Making Crosswalks Safer for Pedestrians

Application of a Multidisciplinary Approach to Improve Pedestrian Safety at Crosswalks in St. Petersburg, Florida

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Disclaimer

The contents of this report reflect the views of the authors who are responsible for the opinions, findings, and conclusions presented herein. The contents do not necessarily reflect the official views or policies of the Florida Department of Transportation.

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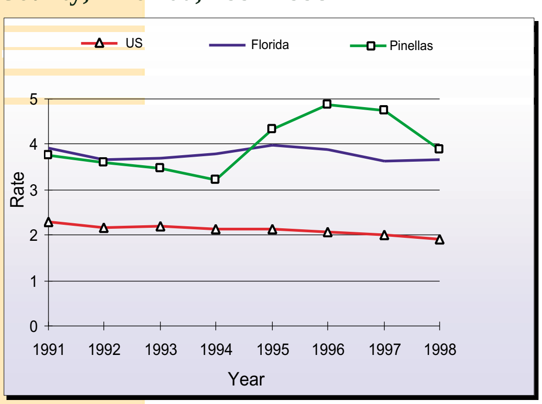
Chapter 1: Introduction

Downtown St. Petersburg, Florida attracts both local visitors and tourists.

Figure 1.1 Pedestrian Fatality Rate Per 100,000 Population: US, Florida, Pinellas County, Florida, 1991-1998



Research Background

The proliferation of motor vehicles has made walking quite dangerous for pedestrians. According to the National Highway Traffic Safety Administration (NHTSA) statistics, a pedestrian is killed every 101 minutes and another is injured every 8 minutes in the United States. These deaths most often occur in urban areas, at non-intersection locations, and during normal weather conditions. In 1998, 5,220 pedestrians died in traffic crashes, accounting for 12.6 percent of all traffic fatalities. Per mile traveled, pedestrians are 36 times more likely to die in a collision than drivers of motor vehicles (NHTSA, 1998). In spite of a 24 percent reduction in pedestrian fatalities over the past ten years, pedestrian-motor vehicle crashes remain a high priority for many states.

In Florida, almost one out of every five fatalities involves a pedestrian. The State's pedestrian fatality rate per 100,000 population is 3.6, almost twice that of the national rate of 1.9. A recent Surface Transportation Policy Project report (2000) ranked the Tampa-St. Petersburg-Clearwater metropolitan area as the most dangerous place for people to walk.

Two of the largest cities in the Tampa-St. Petersburg-Clearwater metropolitan area are located in Pinellas County, Florida. Since 1995, the pedestrian fatality rate for Pinellas County has outpaced both the national and state averages (see Figure 1). A total of 278 pedestrians have died in motor vehicle crashes in Pinellas County from 1991 to 1998. Because of these alarming statistics, the Florida Department of Transportation (FDOT) is very active in funding research to reduce the number of pedestrian fatalities and injuries in areas where the pedestrian crash problem is particularly high.

Experts blame the pedestrian safety problem on the lack of awareness of planning, land use, and engineering applications related to pedestrians, inadequate education for people in their dual roles as both pedestrians and motorists, and limited enforcement of existing laws designed to protect pedestrians (Lewis, 1996). Because the three E's (engineering, education, and enforcement) are important tools in addressing traffic safety issues, the FDOT is especially interested in research that combines these tools to improve safety for pedestrians.

A number of countermeasures have been utilized to reduce the incidence of pedestrian-motor vehicle crashes including engineering treatments such as prompting signs and pavement markings, education programs targeting specific groups, and enforcement campaigns targeting both pedestrians and motorists.

The results of these efforts are well documented in the literature. Retting et al. (1996) found that signs and pavement markings increased the percentage of pedestrians looking for threats from turning vehicles and almost eliminated conflicts between pedestrians and motor vehicles. Van Houten (1988) and Van Houten and Malenfant (1992) found that advance stop lines increase the distance that motorists stop before a crosswalk thus reducing the potential for pedestrian-motor vehicle conflicts (drivers or pedestrians having to take evasive action to avoid a crash).

Educational efforts, such as feedback signs and instructional pedestrian signs, and media campaigns have resulted in an increase in motorists yielding to pedestrians, as well as a greater awareness by citizens of their responsibilities as motorists and pedestrians (Malenfant, et al. 1985). Moreover, the presence of law enforcement officers has been found to influence motorist and pedestrian behavior (Britt, et al., 1995).

Although separately, engineering, education, and enforcement are important traffic safety tools, together they can improve safety when combined into a multidisciplinary approach. Recently, these approaches have been used to address the drinking driver problem, increase seat belt use, and improve pedestrian safety. The results have demonstrated the success in using multidisciplinary strategies to address traffic safety issues.

For instance, *The Saving Lives Program* in Massachusetts resulted in a 46 percent decline in alcohol-related fatal crashes over a five-year period (Hingson, et al., 1996) and North Carolina's *Booze It and Lose It* campaign resulted in an overall decline in impaired driving in four counties. The *Courtesy Promotes Safety* program increased motorists' willing-

The *Courtesy Promotes Safety* program increased motorists' willingness to stop for pedestrians at crosswalks from 33 to 73 percent and reduced crashes in crosswalks by 50 percent over a 1-year period in three Canadian cities.

ness to stop for pedestrians at crosswalks from 33 to 73 percent and reduced crashes in crosswalks by 50 percent over a one-year period in three Canadian cities (Van Houten and Malenfant, 1992). The *Courtesy Promotes Safety* program is a multidisciplinary program that combines engineering, enforcement, and education components to promote pedestrian safety. The program includes traffic enforcement, engineering improvements at crosswalks, educational materials for school children and seniors, and signs to provide community feedback on motorists yielding to pedestrians at crosswalks.

