U.S. Department of Justice
Office of Community Oriented Policing Services

Problem-Oriented Guides for Police
Problem-Specific Guides Series
No. 51

Pedestrian Injuries and Fatalities

by
Justin A. Heinonen
John E. Eck

Problem-Oriented Guides for Police
Problem-Specific Guides Series
Guide No. 51

Pedestrian Injuries and Fatalities

Justin A. Heinonen
John E. Eck

This project was supported by cooperative agreement #2005CKWXK001 by the Office of Community Oriented Policing Services, U.S. Department of Justice. The opinions contained herein are those of the author(s) and do not necessarily represent the Justice Department's official position. References to specific companies, products, or services should not be considered an endorsement of the product by the author(s) or the Justice Department. Rather, the references are used to supplement discussion of the issues.

www.cops.usdoj.gov

ISBN: 1-932582-83-5

October 2007

About the Problem-Specific Guides Series

The *Problem-Specific Guides* summarize knowledge about how police can reduce the harm caused by specific crime and disorder problems. They are guides to prevention and to improving the overall response to incidents, not to investigating offenses or handling specific incidents. Neither do they cover all of the technical details about how to implement specific responses. The guides are written for police—of whatever rank or assignment—who must address the specific problem the guides cover. The guides will be most useful to officers who:

- **Understand basic problem-oriented policing principles and methods.** The guides are not primers in problem-oriented policing. They deal only briefly with the initial decision to focus on a particular problem, methods to analyze the problem, and means to assess the results of a problem-oriented policing project. They are designed to help police decide how best to analyze and address a problem they have already identified. (A companion series of *Problem-Solving Tools* guides has been produced to aid in various aspects of problem analysis and assessment.)

- **Can look at a problem in depth.** Depending on the complexity of the problem, you should be prepared to spend perhaps weeks, or even months, analyzing and responding to it. Carefully studying a problem before responding helps you design the right strategy, one that is most likely to work in your community. You should not blindly adopt the responses others have used; you must decide whether they are appropriate to your local situation. What is true in one place may not be true elsewhere; what works in one place may not work everywhere.

- **Are willing to consider new ways of doing police business.** The guides describe responses that other police departments have used or that researchers have tested. While not all of these responses will be appropriate to your particular problem, they should help give a broader view of the kinds of things you could do. You may think you cannot implement some of these responses in your jurisdiction, but perhaps you can. In many places, when police have discovered a more effective response, they have succeeded in having laws and policies changed, improving the response to the problem. (A companion series of *Response Guides* has been produced to help you understand how commonly-used police responses work on a variety of problems.)

- **Understand the value and the limits of research knowledge.** For some types of problems, a lot of useful research is available to the police; for other problems, little is available. Accordingly, some guides in this series summarize existing research whereas other guides illustrate the need for more research on that particular problem. Regardless, research has not provided definitive answers to all the questions you might have about the problem. The research may help get you started in designing your own responses, but it cannot tell you exactly what to do. This will depend greatly on the particular nature of your local problem. In the interest of keeping the guides readable, not every piece of relevant research has been cited, nor has every point been attributed to its sources. To have done so would have overwhelmed and distracted the reader. The references listed at the end of each guide are those drawn on most heavily; they are not a complete bibliography of research on the subject.

- **Are willing to work with others to find effective solutions to the problem.** The police alone cannot implement many of the responses discussed in the guides. They must frequently implement them in partnership with other responsible private and public bodies including other government agencies, non-governmental organizations, private businesses, public utilities, community groups, and individual citizens. An effective problem-solver must know how to forge genuine partnerships with others and be prepared to invest considerable effort in making these partnerships work. Each guide identifies particular individuals or groups in the community with whom police might work to improve the overall response to that problem. Thorough analysis of problems often reveals that individuals and groups other than the police are in a stronger position to address problems and that police ought to shift some greater responsibility to them to do so. Response Guide No. 3, *Shifting and Sharing Responsibility for Public Safety Problems*, provides further discussion of this topic.

The COPS Office defines community policing as "a policing philosophy that promotes and supports organizational strategies to address the causes and reduce the fear of crime and social disorder through problem-solving tactics and police-community partnerships." These guides emphasize *problem-solving* and *police-community* partnerships in the context of addressing specific public safety problems. For the most part, the organizational strategies that can facilitate problem-solving and police-community partnerships vary considerably and discussion of them is beyond the scope of these guides.

These guides have drawn on research findings and police practices in the United States, the United Kingdom, Canada, Australia, New Zealand, the Netherlands, and Scandinavia. Even though laws, customs and police practices vary from country to country, it is apparent that the police everywhere

experience common problems. In a world that is becoming increasingly interconnected, it is important that police be aware of research and successful practices beyond the borders of their own countries.

Each guide is informed by a thorough review of the research literature and reported police practice, and each guide is anonymously peer-reviewed by a line police officer, a police executive and a researcher prior to publication. The review process is independently managed by the COPS Office, which solicits the reviews.

The COPS Office and the authors encourage you to provide feedback on this guide and to report on your own agency's experiences dealing with a similar problem. Your agency may have effectively addressed a problem using responses not considered in these guides and your experiences and knowledge could benefit others. This information will be used to update the guides. If you wish to provide feedback and share your experiences it should be sent via e-mail to cops_pubs@usdoj.gov.

For more information about problem-oriented policing, visit the Center for Problem-Oriented Policing online at www.popcenter.org. This website offers free online access to:

- the *Problem-Specific* Guides series
- the companion *Response Guides* and *Problem-Solving Tools* series
- instructional information about problem-oriented policing and related topics
- an interactive problem-oriented policing training exercise,
- an interactive *Problem Analysis Module*
- a manual for crime analysts
- online access to important police research and practices
- information about problem-oriented policing conferences and award programs.

Acknowledgments

The *Problem-Oriented Guides for Police* are produced by the Center for Problem-Oriented Policing, whose officers are Michael S. Scott (Director), Ronald V. Clarke (Associate Director) and Graeme R. Newman (Associate Director). While each guide has a primary author, other project team members, COPS Office staff and anonymous peer reviewers contributed to each guide by proposing text, recommending research and offering suggestions on matters of format and style.

The project team that developed the guide series comprised Herman Goldstein (University of Wisconsin Law School), Ronald V. Clarke (Rutgers University), John E. Eck (University of Cincinnati), Michael S. Scott (University of Wisconsin Law School), Rana Sampson (Police Consultant), and Deborah Lamm Weisel (North Carolina State University).

Members of the San Diego; National City, California; and Savannah, Georgia police departments provided feedback on the guides' format and style in the early stages of the project.

Cynthia E. Pappas oversaw the project for the COPS Office and research for the guides was conducted at the Criminal Justice Library at Rutgers University by Phyllis Schultze. Suzanne Fregly edited this guide.

Contents

The Problem of Pedestrian Injuries and Fatalities

What This Guide Does and Does Not Cover

This guide examines the problem of pedestrian-vehicle crashes resulting in injuries and fatalities. It reviews the factors that contribute to such crashes. It then provides a series of questions to help you analyze your local pedestrian injury and fatality problem. Finally, it reviews responses to the problem and what is known about them from evaluative research and police practice.

Pedestrian injuries and fatalities are but one aspect of the larger set of problems related to travel and road safety. This guide addresses only the particular harms created by unsafe pedestrian behavior, vehicle and driver factors, problematic physical environments, and other special conditions. Related problems not directly addressed in this guide include:

- vehicle-vehicle traffic crashes
- public intoxication
- aggressive driving
- drunken driving
- street racing
- speeding in residential areas
- traffic congestion.

Some of these related problems are covered in other guides in this series, all of which are listed at the end of this guide. For the most up-to-date listing of current and future guides, see www.popcenter.org.

General Description of the Problem

Pedestrian-vehicle crashes are a major problem in the United States. In 2003, the National Highway Traffic Safety Administration reported that approximately 4,700 pedestrians were killed and another 70,000 injured due to pedestrian-vehicle crashes.[1] On average, a pedestrian is killed in a traffic collision every 113 minutes and injured every 8 minutes.[2] Although only 8.6 percent of all trips are made on foot, 11.4 percent of all traffic deaths are pedestrians.[3]

The times and days pedestrians are most at risk of injury differ from those when they are most at risk of death. Most pedestrian injuries occur between 6 a.m. and 6 p.m., with a peak time between 3 p.m. and 6 p.m., whereas pedestrian fatalities usually happen at night (i.e., between 5:30 p.m. and 11 p.m.).[4] Most pedestrian-vehicle crashes take place on Friday and Saturday with the fewest crashes occurring on Sunday.[5] It is possible that these temporal patterns correspond with specific conditions. For instance, most pedestrian injuries might occur between 3 p.m. and 6 p.m. because overall vehicle traffic increases during these hours as drivers commute home from work. Furthermore, pedestrian fatalities that occur at night could result from a combination of factors such as drunken drivers, drunken pedestrians, and poor visibility. Analysis of your community's problem might reveal other explanations for temporal patterns of pedestrian injuries and fatalities. Finally, the majority of pedestrian injuries and fatalities happen to males between the ages of 25 and 44.

Pedestrian-vehicle crashes also tend to concentrate at certain places:[6]

- The majority of pedestrian-vehicle crashes (60 percent in urban areas; 67 percent in rural areas) occur at places other than intersections.

- Seventy-four percent of pedestrian-vehicle crashes occur where no traffic control exists.

The patterns mentioned above are general and based on research from several different communities. You should study the particular patterns in your own community, as they may vary from these general patterns.

Factors Contributing to Pedestrian Injuries and Fatalities

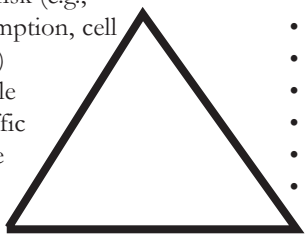
Understanding the factors that contribute to your community's problem will help you frame your own local analysis questions, determine good effectiveness measures, recognize key intervention points, and select appropriate responses.

No single factor is completely responsible for the problem of pedestrian-vehicle crashes resulting in injuries and fatalities. A combination of unsafe pedestrian behavior, vehicle and driver factors, problematic physical environments, and other special conditions all contribute to them.[7] This list of factors is not exhaustive, but instead highlights some common causes of pedestrian-vehicle crashes that result in injuries and fatalities.

Local analysis may reveal unique situations, not on this list, that you may need to address. Local analysis should be based on the pedestrian-vehicle crash triangle (Figure 1). This triangle is a modification of the widely used problem analysis triangle (see www.popcenter.org for a description). Simply stated, pedestrian-vehicle crashes occur when physical environments allow pedestrians to come into contact with moving vehicles. If this occurs repeatedly, then a pedestrian-vehicle crash problem exists. Most such problems will be the result of failures on all three sides of the triangle: pedestrians who are inattentive or incapable of using the street safely;

drivers who operate in ways that make it difficult for them to detect pedestrians in the road; and physical environments that encourage unsafe pedestrian and/or driver behavior, or fail to adequately separate pedestrians and vehicles. The relative importance of each side of the triangle will vary from problem to problem. Fixing any one side may reduce the problems, in principle. Fixing more than one side should give greater assurance that the response to the problem will work.

Figure 1 also lists multiple specific causes of pedestrian-vehicle crashes along each side of the triangle, as well as a set of special conditions you should consider. Each of these is described next.



Vehicle & Driver
- Perception of risk (e.g., alcohol comsumption, cell phone use, etc.)
- Speed of vehicle
- Volume of traffic
- Type of vehicle

Physical Environment
- Lack of crossing devices
- Lack of midblock crossing
- Width of roads
- Poorly timed signals
- Poor sidewalks
- Absence of sidewalks
- Capacity of sidewalks

Special Conditions
- Weather
- People with limited mobility
- Occupational risks
- Children and teens
- Shopping centers
- Construction
- Major Highways
- One-way streets
- Location of attractions
- Unlawful street-vending

Pedestrian Behavior
- Pedestrian Jaywalking
- Perception of risk
- Consumption of alcohol
- Perception of crossing devices
- Speed and pace of life
- Speed of crossing devices
- Perception of enforcement risk
- Unawareness of laws
- "Herd mentality"

Figure 1: Pedestrian-vehicle crash triangle and specific causes of crashes

Pedestrian Behavior

Unsafe pedestrian behavior is a major factor in pedestrian injuries and fatalities. In a recent study of 7,000 pedestrian-vehicle crashes in Florida, researchers discovered that pedestrians were at fault in 80 percent of these incidents.[8] Similarly, in a U.K. study, pedestrian behavior accounted for 90 percent of crashes where vehicle struck a pedestrian.[9]

Pedestrian jaywalking. Specifically, jaywalking is often cited as a poor pedestrian behavior that leads to pedestrian injuries and fatalities. Jaywalking is a general term for any form of illegal street-crossing by a pedestrian.[10] There are several types of pedestrian behavior that qualify as jaywalking:

- walking against a pedestrian walk signal
- crossing a street where there is no crosswalk (midblock crossing)
- crossing a street outside of a marked crosswalk where one is present
- walking on a street along with the traffic flow (ignoring designated pedestrian pathways).

In addition to jaywalking, other unsafe pedestrian behavior could also increase the risk of injury or fatality. According to a study of 5,073 pedestrians involved in traffic crashes, the following factors also contributed to pedestrian-vehicle crashes:[11]

- failing to yield (both drivers and pedestrians)
- jogging/walking in the wrong direction
- working on a parked car
- leaning on a parked car
- pushing a disabled car
- standing between parked cars
- standing in a road.

Jaywalking is often considered to be an urban problem. In one study, the frequency of jaywalking was found to be a function of city size where jaywalking incidents increase as city population increases.[12] In addition, the same study noted that 71 percent of all fatal pedestrian-vehicle crashes in the United States in 2000 occurred in urban areas. The problem of jaywalking, however, is not limited to urban areas. Although researchers found urban areas to have three times more jaywalkers, suburban jaywalking can be a problem due to a lack of sidewalks that separate pedestrians and vehicles.[13]

John Eck

Pedestrians, vehicles, and the physical environment. The interactions of these three elements control the risk of pedestrian-vehicle crashes. Here, many pedestrians walking among moving vehicles in a low light wet environment suggest a hazardous situation.

Despite the link between jaywalking and pedestrian injuries and fatalities, jaywalking remains a low-priority police concern. One reason could be that police tend to lump pedestrian violations into general traffic violations which they often consider minor folk crimes.[14] Consequently, police might not enforce jaywalking violations as actively as other more serious crimes. For instance, the widely touted jaywalking crackdown in New York City actually resulted in only 99 jaywalking tickets being issued for an entire year during the crackdown. This level of enforcement is miniscule considering the size of New York's pedestrian population.[15]

One reason why police might be reluctant to enforce jaywalking violations is because it potentially exposes them to allegations of racial profiling. For instance, the city of Milwaukee, Wisconsin has established a "zero-tolerance" program that aims to reduce quality-of-life violations such as speeding, excessive noise, and jaywalking. A one-year analysis of the program, however, showed that it appeared to have a disparate impact on Milwaukee's minority population. For instance, the police gave the majority of citations for quality-of-life violations, including jaywalking, to ethnic minorities in low-income, high-crime areas.[16] In fact, blacks, Hispanics, and other minorities received three out of every four municipal tickets during a one-year span in Milwaukee.[17] The potential problem is that while blacks, Hispanics, and other minorities received roughly 75 percent of quality-of-life citations, these groups account for approximately 55 percent of Milwaukee's population.[18]

In addition to jaywalking's being a low-priority police concern, it appears that law makers also view jaywalking as a low-priority problem. The current penalties associated with jaywalking reflect this low priority in some cities. For instance, in the District of Columbia, pedestrians face a mere $5 fine for jaywalking.[19]

Although jaywalking contributes to many pedestrian injuries and fatalities, it does not necessarily follow that jaywalking is inherently risky behavior. If many pedestrians jaywalk without getting injured, the number of pedestrian-vehicle crashes might be high, but the risk of a crash for each jaywalking incident might be quite low. There is little available research on jaywalking's risk rate. To calculate such risk, we would need to know the jaywalking crash rate and jaywalking frequency.

