TECHBRIEF

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Where Pedestrians Cross the Roadway

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Objective

This TechBrief describes research on the environmental influences on where and when pedestrians cross the roadway across 20 different sites.

Introduction

Pedestrian-vehicle crashes are both common and deadly. In 2010, 13 percent of all crash fatalities were pedestrians.(1) Of these, 68.1 percent occurred outside of intersections. As a result of the large proportion of pedestrian fatalities that occur at non-intersection locations, it is important to investigate the causal factors of these collisions. Despite the large proportion of crashes, there has been little research investigating why pedestrians cross roadways at unmarked locations.

The present study sought to better understand the environmental influences on both where and when pedestrians elect to cross the road. The study team observed, coded, and analyzed the circumstances surrounding when and where crashes took place at more than 70,000 crossings. The study team created a model to predict crossing behaviors. These data have the potential to guide roadway design. Furthermore, this approach may aid in the selection and location of pedestrian crossing interventions (e.g., new pedestrian activation crossing beacons), ultimately increasing pedestrian safety in shared use environments.

Research

Researchers coded pedestrian roadway crossings at 20 different locations in the Washington, DC, metropolitan area. Each location was one block in length (M = 390 ft) and was flanked by two marked crosswalks at intersections. Crossings were recorded within one marked, signal-controlled crosswalk and the roadway in between it and the next marked crossing (but not within the far crossing).

Daytime pedestrian crossings were coded for several different factors:

1. **Location.** Within the marked crosswalk or not.
2. **Traffic status.** Walk or don't walk signal illuminated.
3. **Yielding.** Pedestrians yielding to vehicles or vehicles yielding to pedestrians in the roadway.
4. **Evasive Actions.** Any evasive movement made by a vehicle or pedestrian in order to avoid collision (e.g., running or abrupt braking).

Figure 1. Example of a crosswalk in Washington, DC.

Characteristics of each location were also recorded:

A. The distance between the marked cross walks.

B. Average annual daily traffic volume (AADT).

C. Street directionality (one- or two-way).

D. Physical barriers in or along the roadway that might prevent pedestrians from easily crossing between the roadway and sidewalk.

E. The presence and location of bus stops.

F. The number of potential pedestrian trip originators/destinations (e.g., shops).

G. The availability of street parking.

H. The presence of a center turn lane.

I. The presence of a "right turn only" lane.

J. The length of the walk signal phase.

K. The length of the don't walk signal phase.

L. The width of the roadway/pedestrian crossing.

M. The presence and type of median (e.g., raised concrete or painted asphalt).

N. The presence of a T-intersection between the two marked crosswalks.

O. The traffic control device of the second crosswalk (i.e., traffic signal, stop sign, or none).

P. The pace at which pedestrians are required to travel in order to complete a crossing entirely during the walk signal phase.

Results and Conclusions

Data were used to create a model to predict where pedestrians were likely to cross the road (marked-intersection crosswalk or non-intersection). All 16 environmental variables were included as possible predictors in the model. However, not all variables were significantly related to crossing location and, as a result, were not selected for the model. The environmental factors that were ultimately included in the model were A (the distance between marked crosswalks), B (AADT), D (physical barriers that might prevent pedestrians from easily crossing the roadway), E (the presence and location of bus stops), F (the number of potential pedestrian trip originators and destinations), I (the presence of a "right turn only" lane), L (the width of the roadway/pedestrian crossing), and N (the presence of a T-intersection between the two marked crossings).

The accuracy of the model ranged from 80.55 to 95.22 percent based on location. The model correctly predicted a mean of 90 percent of crossings. Overall, the model was successful in predicting whether participants would cross at marked crosswalks at intersections or outside of a marked crossing.

A mean of 13.89 percent of pedestrian crossings took place at unmarked non-intersection locations. Given the disproportionate percentage of fatalities that take place outside of marked intersections, this number may be a bit surprising. However, these data suggest that some locations are prone to having more unmarked non-intersection crossings than others. This was indeed the case here. Non-intersection crossings ranged from 3.02 to 36.55 percent.

The location with 36.55 percent of the crossings taking place at a non-intersection was different from many of the other locations in very specific ways. The first is that there is a wide, grassy median that separates traffic directionality. This median allows pedestrians to cross one road segment, wait on the median for a gap in traffic, and complete the second portion of the crossing. Beyond this, the juxtaposition of a Metro (subway) train station and a surrounding neighborhood is such that the most direct route (in terms of absolute distance) between the two areas involves crossing outside of the marked intersection. Given that some might consider traveling through the marked crosswalks to be out of the way, many people may increase their perceived control of the crossing by utilizing the median and cross midblock.

Environmental factors were examined in terms of their influence on crossing behaviors. For example, a significant relationship between the width of the crossing and the percentage of pedestrians that crossed entirely during the walk signal phase at each location was found. In other words, the longer the distance that pedestrians were required to travel to cross the road, the more likely they were to cross entirely during the walk phase of the light cycle. Interestingly, a significant relationship between crossing entirely during the don't walk signal phase and traffic directionality was found, such that pedestrians were more likely to cross during the don't walk phase on one-way streets than on two-way streets.

Not surprisingly, when physical barriers that might prevent pedestrians from easily crossing between the roadway and sidewalk were present, pedestrians were less likely to cross the roadway at unmarked non-intersection areas. Thus, it appears that even small barriers such as flower planters reduce the perceived affordances to cross the roadway.

Overall, only 0.98 percent of crossings involved pedestrians yielding to vehicles. Not surprisingly, a significantly greater percentage of crossings in non-intersections involved pedestrian yielding than in marked crosswalks.

Overall, 8.93 percent of crossings involved a vehicle yielding to a pedestrian. A significantly greater percentage of crossings in the marked intersection involved vehicle yielding than crossings in the unmarked non-intersection areas. This discrepancy is largely attributable to turning vehicles yielding to pedestrians crossing in the marked crossings during the walk phase.

Within the marked intersections, a significantly greater percentage of crossings involved vehicle yielding than pedestrian yielding. However, outside of the marked pedestrian crossing, pedestrians and vehicles were equally likely to yield in order to avoid collision.

Recommendations

When designing areas where there will be pedestrian traffic, an evaluation of the environmental features should be made in order to determine where pedestrian crossings are most likely. The developed model was successful in predicting almost 86 percent of the pedestrian crossings. Areas that have a high predicted likelihood of unmarked non-intersection crossings may be proactively targeted to modify the crossing affordances of the environment, presumably increasing the safety and meeting the needs of all road users. A combined effort of pedestrian education and shared road use planning is hoped to reduce pedestrian injuries and fatalities and ultimately increase roadway safety.

Reference

1. Fatality Reporting Analysis System (2011). http://www-fars.nhtsa.dot.gov/Main/index.aspx. Accessed February 2013.

Researchers—This study was performed by researchers at Turner-Fairbank Highway Research Center, Stacy Balk and Mary Anne Bertola of Leidos, and Jim Shurbutt of FHWA.

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