Because of the program's success in Canada, the FDOT was very interested in determining whether similar results could be achieved through the application of a multidisciplinary program in a Florida city. The FDOT Safety Office contracted with the Center for Urban Transportation Research (CUTR) to implement a multidisciplinary program to increase motorists' willingness to yield to pedestrians in the City of St. Petersburg, Florida. The project team included Dr. Louis Malenfant and Dr. Ron Van Houten from the Centre for Education and Research in Safety (CERS) who developed and implemented the *Courtesy Promotes Safety* program in Canada. The City of St. Petersburg was largely selected because of the need for pedestrian safety improvements and the City's support in implementing the program. Further, the Pinellas County Metropolitan Planning Organization (MPO) and the Pinellas Community Traffic Safety Team (CTST) previously implemented a variety of pedestrian safety improvements and actively worked with law enforcement agencies, community groups, and the media to promote pedestrian safety.

During the study period, the FDOT Safety Office funded additional research to implement the multidisciplinary program throughout Pinellas County. This report documents the application of a multidisciplinary program in the City of St. Petersburg. A report documenting the application of the program countywide will be published separately. Any questions on the program results should be directed to the FDOT Safety Office.

Research Objectives

The research objectives included implementing a multidisciplinary program consisting of engineering, education, and enforcement components to improve pedestrian safety at crosswalks and evaluating the effectiveness of the program. The research study consisted of three phases: community assessment, program implementation, and program evaluation. Several goals were established at the program's onset and included:

1. Increase citywide motorists yielding behavior from single digit levels to over 70 percent,
2. Reduce conflicts and crashes in crosswalks by 50 percent, and
3. Increase pedestrians' feelings of comfort and safety while crossing the street.

Research Approach

Researchers completed a number of activities to accomplish the objectives of this research. First, researchers conducted a community assessment that included identifying pedestrian safety issues, analyzing pedestrian crash records, conducting an audit to identify crosswalks with pedestrian safety problems, selecting intersections and crosswalks for interventions, and collecting baseline observational data.

Second, researchers implemented several engineering, education, and enforcement interventions at varying times throughout the study period. Engineering efforts ranged from relocating advance stop lines, to installing devices to give pedestrians a head start in crossing the street, to the complete redesign of crosswalks. Education components consisted of installing electronic messages boards, distributing pedestrian safety brochures and posters, and developing radio and television public service announcements. Enforcement efforts focused on educating motorists about their obligation to yield to pedestrians.

Third, researchers used a time series design to evaluate the program's effectiveness. Baseline data collected prior to implementation of interventions were compared to post-intervention data to determine the impact of the interventions on motorists yielding behavior and pedestrian-motor vehicle conflicts.

A major challenge for behavioral scientists, public health officials, traffic safety groups, and communities is to work together to design and implement effective interventions targeted toward at-risk populations. This research attempts to demonstrate that strategies combining engineering, education, and enforcement efforts are effective in increasing motorists awareness of yielding to pedestrians in crosswalks and reducing the number of pedestrian-motor vehicle conflicts. In addition, the research attempts to demonstrate the value of using a multidisciplinary approach to address traffic safety issues in communities. The study results are intended to provide a model that can be used by other communities to design, implement, and evaluate an effective pedestrian safety program.

Report Organization

The remainder of the report is divided into four chapters. Chapter 2 presents the information collected during the community assessment

A major challenge for behavioral scientists, public health officials, traffic safety groups, and communities is to work together to design and implement effective interventions targeted toward at-risk populations.

phase, including analysis of fatal and injury pedestrian crash data in St. Petersburg, discussion of community walkability issues, and results of the crosswalk audit and pedestrian comfort survey. The chapter also describes how intersections were identified for inclusion in the study and details the process for collecting baseline data for use in evaluating the program. Chapter 3 details engineering, education, and enforcement interventions implemented during the study period. An evaluation of the program is discussed in Chapter 4. The final chapter summarizes the research findings, discusses the study limitations, and provides recommendations for future actions to improve pedestrian safety in St. Petersburg.

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Chapter 2: Community Assessment

Pedestrians at risk in Pinellas County, Florida.
(Photo courtesy of St. Petersburg Times)

Pedestrians crossing the street in downtown St. Petersburg, Florida.

Overview

A community assessment helps to prioritize and select countermeasures to improve motorists yielding to pedestrians in crosswalks and reduce pedestrian-motor vehicle conflicts. The results of the assessment help to identify whom to target pedestrian safety messages and which corridors and intersections to target engineering and enforcement strategies. Moreover, the assessment allows researchers to identify the pedestrian safety concerns of the community.

The success of the community assessment was largely dependent on the cooperation and support of the Triple E committee, which consisted of local representatives from the engineering, education, and enforcement community. The Committee assisted with the selection and implementation of program interventions and in several instances, provided materials and resources for the implementation of program components. The Committee also worked with citizen groups to develop goals for improving overall traffic safety in the community. This cooperative effort lead to improved communication and coordination between the participating agencies and fostered teamwork through sharing resources and costs.

Assessment Process

The community assessment consisted of five steps:

1. Collecting and analyzing pedestrian crash data;
2. Identifying citizens concerns regarding walking in the community;
3. Documenting crosswalk conditions;
4. Selecting intersections for pedestrian safety interventions; and
5. Collecting baseline data on motorists yielding behavior and pedestrian-motor vehicle conflicts.

STEP 1. Analyze Pedestrian Crash Data

The purpose of the crash analysis was to identify pedestrian crash trends and pinpoint areas with high concentrations of pedestrian-motor vehicle conflicts or crashes. Data from traffic crash reports were received from the St. Petersburg Police Department (SPPD) on all pedestrian-related motor vehicle crashes (fatal and non-fatal) that occurred in the city from 1994 to 1998. For some crashes, only limited information was available.