With that said, the following sections describe several factors that, when identified, should help your agency move beyond solely enforcing jaywalking to reducing actual pedestrian-vehicle crashes that result in injuries and fatalities.

Pedestrian perceptions of risk. Some pedestrians might be injured or killed because they are unaware of their own risk of being involved in a pedestrian-vehicle crash. Often, pedestrians have perceptions of low risk when they frequently travel familiar routes. In fact, pedestrians who regularly use certain paths or crosswalks are likely to reduce the time they wait at pedestrian crossings.[20] Conversely, pedestrians who have been involved in or who have witnessed a pedestrian-vehicle crash are willing to wait longer at crosswalks.

Distracted pedestrians are also at higher risk. For instance, pedestrians using a cell phone are less likely to look at traffic before crossing, to wait for traffic to stop, to look at traffic while crossing, or to walk briskly.[21]

Pedestrian consumption of alcohol. Drunken driving is the cause of many traffic crashes throughout the world. Similarly, drinking contributes to unsafe pedestrian behavior that results in crashes with vehicles. Pedestrians who have been drinking run an even higher risk of getting killed in traffic, constituting between 39 percent and 60 percent of all pedestrian fatalities.[22] Of pedestrian fatalities resulting from traffic crashes, between 42 percent and 61 percent of fatally injured pedestrians had blood-alcohol content levels (BAC) of 0.10 percent or more.[23] Drivers with this BAC level are considered "impaired" under statutory definition and cannot legally drive.[24]Although also "impaired" under this statutory definition, it is not illegal for pedestrians to walk with a BAC level of 0.10 percent. Nonetheless, "impaired" pedestrians can contribute to pedestrian-vehicle crashes because they likely have slower reaction time, have poor judgment, and are not likely assessing the safeness of walking conditions.

For instance, while pedestrians who have not drunk alcohol are more aware of increased walking risks, drunken pedestrians tend to be more oblivious to traffic conditions, poor lighting, and poor weather.[25] Consequently, drunken pedestrians are more likely to be injured or killed by vehicles because of their inability to recognize dangerous walking and traffic conditions.

Finally, the more one drinks, the higher the risk of being involved in a pedestrian-vehicle crash resulting in a fatality. One study found that out of 176 pedestrian fatalities, 86 of those involved pedestrians who had been drinking, nearly all of whom had BACs of 0.10 percent or more.[26]

Pedestrian perceptions of crossing devices. Some pedestrians might not understand or be aware of signs that convey safe walking procedures.[27] Therefore, some pedestrians might inadvertently enter roads and be struck by oncoming traffic because they are confused. For instance, some pedestrians may jaywalk simply because they do not know where and when they have the right-of-way.

Pedestrian speed and pace of life. Pedestrian non-compliance with signs and signals is a significant factor in pedestrian-vehicle crashes nationwide.[28] Some researchers have suggested that pedestrian non-compliance could be due to the pace of life that is often associated with larger cities. For instance, pedestrians move more quickly in big cities when compared with small towns.[29] One researcher also discovered that whether male pedestrians were in a hurry or not influenced their decision to cross the street while the light was red.[30]

Pedestrian speed versus crossing-device speed. Crossing devices that do not accommodate the rate at which urban pedestrians would like to travel may also encourage poor pedestrian behavior. For instance, if pedestrians have to wait a relatively long time for a walk signal, they are more likely to cross midblock to avoid delays.[31]

In addition, if a pedestrian is trying to go to the opposite side of an intersection after crossing one street, the pedestrian will need to cross the adjacent street. However, the timing of crossing devices may not correspond to the walker's directional path (see Figure 2). Therefore, after crossing one street, a rushed pedestrian may be less inclined to wait for a walk signal to cross the next street. Some researchers have found that significantly fewer pedestrians jaywalked when there were short wait times to cross the second street.[32]

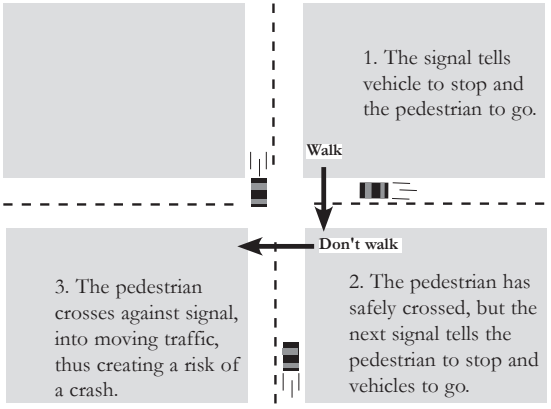


Figure 2: Signal timing at crosswalks

Pedestrian perceptions of enforcement risk. Some pedestrians may conform to walking regulations because of personal preference or habit, while other pedestrians calculate the risk of getting caught by police against the benefits of jaywalking.[33] Because many cities and police departments do not give high priority to jaywalking enforcement, the risk of getting caught and cited is quite low. Enforcing traffic laws is unpopular with officers because it is perceived as trivial and can lead to friction between citizens and police.[34] Consequently, the lack of enforcement or penalties could result in a larger disregard for pedestrian safety rules, resulting in higher crash rates.[35]

Pedestrian unawareness of pedestrian laws and safety. Another problem related to pedestrian laws is the possibility that pedestrians might be unaware of or misunderstand pedestrian laws that designate where and when they have the right of way. It is also possible that some drivers are unaware of their rights and duties or pedestrians' rights and duties. Furthermore, a test on pedestrian safety in one police department revealed that a large majority of officers had a difficult time identifying pedestrian safety laws and the rights and duties of both drivers and pedestrians.[§] Given that some police officers have trouble identifying driver and pedestrian laws and rights, it is possible that many people in the general population are unaware of pedestrian laws and safe behavior. This, too, may contribute to pedestrian-vehicle crashes.

§ This point was substantiated by an anonymous police officer reviewer of this guide whose agency reached this conclusion on the basis of an internal officer survey.

Pedestrians' following the leader. Cues from other pedestrians affect the cautiousness and walking behavior of pedestrians sharing the same intersection or route. For instance, some pedestrians act as "frontliners" (those pedestrians nearest to the street at an intersection) while others act as "backfielders" (those pedestrians behind other pedestrians at an intersection). One study found that when "frontliners" crossed, "backfielders" followed without examining walking conditions.[36] Therefore, if "frontliners" cross illegally, other walkers may enter a road without adequately assessing their own individual risk. Essentially, this situation can be described as a "herd mentality" where each member feels an exaggerated sense of protection from being part of a group.

Similarly, obedient pedestrians (those who do not jaywalk) and disobedient pedestrians (those who do) influence one another's behavior: the disobedient encourage jaywalking among the normally obedient, but the obedient can reduce jaywalking among the normally disobedient.[37] In addition,

disobedient walkers can diminish pedestrian penalties' deterrent effects. For example, disobedient walkers might motivate other pedestrians to cross illegally because their behavior indicates that particular situations lack penalties.[38]

Vehicle and Driver Factors

Vehicles and their drivers' behavior are the second major group of factors that you should consider. In all, this guide identifies four vehicle and driver factors that could contribute to pedestrian-vehicle crashes that result in injuries and fatalities. Like the pedestrian factors described above, the importance of each factor is often unclear because of a lack of research and probably varies from problem to problem.

Driver perceptions of risk. Similar to pedestrians, drivers can also be unaware of their own risk of hitting a pedestrian. Furthermore, some of the factors that affect pedestrian perceptions of risk can also influence driver perceptions of risk. For instance, alcohol, familiarity with travel routes, and cell phone use might reduce a driver's ability to recognize the risk of hitting a pedestrian.

Speed of vehicle. Speeding is a major contributor to vehicle-vehicle crashes. It is not surprising, then, that speeding is also an important consideration when examining pedestrian-vehicle crashes. Speed influences these crashes in two distinct ways. First, speed increases the chances of a collision. Simply, faster vehicle speeds make it more difficult for drivers to see pedestrians, and at the same time, high speeds reduce the amount of time the driver and pedestrian have to avoid a crash.[39] Second, given a crash, the faster the vehicle the more severe the injury to the pedestrian. For example, a pedestrian hit at 40 miles per hour has an 85 percent chance of getting killed, whereas the likelihood goes down to 45 percent at 30 miles per hour and 5 percent at 20 miles per hour.[40]

Volume of traffic. The greater the pedestrian and vehicle traffic, the greater the chances that pedestrians and vehicles will encounter each other on the street. As mentioned above, most pedestrian injuries and fatalities occur in urban areas, undoubtedly in part because cities have both more vehicles and more pedestrians when compared with non-urban areas.[41]

Type of vehicle. The type of vehicle involved in a collision influences the severity of injury and the chance of death for a pedestrian involved in the collision. For instance, an increase in the number of light truck vehicles (LTVs) has changed the pedestrian injury profile due to their raised bumper height.[42] Unlike LTVs, vehicles with lower bumper heights strike the lower part of pedestrians, causing them to hit the car's hood or windshield. Conversely, LTVs strike pedestrians above their center of gravity causing them to project forward, increasing the probability that the same vehicle will subsequently run over them. Consequently, the risk of death in an LTV-pedestrian crash is 3.4 times higher than that of crashes involving pedestrians and standard passenger vehicles.

Physical Environment

The physical layout of a city and its pedestrian transportation routes and crossing devices might encourage some pedestrians to cross or enter roads in unsafe situations. The following environmental features could encourage risky pedestrian behavior.

Lack of pedestrian crossing devices. Pedestrian crossing devices serve two purposes. First, they regulate behavior by indicating what is right and wrong. For instance, the "Don't Walk" signal indicates that it is wrong to cross at that time. Second, crossing devices help people judge safety. The same "Don't Walk" signal also indicates that it is possibly dangerous

to cross at that time. However, when intersections lack walking signs, crossing devices, or crosswalks, it is difficult for pedestrians to determine appropriate behavior or judge the safety of a particular walking route. Consequently, the lack of signals at intersections can contribute to pedestrian-vehicle crashes that result in injuries and fatalities.

Absence of midblock crosswalks. As mentioned, pedestrians might avoid inconvenient intersection crossings because they delay the pace of travel. However, midblock crossing is implicated in 55 percent of all fatal pedestrian-vehicle crashes.[43] If convenient midblock crosswalks were available at popular crossing points, pedestrians could cross these areas that would otherwise be unsafe and illegal.

Width of roads. Pedestrians are far less likely to jaywalk when crossing distance increases.[44] This finding suggests that narrower roads could encourage unsafe pedestrian behavior. Wider roads, however, could promote higher vehicle speeds, resulting in a possible trade-off with regard to pedestrian safety.

Poor timing of crossing signals. Fast crossing signals can also create problems in some circumstances. For instance, wide roads (or widening roads as a strategy) could have the unintended consequence of putting specific pedestrian groups at higher risk when signals do not allow enough time for these groups to cross safely. When crosswalk times are set for the average pedestrian, then slower pedestrians—the elderly, people with movement-related limitations, parents with children, and so forth—may not be able to completely cross before traffic starts again. In neighborhoods where slower pedestrians make up a significant part of the population (e.g., around retirement homes and medical facilities), a "crash hotspot," or area with a high pedestrian-vehicle crash frequency, might develop. The box below reveals an example of this type of problem, and how the city addressed it.

Addressing an Elderly Pedestrian Crash Problem in New York City[45]

Scanning: The New York City Department of Transportation's Safety Division identified a pedestrian-vehicle crash hotspot on Queens Boulevard.

Analysis: Data on pedestrian-vehicle crashes resulting in fatalities as well as an examination of the environment revealed several factors that contributed to the problem. First, Queens Boulevard is the widest street in New York City. Second, traffic volume is heavy across the street's 12 lanes. Third, elderly pedestrians were most often involved in the collisions. In fact, crash data indicated that all 20 pedestrians who were killed in the sample were at least 60 years old or older. Researchers discovered that stoplight signals did not allow enough time for elderly pedestrians to cross such a wide road.

Response: In 1985, the Safety Division implemented several strategies to address the problem. However, the response most pertinent to this section was the modification of stoplight signals to increase pedestrian crossing time.

Assessment: Two years after the intervention, researchers determined that traffic volume had actually increased by 19 percent on Queens Boulevard. Nevertheless, the number of both fatal and likely fatal pedestrian injuries decreased after the intervention by 43 percent and 86 percent, respectively. During the same time frame, however, fatal pedestrian injuries occurring citywide decreased by only 4 percent.

Despite the strategy's initial effectiveness, the city has established new efforts to reduce pedestrian-vehicle crashes on Queens Boulevard as recently as 2003.[46] The lesson is that solutions are not permanent and need to be revisited as traffic and other conditions change.

Poor conditions of sidewalks. Poor sidewalk conditions might influence pedestrians to overlook safety and seek better walking conditions along the street. In addition, poor sidewalks may be a particular problem for runners or other similar groups who prefer smooth surfaces for their activities (for example, speed walkers and cyclists). Poor sidewalk conditions, including the absence of curb cuts, also places people with movement-related limitations in a dilemma; the street is risky, but the sidewalk is impassible.

In addition to the conditions of sidewalks themselves, obstructions around sidewalks could also be problematic. For instance, in residential areas, bushes and trees can overhang sidewalks making passage difficult. Leaf and other plant litter, or snow and ice, can also cause obstructions when not quickly removed. In addition, cars in many urban and congested suburban areas often park across the sidewalk while parked in their own driveway. This situation could also result in pedestrians' having to leave the sidewalk to walk around the cars.

Absence of sidewalks in certain areas. Some travel paths do not have sidewalks at all. The absence of sidewalks could encourage or even force some pedestrians to walk along dangerous roads. Again, people with limited mobility might choose the street over walking on grass, dirt, or uneven terrain.

Capacity of sidewalks. Pedestrians prefer to walk on wide sidewalks.[47] However, pedestrians and vehicles compete with each other for how transportation space will be allocated in larger cities. In response to greater vehicle traffic volumes, some central business districts have reduced sidewalk width to accommodate traffic flow.[48] In addition, in some commercial districts, new sidewalk cafes reduce the available space for walking. Consequently, pedestrians often exceed

sidewalk capacity, thus encouraging pedestrian use of streets and making crashes more common. No studies were found that directly discussed whether this problem creates crash hotspots. However, given the other findings and what we know from other problems, crash hotspots are highly likely.

