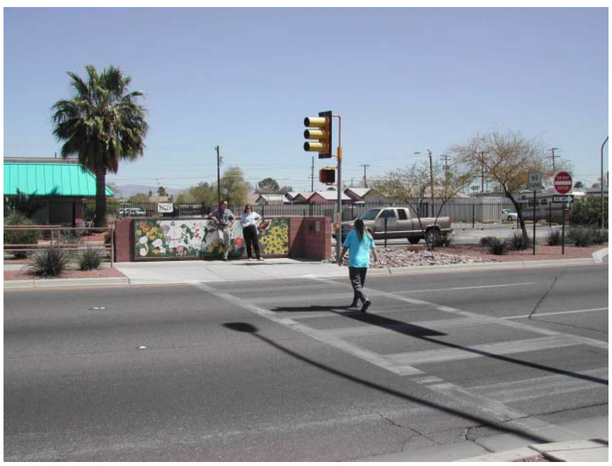
Site 4 was located on four-lane roadway with a two-way left turn lane and a bike lane on each side (see Figure 3). Laddle-style crosswalk markings were present at the crossing. The speed limit was 35 mph (56 km/h), and the pedestrian crossing signal was located at a transit center. As such, the majority of the pedestrian population at this site was transit dependent. With the exception of the transit center and a few small local businesses, the area was predominantly residential.

FIGURE 3 Hawk Treatment at Site 4.

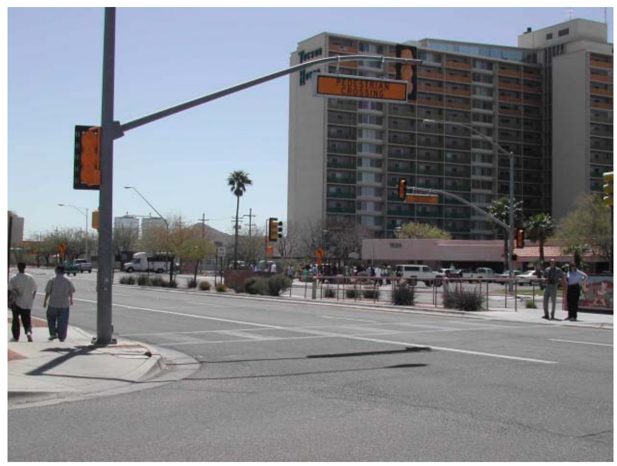
Split Midblock Signal Treatment

The Split Midblock Signal treatment uses a traffic signal configuration where a pedestrian uses a pedestrian signal button to activate the signal and cross the first half of the street, then proceed down a center refuge island approximately 100 feet (31 m) long to push a second pedestrian signal button and activate the second half of the pedestrian traffic signal. This treatment allows the stop time for each direction of traffic to be shorter than if one button activated the entire crossing. If one button activated the entire crossing then the walk indication would need to be timed to allow the pedestrian to cross both directions of traffic. The Split Midblock Signal permits the walk indication to be times uniquely for each direction.

Site 5 was a six-lane divided roadway with a raised center median (see Figure 4a). The speed limit was posted at 40 mph (64 km/h) and curbside transit shelters existed on each side of the roadway. The land use consisted of government supported housing and commercial properties (see Figure 4b). The apartment building provided housing to many disabled and older transit-dependent pedestrians who were surveyed as part of this study.