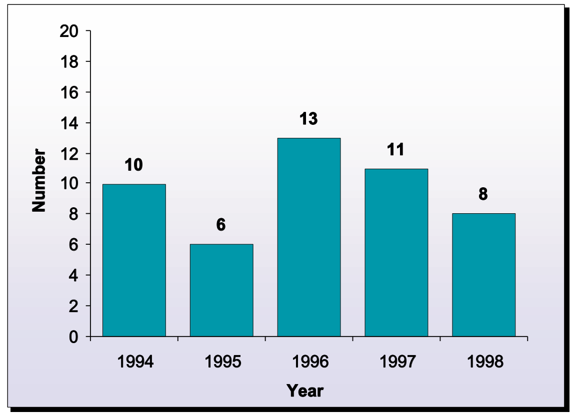
Several crash characteristics were analyzed including: month and year of crash; age and gender of pedestrians; weather condition at time of crash; and crash location.

Fatal Pedestrian Crashes

A total of 48 pedestrians were fatally injured in traffic crashes in St. Petersburg from 1994 to 1998. Figure 2.1 shows that the yearly totals were fairly consistent, ranging from a high of 13 in 1996, to a low of 6 in 1995.

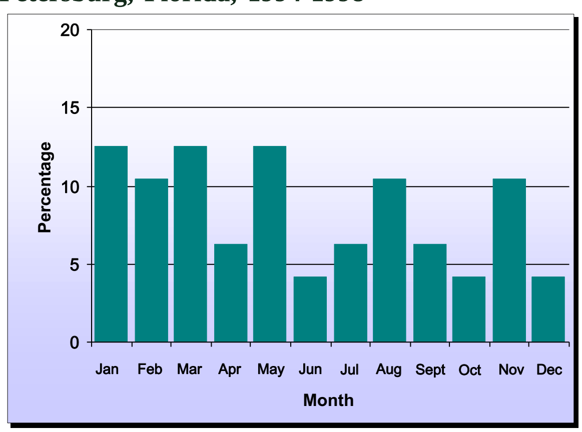
The monthly distribution of these crashes is shown in Figure 2.2. January, March, and May had the highest number of fatal crashes (6), followed by February, August, and November, all with 5 fatalities each.

Figure 2.1 Pedestrian Fatalities Per Year: St. Petersburg, Florida, 1994-1998



Source: St. Petersburg Police Department Crash Database.

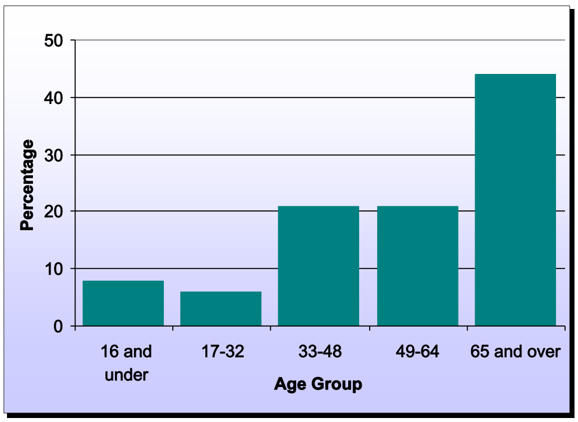
Figure 2.2 Pedestrian Fatalities by Month: St. Petersburg, Florida, 1994-1998



Source: St. Petersburg Police Department Crash Database.

A total of 48 pedestrians were fatally injured in traffic crashes in St. Petersburg from 1994 to 1998.

Figure 2.3 Pedestrian Fatalities by Age Group: St. Petersburg, Florida, 1994-1998



Source: St. Petersburg Police Department Crash Database.

As Figure 2.3 illustrates, the majority of pedestrians killed over the 5-year period were 65 years and older (44 percent) with more than half of these over the age of 80 years. Only 4 of the 48 fatalities involved pedestrians aged 16 years and younger. These findings suggest that countermeasures aimed at senior citizens may help reduce pedestrian crashes.

Almost one half of all fatal pedestrian crashes occurred between the hours of 6 p.m. and midnight (46 percent). Regarding gender and ethnicity, 54 percent of all pedestrians killed were male, and 77 percent were reported as being "white", while those reported as "black" accounted for the remaining 23 percent. Lastly, 77 percent of the fatal crashes occurred during "clear and dry" weather conditions, and only 3 fatal crashes occurred during "rain" or "light rain."

Pedestrian Crash Maps

MapInfo®, a geographic information system (GIS) mapping software program, was used to plot crash locations so that corridors and intersections with high concentrations of pedestrian-motor vehicle crashes could be identified. This information was used to aid in the selection of intersections for inclusion in the study and for data collection.

The 48 fatal crashes are mapped in Figure 2.4. The map shows that fatal pedestrian crashes have primarily clustered along two major north-south corridors, 4th St and 34th St (US 19). Several fatal crashes occurred in the area where 34th St N intersects with 9th Ave, 5th Ave, and Central Ave. High pedestrian traffic in this area is associated with the location of businesses such as fast food restaurants and groceries, a post office, and multiple bus stops. This area also borders a low-income neighborhood with a high transit-dependent population.

Figure 2.5 maps the crash location for all injury and fatal pedestrian crashes in St. Petersburg from 1995 through 1997. Crash frequencies were grouped into four major categories: over 40 crashes, 30-40 crashes, 20-30 crashes,

The majority of pedestrians killed over the 5-year period were 65 years and older (44 percent) with more than half of these over the age of 80 years.