Special Conditions

Special conditions are circumstances that accentuate one or more of the factors already mentioned and concentrate them at particular times (e.g., when there is bad weather), at particular places (e.g., shopping centers), among particular types of people (e.g., those with limited mobility), or some combination of times, places, and people (e.g., construction sites). Patterns involving these special conditions can be difficult to detect. For example, pedestrian-vehicle crashes involving shopping centers might be spread over several shopping areas with no discernable hotspot on a map. Only if you looked specifically for a pattern involving shopping centers would you see the pattern. Similarly, people with limited mobility may be involved in crashes at a variety of places and only by looking for special victim characteristics would you notice that this group is particularly vulnerable. There are ten obvious and common special conditions listed below, but you should consider others that might be important in your community. Though potentially difficult to detect, once detected it might be easier to identify effective solutions; the circumstances may be peculiar enough to point to a few obvious ones.

John Eck

Bad weather can increase pedestrian-vehicle crashes. A snow storm has made sidewalks in this residential area difficult to use. It has also reduced the driving width of the streets and made them slick.

Weather. Inclement weather can influence how pedestrians behave and their ability to assess walking conditions. In addition, inclement weather can also affect drivers' ability to avoid collisions with pedestrians. Specifically, weather could have an effect on pedestrian injuries and fatalities in the following ways:

- *Haste and speed.* Poor weather makes people uncomfortable, so they are likely to move faster to get out of it. Their haste may make them less attentive and more willing to take risks.
- *Altered walking conditions.* Weather can also make walking surfaces more dangerous and put pedestrians at a higher risk of injury. For example, in the winter, slippery surfaces can decrease pedestrians' ability to move out of danger—e.g., change direction quickly. In fact, evidence suggests that, among older pedestrians, more crashes occur during fall and winter months.[49] Standing water and puddles during other seasons could also contribute to altered pedestrian patterns.

- *Reduced visibility for pedestrians.* Fog, rain, snow, and darkness reduce visibility, and consequently, the amount of time pedestrians have to react to vehicles. Precipitation also reduces ambient light which makes dawn and dusk more problematic. In addition, rain gear and cold-weather clothing can restrict visibility. In particular, coat hoods can restrict peripheral vision, especially the deep hoods that have become more popular.
- *Reduced visibility for drivers.* Some of the same factors that reduce pedestrians' ability to see also affect drivers'. Although fully functioning wipers can help with visibility, fog, rain, and snow still restrict drivers' ability to see, particularly objects not directly in front of the car.

A pedestrian-vehicle crash hotspot might occur because a location that is safe during good weather becomes high risk in bad weather. Responses that may be effective in good weather, might not work as well in bad weather. Creating weather-specific responses may be difficult, but you should consider doing so.

People with limited mobility. People who use wheelchairs or electric scooters to aid mobility often travel on streets instead of sidewalks. The fact that they are slower than most cars, and often unexpected, puts them at great risk. Many people have temporary limited mobility—parents pushing strollers or walking with very young children, or people carrying objects or pushing a shopping cart, for example—that can put them at higher risk of being hit by a vehicle.

People with occupational risks. Some occupations require employees to do their job close to traffic. For instance, police officers, construction workers, mail carriers, garbage collectors, and parking officers often work near roads. Local analysis in your community might reveal that these types of workers are involved in pedestrian-vehicle crashes more often than other types of pedestrians.

Children and teens. Children are potentially a high-risk group. For instance, pedestrian injury is the third leading cause of unintentional injury-related deaths among children ages five to 14.[50] The "dart-out" phenomenon, where children quickly enter traffic from between parked cars, is one major factor that has contributed to 80 percent of pedestrian-vehicle crashes involving children aged six to eight from 1983 to 1990.[51] In addition to the "dart-out" phenomenon, several other factors could put children and teens at higher risk:

- Walking is a major form of transportation for children.
- Children frequently don't pay attention to traffic conditions.
- Children's height makes them difficult to see.
- Teens can be at high risk when in groups (for example, since teens often travel in groups, they might be more prone to "herd mentality").

When children and teens use streets as recreation areas, this puts them in direct conflict with vehicles. Streets through areas with high concentrations of children and teens are potential crash locations. It is not clear, however, that restricting children and teens from roads is the only way to achieve a net safety effect. For instance, the Dutch have built mixed-use roads where streets are designed as extensions of public space used for nondriving activities such as walking, running, and playing rather than separate roads for vehicle travel only.[§] Some cities in the U.S. have also implemented this traffic-calming strategy.

§ See Problem-Specific Guide No. 3, *Speeding in Residential Areas*.

John Eck

Encumbered pedestrians are at risk of being involved in crashes. This man is crossing a street pushing a shopping cart and holding a cup of coffee. The photo was taken through the driver side window to give the driver's view.

Parking areas near shopping centers. Parking areas near shopping centers could be highly problematic as there are fewer clear pedestrian paths. Consequently, pedestrians interact more with cars. Furthermore, pedestrians are often encumbered with children, packages, carts, and other items. At the same time, drivers are looking for parking spaces, reading store signs, avoiding oncoming traffic, and having to contend with pedestrians. Therefore, parking areas are marked by both distracted pedestrians and drivers, thereby increasing the chance of a crash. In fact, one study discovered that the majority of a sample of pedestrian-vehicle crashes occurred in a shopping business district.[52] Efforts to reduce crashes in such places likely require owner and vendor participation.

Street repair and construction sites. Construction of sidewalks, streets, and buildings can create temporary unsafe environments for pedestrians. Pedestrians who are asked to make long detours around these sites may choose instead to walk on the streets to save time or avoid the crowded detour route. In addition, construction debris and materials can create obstacles that force pedestrians into the street. Since

construction sites are temporary, the problems they create may be hidden: because the crashes are spread over a large area they may not form a spatial cluster on maps, and if there are not good records of where and when construction sites existed, it might be difficult to associate crashes with these sites. Solving such problems requires coordination with the building contractors and the local inspection and licensing authorities.

Major highways. Largely, this guide has focused on pedestrian-vehicle crashes that occur in residential or urban areas. However, major highways also provide special conditions that could contribute to pedestrian-vehicle crashes. One problem could entail highway off-ramps. These ramps contain rapidly exiting cars entering the traffic stream at an angle. Therefore, drivers might not see a pedestrian in time to avoid a collision. The same problem could occur at on-ramps where vehicles enter the highway at an oblique angle from a major thoroughfare.

You should also consider walking along major highways as a special risk factor. For instance, it is possible that when a motorist's vehicle breaks down or runs out of gas on the highway, the driver will likely exit his or her car to inspect the problem or walk to the nearest gas station. In doing so, the person exposes him- or herself to high-speed traffic, without any form of physical separation from passing vehicles.

One-way streets. Busy one-way streets can create a special hazard when motorists looking for vehicle traffic from only one direction fail to notice a pedestrian crossing the road in the opposite direction from where the motorist is looking.

Location of attractions. A popular attraction could be located across the street from where people live. For instance, the only nearby store or restaurant might be opposite to a

large housing complex. In some areas, however, there might not be a convenient marked crossing for pedestrians traveling to such locations. In this case, the solution might be to install a crosswalk or crossing device where pedestrians often cross the street to reach a popular attraction. In other cases, the solution might be to relocate needed services on the side of the road where the majority of residents live, so they do not need to constantly cross the street.

Unlawful street-vending. Unlicensed vendors who sell various items (e.g., bottled water, newspapers, window-washing services) to motorists in streets or from medians risk being hit by a car because they move quickly across traffic lanes and around stopped cars. In some communities, children are increasingly street-vending, especially during summer. Doing so provides those who are too young to work legally with a way to earn money for themselves and their families.[53] Some police departments have begun fining street vendors, while also encouraging young street vendors to sell their items from sidewalks.[54]

Understanding Your Local Problem

The summary of what is known about pedestrian-vehicle crashes and resulting injuries and fatalities provides a very general overview. To understand your local pedestrian-vehicle crash problem, you must combine this general knowledge with specific facts describing your local conditions. Carefully analyzing your local problem will help you design an effective response strategy that fits your specific needs.

Stakeholders

In addition to criminal justice agencies, the following groups have an interest in the pedestrian injury and fatality problem, and you should consult them when gathering information about the problem and responding to it:

- local government agencies (e.g., traffic engineering departments, transportation departments, planning departments, emergency medical services departments, medical examiners' and coroners' offices, public health departments):
  - such agencies could provide data for analyzing the problem and also help plan and implement responses
  - these agencies can implement costly responses that go beyond the scope of local neighborhood or resident groups
  - when approaching government agencies for help, however, it might be useful to suggest building a partnership of several organizations instead of asking a single agency to take sole responsibility for the problem and its solution.

- hospitals that handle crash victims:
  - medical staff (i.e., doctors and nurses) often handle the aftermath of pedestrian injuries and fatalities making them useful advocates to implement responses in your community
  - some medical staff are injury experts and do much in the area of prevention, in addition to the aftermath
  - since medical staff are usually occupied with patients, it might be useful to contact hospital administrators for aid.

- neighborhood safety groups:
  - these groups can use their local knowledge to identify the problem and potential contributing factors
  - their knowledge could be especially useful to identify problems involving special factors that can be difficult to detect
  - government and other agencies might also be more inclined to help plan and implement responses if approached by organized neighborhood safety groups.

- neighborhood resident and business associations:
  - these groups can help guard against negative public reactions to responses that impose a cost on either pedestrians or drivers.

- local schools:
  - schools are critical to developing and distributing pedestrian-safety education/awareness campaigns and information when children and teens are a high-risk group in your community.

- organizations representing high-frequency walkers (e.g., joggers, speed walkers, dog walkers):
  - these organizations could provide input from several high-risk groups that help to develop responses.

- high-frequency drivers (e.g., commuters, taxi drivers):
  - such drivers are likely familiar with travel routes and could help to identify problem locations and contributing factors.

- public transportation authorities that run bus routes:
  - like high-frequency drivers, these authorities are also familiar with travel routes and could help to identify problem locations and contributing factors.

- insurance companies:
  - since insurance companies have a financial stake in pedestrian-vehicle crashes, they might be apt to help develop and fund responses that prevent such crashes.

Asking the Right Questions

Ask the following questions to gain a better understanding of your community's pedestrian injury and fatality problem. The answers to these questions will help you develop an effective response that reduces the frequency of pedestrian injuries and fatalities.

Incidents

- How many pedestrian injuries and fatalities occur in your jurisdiction, community, or area of interest?
- What percentage of pedestrian injuries and fatalities is the fault of pedestrians? Local data could show which factors listed earlier have been contributory causes.

- What are the general circumstances surrounding pedestrian injuries and fatalities (e.g., were pedestrians/drivers intoxicated)? Again, local data could shed light on these circumstances.
- How concerned is the community with the problem of pedestrian injuries and fatalities? This information could be useful for planning responses that involve community participation.
- Does the problem cause traffic congestion or any other potentially harmful problems (e.g., traffic slowing at crash sites)?
- How long has your community had problems with pedestrian injuries and fatalities?
- Do vehicle-vehicle crashes occur in areas of heavy foot traffic because drivers are trying to avoid hitting pedestrians?

Locations/Times

- Where do pedestrian injuries and fatalities frequently occur in your community? Which particular blocks, intersections, or other areas?
- In what types of areas do pedestrian injuries and fatalities frequently occur in (e.g., residential, commercial)?
- Is there a certain community location where pedestrian injuries and fatalities repeatedly occur? For instance, perhaps your community has a popular business that is located midblock but its parking is across a large street.
- When do pedestrian injuries and fatalities frequently occur (morning, midday, or evening; day of week; certain seasons)?

Victims

- Who are the pedestrian victims? Are there noticeable demographic patterns among them (e.g., sex, occupation, age, or limited mobility)?
- What are pedestrians doing before crashes occur (e.g., shopping, running, drinking)?
- Are pedestrian victims mostly community residents or visitors from out of town?
- Typically, how serious are the pedestrians' injuries? For example, do injuries often require emergency medical care? Or are injuries often minor, requiring no medical care?
- What pedestrian characteristics could have caused them to illegally enter or cross a road? For instance, were the victims drinking before entering the road?

Physical Characteristics

- Do common physical conditions exist around crash sites? For instance, are there certain types of traffic signals or crosswalk designs associated with high-frequency crash sites?
- Are your pedestrian crosswalks clearly identifiable to passing motorists as well as to pedestrians? If not, why?
- Do signs or signals (or their absence) appear to contribute to the crashes? For instance, is a crossing signal's timing interval problematic for some pedestrians, is the crossing device broken, or is there no crossing device at the intersection?
- Are sidewalks crowded near problem locations? For instance, is there a popular attraction nearby, or are sidewalks too narrow?

- Are certain sidewalks damaged or difficult to use near problem locations?
- Does weather make walking difficult in your community? What season or type of weather is often associated with pedestrian-vehicle crashes?

Current and Previous Responses

- Does your community currently have enforceable jaywalking laws?
- If so, do police officers commonly enforce jaywalking laws? Also, how do officers handle jaywalking incidents (e.g., give verbal warnings, issue citations, or something else)? If police do not commonly enforce jaywalking laws, why not?
- Do police place higher priority on enforcing pedestrian laws and safety after injuries and fatalities occur?
- What is the typical investigation process for a pedestrian-vehicle crash? Do police typically involve other agencies in these investigations?
- Does your agency have a special unit designed to handle pedestrian traffic enforcement?
- Are local citizens educated on the harms related to unsafe pedestrian behavior? If so, how is that education conveyed?
- Has your community redesigned or installed improved crossing devices?
- How has your community dealt with pedestrian-vehicle crashes in the past? Which agencies were involved? What did these agencies do? How successful at preventing crashes were they?
- Is pedestrian safety routinely considered when planning city streets and sidewalks?

Measuring Your Effectiveness

Measurement allows you to determine to what degree your efforts have succeeded, and suggests how you might modify your responses if they are not producing the intended results. You should take measures of your problem *before* you implement responses, to determine how serious the problem is, and *after* you implement them, to determine whether they have been effective. You should take all measures in both the target area and the surrounding area. For more detailed guidance on measuring effectiveness, see the Problem-Solving Tools guide, *Assessing Responses to Problems: An Introductory Guide for Police Problem-Solvers*.

The following are potentially useful measures of the effectiveness of responses to pedestrian injuries and fatalities. These measures are divided into two groups: those that measure the impact on the problem (so-called outcome measures), and those that measure how well your agency the responses (so-called process measures).

Impact on the Problem

- Reduced number of pedestrian injuries and fatalities in your community
- reduced number of pedestrian injuries and fatalities at hotspots
- reduced calls for police service for pedestrian injuries and fatalities
- reduced seriousness of injuries (e.g., fewer deaths per crash, shorter hospital stays)
- reduced number of secondary crashes (e.g., vehicle-vehicle crashes caused by drivers avoiding pedestrians) associated with the problem.

Impact on Pedestrian and Driver Behavior

- Increased pedestrian perception of risk
- increased pedestrian perception of crossing devices
- increased driver awareness of pedestrian right-of-way laws
- improved sidewalk access and mobility
- compliance with pedestrian laws after any temporary responses (e.g., increased enforcement is removed).

Data, Information, and Analysis

Initially, your agency's ability to reduce incidents of pedestrian injuries and fatalities depends on the data available for analysis. For instance, data are necessary to identify high-frequency pedestrian-vehicle crash locations where you should implement responses or to show if alcohol was involved.

In addition, your agency must also determine which type of pedestrian behavior is problematic and which factors contribute to pedestrian injuries and fatalities. Several methods of data collection could help your agency analyze these variables.