(a) Site 5



(b) Site 5

(c) Site 6

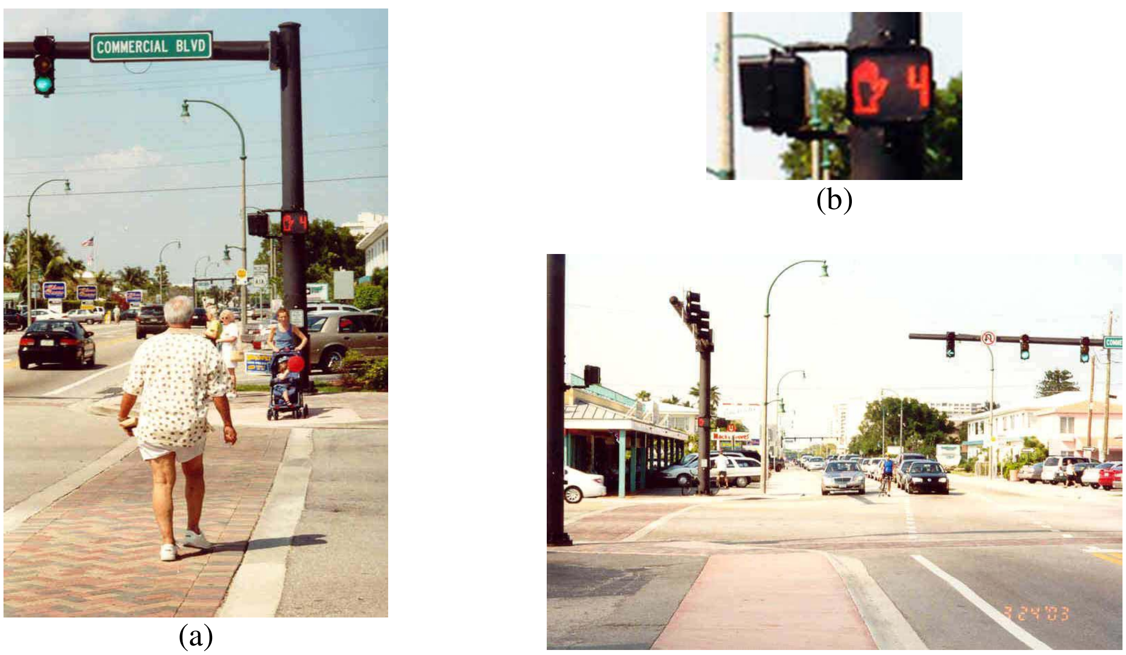
(d) Site 6

FIGURE 4 Split Midblock Signal Crossing at Sites 5 and 6.

Site 6 was a six-lane divided roadway with three lanes in each direction and a raised median (see Figure 4c). The posted speed limit was 35 mph (56 km/h). A transit shelter existed on the southbound side, but the northbound transit shelter was temporarily relocated due to nearby roadway construction that was present while the on-street survey was conducted (see Figure 4d). The pedestrians surveyed consisted largely of medical center employees, as well as visitors to the medical center.

Countdown Display With Signal

Site 7 was a signalized intersection with pedestrian crossing signals on each approach that provided a countdown display. The countdown feature started with the beginning of the flashing don't walk phase. The site was an intersection of a four-lane roadway with a two-lane roadway. The four-lane roadway was divided with a raised median. The minor two lane street widened to four lanes at the intersection to accommodate turns. The survey population was a mix of local residents and tourists. Figure 5a shows one of the crossings. Note the countdown signal shows 4 sec remaining with the flashing hand (enlargement shown in Figure 5b). Figure 5c shows the minor road approach.



(a) (b) (c)

FIGURE 5 Countdown Pedestrian Signal.

FINDINGS

Table 2 summarizes the demographics for the seven sites. The data analysis was categorized based upon the crossing treatment present at the pedestrian interview sites.

Marked Crosswalk

Sites 1 and 2 had treatments that included a marked crosswalk and pedestrian crossing warning signs. The perspective of pedestrians at this type of crossing was that the crossing was unsafe. When asked if they thought the crossing treatment was safe and effective, 85 percent of the Site 2 participants and 66 percent of the Site 1 participants said no. Some of the primary reasons given for not feeling safe were:

- cars do not stop for pedestrians;
- high traffic volume;
- high speed traffic; and
- motorists are not watching for pedestrians.

At Site 1 specifically, it was felt that the location of the crosswalk made it ineffective because it was too far from the bus stop to encourage people to walk to the crossing. This was considered to be especially true since there was no "benefit" to using the crossing without some type of active system to warn drivers to watch for pedestrians.

Pedestrians did feel that this type of crossing treatment was easy for the pedestrian to understand. However, there were comments that the unpredictability of the traffic turning, changing lanes, and/or stopping could make it confusing. When asked if they would add or change the intersection to improve its safety, over 85 percent of the participants at each site indicated that they would. Some of the most common suggestions were:

- add amber flashing warning lights;
- install a pedestrian crossing signal; and
- add advance warning signs.