Figure 2.4 Location of Fatal Pedestrian Crashes in St. Petersburg, Florida, 1994-1998

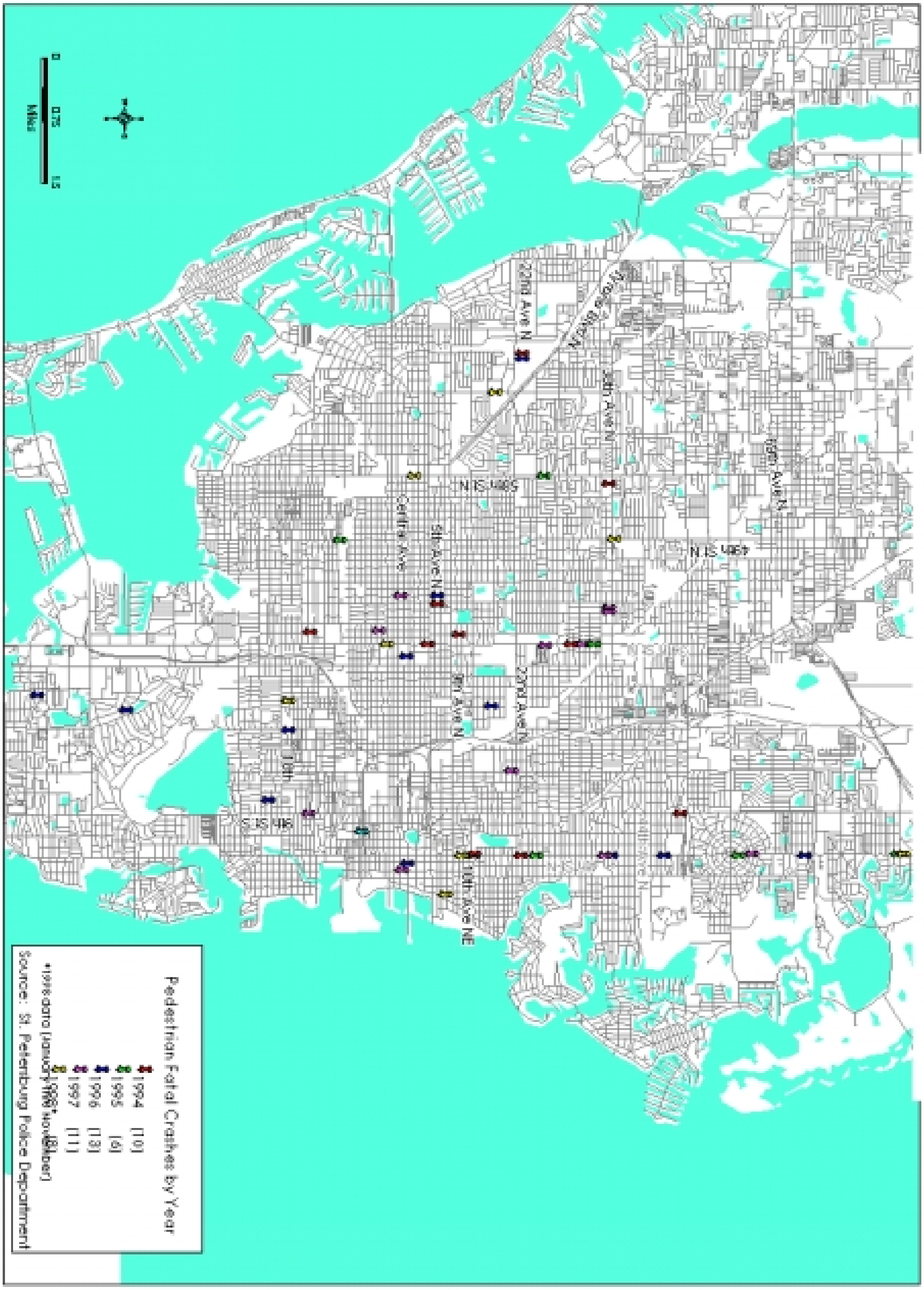
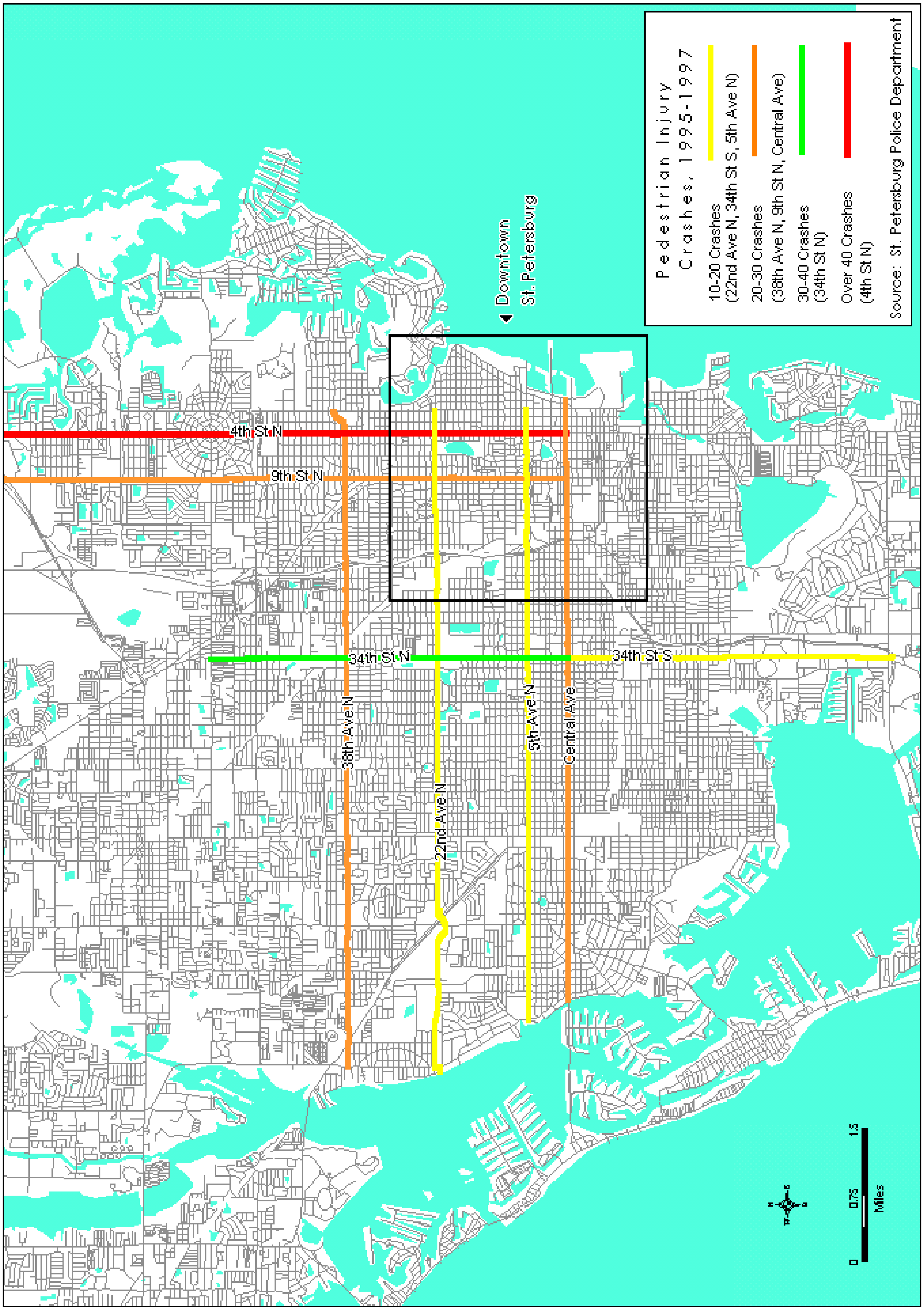