First, your agency could systematically observe pedestrian walking behavior at identified problem areas. You could identify problem areas through pedestrian injury and fatality statistics. Systematic observation allows you to analyze variables such as street/sidewalk design, pedestrian signs/crossing devices, pedestrian paths, etc. To best understand the problem, the observers should not be uniformed police officers, or if they are, they should be hidden from the view of the people being watched. Otherwise, pedestrians might change their behavior and you will not know how

they behave when the police are not present. You can use videotapes of these observations for detailed analysis and group discussion later. You can also use videotapes to help illustrate the problem to other stakeholders, educate the public, and potentially evaluate the response (by comparing before-and-after response video imagery of the same location at the same times).

Second, your agency should consider conducting surveys of pedestrians in the problem areas. You should design surveys to reveal why pedestrians choose certain behaviors at particular locations rather than other behaviors. You can also use them to learn about pedestrian perceptions of signs, signals, and other physical conditions. For an example of a police-pedestrian survey from the Madison (Wisconsin) Police Department, see www.ci.madison.wi.us/police/pedestrian.html.

Third, your agency could interview drivers and pedestrians involved in crashes. These data could provide detailed accounts of the situation leading up to the crash. In addition, police investigative reports can provide important information. Data from other first responders (i.e., fire and EMS) might also be useful, as well as information from emergency room physicians. Because of medical privacy legislation, medical staff cannot share much of this data. However, discussions with medical professionals can identify ways to ensure patient privacy and legal compliance, and still yield valuable information.

Fourth, your agency should compare streets with high rates of pedestrian injuries and fatalities to similar streets (in terms of traffic volume, pedestrian volume, location types, etc.) without many pedestrian injuries and fatalities. This will help reveal factors that are major contributors to the problem (factors found at problem locations but not at similar nonproblem locations).

Responses to the Problem of Pedestrian Injuries and Fatalities

Once you have analyzed your local problem and established a baseline for measuring effectiveness, you should consider possible responses to address the problem. The following responses provide a foundation of ideas for addressing your particular pedestrian-vehicle crash problem. Several of these responses may be applicable to your community's problem. It is critical that you tailor responses to local circumstances, and that you can justify each response based on reliable analysis of your local conditions. In most cases, an effective strategy will involve implementing several different responses. Law enforcement responses alone are seldom effective in reducing or solving such a problem. Do not limit yourself to considering what police can do: carefully consider whether others in your community share responsibility for the problem and can help police better respond to it. In some cases, you may need to be shift the responsibility to those who can implement more-effective responses. For example, it might be that redesigning an intersection may be the most effective response. In such a circumstance nonpolice public agencies and private organizations will have to do most of the work in carrying out the response. (For more detailed information on shifting and sharing responsibility, see Response Guide No. 3, *Shifting and Sharing Responsibility for Public Safety Problems*.)

General Considerations for an Effective Response Strategy

The following are some general considerations that may help you develop and implement an effective response strategy.

1. Designating a special pedestrian-safety taskforce within your agency. If pedestrian safety problems are common and serious, then it may be worth considering creating a special group to address these problems. Because the pedestrian behaviors that lead to crashes are often minor, police officers sometimes ignore them. A special group can give them the priority they deserve and can have the flexibility to devise creative responses, based on analysis, that have an impact on the problems.

The taskforce might be temporary, with a limited mandate to address specific problems, after which it will disband. Or it might be a permanent special unit, with long-term responsibility. In either case, this response works best if the group has the goal of reducing crashes, injuries and deaths, and that hard data measure the achievement of this goal. Under no circumstances should you measure the group's success by their activities—citations issued, arrests made, meetings attended, fliers passed out, etc. In short, if the taskforce is not reducing crashes, injuries, or deaths, then it is not working.

2. Training city planners to consider pedestrian safety. City planners are typically involved in road construction, sidewalk repair, sidewalk extensions, etc. Therefore, these personnel should be trained to consider pedestrian safety when modifying the city environment. In doing so, city planners could proactively "design out" the possibility of pedestrian injuries and fatalities before

they become a community problem. Some of the websites listed in Appendix B provide information you could use to train city planners on improving pedestrian safety through environmental design.

3. Creating ordinances to reduce pedestrian-vehicle crashes. Pedestrian ordinances could target certain factors that cause pedestrian-vehicle crashes. For instance, some communities have ordinances that require drivers to park their vehicles a certain distance from marked crosswalks to help drivers and pedestrians see each other.[55] It is likely that many cities have parking enforcement agencies, recognizing that enforcement will not be a high police priority. To be most effective, ordinances should target high-risk locations.

4. Guarding against negative public reactions. Responses that impose a cost on either pedestrians or drivers can cause them to change behaviors. That is the point. But some possible changes could displace the problem. If drivers shift from major streets to residential side streets to avoid traffic calming, for example, they may put pedestrians on the side streets at risk. If midblock crossing is encouraged, but nothing is done to warn drivers, then making it easier to cross midblock will increase pedestrian-vehicle crashes.

There is considerable controversy over perceived police differential enforcement against minorities, particularly young minority males. Young male pedestrians are at higher risk of being involved in crashes than older males and women, so enforcement will likely impact them the most. If the problem area is in a minority neighborhood, perceptions of racial profiling might increase, unless police discuss the problem and possible responses with the community in advance.

Even when race is not a factor, those subject to enforcement are likely to perceive it as unfair, unless the police have already sensitized the community to the problem and the need for pedestrians to follow crossing rules. In addition, local merchants, who may rely on pedestrians or drivers, may feel that anything that inconveniences their customers imperils their livelihoods. Working with them early in the problem-solving process can allay some of these fears and help craft solutions that benefit everyone. Finally, gaining community members' and leaders' support might guard against negative public reactions. For example, upset residents might be more tolerant of enforcement if their neighbor or a prominent community leader is standing alongside the police department, explaining the necessity of the enforcement.

One way to gain community support could be to create community-pedestrian safety teams or groups. These collaborative groups could include representatives from law enforcement, city/county traffic engineering, and community and business groups. Such groups could help get feedback from the community about the problem of pedestrian injuries and fatalities, as well as aid in the understanding of the problem and the possible solutions. All the while, including community participants could help create "buy-in" to whatever resulting changes safety teams propose.

Using a Process Model to Develop Specific Responses

This guide has focused on two actors involved in the process of a pedestrian-vehicle crash: the pedestrian and the driver. It has also focused on the physical environment immediately around these two actors' interaction. We can usefully expand the ideas the pedestrian-vehicle crash triangle summarizes by considering the process by which these crashes take place. Figure 3 depicts this process.

Before pedestrians and drivers are in the same environment, either or both have acted early to either help prevent a crash or make it more likely. Examples of this include drinking, talking on a cell phone, or speeding. As the two actors converge, their earlier decisions influence what they can do just before a potential crash. We call these the immediate actions. Some immediate actions help prevent the crash (e.g., looking both ways before crossing, crossing at the light, slowing down when pedestrians appear to be trying to cross the road, etc) while others make the crash more likely (e.g., darting off the curb).

The physical environment plays a large role here. A barricade, for example, can prevent a drunken pedestrian from crossing a car's path. The physical environment includes all the proximate physical circumstances that can facilitate or prevent a crash (e.g., signs, signals, barriers, curbs, cars parked at curbs, ice, lighting conditions). The agents' interaction in this environment determines if a crash will occur.

Finally, as the actors separate, there is the aftermath to consider. If the crash was avoided, the aftermath might simply be some jangled nerves. If there is a crash, the aftermath includes the injuries sustained, vehicle damage, traffic congestion, etc. As this guide focuses on prevention, we have not addressed the aftermath here. Nevertheless, a problem-solver might want to consider whether changing how the aftermath is handled—by drivers, pedestrians, police, emergency medical services, emergency room staff, and others—could reduce the harm from crashes that do occur. For example, if a substantial number of drivers leave the scene of crashes without reporting to police (hit-and-run), this problem might require separate examination.

The process model is useful for three reasons. First, the model can help you consider the major factors involved in a particular pedestrian-vehicle crash problem. Second, it can help you organize a list of important questions regarding each component of the crash process. Third, the model can help your agency better formulate responses by considering all areas where they could address the problem (e.g., drivers' early decisions, pedestrians' immediate decisions). (See Appendix C, "Developing a Comprehensive Response to Pedestrian-Vehicle Crashes.") The responses this guide next discusses target several components of the process model.

The process model suggests five separate intervention points for a comprehensive response to a pedestrian-vehicle crash: two each for the two actors—to influence early and immediate actions—and one for the physical environment. The responses that follow influence one or more of these five points (we have labeled pedestrian

and driver interventions as "early" and "immediate" to show how they fit into this process). Though you should not neglect the aftermath, it is important to remember that preventing the crash in the first place should be the primary goal.

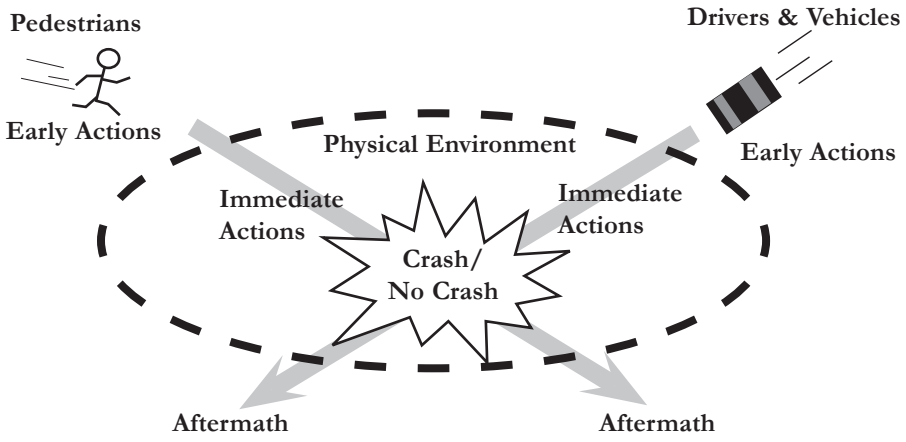


Figure 3: The process of pedestrian-vehicle crashes

Some evaluation research studies directly examine the problem of pedestrian injuries and fatalities. Many of these analyses, however, report mixed results regarding the effectiveness of certain responses. And researchers have not evaluated some responses. For these reasons, many of the following responses are suggested because of their *potential* effectiveness for *particular* circumstances, rather than for widespread applicability. It is important that you continually evaluate your response to assess its impact in your particular community.

Specific Responses to Pedestrian Injuries and Fatalities

Pedestrian Behavior

This set of responses addresses both early and immediate actions.

5. Establishing hotspot-specific crackdowns on jaywalking (immediate). As mentioned, pedestrians might jaywalk if they do not perceive any consequences for their actions. Therefore, your agency could consider increasing the priority of jaywalking enforcement. This approach works best under five conditions:

- First, the enforcement focuses on a known crash hotspot. Evidence of crackdown effectiveness against other offenses suggests that crackdowns are effective when concentrated in small hotspots, but their effects wear off (see Response Guide No. 1, *The Benefits and Consequences of Police Crackdowns*).
- Second, the enforcement concentrates on known times of crashes in these hotspots.
- Third, the police clearly articulate the reasons for enforcement to the local community, so it is seen as necessary and not arbitrary.
- Fourth, officers actually act on the increased priority.
- Fifth, the penalties are sufficiently strong to induce pedestrians to avoid jaywalking but not so onerous that citizen complaints force the police to reduce enforcement prematurely.

It is also important to note that enforcement crackdowns are seldom sustainable for long periods, so you should best consider crackdowns as a short-term response and not a long-

term solution. Consider them to be a short-term supplement to other longer-term responses.

There is some evidence, however, that jaywalking enforcement programs may not achieve much deterrence. As mentioned above, one report described the "crackdown" that New York City waged on jaywalking during the late-1990s. Nonetheless, this effort to step up jaywalking enforcement seemed to go unnoticed by both police authorities and citizens. In fact, the same article noted that the president of the police officers' union claimed he had forgotten about the crackdown, while at the same time, dozens of jaywalking New Yorkers said they had seen no change in jaywalking enforcement.

Finally, although jaywalking and other types of pedestrian behavior have been emphasized as major factors in pedestrian injuries and fatalities, it is important not to confuse the ends and means of the problem. In other words, your agency's goal should be to reduce pedestrian encounters with moving vehicles, not necessarily to reduce jaywalking. Therefore, be mindful that you should frame responses aimed at pedestrian behavior in the context of reducing actual pedestrian injuries and fatalities, rather than part of a more general crime control strategy.

6. Launching location-specific pedestrian-safety education/awareness campaigns (early). Some pedestrians might not accurately perceive the risk of injury or fatality from a collision with a vehicle. Consequently, they engage in risky behavior. Pedestrian-safety education/awareness campaigns are a way to alert the public to the dangers of such behavior.[56] Some campaigns appear to be effective. For instance, the National Highway Traffic Safety Administration developed an educational video ("Willie Whistle") intended to teach kindergarteners to third-graders safe crossing practices.

An evaluation of the campaign revealed that "dart-and-dash" collisions involving four- to six-year-olds were reduced by 30 percent in test cities.[57] In addition, you could target safety campaigns toward unsafe driver behavior. Materials that could help in designing such campaigns are currently available. For a start, see the web resources for improving pedestrian safety in Appendix B.

§ See Response Guide No. 5, *Crime Prevention Publicity Campaigns*.

In some cities, citizen groups have also created awareness campaigns against jaywalking. For example, volunteers in Shanghai, China have monitored some of the city's crosswalks.[58] These citizens believe that figurative "whistle-blowing" can improve public awareness of the problem of jaywalking.

Education/awareness campaigns are more successful when they target people who are directly at risk of the problem.[§] For instance, if the problem involves a particular high school where students jaywalk at the school's opening and closing times, then the campaign should focus on those students and not on students in other, low-risk schools. In addition, you should isolate the awareness campaign's geographic coverage to problem areas. Using the same example, the message will be more effective if delivered at or near the intersections where the problem occurs, rather than only in school assemblies, for instance. General public-safety campaigns targeting the larger community are largely ineffective, as most people are unaffected by the problem, and the few that are affected forget about the message before they need to apply it.

7. Coordinating crossing devices to facilitate uninterrupted walking paths (immediate). Some urban pedestrians disobey crossing devices because of their pace of life. These "rushed" pedestrians may have less need to cross against a "Don't Walk" signal when crossing systems allow for an uninterrupted walking sequence. This response could be inexpensive, as it only involves manipulating crossing-device timing. However, one possible drawback of this response could be increased traffic congestion. Furthermore, coordinating crossing devices at certain locations could be difficult if there is a mix of both pedestrians with and without limited mobility. In other words, the timing of a particular crossing sequence might not accommodate all types of pedestrians.

8. Installing pedestrian countdown-timer signals at problem intersections (immediate). Some pedestrians might avoid waiting at crossing lights because of the uncertainty of how the long the wait might be.[59] Countdown-timer signals inform pedestrians how much time they have until a "Walk" signal flashes, thereby removing the uncertainty. In one community, this crossing system resulted in a 12 percent reduction in jaywalking.[60]

Another type of timer signal counts the amount of time a pedestrian has left to cross, rather than the amount of time until a "Walk" signal flashes. Walkers view the devices favorably because they provide additional information, and they understand them better than conventional pedestrian signals.[61] Easily understood crossing systems could discourage pedestrians from resorting to jaywalking. The signals are easy to install, have a positive maintenance record, and have been credited with a 52 percent reduction in pedestrian injury collisions.[62]

9. Addressing pedestrian drinking behavior (early). If the problem stems from pedestrians' drinking at bars, then focusing on that might be effective (see box).