One simple improvement that was mentioned at both locations was that the faded crosswalks should be repainted to improve their visibility to motorists. At Site 1, additional location specific suggestions included moving the crossing closer to the transit stop and adding a crossing guard (this was influenced by the close proximity of an elementary school).

Finally, pedestrians were asked if they would walk to a nearby signalized intersection if the current crossing was not available. At Site 1, 49 percent said they would. At Site 2, 65 percent said that they would. The most prevalent reason given by the interviewed pedestrians for walking to the next intersection was that it was safer than trying to cross without a crossing treatment. Of those who said they would not go to the next intersection, the typical reasoning was that it was out of their way and too far to walk. However, one interesting finding was that two of the respondents indicated they would rather cross at an uncontrolled midblock location versus a signalized intersection because of the fewer turning movements made by vehicles.

TABLE 2 Demographics for Seven Sites.

Demographic	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7
Number of Completed Surveys	41	40	42	40	40	40	44
Visually Impaired (%)							
Yes	27	0	2	10	85	5	2
No	73	100	98	90	15	95	98
Age Category (%)							
21-40	46	50	50	62	35	58	24
41-55	37	20	40	20	30	20	35
56-64	10	10	10	10	20	12	13
65+	5	20	0	8	15	10	24
Other	2	0	0	0	0	0	4
Gender (%)							
Female	45	45	40	49	38	56	51
Male	55	55	58	51	62	44	44
Not Recorded	0	0	2	2	0	0	5
Ethnicity (%)							
Caucasian	87	53	53	13	60	67	79
Hispanic	13	38	11	83	22	18	14
African American	0	2	23	4	12	0	0
Asian	0	4	9	0	0	11	2
Other	0	4	4	0	4	4	5
Did your trip today start with a bus ride, car, walking or biking? (%)							
Bus	76	33	7	40	78	23	10
Car	7	18	86	20	0	50	45
Walking	17	48	7	38	15	23	45
Bike	0	3	0	3	0	5	0
In a typical week how many times do you cross the street at this location? (frequency)							
Average	6.7	6.5	14.4	8.1	6.9	8.0	17.7
How many streets do you cross in a typical day? (%)							
1 to 5	51	63	86	60	60	63	65
6 to 10	29	20	7	23	15	23	20
11 to 15	12	3	5	10	10	8	5
16 to 20	0	3	0	0	0	3	5
> 20	7	13	2	5	15	3	5
Do you have a current driver's license? (%)							
No	46	43	2	55	67	15	9
Yes	51	57	98	45	33	85	86

In-Roadway Warning Lights

In addition to a marked crosswalk, Site 3 had amber flashing lights on top of the pedestrian crossing warning signs and in the pavement along the crosswalk (see Figure 2). With the addition of the amber warning lights and in-pavement warning lights, pedestrian perception about safety was somewhat higher than if only a marked crosswalk existed. Nevertheless, the answers are still skewed to the negative side with over 60 percent of the participants rating the crossing as unsafe. However, even with the inclusion of so many additional features, pedestrians did not typically find the crossing to be confusing or hard to understand.

When asked if the pedestrian thought that the treatment was safe and effective at this location, the reaction was split with 50 percent responding no, 48 percent responding yes, and 2 percent undecided. Of the respondents who were unsatisfied with the in-pavement warning light treatment, the reasoning given for this response was again typically related to vehicle reactions to the crossing. The pedestrian perception was that the traffic characteristics (speed, volume, and stopping behavior) were unsafe for a pedestrian or that the motorists did not understand that they needed to yield the right of way to pedestrians when the amber lights were flashing. On the positive side, the pedestrians responding yes to this question thought that the lights had helped in stopping traffic and that it was an improvement over the previous crosswalks.

When participants were asked if they would do anything to improve the safety of the crossing, 79 percent responded that they would. Responses to this question brought the following suggestions:

- pedestrian bridge,
- red light in place of the amber,
- greater amount of law enforcement, and
- moving or adding advance warning signs to a further upstream position.