Figure 2.5 Most Dangerous Intersections for Pedestrians in St. Petersburg, Florida



and 10-20 crashes. The majority of pedestrian injury and fatal crashes occurred along 4th St. This 6-lane road is a major business corridor for the eastern part of St. Petersburg and connects commuters to Interstate 275 and Gandy Blvd (two major access roads to Tampa). Several fatal crashes are noted at major intersections along the corridor such as 54 Ave N, 38th Ave N, 22nd Ave N, and 9th Ave N. Other high crash corridors include 34th St N (30-40 crashes) and 38th Ave N, 9th St N, and Central Ave (20-30 crashes).

1998 Pedestrian Crash Analysis

Researchers also analyzed data from January through November 1998 to examine recent pedestrian-motor vehicle crash characteristics (December data were not available during study period). A total of 148 pedestrian crashes were reported, including 8 fatalities. The distribution of crashes by age shows that younger pedestrians (under 19 years) accounted for almost 40 percent of all pedestrian crash victims in 1998. These findings suggest that countermeasures aimed at school age children may help to reduce pedestrian crashes.

Table 2.2 shows how far the person was struck from the nearest intersection. Information on the crash distance from the intersection was missing on 43 of the 148 crash reports. On reports indicating distance, one third of all pedestrian-motor vehicle crashes took place within 50 feet of an intersection. These findings suggest that educating people on the importance of using a marked crosswalk to cross the street may reduce pedestrian injuries and fatalities.

Table 2.1 Pedestrian-Related Crashes By Age, Jan to Nov, 1998

Age Group	Number of Crashes	Percent of Total
0-19 years	56	38
20-39 years	41	28
40-59 years	23	16
60 years and over	26	18
*Missing	2	<1
Total	148	100

Source: St. Petersburg Police Department Crash Database.

Table 2.2 Distance of Pedestrian-Related Crashes from Intersections, Jan to Nov, 1998

Distance from Crosswalk	Frequency	Percent (%)	Cumulative Percent
10 feet or less	17	11	11
11 to 50 feet	33	22	33
51 to 100 feet	29	20	53
101 feet and over	26	18	71
*Missing	43	29	100
Total	148	100	100

Source: St. Petersburg Police Department Crash Database.

Younger pedestrians (under 19 years) accounted for almost 40 percent of all pedestrian crash victims in 1998.

STEP 2. Identify Community "Walkability" Issues

This step involved identifying citizens concerns about pedestrian safety to help researchers select engineering, education, and enforcement interventions for implementation. "Walkability" issues are best described as conditions, or perceived conditions, that present a safety risk to pedestrians.

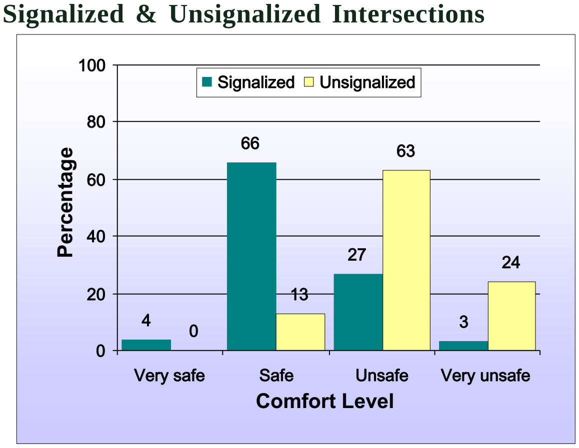
Researchers conducted two workshops and a survey to identify pedestrian safety concerns in the community. During the first workshop in September 1998, former FDOT Bicycle/Pedestrian Coordinator Dan Burden and members of the Triple E Committee answered citizen's questions on how to make neighborhoods safer for pedestrians. Researchers also received citizen feedback about pedestrian safety issues during a neighborhood summit held in November 1998. Some of the pedestrian safety concerns identified were related to+:

- Young children as pedestrians;
- Risk taking behavior by motorists at crosswalks such as speeding, red-light running, and failure to yield to pedestrians resulting in some pedestrians being stranded in the median;
- Risk taking behavior by pedestrians at crosswalks including failure to observe moving vehicles when crossing, disregard of traffic signals, and entering of crosswalks without warning; and
- Visually challenged/blind pedestrians.

Pedestrians scanning for traffic at a crosswalk in downtown St. Petersburg, Florida.