Addressing Pedestrians' Early Actions: Bar Management and Pedestrian Safety in Shawnee, Kansas[63]

In some circumstances, bars' serving practices combine with street crossing configurations and traffic flow to create dangerous situations. In this example, a police effort to reduce calls from a problem bar seems to have had the positive side effect of reducing pedestrian-vehicle crashes. The Shawnee Police Department's crime analyst, Susan Smith, had identified one bar we will call "Ferro's" as the source of a very high number of calls, particularly involving assaults.

Pedestrian-Vehicle Crashes Before and After Changing Bar Management Practices

Year	Accidents
2001	4
2002	6
2003	8
2004	7
2005	2
2006	1

Ferro's was located on a major thoroughfare. The bar attracted a very large crowd, but patrons had to park on the far side of the thoroughfare. Large numbers of patrons, therefore, crossed the road sober and returned to their cars drunk.

To reduce the violence calls, police put pressure on the owners to improve their bar management practices. Among the many changes the owners introduced was a reduction in the number of patrons, which lessened the crowding and accompanying provocations leading to fights. Though the police looked into ways to move the parking area to the same side of the street as Ferro's, they were unsuccessful.

Nevertheless, the bar management improvements may have reduced pedestrian-vehicle crashes, as can be seen in the accompanying table. Smith's work and police pressure to change Ferro's practices began in May 2004. If the figures for 2005–06 are indicative of future crashes, then changing bar management reduced the problem from two thirds to three quarters of the 2002–04 levels. The decline might be due to fewer patrons' crossing the street, or to patrons' being less inebriated when returning to their vehicles. In either case, if a random fluctuation did not cause the drop in crashes, it seems quite likely that the drop was due to changes in bar practices, as there were no other changes in the immediate area that could have caused this drop.

Vehicle and Driver Factors

All of these responses address early decisions, though one also influences immediate decisions. Because of drivers' isolation in their vehicles and the speed they are traveling, it is difficult to craft immediate responses directed drivers. The physical environment responses, shown later, have immediate effects on drivers and/or pedestrians.

§ See Problem-Specific Guide No. 3, *Speeding in Residential Areas*, for further information on controlling speeding.

10. Enforcing speeding violations and other unsafe driver behaviors at high-risk locations (early). Since pedestrians are more likely to be injured or killed as vehicle speeds increase, police could establish speed zones and increase the number of speeding citations at high-risk locations.§ One way to establish a speed zone could be to install traffic cameras at problem intersections. In addition, local court authorities should aggressively enforce violations related to pedestrian safety. Beyond speeding enforcement, police should also issue citations for unsafe driver behavior that could put pedestrians at risk at intersections (e.g., running red lights, turning on red without looking, failing to yield right-of-way to pedestrians). The more focused enforcement is at high-risk places, and the more the community understands the reasons for the enforcement, the less likely it is to create pressure from the public to curtail the enforcement. As with pedestrian enforcement, you should consider speed enforcement a temporary strategy supporting a longer-term solution.

11. Increasing driver's perceptions of risk regarding pedestrian injuries and fatalities (early). An information program's impact is probably very low unless police highly target the program at drivers who frequent high-risk locations, and it occurs at those locations. Highly visible warning signs and other devices near crash hotspots may be more effective than general campaigns. During traffic stops at high-risk locations, police officers could distribute information regarding

§ See the POP guide titled *Drunk Driving* for further information on controlling drunken drivers.

pedestrian and vehicle safety. Another way to make drivers aware of the risk of pedestrian injuries and fatalities is through community-based safety campaigns. For instance, community residents could post lawn signs notifying drivers to slow down because children are at play. In addition, similar to the anti-speeding strategy the Madison Police Department used, community volunteers could join police officers on traffic stops to help explain to speeding drivers the dangers of pedestrian-vehicle crashes. Though it is often difficult to convey information to drivers in moving vehicles, in highly specific circumstances, there may be opportunities to make some of these approaches very useful.

12. Diverting or calming traffic near pedestrian-vehicle crash hotspots (early and immediate). Police could use barricades or other rerouting devices to direct vehicle traffic away from high-risk locations. In addition, installing speed bumps or speed humps is another option. Speed bumps or humps calm traffic without directly causing drivers to divert from their typical travel routes. In both cases, vehicle traffic could increase in other nearby areas as drivers try to avoid traffic calming. Consequently, areas not experiencing many pedestrian injuries and fatalities could become high-risk locations. So traffic calming should work best when there are few good alternative routes and maintaining rapid traffic flow is not a high priority. In addition, it might be best to divert traffic to nearby areas that have small pedestrian populations.

13. Addressing drunken drivers (early). This response is likely most appropriate in "night life" areas marked by both heavy pedestrian and vehicle traffic. Police could establish DUI checkpoints to deter drunken motorists from driving in areas with heavy pedestrian traffic. They could use this response in conjunction with monitoring drunken pedestrians, as mentioned above. Interventions with bar owners regarding serving policies might also be useful in some circumstances.§

Immediate Physical Environment

Because the physical environment surrounds the immediate decisions, all of these interventions are designed to influence pedestrian and/or driver decisions in the immediate context of a potential crash. In addition, some of the following responses focus on improving existing crossing systems and other safety measures. Some crash hotspots, however, might not have any crossing systems or safety measures to begin with. Therefore, your agency might consider less expensive devices before resorting to some of the more sophisticated crossing systems and safety measures discussed below.

14. Constructing pedestrian barriers to separate foot traffic from vehicles at pedestrian-vehicle collision hotspots. This response is based on the idea that physical separation keeps pedestrians from crossing streets at prohibited sites. In two cities, significant decreases occurred in the number of pedestrians crossing midblock before and after the installation of pedestrian barricades.[64] One drawback, however, is that installing such barricades can be expensive.[65] However, using more-inexpensive barricades, such as shrubs and planters, could also be an option. A variation on these barricades is to place them down the middle of very wide streets, in a median. Pedestrians thinking of crossing would note that they could not cross completely so they would go to the appropriate crossing. One drawback to this option is that the barricade can act as a trap for pedestrians who miscalculate and try to cross the street.

John Eck

A variety of safety barriers are possible. The first photo shows a simple barrier designed to separate children from their parents' vehicles during drop-off and pick-up times at a private school. The second photo shows a barrier along a busy street that was designed to enhance the environment. The barrier consists of a decorative chain, plantings, street furniture, and a change in the walking surface. It leads to a designated crossing point marked by signs and lights. The lights are pedestrian-controlled.

15. Installing curb extensions at problem locations. At both intersections and midblock areas, the curb can be extended into the road to narrow the distance between crossing points and increase visibility for both drivers and pedestrians (e.g., when looking past parked cars).[66] One problem with curb extensions is that they place pedestrians closer to moving traffic when compared with traditional intersections. In addition, curb extensions could affect bus routes, require maintenance, and interfere with street drainage patterns.[67]

16. Installing crossing systems that include a pedestrian detection system. These crossing systems have low poles with sensors on both sides of the crosswalk. When pedestrians approach, warning lights that are raised above the pavement send a bright beam of light toward oncoming traffic to yield.[68] The systems run on solar power, so power loss is not a problem, at least in areas with sufficient sunlight. These systems give pedestrians the right-of-way, which caused a reduction in pedestrians' crossing outside the crosswalk in

one evaluation.[69] The appearance of these crossing systems, however, could confuse both drivers and pedestrians creating a worse hazard.

17. Installing fluorescent strong yellow-green (SYG) pedestrian warning signs. If the visibility of pedestrian warning signs is creating a problem, your agency could consider using fluorescent SYG pedestrian warning signs made from microprismatic material.[70] These types of signs are more reflective and more visible to drivers when compared with traditional engineer-grade yellow pedestrian warning signs.[71] Overall, SYGs have produced marginal improvements in pedestrian safety during daylight conditions.[72] One problem with SYGs is that they are not as effective (i.e., less reflective) under low ambient-light conditions.[73] Therefore, SYGs might not be appropriate for reducing pedestrian-vehicle crashes at hotspots where most crashes occur at dusk, at dawn, or in the evening.

18. Designing wider roads and increasing existing roads' width to deter jaywalking. We could not locate an evaluation of this response's effectiveness. Two obvious drawbacks of this response, however, are that road widening is expensive, and construction could be inconvenient for the community. Another consequence is that wider roads could encourage faster traffic and longer risk-exposure times for pedestrians. Therefore, it might work best if you install pedestrian barricades if you widen roads, and you may want to also increase crossing-signal time for higher-risk pedestrians, as well. In doing so, this strategy could both potentially curb jaywalking and still allow enough time for higher-risk pedestrians to cross safely. Your agency should consider the characteristics of people involved in pedestrian-vehicle crashes before implementing this response. Note that this solution is opposite to the idea of traffic calming.

19. Increasing the length of crossing signal intervals. This response might be most useful at wider roads where specific pedestrian groups (e.g., the elderly, people with limited mobility) are frequently injured or killed because they do not have enough time to cross safely. For reasons mentioned above, this response might be necessary if your agency widens roads to deter jaywalkers.

20. Improving sidewalks and other pedestrian walkways. You should have damaged sidewalks repaired and congested walkways widened. Your agency could reduce jaywalking-related pedestrian-vehicle crashes by providing an acceptable travel surface for pedestrians. Your agency might need to cooperate with homeowners or apartment managers when controlling sidewalk obstructions is their responsibility. If the local government is responsible for trees planted along sidewalks, the appropriate city agency should prune them to a height that allows pedestrians to pass safely.

21. Encouraging pedestrians to cross at controlled intersections. Midblock bus stops increase the risk pedestrians will cross midblock, even when there is no crossing. The city of San Diego relocated several bus stops from midblock to locations closer to intersections.[74] This strategy increased the use of marked crosswalks and pedestrian signals at the intersections.

22. Increasing lighting near high-risk intersections and pedestrian routes. To ensure that drivers can see pedestrians at night, the city should install lights near high-risk intersections and pedestrian routes. If lights are already present in these types of areas, you should have their brightness assessed and increased, if needed.

John Eck

A pedestrian safety island. This island is on a busy street bounding a large university. It was created when the university built a student housing complex on the opposite side of the street. It is marked by signs, but does not have a light.

23. Providing midblock pedestrian islands when blocks are long and streets are wide. If pedestrians have to walk very long distances out of their way to cross a street, then they are more likely to cross in midblock. Facilitating safe crossing midblock is an option in such cases. When the streets are wide, a safe haven in the middle of the street lets pedestrians make two short crossings. Further, they have to look only one way for oncoming traffic, rather than having to look for vehicles coming from two directions. You should ensure that the islands are clearly marked for pedestrians and visible to drivers, so they can easily move around them but still see pedestrians.

24. Providing marked midblock crossings on narrow streets. In areas where pedestrian traffic and street crossing is common, you can have designated midblock crossings marked on the pavement and through signs. This notifies drivers about pedestrians' right-of-way in such crossings. You often find such a response in shopping areas, on streets with busy bus stops on both sides (thus facilitating transfers), and around college campuses. Clearly, these crosswalks impede vehicle traffic, so they are best used on streets where flow speed is not essential and traffic calming is desirable.

In addition, raising crosswalks' table higher than the road (so they act like speed humps), and/or building crosswalks out of textured material, can also draw drivers' attention to them. In snowy communities, however, such crosswalks might not be viable due to snowplow damage.

25. Establishing parking regulations in low-visibility areas. Cars parked on the street could flank some crossing areas while cars parked at the end of driveways could block sidewalks. Consequently, pedestrians might cross from between cars parked where it is difficult to see oncoming traffic, or enter roads to avoid parked cars. Therefore, removing parked cars from such areas could increase both pedestrian and driver visibility.

26. Creating pedestrian flag locations. The city of Madison has installed pedestrian flags at 50 intersections as part of the "Flags Over Dane County" program. These flags are meant to make drivers aware of pedestrian traffic, causing them to yield. Specifically, pedestrians first use red flags to signal their intent to cross the street, then cross while still holding the flags. Although flag-carrying pedestrians have the right-of-way, they should not assume that carrying a flag is a safeguard in itself. Pedestrians should still be cautious of heavy vehicle traffic and the fact that some motorists might not see a flag. For more information on Madison's specific strategy, see www.ci.madison.wi.us/police/pedestrianflags.html.

27. Using portable pedestrian warning signs. You can use portable warning signs to make both drivers and pedestrians aware of pedestrian safety near crash hotspots. Portable signs are likely less expensive than more-permanent environmental changes. In addition, you can quickly install portable signs if other crash hotspots develop.

28. Installing in-street yield-to-pedestrian signs. In-street yield-to-pedestrian signs might be more visible to drivers than pedestrian signs that are located near intersection sidewalks. In Madison, in-street yield-to-pedestrian signs led to a significant increase in drivers' yielding to pedestrians in two out of three test locations.[75] At the site where researchers found no improvement, the in-street yield sign was placed on a raised median and farthest from vehicle travel lanes.[76] Therefore, this response's effectiveness might depend on where you place the signs and on the intersections' characteristics.

Special Conditions

29. Maintaining walking surfaces in inclement weather. If your community experiences snowy and icy weather, your agency might want to encourage local government and business owners to maintain safe walking surfaces. For instance, perhaps snow removal and sidewalk de-icing near dangerous intersections might enable pedestrians to avoid crashes with cars.

30. Improving conditions for pedestrians with limited mobility. In areas where pedestrians with limited mobility represent a large proportion of the population, it might be possible to design sidewalks to accommodate wheelchair/scooter travel. At minimum, sidewalks should be smooth, have no obstructions, and have useable curb cuts (i.e., they do not fill with water, snow, or ice in inclement weather). In addition, your agency could encourage pedestrians with limited mobility to use high-visibility accessories on their chairs and scooters. In any case, during scanning and analysis, police should look at victims' capabilities and assess whether there is a separate problem associated with a special population. If so, partnering with a local, state, or national organization for such people is advisable. It is worth noting that many of the same features that aid people with

movement-related limitations also help people without these limitations (e.g., all pedestrians benefit from sidewalks without buckled pavement, cracks, and water traps).

31. Making streets safer for children and teens. You can apply most of the responses in this guide to specific problems involving children and teens. However, there may be particular considerations. Improving or creating recreation sites that serve the needs of children and teens can shift their play from streets to safe areas. But doing so will work only if the recreation sites facilitate the play they are interested in: a playground for toddlers will not serve the needs of 12- or 16-year-olds, for example. Along walking routes to schools, it has been common practice for crossing guards, parents, and older children to provide street-crossing supervision.

Consulting with schools, recreation departments, parents, and others involved with children and teens will be important in crafting an effective response. For instance, the Hamilton-Wentworth (Ontario) Police Department partnered with various city departments, the board of education, parents' associations, and other related traffic-safety councils to develop KIDestrian.[77] This strategy resulted in the development and distribution of a pedestrian safety book, along with kits that included a series of safety information and practical exercises.[78] In addition, you might consult with older children and teens to understand what responses these groups find most appealing.

32. Improving pedestrian safety in shopping-center parking areas. You could improve parking areas with some of the same measures used to make city streets safer for pedestrians. For example, local commerce organizations or business owners could install signs, crossing devices, crosswalks, and lighting to increase visibility for both pedestrians and drivers.