Most respondents (76 percent) were not willing to walk to the next intersection (550 ft [168 m]) as an alternate means of crossing the roadway.

Hawk

Site 4 had a Hawk pedestrian crossing treatment. With this type of a crossing treatment, the survey responses from the pedestrians have again moved towards a more positive perception of safety as the crossing treatment control has increased. At this location, 75 percent of the participants indicated that they felt safe at this crossing. Ninety-eight percent responded that the signal was not hard to understand. Although the general perception of this crossing was that the pedestrians liked the signals because they stopped the traffic, there was still the complaint that the unpredictability of the traffic was a concern (i.e. whether motorists would stop for the signal).

When asked if there was anything that could improve the safety at this crossing location, 50 percent of the people responded yes. The pedestrians felt that the following could improve this crossing's safety:

- a pedestrian bridge,
- longer crossing time (i.e. walk indication), and

- law enforcement for speeding and compliance with signal.

Lastly, the pedestrians were asked if they would walk to the next signalized intersection if this crossing was not available. Seventy-five percent said that they would not go to the next intersection (about 1000 ft [305 m] away) because it was too far out of the way for them to walk. The 25 percent who indicated they would go to the next intersection said they would do so because it is safer and the traffic volume is too high to cross without a signal.

Split Midblock Signal

The traffic control provided at the Split Midblock Signal included a traffic signal along with a pedestrian median refuge island. In this situation, the reactions of the pedestrians at Site 6 were overwhelmingly positive with 78 percent of the pedestrians responding that the crossing is very safe. Site 5 responses were more diverse with an even spread of responses from very safe to unsafe. The researchers feel that the difference of perceptions between these two locations could be largely influenced by the type of pedestrian traffic in the area (see Table 2 for demographics). The feeling of safety is much lower for Site 5 which had an older population and more disabled pedestrians. Although Site 6 is located at the hospital, the pedestrians who were crossing the street were primarily hospital staff and visitors. The older and/or disabled people at this site are typically being dropped off prior to parking due to the long walk required between the parking lot and the hospital entrance.

When the pedestrians were asked if they thought this type of crossing treatment was safe and effective 78 percent at Site 6 and 68 percent at Site 5 responded yes. The comments made by these responders were primarily that they liked having the signal to stop the traffic. Of the respondents who said no, comments were made that not all of the cars stop for the signals. At Site 6, a significant number of both the positive and negative respondents (23 percent) commented that they did not like the median treatment because it took them out of their way to reach the second crossing signal and therefore made the crossing inefficient for pedestrians.

Most pedestrians did not feel that the Split Midblock Signal treatment was hard to understand. Only 15 percent at Site 5 and 20 percent at Site 6 felt that it was confusing. Comments made indicated that the median was confusing to some users and that motorists didn't understand how to act at this crossing treatment.

When asked if they would change anything to improve the safety of this crossing location, over 40 percent of the respondents at each location indicated they would. Due to the diverse feelings of the participants, the ideas for improvement varied greatly between the two crossings. At Site 5, the main concerns were increasing the available walk time, improving the audible signals, and increasing law enforcement for speeding. These responses were influenced by the disabled and older population of the area. At Site 6, the primary concerns were that there was not a direct path between the crossing and the hospital and that the median should allow pedestrians to go straight across without the jog in the path which takes them off of their desired route.

At Site 5, it was not appropriate to ask pedestrians about going to the next signalized intersection to cross due to the distance to the next intersection from the current crossing (over 3200 ft [975 m]). When this question was asked at Site 6, 75 percent indicated that they would not walk to the next signal in order to cross the street (about 950 ft [290 m]). Again, it was stated by the pedestrians that the crossings were too far out of their way, making it inefficient for them in getting to their destination. Of the people who indicated they would go to the next intersection, common reasons provided included safety concerns and a desire to cross at a controlled location.

Countdown Indication at a Signalized Intersection

The final treatment studied was a signalized intersection with a pedestrian countdown indication. The participants in the survey included a mix of both local residents who cross at this location frequently and first time visitors.