Researchers also surveyed pedestrians to assess their feelings of safety at crosswalks. The sample included 49 males and 51 females, ranging in estimated age from 10 to over 70 years. As Figure 2.6 shows, 66 percent of those surveyed felt "safe" when crossing at intersections with traffic signals. One-forth of the

Figure 2.6 Pedestrian Comfort Levels at Signalized & Unsignalized Intersections



Source: Pedestrian comfort survey conducted by Center for Urban Transportation Research, University of South Florida, October, 1998.

pedestrians (27 percent) surveyed felt "unsafe" and 3 percent felt "very unsafe" when crossing at intersections with traffic signals. It follows that pedestrians generally do not feel safe in crosswalks without traffic signals. Almost two-thirds of those surveyed (63 percent) felt "unsafe" and 24 percent felt "very unsafe" when crossing at intersections without traffic signals.

The survey also assessed pedestrians' perceptions of driver and pedestrian compliance of traffic regulations related to crosswalks. Approximately one-half of those surveyed (49 percent) felt that pedestrians obeyed crosswalk rules while 60 percent felt that drivers did not follow crosswalk rules. Fifteen pedestrians surveyed reported experiencing a "close call" within the past month, and eight pedestrians said they knew someone who had been struck in a crosswalk.

Pedestrians were asked about ways to improve pedestrian safety at crosswalks. Seven percent said more police enforcement was needed; three percent said better designed crosswalks would help; and 14 percent felt more public education would improve pedestrian safety at crosswalks. The majority of those surveyed (75 percent) felt that a combination of engineering, education, and enforcement strategies would improve pedestrian safety at crosswalks. Pedestrians were also asked to offer suggestions on increasing the feelings of security for

Example of improper pedestrian crossing behavior. Pedestrians crossing street on a red pedestrian signal in downtown St. Petersburg, Florida.

An example of improper yielding to pedestrians at a crosswalk. The driver stops in the crosswalk during the WALK phase at an intersection in downtown St. Petersburg, Florida.

Approximately one-half of those surveyed felt that pedestrians obeyed crosswalk rules while 60 percent felt that drivers did not follow crosswalk rules.

pedestrians at crosswalks. The most common suggestion was to extend the duration of the WALK phase or improve the signal timings. Others suggested improving driver, pedestrian, and public education and driver attention and respect of pedestrians.

STEP 3. Document Crosswalk Conditions

This step involved compiling information about the presence of pedestrian safety improvements and the condition of crosswalks at intersections to assist with the selection of crosswalks for inclusion in the study. Researchers examined 264 signalized intersections and 45 unsignalized intersections (intersections with no traffic control signals) and compiled the results into a database.

Data were collected on the presence of pavement markings (crosswalks, advance stop lines), pedestrian signs and signals (pedestrian and motorist prompting signs, signal heads, advanced turn lane arrows); and signalization at intersections. In addition, information regarding the presence of bus stops and wheelchair access were collected. Pedestrian safety improvements were indicated by the presence of advance stop lines (ASLs), pedestrian signs, and pedestrian signal heads.

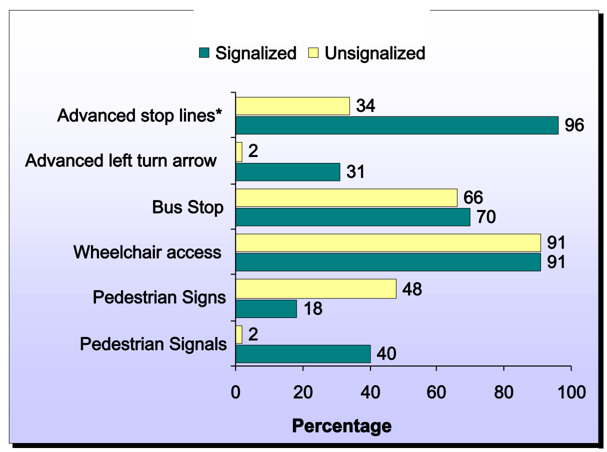
Figure 2.7 illustrates that 40 percent of all signalized intersections had pedestrian signals.

Among the 45 crosswalks surveyed at unsignalized intersections, 48 percent had pedestrian signs and only 2 percent had pedestrian signals.

Only 46 of the 264 signalized intersections (18 percent) had pedestrian signs and over 95 percent of the crosswalks had an advance stop line less than 5 feet from the crosswalk. Almost one-third of the intersections (31 percent) had advanced left turn arrows.

Researchers found it difficult to find crosswalks at unsignalized intersections with significant pedestrian traffic. Among the 45 surveyed, almost one-half of the crosswalks (48 percent) had pedestrian signs and only 2 percent had pedestrian signals. Over one-third of the unsignalized crosswalks (34 percent) had (ASLs). However, these lines were only present in crosswalks with stop or yield signs. Only 2 percent had advanced left turn arrows.

Figure 2.7 Pedestrian Safety Features at Signalized & Unsignalized Intersections



Note: Advance stop lines present only at unsignalized crosswalks when stop or yield sign was present.
Source: Crosswalk survey conducted by the Center for Urban Transportation Research, University of South Florida, Tampa, 1998.

Over 90 percent of the crosswalks at both signalized and unsignalized intersections had wheelchair access. Bus stops were noted at 70 percent of the crosswalks at signalized intersections and 66 percent of the crosswalks at unsignalized intersections.

The condition of the crosswalk pavement markings was noted at signalized and unsignalized intersections (see Table 2.3). The majority of markings were in “fair” to “good” condition (70 percent at signalized intersections and 65 percent at unsignalized intersections). One out of every 5 intersections, regardless of type, had markings that were considered “poor”.