33. Monitoring construction sites. Your agency could partner with builder associations to make sure pedestrian detour routes are more convenient and safer to use. In addition, your agency could make sure debris and other construction materials do not block pedestrian paths.

34. Improving safety for workers at higher risk of crashes. You could encourage the training of newly hired workers in high-risk positions to avoid dangerous situations and behaviors during orientation seminars. In addition, high-visibility gear and equipment (e.g., reflective clothing, vehicle warning lights) could also make workers more visible to oncoming motorists. You should encourage agencies whose employees work on the streets to adopt safer standard operating procedures.

35. Separating pedestrians from highway entrance/exit ramps. Building pedestrian tunnels and bridges near highway ramps provides a place for pedestrians to walk that separates them from merging traffic. However, some liabilities to both structures exist. First, pedestrian tunnels could induce the fear of being mugged. Therefore, tunnels should be well lit and short and wide enough that someone, upon entering, can see the other side. Second, tunnels should not contain obstructions behind which people could hide. Third, pedestrian bridges could become icy and dangerous in the winter. Fourth, building both pedestrian tunnels and bridges is very expensive. Fifth, some pedestrians might avoid these structures because they require extra effort to descend or climb stairs. Finally, overpasses can also create opportunities for vandalism and throwing objects at vehicles passing below.

36. Relocating popular attractions or services. When nearby attractions or services are across the street from where many residents live or from parking facilities or locations, it might be possible to relocate such places on the side of the road where most people live or park, so they do not need to cross the road. Relocating businesses is likely very expensive and would require major rezoning. In addition, established business owners might be reluctant to move their location.

§ See Response Guide No. 5, *Crime Prevention Publicity Campaigns*.

Responses With Limited Effectiveness

37. Redesigning dangerous vehicles. Vehicles, in particular light truck vehicles, should be redesigned to minimize the harm caused in pedestrian-vehicle crashes. However, redesigning vehicles likely does little to reduce the actual occurrence of pedestrian-vehicle crashes. Therefore, the response is largely limited to reducing the severity of the crash rather than the likelihood of the crash itself. Though redesigning vehicles is beyond any single local government's ability, restricting which types of vehicles can use particular streets may be useful in some circumstances.

38. Launching a *general* pedestrian-safety education/ awareness campaign. As mentioned, publicity campaigns used to educate the public on pedestrian-vehicle crashes should target a specific audience, ideally potential victims and offenders.§ Therefore, informing the general public about pedestrian-vehicle crashes is probably a waste of resources as such campaigns may not reach the relatively few people who need to know. Furthermore, a general education campaign would not target the times and places most salient to the pedestrians and drivers involved. Outside of the crash hotspots, bill boards, radio and television spots, and other media efforts are unlikely to convey the message to the right people when they can use it.

39. Launching a *general* enforcement campaign against jaywalkers. Enforcement is effective when highly focused, and then only as an interim solution. Citywide enforcement campaigns to improve pedestrian safety are unlikely to work for four reasons: 1) police are spread too thin to create a strong deterrent; 2) the average patrol officer has many other higher-priority tasks; 3) police will direct most of the effort at locations where pedestrian-vehicle crash risks are low; and 4) broadscale enforcement undermines police authority by increasing negative police-citizen interactions.

Considering a Combined Response

Some communities could experience multiple factors that cause a pedestrian injury and fatality problem. For instance, it is possible that your community has high-risk areas due to pedestrian behavior and vehicle and driver factors, as well as structural issues. The following example shows how the city of San Diego used enforcement, education, and engineering to address pedestrian and structural factors.

A Combined Response to Pedestrian-Vehicle Crashes in San Diego[79]

In 1998, the city of San Diego experienced 24 fatal crashes involving pedestrians, with pedestrians' being at fault 80 percent of the time. In 1999, the city experienced a 50 percent increase in fatal crashes involving pedestrians, with pedestrians' being at fault 72 percent of the time. Analysts discovered that the problem disproportionately occurred along two main streets.

Police used the SARA (Scanning, Analysis, Response, and Assessment) process to address the problem. Following analysis, the San Diego Police Department developed a response that included enforcement, education, and engineering strategies.
The strategy involved these elements:

Enforcement: A multiunit approach to aggressive jaywalking enforcement resulted in 859 pedestrian-officer contacts.

Education: Officers from the Traffic Safety Office developed a brochure outlining pedestrian safety and responsibility. In addition, media coverage highlighted the problem of pedestrian-vehicle crashes, applicable laws, and the police department's response.

Engineering: The problem was related to midblock bus stops, where riders exited and crossed the street midblock rather than walking to the nearest pedestrian-regulated intersection. Therefore, the city moved eight different bus stops from midblock locations closer to intersections (thereby increasing the use of marked crosswalks and pedestrian signals).

Later evaluation revealed that there was nearly a 20 percent reduction in the pedestrian-vehicle crash rate in the project area.

Appendix A: Summary of General Considerations and Responses to Pedestrian Injuries and Fatalities

The table below summarizes the responses to pedestrian injuries and fatalities, the mechanism by which they are intended to work, the conditions under which they ought to work best, and some factors you should consider before implementing a particular response. It is critical that you tailor responses to local circumstances, and that you can justify each response based on reliable analysis. In most cases, an effective strategy will involve implementing several different responses. Law enforcement responses alone are seldom effective in reducing or solving the problem.

Response No.	Page No.	Response	How It Works	Works Best If…	Considerations
General Considerations for an Effective Response Strategy					
1	36	Designating a special pedestrian-safety task force within your agency	A subunit within your agency focuses on enforcing pedestrian regulations	…your community's pedestrian-safety problems are common and serious	Creating a subunit within your agency may require funds to support additional staffing, training, and equipment
2	36	Training city planners to consider pedestrian safety	Educating planners on pedestrian safety could result in "designing out" unsafe walking conditions	…planners take training seriously and actually put it into practice and structural modification	In some cases, "designing out" unsafe walking conditions might not be possible due to training or structural modification costs; your agency would also have to establish a working relationship with city planners or those responsible for road design

Response No.	Page No.	Response	How It Works	Works Best If…	Considerations
3	37	Creating ordinances to reduce pedestrian-vehicle crashes	Officially regulates situations that could increase the crash risks	…police enforce ordinances seriously, especially at high-risk locations	For reasons mentioned above, police may not give high priority to enforcing safety ordinances
4	37	Guarding against negative public reactions	Your agency should work with residents, businesses, and community groups to allay their fears about the negative impact of pedestrian safety strategies	…your agency partners with residents, businesses, and community groups early in the problem-solving process	Regardless of early efforts to work with the public, there will still likely be some controversy surrounding problem displacement and certain strategies' fairness
Specific Responses to Pedestrian Injuries and Fatalities					
Pedestrian Behavior					
5	42	Establishing hotspot-specific crackdowns on jaywalking (immediate)	It increases the threat of citations and penalties	…enforcement is focused on hotspots, concentrated at known times in hotspots, seen as necessary by the community, considered high priority, and coupled with sufficient penalties	An enforcement crackdown may not be an adequate long-term response; it could also unnecessarily anger the public
6	43	Launching location-specific pedestrian-safety education/ awareness campaigns (early)	High-risk pedestrians are educated on the risks associated with pedestrian-vehicle crashes	…the awareness campaign targets pedestrians at high risk and is close to where the problem occurs	Avoid campaigns that are too general because the message may not reach the intended audience or address the problem

Response No.	Page No.	Response	How It Works	Works Best If…	Considerations
7	45	Coordinating crossing devices to facilitate uninterrupted walking paths (immediate)	When pedestrians cross one street, the adjacent crossing signal is timed to allow an uninterrupted walking sequence	…pedestrian-vehicle crashes occur where pedestrian walking sequences are restricted by lengthy time intervals	Adjusting signals to facilitate uninterrupted walking sequences might disrupt vehicle flow, causing traffic congestion; in addition, a timed crossing sequence might not accommodate all pedestrians' speed
8	45	Installing pedestrian countdown-timer signals at problem intersections (immediate)	It provides a timer indicating how much time is left to cross the street or how much time is left before a "Walk" signal flashes	…your community's pedestrians jaywalk because of the uncertainty of the waiting time before they can cross the street	Countdown signals still allow pedestrians to cross against "Don't Walk" signals, unlike pedestrian barricades
9	46	Addressing pedestrian drinking behavior (early)	It targets unsafe pedestrian behavior as a result of drinking alcohol	…if police and other stakeholders (i.e., bar owners) at hotspot locations collaborate	The police alone should not bear the burden of addressing pedestrian drinking behavior
Vehicle and Driver Factors					
10	47	Enforcing speeding violations and other unsafe driver behaviors at high-risk locations (early)	Enforcement may deter drivers from speeding	…enforcement campaigns are waged in high-risk areas where speeding is causing the problem	Increased enforcement may increase traffic congestion or cause further distractions; this response could also be hard to maintain over a long time period

Response No.	Page No.	Response	How It Works	Works Best If…	Considerations
11	47	Increasing driver's perceptions of risk regarding pedestrian injuries and fatalities (early)	During traffic stops, police distribute pedestrian-awareness information; also, driver's classes/exams could be redesigned to emphasize pedestrian awareness	…enforcement strategies are in place to increase the distribution of pedestrian-awareness information	Implementing changes in state driver's exams could be difficult for communities dealing with a local problem
12	48	Diverting or calming traffic near pedestrian-vehicle crash hotspots (early and immediate)	The use of speed bumps or route redirection slows traffic in high-risk areas or lessens congestion in those areas	…your agency accurately identifies high-risk areas	Traffic redirection could create high-risk areas on adjacent streets
13	48	Addressing drunken drivers (early)	DUI check points deter drunken drivers from driving in dense pedestrian areas	…your pedestrian injury and fatality problem is concentrated in heavily trafficked nightlife districts	DUI checkpoints could increase traffic congestion, create additional distractions, and disrupt neighborhood businesses
Immediate Physical Environment					
14	49	Constructing pedestrian barriers to separate foot traffic from vehicles at pedestrian-vehicle crash hotspots	It prevents pedestrians from jaywalking by physically taking away the opportunity to do so	…your agency has properly planned to identify high frequency crash sites where the barriers would be most effective	Installation of pedestrian barriers could be expensive and disliked by hurried pedestrians

Response No.	Page No.	Response	How It Works	Works Best If…	Considerations
15	50	Installing curb extensions at problem locations	Street curbs are extended into roads to narrow crossing distances and improve driver/ pedestrian visibility at intersections or midblock areas	…poor driver/ pedestrian visibility or long crossing distances are creating problems	Curb extensions put pedestrians closer to moving traffic; in addition, curb extensions could potentially create several infrastructure problems (see description above)
16	50	Installing crossing systems that include a pedestrian detection system	It initiates crossing beams when pedestrians approach crosswalk	…a cause of jaywalking in your community relates to rushed pedestrians (pace of life) who might be more compliant if given automatic right-of-way	Installation of automated crossing systems might be too costly, and it might upset drivers by restricting their mobility; in addition, these crossing systems could be visually confusing to pedestrians and drivers
17	51	Installing fluorescent strong yellow-green (SYG) pedestrian warning signs	Traditional pedestrian warning signs are replaced with signs made from highly reflective and more-visible material	…crashes occur during daytime hours, when reflective material is most visible	SYGs are not as effective (i.e., less reflective) in low ambient-light conditions
18	51	Designing wider roads and increasing existing roads' width to deter jaywalking	Increasing crossing distances could create the illusion of risk, keeping some pedestrians from jaywalking	…many of your community's pedestrian-vehicle crashes occur on narrow streets	Redesigning streets may be costly and may inconvenience travel ease during construction; this could also increase the crash risk for specific groups of pedestrians (i.e., the elderly) by increasing crossing distance; if this is the case, increasing crossing signal intervals may be necessary

Response No.	Page No.	Response	How It Works	Works Best If…	Considerations
19	52	Increasing the length of crossing signal intervals	It adjusts crossing devices to increase the time pedestrians have to cross the street	…longer walking intervals are needed at wider roads; also, it works best if the area has a high proportion of slower moving pedestrians	Longer crossing intervals mean that traffic will stop at intersections longer; this could result in traffic congestion at certain intersections
20	52	Improving sidewalks and other pedestrian walkways	Better walking conditions may provide pedestrians with more incentive to stay on designated walking paths	…a high frequency of pedestrian-vehicle crashes occur near locations where sidewalks are damaged and overcrowded	Sidewalk improvement and redevelopment may be costly and temporarily inconvenience pedestrian travel
21	52	Encouraging pedestrians to cross at controlled intersections	Public transportation systems establish pickup/drop-off spots near areas with crossing devices	…your community relies heavily on public transportation	Rerouting bus stops may make public transportation more time-consuming and less convenient for riders
22	52	Increasing lighting near high-risk intersections and pedestrian routes	Better visibility may help pedestrians and drivers assess the safety of walking/driving conditions	…high-risk areas are marked by inadequate lighting and poor visibility	Installing and maintaining lights may be costly
23	53	Providing midblock pedestrian islands when blocks are long and streets are wide	It allows two shorter crossings when streets are wide	…pedestrians have to travel long distances to cross certain streets; also, islands should be clearly marked and visible to vehicles	Installing islands may require extensive road construction and costs

Response No.	Page No.	Response	How It Works	Works Best If…	Considerations
24	53	Providing marked midblock crossings on narrow streets	Midblock crossings are marked with signs to calm traffic and alert drivers to pedestrians' right-of-way	...street crossing is common away from intersections and areas without crossing devices	Midblock crosswalks impede vehicle traffic and should be used on streets where flow speed is not essential
25	54	Establishing parking regulations in low-visibility areas	It removes parked cars that restrict the visibility of both pedestrians and drivers	…they are established at locations where pedestrians frequently cross streets between cars	Removing parking spots could increase moving traffic if drivers cannot find parking places; also, drivers may avoid such areas due to the inconvenience; therefore, this strategy may not be suitable for business districts
26	54	Creating pedestrian flag locations	The city installs warning flags at intersections or other crossing areas	…flags are installed at risky locations and are visible to both drivers and pedestrians	Pedestrian flags might not be as noticeable or effective as more permanent environmental changes; also, pedestrians should still use caution while crossing, as there is no guarantee drivers will notice the flags
27	54	Using portable pedestrian warning signs	The city places portable warning signs at intersections or other crossing areas	…warning signs are installed at risky locations and are visible to both drivers and pedestrians	Portable warning signs might not be as noticeable or effective as more-permanent environmental changes

Response No.	Page No.	Response	How It Works	Works Best If…	Considerations
28	55	Installing in-street yield-to-pedestrian signs	The city installs pedestrian signs in the middle of roads to warn drivers to yield to pedestrian traffic	…drivers have difficulty seeing pedestrian warning signs that are posted near sidewalks at intersection crosswalks	These signs' effectiveness might depend on where they are placed (e.g., which intersections)
Special Conditions					
29	55	Maintaining walking surfaces in inclement weather	It makes walking surfaces safe and accommodating, even in poor weather	…your community experiences winter weather that includes ice and snow	Substances used to clear sidewalks (i.e. de-icers, salt) could damage surfaces, resulting in additional costs
30	55	Improving conditions for pedestrians with limited mobility	It makes sidewalks more usable and pedestrians with limited mobility more visible	…it is implemented in areas with a high proportion of pedestrians with limited mobility	Improvements to sidewalks could be costly and benefit only a few
31	56	Making streets safer for children and teens	It addresses the specific needs of children and teens	…special circumstances put children and teens at particular risk	You need to examine carefully the particular needs of children and teens and bring older children and teens brought into the problem-solving process
32	56	Improving pedestrian safety in shopping-center parking areas	It uses measures similar to those aimed at making city streets and intersections safer for pedestrians	…safety measures are aimed at both pedestrians and drivers, since both are distracted in parking areas	Surrounding businesses might have to cover the expense of the safety measures