The pedestrians were again asked to rate their feeling of safety as they crossed this intersection. The split of responses was very even from very safe to unsafe. The reasons given for feeling unsafe were primarily related to the traffic that was either turning or did not stop. However, when asked if this was a safe and effective crossing treatment, 68 percent responded yes. These pedestrians felt that the signal made it easy to cross and that the countdown lets you know when the signal was going to change. Of those who did not feel safe at the crossing, common perceptions were that:

- the walk time was not long enough,
- there needed to be more law enforcement, and
- turning vehicles made it unsafe to cross.

At this location, it was observed by the researchers that the left-turning traffic frequently interfered with the pedestrian walk phase and that the right-turning traffic frequently stopped within the crosswalk.

Of the pedestrians interviewed 30 percent felt the crossing was hard to understand. Most commented that the turning traffic made them unsure of when to cross and they did not understand what the countdown numbers meant. The pedestrians were asked if they would add or change anything to improve the safety at this intersection. Fifty-two percent responded that they would. Of these people, the following items are what they would like to see at the crossing:

- no vehicle turns allowed during the pedestrian crossing time,
- adjust the amount of time allotted for walking,
- increased police enforcement,
- audible signals, and
- better pavement markings for visibility.

Comparison of Selected Findings

Distance to Nearest Signal

As part of the on-street pedestrian surveys those interviewed were asked “if this crossing was not here, would you walk to the next intersection (*point to intersection of interest*)?” For three of the sites, only about 25 percent of the respondents would walk to a signalized intersection that was located at either 550, 950, or 1000 ft (168, 290, or 305 m). For the site with a signalized intersection about 200 ft (61 m) from the crossing about half of those interviewed would walk to that crossing. The remaining site where this question was appropriate did not follow similar findings (i.e., half or less being willing to walk 200 ft (61 m) or more to a controlled crossing). A much higher percentage indicated that they would be willing to walk to another crossing. Over 65 percent of the respondents at Site 2 indicated that they would walk 600 ft (183 m) to cross at a signalized crossing. The greater number of individuals willing to walk such a distance was influenced by the number of lanes at the site (6 lanes), speed and volume of traffic (high), and existing treatment (marked crosswalk only). Several of the respondents selected "yes" to the question and then commented that they walk to the nearby crossing "most of the time" or "sometimes" depending upon the "weather" or other factors.

Pedestrian Delay Thresholds

The participants were asked, "What is the maximum amount of time a person should have to wait to cross this street?" Their responses are summarized in Table 3. When asked, about 75 percent of pedestrians feel that they should have to wait one minute or less before being able to safely cross a street (the remaining 25 percent report that they are willing to wait longer than one minute). Of course, there may be a significant difference between pedestrians' perceived tolerable delay and their actions.

TABLE 3 Results of Perceived Pedestrian Delay Thresholds (%)

Delay Threshold	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
< 30 sec	20	28	**43**	**40**	25	23
< 1 min	**29**	**60**	38	35	**48**	**50**
< 2 min	24	5	14	13	18	23
< 3 min	24	3	5	5	8	5
Other	2	5	0	5	3	0
Sample Size	41	40	42	40	40	40

Pedestrian Safety Ratings

It was found through this study that as the control at a pedestrian crossing increases through the addition of signs, flashing lights, and/or signals, the pedestrians' perception of safety also increases. This trend is illustrated in Figure 6 where the average pedestrian safety ratings for each site were plotted. The ratings were based on a scale where 1 indicates very safe and 5 indicates unsafe. Figure 6 also shows the sites as the pedestrian crossings treatments progress from least amount of control at the left to most control at the right.

The one abnormality in this trend is that the signalized intersection (Site 7) is considered either to be equally safe or less safe than the Split Midblock Signal treatment (Site 5 and 6). It is believed by the researchers that this variance is due to the fact that a pedestrian crossing at a major signalized intersection has a larger number of turning vehicles in conflict with the pedestrians which negatively impacts their feelings of safety.