STEP 4: Select Intersections for Pedestrian Safety Interventions

The results of the crash analyses, community workshops, pedestrian survey, and crosswalk assessment were used to generate a list of signalized and unsignalized intersections to receive engineering, education, and enforcement interventions. Several challenges arose during the selection process including: low pedestrian volume at intersections (especially unsignalized intersections), infrequent pedestrian-vehicle conflicts, few opportunities to observe motorists yielding behavior, and the low number of unsignalized crosswalks. Crosswalks in or near school zones were excluded from selection because of the presence of school crossing guards.

Table 2.3 Condition of Crosswalk Markings: Signalized and Unsignalized Intersections

Condition of Markings	Signalized* (%)	Unsignalized (%)
Newly painted	3	13
Good	40	35
Fair	30	30
Poor	24	22
Total	100	100

*Note: *3% of signalized intersections not rated*
Source: Crosswalk Survey completed by the Center for Urban Transportation Research, University of South Florida, Tampa, October 1998 – March 1999.

A crosswalk leading to The Pier in downtown St. Petersburg, Florida.

A redesigned crosswalk at a midblock pedestrian crossing in St. Petersburg, Florida.

Researchers selected 16 intersections to observe motorists yielding behavior and pedestrian-vehicle conflicts throughout the study period. The original intent was to select 8 signalized and 8 unsignalized intersections for observation; however, because of low pedestrian traffic at many unsignalized sites, the distribution of observation sites was revised to include 10 signalized and 6 unsignalized intersections. The number of pedestrians using the crosswalks largely drove the final selection.

Table 2.4 indicates the crosswalk observation sites, the intersection type, and the current or planned pedestrian safety improvements at the crosswalks. Several downtown intersections were selected because of the high concentration of crashes, high volumes of pedestrian traffic, and previously planned pedestrian safety improvements. A list of intersections along with specific interventions was presented to the Triple E Committee for approval.

STEP 5: Collect Baseline Observational Data

The observation of pedestrian and motorist behavior is a frequently used measurement in transportation safety research. While the numbers of crashes, fatalities, and injuries are important sources of information, it often takes a while to compile the data. Also, it is difficult to link specific programs and interventions as factors in changes to injury rates (Britt et al., 1995). Therefore, observational measures were used to approximate the impact of interventions.

Researchers collected baseline data at 15 of the selected crosswalks for use evaluating the multidisciplinary program. (The intersection of 9th St N and 62nd Ave N was abandoned due to a lack of pedestrian traffic.) During November 1998, each location was observed 6 to 8 times over a 4-week period. Each observation period lasted for one hour, or until 50 pedestrians were recorded. Observers recorded information about motorists yielding behavior and pedestrian-vehicle conflicts. Pedestrians were counted only when the potential for a traffic conflict existed.

For motorists yielding behavior at signalized intersections, data were recorded only for pedestrians who crossed during the WALK phase and only when turning vehicles were present. A driver was scored as yielding if he or she stopped to allow the pedestrian to cross before completing the turn. Drivers were scored as not yielding if their vehicle passed within two lanes in front of the crossing pedestrian.

At unsignalized intersections, pedestrians were counted only if he or she stood at the curb in front of the crosswalk and faced the crosswalk or oncoming traffic to indicate the desire to

Each intersection was observed 6 to 8 times over a 4-week period. Each observation period lasted for one hour, or until 50 pedestrians were recorded.

Table 2.4 Signalized and Unsignalized Intersections Selected for Pedestrian Safety Interventions

Location of Intersection	Intersection Type		Current / Planned Safety Improvement
	Signalized	Unsignalized	
1st St NE & 2nd Ave. N	Yes		No pedestrian signs or heads present Planned: pedestrian prompting signs
2nd St N & 1st Ave N	Yes		Current: pedestrians heads present Planned: ASLs, motorist prompting signs
3rd St N & 1st Ave N	Yes		Current: pedestrian heads present Planned: scanning eye pedestrian signals
3rd St N & 2nd Ave N	Yes		Current: pedestrian heads present Planned: ASLs, motorist prompting signs
4th St & Central Ave	Yes		Current: pedestrian heads present Planned: scanning eye pedestrian signals
4th St S & 1st Ave S	Yes		Current: pedestrian heads present Planned: ASLs, LPIs
4th St N & 2nd Ave N	Yes		Current: pedestrian heads present Planned: ASLs
8th St N & 1st Ave N	Yes		No pedestrian signs or heads present Planned: pedestrian prompting signs
9th St N & 62nd Ave N	Yes		No pedestrian signs or heads present
9th St N & 77th Ave N	Yes		No pedestrian signs or heads present
Central Ave between 8th St and 9th St		Yes	Current: pedestrian heads present
Central Ave between 32nd St and 33rd St		Yes	No pedestrian signs or heads present Planned: special crosswalk markings, motorist prompting signs, ASLs, ITS crosswalk warning system
8th St N & 2nd Ave N		Yes	No pedestrian signs or heads present Planned: pedestrian prompting signs
9th St S & 3rd Ave S		Yes	Current: pedestrian signs present Planned: ASLs, motorist prompting signs, half signal
38th Ave N between 2nd St N & 3rd St N		Yes	Current: pedestrian signs present Planned: ASLs
9th St N between 77th Ave N and 83rd Ave N		Yes	No pedestrian signs or heads present Planned: ASLs, pedestrian prompting signs

cross the street. Motorists were scored as yielding if they stopped or slowed down to allow the pedestrian(s) to cross safely. To provide a safe and reasonable stopping distance at 30 miles per hour, approaching vehicles had to be a minimum of 185 feet from the crosswalk to be scored as not yielding. Motorists closer than 185 feet were not counted if they failed to stop for the pedestrian. On one-way streets, yielding by motorists in all lanes was observed immediately after the pedestrian left the curb. For two-way streets, motorists on the initial side of crossing were scored until the pedestrian reached the median or center of the roadway. Motorists on the opposite side were scored after the pedestrian reached the median zone or was within half a lane to the centerline if no median was present.