Response No.	Page No.	Response	How It Works	Works Best If…	Considerations
33	57	Monitoring construction sites	It ensures that pedestrian routes are convenient and accessible	…your agency forms partnerships with building companies so that monitoring continues throughout the project's duration	Construction sites are temporary and frequently change locations; changing conditions could make monitoring difficult; therefore, your agency could work with local government to require contractors to agree to site monitoring at the permitting stage of construction
34	57	Improving safety for workers at higher risk of crashes	It trains high-risk workers to consider dangerous conditions and behavior while on the job; also, workers can use special gear to make themselves more visible to drivers	…workers take the training seriously	Workers may not use safe practices unless they are regulated
35	57	Separating pedestrians from highway entrance/exit ramps	It provides safe walking routes for pedestrians near high-speed traffic	…pedestrian tunnels and bridges are built so that pedestrians are physically separated from merging traffic	Various unintended consequences of both structures might not be considered before construction; see above for possible consequences
36	58	Relocating popular attractions or services	Frequently patronized stores, restaurants, or other businesses are relocated to the side of the road where people live so they do not need to cross the street	…a crash hotspot results from many residents having to continually cross from a central location to patronize attractions or services	Relocating businesses is likely very expensive and would require major rezoning; also, established business owners might be reluctant to move their location

Response No.	Page No.	Response	How It Works	Works Best If…	Considerations
Responses With Limited Effectiveness					
37	58	Redesigning dangerous vehicles	Vehicle body changes can minimize the seriousness of injury and chance of death upon collision	…problematic designs (e.g., light truck vehicles) are identified and improved	This response requires cooperation with government agencies and vehicle manufacturers, which may be beyond your agency's scope
38	58	Launching a *general* pedestrian-safety education/ aware-ness campaign	It uses the mass media to promote pedestrian safety to a general audience	…the problem is widespread and affects many people in your community	Most problems affect only certain people during certain times; therefore, a general message may not reach those who would benefit the most
39	59	Launching a *general* enforcement campaign against jaywalkers	Police crack down on jaywalking throughout the jurisdiction	…crashes are common, largely due to jaywalking, and there are no concentrations	It can create perceptions of racial profiling, puts police in conflict with many citizens who are not at risk, maybe expensive, and is difficult to maintain

** "Immediate" refers to responses that take effect just moments before a possible crash. "Early" marks responses that take effect long before potential crashes. See Figure 3 and accompanying text.*

Appendix B: Web Resources for Improving Pedestrian Safety

Government

The Pedestrian Safety Guide and Countermeasure Selection System

"The Pedestrian Safety Guide and Countermeasure Selection System are meant to provide practitioners with the latest information available for improving the safety and mobility of those who walk. The online tools provide the user with a list of possible engineering, education, or enforcement treatments to improve pedestrian safety and/or mobility based on user input about a specific location" (source: from the URL below, accessed January 6, 2007). www.walkinginfo.org/pedsafe/index.cfm.

Federal Highway Administration: Pedestrian and Bicycle Safety Research Page

It contains reports on effective safety procedures, and other information useful for understanding pedestrian safety. www.tfhrc.gov/safety/pedbike/pedbike.htm.

National Transportation Library

It contains various reports, documents, and other publications on safety issues. http://ntl.bts.gov/display.cfm?sub=e2&cat=5.

Advocacy

Active Living Research

"The chief aim of Active Living Research is to increase knowledge about active living by supporting research to

identify environmental factors and policies with potential to substantially increase levels of physical activity among Americans of all ages, incomes and ethnic backgrounds" (source: from the URL below, accessed January 6, 2007). www.activelivingresearch.org/index.php/What_We_are_Learning/117.

National Center for Bicycling and Walking

"The mission of the National Center for Bicycling & Walking (NCBW) is to help create bicycle-friendly and walkable communities across North America by encouraging and supporting the efforts of individuals, organizations, and agencies" (source: from the URL below, accessed January 6, 2007). www.bikewalk.org.

Partnership for a Walkable America

"The Partnership for a Walkable America (PWA) is a national coalition working to improve the conditions for walking in America and to increase the number of Americans who walk regularly. The members are national governmental agencies and non-profit organizations concerned about three main areas: health, safety and the environment" (source: from the URL below, accessed January 6, 2007). www.Walkableamerica.Org.

Safe Kids Worldwide

"Safe Kids Worldwide is a global network of organizations whose mission is to prevent accidental childhood injury, a leading killer of children 14 and under. More than 450 coalitions in 15 countries bring together health and safety experts, educators, corporations, foundations, governments, and volunteers to educate and protect families" (source: from the URL below, accessed January 6, 2007). www.safekids.org.

Appendix C: Developing a Comprehensive Response to Pedestrian-Vehicle Crashes

This guide has emphasized the interaction of three factors—pedestrians, drivers, and the physical environment—that cause pedestrian-vehicle crashes. This interaction is reflected in the pedestrian-vehicle crash triangle (Figure 1), and in the process of pedestrian-vehicle crashes (Figure 3). The practical implication is that a comprehensive response should address more than one factor: pedestrians, drivers, physical environment, early decisions, and immediate decisions. The following checklist is based on this insight.

This checklist also uses the five main categories of situational crime prevention responses (for more information, see www.popcenter.org): increasing risks, increasing effort, decreasing rewards, decreasing excuses, and decreasing provocations.

- **Increasing risks** involves making the perceived penalty for misbehavior more likely. For example, increased enforcement of speeding or jaywalking increases the risk of fines for people who do so.
- **Increasing effort** involves making it harder to engage in troublesome behavior. For example, traffic calming forces drivers to slow down by making it more difficult to speed.
- **Decreasing rewards** decreases the gain from misbehavior. For example, if pedestrians cross midblock to catch buses, moving bus stops to corners removes the incentive to cross midblock.
- **Decreasing excuses** involves making it more difficult for people to justify their misbehavior. For example, providing clearly marked crossing points for pedestrians reduces their ability to claim they did not know where to cross.

- **Decreasing provocations** involves reducing inducements to misbehave. For example, altering crossing-walk timing to facilitate pedestrian movement reduces pedestrians' perceived need to jaywalk.

Combining the factors discussed in this guide with situational prevention techniques reveals 25 intervention categories (see Table 1). A comprehensive response involves using multiple situational approaches against multiple causes. This approach ensures that one intervention's weaknesses are offset by other interventions' strengths.

In the example shown in the table, the response consists of types of four interventions involving pedestrians (immediate decisions), drivers (early decisions), and the physical environment. These four interventions involve four different situational prevention types: increasing risks to drivers, decreasing drivers' excuses for speeding, decreasing pedestrian provocations to jaywalk, and increasing the difficulty of jaywalking. Notice that because speeding enforcement may not be sustainable, the signs remain as a reminder. Even so, in this example, police may have to employ periodic speeding crackdowns.

Lastly, the "Planning Framework for Preventing Pedestrian-Vehicle Crashes" checklist is designed to provide you with a useful planning tool when developing a response. Supervisors can also use it for approving a response before implementation. Finally, you can use it to document the relationships among the interventions you apply.

Table 1
Example of a Comprehensive Response

Situational Prevention Type	Pedestrians		Drivers & Vehicles		Physical Environment
	Early	Immediate	Early	Immediate	
Increase Risks			Enforce speeding in an area		
Increase Effort					Install pedestrian barricades midblock
Decrease Rewards					
Decrease Excuses			Erect signs warning of pedestrians		
Decrease Provocations		Coordinate crossing-light timing			

Planning Framework for Preventing Pedestrian-Vehicle Crashes

Problem: _____ Date: _____

INTERVENTION CLASSIFICATIONS

SITUATIONAL PREVENTION TYPE	Early Pedestrian Decisions	Immediate Pedestrian Decisions	Early Driver Decisions	Immediate Driver Decisions	Physical Environment
Increase Risk					
Increase Effort					
Reduce Rewards					
Remove Excuses					
Reduce Provocations					
TOTAL INTERVENTIONS					

Planning Assessment*

1. Have you used at least one *intervention* for pedestrians, drivers, and the physical environment?
Yes ☐ No ☐

2. If not, which factor is lacking an intervention? _____

3. Have you used at least two different situational prevention *types* for the interventions?
Yes ☐ No ☐

4. If not, which situational prevention types are not used? _____
_____

*You should consider changes or additions to your overall action plan if you answered "No" to any of the above questions.

Endnotes

1 National Highway Traffic Safety Administration, in Lee and Abdel-Aty (2005), p. 775.
2 National Highway Traffic Safety Administration (2005).
3 Ernst et al. (2004).
4 Campbell et al. (2004).
5 Campbell et al. (2004).
6 Campbell et al. (2004).
7 Campbell et al. (2004).
8 Lee and Abdel-Aty (2005).
9 Teanby, Gorman, and Boot (1993).
10 Mullen, Cooper, and Driskell (1990).
11 Campbell et al. (2004).
12 Do (2002).
13 Moudon et al. (1997).
14 Hill and Roemer (1977).
15 Wilgoren (1999).
16 Umhoefer (2000).
17 Umhoefer (2000).
18 U.S. Bureau of the Census (2005).
19 Collins (1998).
20 Hamed (2001).
21 Hatfield and Murphy (2007).
22 Carole Millar Research (1998).
23 Campbell et al. (2004).
24 Campbell et al. (2004).
25 Carole Millar Research (1998).
26 Rehabilitation Alcohol Test, in Campbell et al. (2004).
27 Redmon (2003).
28 Markowitz et al. (2006).
29 Walmsley and Lewis (1989).
30 Keegan and O'Mahoney (2003).
31 Cui and Nambisan (2003).
32 Jason and Liotta (1982).

[33] Yagil (2000).
[34] Giacopassi and Forde (2000).
[35] Giacopassi and Forde (2000).
[36] Harrell (1991).
[37] Mullen, Cooper, and Driskell (1990).
[38] Russell, Wilson, and Jenkins (1976).
[39] Harkey and Zegeer (2004).
[40] Harkey and Zegeer (2004).
[41] Harkey and Zegeer (2004).
[42] Roudsari et al. (2004).
[43] Cui and Nambisan (2003).
[44] Chu, Guttenplan, and Baltes (2004).
[45] Centers for Disease Control and Prevention (1989).
[46] New York City Department of Transportation (n.d.).
[47] Moudon et al. (1997).
[48] Campbell et al. (2004).
[49] Campbell et al. (2004).
[50] Ernst et al. (2004).
[51] Hamilton-Wentworth Police Department (1994).
[52] Davis and Huelke, in Campbell et al. (2004).
[53] Associated Press (2007).
[54] Associated Press (2007).
[55] Campbell et al. (2004).
[56] Hamed (2001).
[57] Blomberg, in Campbell et al. (2004).
[58] Sonnenberg (2006).
[59] Keegan and O'Mahoney (2003).
[60] Keegan and O'Mahoney (2003).
[61] Markowitz et al. (2006).
[62] Markowitz et al. (2006).
[63] Smith (2005–2007).
[64] Berger, in Retting, Ferguson, and McCartt (2003), p. 9.
[65] Ostram and Ericksson (2001).

66 Los Angeles Department of Public Works (2007).
67 Los Angeles Department of Public Works (2007).
68 Hakkert, Gitelman, and Ben-Shabat (2002).
69 Hakkert, Gitelman, and Ben-Shabat (2002).
70 Clark, Hummer, and Dutt (1996).
71 Department of Public Works, Traffic Engineering Division, Arlington (Virginia) (n.d.).
72 Clark, Hummer, and Dutt (1996).
73 Clark, Hummer, and Dutt (1996).
74 San Diego Police Department (2001).
75 City of Madison Department of Transportation, Traffic Engineering Division (1999).
76 City of Madison Department of Transportation, Traffic Engineering Division (1999).
77 Hamilton-Wentworth Police Department (1994).
78 Hamilton-Wentworth Police Department (1994).
79 San Diego Police Department (2001).

References

Associated Press (2007). "Officials: Street Water Sales Risky." *Wisconsin State Journal*, July 2, p. C3.

Campbell, B., C. Zegeer, H. Huang and M. Cynecki (2004). *A Review of Pedestrian Safety Research in the United States and Abroad.* McLean (Virginia): U.S. Department of Transportation, Federal Highway Administration.

Carole Millar Research (1998). *Alcohol and the Pedestrian Road Casualty.* Development Department Research Programme Research Findings No. 49. Edinburgh: Scottish Office Central Research Unit.

Centers for Disease Control and Prevention (1989). "Current Trends: Queens Boulevard Pedestrian Safety Project–New York City." *Morbidity and Mortality Weekly Report* 38(5): 61–63.

Chu, X., M. Guttenplan and M. Baltes (2004). "Why People Cross Where They Do: The Role of the Street Environment." Unpublished.

City of Madison Department of Transportation, Traffic Engineering Division (1999). "Field Evaluation of Experimental In-Street Yield to Pedestrian Signs." Submitted to Federal Highway Administration.

Clark, K., J. Hummer and N. Dutt (1996). "Field Evaluation of Fluorescent Strong Yellow-Green Pedestrian Warning Signs." *Transportation Research Record* 1538: 39-46.

Collins, G. (1998). "Walking the Walk, Against the Light." *New York Times*, January 14, p. 3B.

Cui, Z., and S. Nambisan (2003). "Methodology for Evaluating the Safety of Midblock Pedestrian Crossings." *Transportation Research Record* 1828:75–82.

Department of Public Works, Traffic Engineering Division, Arlington (Virginia) (n.d.). "ITE Pedestrian Project Award Application". Retrieved March 26, 2007. www.ite.org/activeliving/files/C-2-C_ppa019.pdf.

Do, A. (2002). "Walking the Safety Walk." *Public Roads* 66(2):2–6.

Ernst, M., L. Bailey, A. Canby and K. McCarty (2004). *Mean Streets 2004: How Far Have We Come? Pedestrian Safety, 1994-2003*. Washington, D.C.: Surface Transportation Policy Project.

Giacopassi, D., and D. Forde (2000). "Broken Windows, Crumpled Fenders, and Crime." *Journal of Criminal Justice* 28(4):397–405.

Hakkert, A., V. Gitelman and E. Ben-Shabat (2002). "An Evaluation of Crosswalk Warning Systems: Effects on Pedestrian and Vehicle Behaviour." *Transportation Research Part F: Traffic Psychology and Behavior* 5(4):275–292.

Hamed, M. (2001). "Analysis of Pedestrians' Behavior at Pedestrian Crossing." *Safety Science* 38(1):63–82.

Hamilton-Wentworth Police Department (1994). "KIDestrians: Child Pedestrian Safety." Submission for the Herman Goldstein Project Award for Excellence in Problem-Oriented Policing (finalist).

Harkey, D., and C. Zegeer (2004). "PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System." McLean (Virginia): U.S. Department of Transportation, Federal Highway Administration.