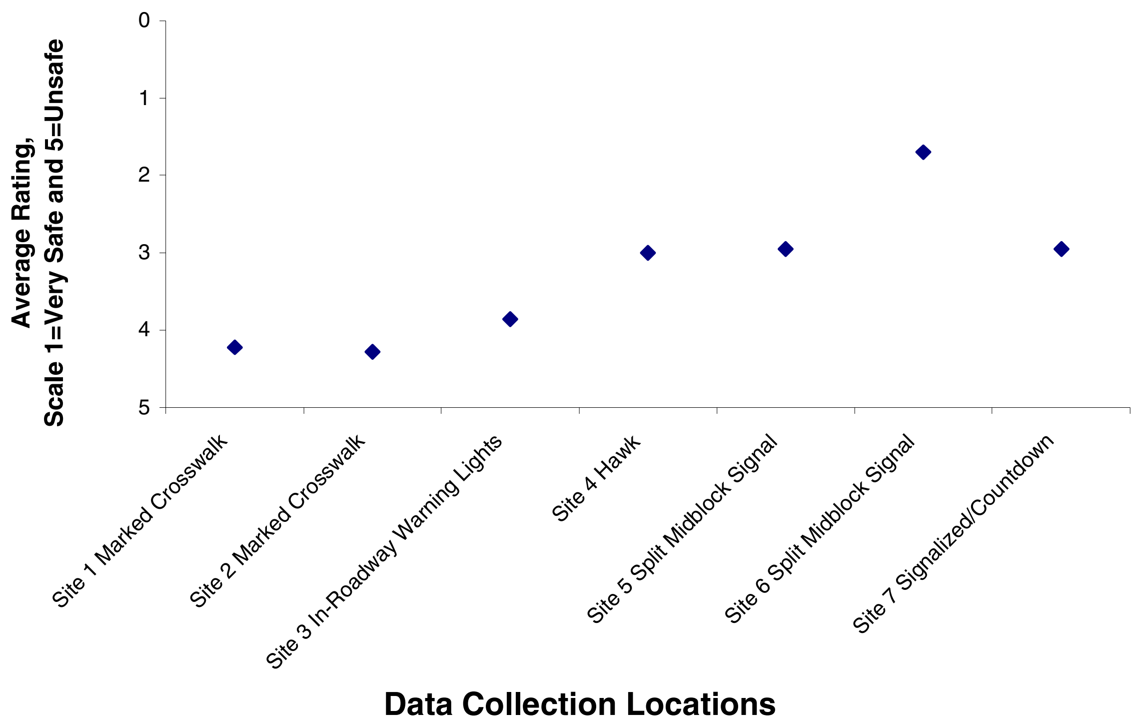


FIGURE 6 Average Pedestrian Safety Ratings.

CONCLUSIONS

When determining the amount of traffic control to be used at a pedestrian crossing location, there are many factors that should be considered. Based on the responses of the survey participants, the factors that have the greatest influence on the pedestrians responses are:

- traffic volume,
- turning traffic,
- presence of disabled pedestrians,
- traffic speed, and
- the availability of an alternate crossing.

Other findings from the survey included:

- At distances of 550 to 1000 ft (168 to 305 m) only about 25 percent of the respondents would walk to a signalized intersection.
- About 75 percent of the pedestrians felt they should have to wait one minute or less before crossing the street.
- As the control at a pedestrian crossing increases through the addition of signs, flashing lights, and/or signals, the pedestrians perception of safety also increases.

The unpredictability of drivers remains the number one concern to the pedestrians no matter what type of pedestrian treatment is utilized. Even at highly controlled crossings where all traffic is required to stop, determining whether a vehicle will obey the signal is one of the major concerns of the pedestrians surveyed.

Finally, the perception of pedestrians can be greatly influenced based on their own abilities. In the case of the two sites with the Split Midblock Signal treatment (Sites 5 and 6), perceptions were greatly altered depending on the pedestrian population. At the location with a greater number of disabled or older people crossing, the extended median was viewed favorably. However, at the location without this type of pedestrian traffic, the jog in the pedestrian path was considered to be a delay and therefore not an effective crossing design.

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