Harrell, W. (1991). "Factors Influencing Pedestrian Cautiousness in Crossing Streets." *Journal of Social Psychology* 131(3):367–372.

Hatfield, J., and S. Murphy (2007). "The Effects of Mobile Phone Use on Pedestrian Crossing Behaviour at Signalised and Unsignalised Intersections." *Accident Analysis and Prevention* 39(1):197–205.

Hill, M., and T. Roemer (1977). "Toward an Explanation of Jaywalking Behavior: A Linear Regression Approach." *Man-Environment Systems* 7(6):342–349.

Jason, L., and R. Liotta (1982). "Pedestrian Jaywalking Under Facilitating and Nonfacilitating Conditions." *Journal of Applied Behavior Analysis* 15(3):469–473.

Keegan, O., and M. O'Mahony (2003). "Modifying Pedestrian Behaviour." *Transportation Research Part A: Policy and Practice* 37(10):889–901.

Lee, C., and M. Abdel-Aty (2005). "Comprehensive Analysis of Vehicle-Pedestrian Crashes at Intersections in Florida." *Accident Analysis and Prevention* 37(4):775–786.

Los Angeles Department of Public Works (2007). "Slow Down LA County: Neighborhood Traffic Management Program". Retrieved March 25, 2007. http://ladpw.org/TNL/NTMP/Page_02.cfm.

Markowitz, F., S. Sciortino, J. Fleck, and B. Yee (2006). "Pedestrian Countdown Signals: Experience with an Extensive Pilot Installation." *ITE Journal* 76(1):43–48.

Moudon, A., P. Hess, M. Snyder, and K. Stanilov (1997). *Effects of Site Design on Pedestrian Travel in Mixed-Use, Medium-Density Environments.* Olympia: Washington State Department of Transportation.

Mullen, B., C. Cooper, and J. Driskell (1990). "Jaywalking as a Function of Model Behavior." *Personality and Social Psychology Bulletin* 16(2):320–330.

National Highway Traffic Safety Administration, National Center for Statistics and Analysis (2005). "Traffic Safety Facts: 2004 Data." Washington, D.C.: National Center for Statistics and Analysis.

New York City Department of Transportation (n.d.). "Queens Boulevard Pedestrian Safety Study."

Ostrom, M., and A. Eriksson (2001). "Pedestrian Fatalities and Alcohol." *Accident Analysis and Prevention* 33(2):173–180.

Redmon, T. (2003). "Assessing the Attitudes and Behaviors of Pedestrians and Drivers in Traffic Situations." *ITE Journal* 7(3):26–30.

Retting, R., S. Ferguson and A. McCartt (2003). "A Review of Evidence-Based Traffic Engineering Measures Designed To Reduce Pedestrian-Motor Vehicle Crashes." *American Journal of Public Health* 93(9):1456–1463.

Roudsari, B., C. Mock, R. Kaufman, D. Grossman, B. Henary and J. Crandall (2004). "Pedestrian Crashes: Higher Injury Severity and Mortality Rate for Light Truck Vehicles Compared With Passenger Vehicles." *Injury Prevention* 10(3):154–158.

Russell, J., D. Wilson and J. Jenkins (1976). "Information Properties of Jaywalking Models as determinants of Imitated Jaywalking: An Extension of Model Sex, Race and Number." *Sociometry* 39(3):270–273.

San Diego Police Department (2001). "Project To Address and Reduce the Number of Traffic Collisions Involving Pedestrians." Submission for the Herman Goldstein Award for Excellence in Problem-Oriented Policing.

Smith, Susan (2005–2007). Shawnee Police Department. Communication with J. Eck.

Sonnenberg, B. (2006). "Put Your Best Foot Forward." *Time International*, July 24, p. 17.

Teanby, D., D. Gorman and D. Boot (1993). "Pedestrian Accidents on Merseyside: The Case for Criminalization of Jaywalking." *Injury* 24(1):10–12.

Umhoefer, D. (2000). "Ticket Blitz Has Winners, Losers." *Milwaukee Journal Sentinal*, June 18, p. 015A.

U.S. Bureau of the Census (2005). "2005 American Community Survey." Washington, D.C.: U.S. Government Printing Office.

Walmsley, D., and G. Lewis (1989). "The Pace of Pedestrian Flows in Cities." *Environment and Behavior* 21(2):123–150.

Wilgoren, J. (1999). "Cross at Green? No. In Between: Only a Few Jaywalkers Are Getting Tickets, or Qualms." *New York Times*, April 9, p. 1B.

Yagil, D. (2000). "Beliefs, Motives and Situational Factors Related to Pedestrians' Self-Reported Behavior at Signal-Controlled Crossings." *Transportation Research Part F: Traffic Psychology and Behavior* 3(1):1–13.

About the Authors

Justin A. Heinonen

Justin A. Heinonen is currently a doctoral student at the University of Cincinnati's Division of Criminal Justice. Heinonen is also a research associate in the University of Cincinnati's Policing Institute, where he is currently working on the Uptown Consortium project. This project involves providing consortium members with ongoing analyses of crime problems and hot spots in uptown Cincinnati, recommending the most effective responses for these locations, and assessing the effectiveness of each response in terms of crime reduction. His specific research interests include situational crime prevention, crime mapping, white-collar crime, and victimology. Heinonen holds a bachelor's degree in criminal justice from the University of Toledo, and a master's degree in criminal justice from Bowling Green State University.

John E. Eck

John E. Eck is a criminal justice professor at the University of Cincinnati, where he teaches police effectiveness, criminal justice policy, research methods and crime prevention. His research has focused on the development of problem-oriented policing, police effectiveness, crime patterns, and crime prevention. Eck was a member of the National Academy of Sciences' Committee to Review Research on Police Policy and Practices. He is an individual affiliate of the Center for Problem-Oriented Policing. Eck is the coauthor (with Ronald V. Clarke) of *Crime Analysis for Problem-Solvers: In 60 Small Steps*, as well as the author or coauthor of many publications on problem-oriented policing, crime mapping, and crime prevention. Eck received his bachelor's and master's degrees from the University of Michigan, and his doctorate from the University of Maryland's Department of Criminology.

Other Problem-Oriented Guides for Police

Problem-Specific Guides series:

1. **Assaults in and Around Bars, 2nd Edition.** Michael S. Scott. 2001. ISBN: 1-932582-00-2
2. **Street Prostitution, 2nd Edition.** Michael S. Scott. 2001. ISBN: 1-932582-01-0
3. **Speeding in Residential Areas.** Michael S. Scott. 2001. ISBN: 1-932582-02-9
4. **Drug Dealing in Privately Owned Apartment Complexes**. Rana Sampson. 2001. ISBN: 1-932582-03-7
5. **False Burglar Alarms, 2nd Edition.** Rana Sampson. 2001. ISBN: 1-932582-04-5
6. **Disorderly Youth in Public Places.** Michael S. Scott. 2001. ISBN: 1-932582-05-3
7. **Loud Car Stereos.** Michael S. Scott. 2001. ISBN: 1-932582-06-1
8. **Robbery at Automated Teller Machines.** Michael S. Scott. 2001. ISBN: 1-932582-07-X
9. **Graffiti.** Deborah Lamm Weisel. 2002. ISBN: 1-932582-08-8
10. **Thefts of and From Cars in Parking Facilities.** Ronald V. Clarke. 2002. ISBN: 1-932582-09-6
11. **Shoplifting.** Ronald V. Clarke. 2002. ISBN: 1-932582-10-X
12. **Bullying in Schools.** Rana Sampson. 2002. ISBN: 1-932582-11-8
13. **Panhandling.** Michael S. Scott. 2002. ISBN: 1-932582-12-6
14. **Rave Parties.** Michael S. Scott. 2002. ISBN: 1-932582-13-4
15. **Burglary of Retail Establishments.** Ronald V. Clarke. 2002. ISBN: 1-932582-14-2
16. **Clandestine Methamphetamine Labs, 2nd Edition.** Michael S. Scott. 2002. ISBN: 1-932582-15-0
17. **Acquaintance Rape of College Students.** Rana Sampson. 2002. ISBN: 1-932582-16-9
18. **Burglary of Single-Family Houses.** Deborah Lamm Weisel. 2002. ISBN: 1-932582-17-7

19. **Misuse and Abuse of 911.** Rana Sampson. 2002. ISBN: 1-932582-18-5
20. **Financial Crimes Against the Elderly.** Kelly Dedel Johnson. 2003. ISBN: 1-932582-22-3
21. **Check and Card Fraud.** Graeme R. Newman. 2003. ISBN: 1-932582-27-4
22. **Stalking.** The National Center for Victims of Crime. 2004. ISBN: 1-932582-30-4
23. **Gun Violence Among Serious Young Offenders.** Anthony A. Braga. 2004. ISBN: 1-932582-31-2
24. **Prescription Fraud.** Julie Wartell and Nancy G. La Vigne. 2004. ISBN: 1-932582-33-9
25. **Identity Theft**. Graeme R. Newman. 2004. ISBN: 1-932582-35-3
26. **Crimes Against Tourists.** Ronald W. Glensor and Kenneth J. Peak. 2004. ISBN: 1-932582-36-3
27. **Underage Drinking.** Kelly Dedel Johnson. 2004. ISBN: 1-932582-39-8
28. **Street Racing.** Kenneth J. Peak and Ronald W. Glensor. 2004. ISBN: 1-932582-42-8
29. **Cruising.** Kenneth J. Peak and Ronald W. Glensor. 2004. ISBN: 1-932582-43-6
30. **Disorder at Budget Motels**. Karin Schmerler. 2005. ISBN: 1-932582-41-X
31. **Drug Dealing in Open-Air Markets.** Alex Harocopos and Mike Hough. 2005. ISBN: 1-932582-45-2
32. **Bomb Threats in Schools.** Graeme R. Newman. 2005. ISBN: 1-932582-46-0
33. **Illicit Sexual Activity in Public Places.** Kelly Dedel Johnson. 2005. ISBN: 1-932582-47-9
34. **Robbery of Taxi Drivers.** Martha J. Smith. 2005. ISBN: 1-932582-50-9
35. **School Vandalism and Break-Ins.** Kelly Dedel Johnson. 2005. ISBN: 1-9325802-51-7
36. **Drunk Driving.** Michael S. Scott, Nina J. Emerson, Louis B. Antonacci, and Joel B. Plant. 2005. ISBN: 1-932582-57-6
37. **Juvenile Runaways.** Kelly Dedel. 2006. ISBN: 1932582-56-8
38. **The Exploitation of Trafficked Women.** Graeme R. Newman. 2006. ISBN: 1-932582-59-2

39. **Student Party Riots.** Tamara D. Madensen and John E. Eck. 2006. ISBN: 1-932582-60-6
40. **People with Mental Illness.** Gary Cordner. 2006. ISBN: 1-932582-63-0
41. **Child Pornography on the Internet.** Richard Wortley and Stephen Smallbone. 2006. ISBN: 1-932582-65-7
42. **Witness Intimidation.** Kelly Dedel. 2006. ISBN: 1-932582-67-3
43. **Burglary at Single-Family House Construction Sites.** Rachel Boba and Roberto Santos. 2006. ISBN: 1-932582-00-2
44. **Disorder at Day Laborer Sites.** Rob Guerette. 2007. ISBN: 1-932582-72-X
45. **Domestic Violence.** Rana Sampson. 2007. ISBN: 1-932582-74-6
46. **Thefts of and from Cars on Residential Streets and Driveways.** Todd Keister. 2007. ISBN: 1-932582-76-2
47. **Drive-By Shootings.** Kelly Dedel. 2007. ISBN: 1-932582-77-0
48. **Bank Robbery.** Deborah Lamm Weisel. 2007. ISBN: 1-932582-78-9
49. **Robbery of Convenience Stores.** Alicia Altizio and Diana York. 2007. ISBN: 1-932582-79-7
50. **Traffic Congestion Around Schools.** Nancy G. La Vigne. 2007. ISBN: 1-932582-82-7
51. **Pedestrian Injuries and Fatalities.** Justin A. Heinonen and John E. Eck. 2007. ISBN: 1-932582-83-5

Response Guides series:

1. **The Benefits and Consequences of Police Crackdowns.** Michael S. Scott. 2003. ISBN: 1-932582-24-X
2. **Closing Streets and Alleys to Reduce Crime: Should You Go Down This Road?** Ronald V. Clarke. 2004. ISBN: 1-932582-41-X
3. **Shifting and Sharing Responsibility for Public Safety Problems.** Michael S. Scott and Herman Goldstein. 2005. ISBN: 1-932582-55-X
4. **Video Surveillance of Public Places.** Jerry Ratcliffe. 2006 ISBN: 1-932582-58-4
5. **Crime Prevention Publicity Campaigns.** Emmanuel Barthe. 2006 ISBN: 1-932582-66-5

Problem-Solving Tools series:

1. **Assessing Responses to Problems: An Introductory Guide for Police Problem-Solvers.** John E. Eck. 2002. ISBN: 1-932582-19-3
2. **Researching a Problem.** Ronald V. Clarke and Phyllis A. Schultz. 2005. ISBN: 1-932582-48-7
3. **Using Offender Interviews to Inform Police Problem Solving.** Scott H. Decker. 2005. ISBN: 1-932582-49-5
4. **Analyzing Repeat Victimization.** Deborah Lamm Weisel. 2005. ISBN: 1-932582-54-1
5. **Partnering with Businesses to Address Public Safety Problems.** Sharon Chamard. 2006. ISBN: 1-932582-62-2
6. **Understanding Risky Facilities.** Ronald V. Clarke and John E. Eck. 2007. ISBN: 1-932582-75-4
7. **Implementing Responses to Problems.** Rick Brown and Michael S. Scott. 2007. ISBN: 1-932582-80-0
8. **Using Crime Prevention Through Enviornmental Design in Problem Solving.** Diane Zahm. 2007. ISBN: 1-932582-81-9

Upcoming Problem-Oriented Guides for Police

Problem-Specific Guides
Abandoned Vehicles
Bicycle Theft
Crowd Control at Stadiums and Other Entertainment Venues
Child Abuse
Crime and Disorder in Parks
Transient Encampments

Problem-Solving Tools
Designing a Problem Analysis System
Displacement

Response Guides
Enhancing Lighting
Sting Operations

For more information about the *Problem-Oriented Guides for Police* series and other COPS Office publications, please call the COPS Office Response Center at 800.421.6770 or visit COPS Online at www.cops.usdoj.gov.

www.PopCenter.org

Center for Problem-Oriented Policing

Got a Problem? We've got answers!

Log onto the Center for Problem-Oriented Policing website at www.popcenter.org for a wealth of information to help you deal more effectively with crime and disorder in your community, including:

- Web-enhanced versions of all currently available Guides
- Interactive training exercises
- Online access to research and police practices
- Online problem analysis module
- Recommended readings in problem-oriented policing and situational crime prevention
- A complete listing of other POP Guides
- A listing of forthcoming POP Guides.

Designed for police and those who work with them to address community problems, www.popcenter.org is a great resource in problem-oriented policing.

For More Information:

U.S. Department of Justice
Office of Community Oriented Policing Services
1100 Vermont Avenue, N.W.
Washington, DC 20530

To obtain details on COPS programs, call the
COPS Office Response Center at 800.421.6770

Visit COPS Online at the address listed below.

e090725108 October 2007
ISBN: 1-932582-83-5

www.cops.usdoj.gov