At both types of intersections, observers recorded a motorist-pedestrian conflict when:

- The motorist had to stop suddenly to avoid striking the pedestrian or had to change lanes abruptly to avoid striking the pedestrian. This action was scored as "vehicle evaded."
- The pedestrian had to jump, run, lunge, or rapidly step back to avoid being struck by a vehicle. This action was scored as "pedestrian evaded."
- Sudden braking was defined as braking hard enough that the rear end of the car visibly rose or the sound of the brakes could be heard.

Table 2.5 summarizes the baseline results of motorists yielding behavior and pedestrian-motor vehicle conflicts at the 9 signalized intersections. Overall, 60 percent of the motorists observed yielded to pedestrians in crosswalks. Baseline percentages for motorists yielding behavior ranged from a high of 74 percent (3rd St. N & 2nd Ave) to a low of 46 percent (8th St. N. & 1st Ave). A total of 13 conflicts were recorded at the 15 intersections. The overall percentage of pedestrian-motor vehicle conflicts observed was 3 percent.

The baseline results for motorists yielding behavior and pedestrian-motor vehicle conflicts at the six unsignalized intersections are summarized in Table 2.6. As expected, yielding behavior was extremely poor at crosswalks located at unsignalized intersections (3 percent). The percentage of pedestrian-motor vehicle conflicts was the same as that for crosswalks at signalized intersections (3 percent).

Baseline percentages for motorists yielding behavior ranged from a high of 74 percent to a low of 46 percent.

Table 2.5 Baseline Conditions at Signalized Intersections, November 1998

Signalized Intersection Location	Total Pedestrians	Total Vehicles	Total Yielding	Percent Yielding	Total Conflicts	Percent Conflicts
1st St NE & 2nd Ave N	30	34	20	59	0	0
2nd St N & 1st Ave N	41	58	32	55	3	7
3rd St N & 1st Ave N	77	107	59	55	3	4
3rd St N & 2nd Ave N	39	46	34	74	0	0
4th St & Central Ave.	83	117	69	59	1	1
4th St S & 1st Ave S	72	87	56	64	5	7
4th St N & 2nd Ave N	51	42	29	69	1	2
8th St N & 1st Ave N	38	52	24	46	0	0
9th St N & 77th Ave N	23	39	25	64	0	0
All Sites	454	582	348	60	13	3

Source: Baseline data collection completed by the Center for Urban Transportation Research, University of South Florida, Tampa, November 1998.

Table 2.6 Baseline Conditions at Unsignalized Intersections, November 1998

Unsignalized Intersection Location	Total Pedestrians	Total Vehicles	Total Yielding	Percent Yielding	Total Conflicts	Percent Conflicts
Central Ave between 8th St & 9th St	80	332	8	2	3	4
Central Ave between 32nd St & 33rd St	126	587	17	3	3	2
8th St N & 2nd Ave N	47	181	4	2	3	6
9th St S & 3rd Ave S	74	467	15	3	3	4
38th Ave N between 2nd St N & 3rd St N	28	181	6	3	1	4
9th St N between 77th Ave N & 83rd Ave N	7	66	0	0	0	0
All Sites	362	1,814	50	3	13	4

Source: Baseline data collection completed by the Center for Urban Transportation Research, University of South Florida, Tampa, November 1998.

Chapter 3: Program Implementation

Introduction

Experts agree that the most effective way to improve safety conditions for both motorists and pedestrians is to to utilize a combination of engineering, education, and enforcement efforts. For example, Malenfant, et al. (1985) obtained results by improving lighting at crosswalks, placing feedback signs at strategic locations, and working with local agencies to increase enforcement of pedestrian safety laws. Malenfant and Van Houten also realized positive results by relocating ASLs farther away from crosswalks and adding signs to prompt motorists to yield (1988; 1992).

Advance stop lines were painted further away from the crosswalk to increase the distance between the motorist and the pedestrian.

Researchers drew on past experience, as well as knowledge gained during the community assessment, to help design and implement the multidisciplinary program. The program was implemented from December 1998 through October 1999 and consisted of nine engineering components, eight educational components, and two law enforcement components. Some of the interventions included the design of a new crosswalk adjacent to a senior citizens' center that utilized several engineering components, the distribution of posters and brochures to all county schools, and the coordination of enforcement blitzes. This chapter describes the engineering, education, and enforcement components in greater detail.

Successful efforts to improve motorists yielding to pedestrians at crosswalks involve law enforcemnt.

Engineering Components

A major component of the multidisciplinary program was the implementation of engineering improvements at selected intersections. Engineering efforts to improve pedestrian safety included the relocation of ASLs, the installation of devices that create a three-second all-red phase at signalized intersections, and the complete redesign of certain crosswalks. Table 3.1 lists the engineering interventions that were implemented during the study period along with implementation dates. Many crosswalks in the downtown area received single interventions, while several crosswalks located along the 4th St. North corridor received multiple pedestrian safety improvements. Each engineering improvement is described in the next section.

Table 3.1 Engineering Interventions and Implementation Dates

Interventions	Date(s) Implemented
Advance stop lines (ASLs)	August to October 1999
Lead pedestrian intervals (LPIs)	July 1999
Scanning eyes on pedestrian signal heads	July 1999
ITS crosswalk warning system	August to September 1999
Half signal	September 1999
Pedestrian prompting signs	April 1999
Motorist prompting signs	August to October 1999
Menorah Center	December 1998

Advance Stop Lines at Crosswalks

A real threat for pedestrians crossing streets with multiple lanes is being struck by a second vehicle in an alternate lane after the first vehicle stops to yield. In this situation, the vehicle yielding to the pedestrian often obscures the other driver's view. ASLs are on pavement stop markings placed in front of crosswalks to encourage motorists to stop farther away from the crosswalk, thus, increasing pedestrians' visibility to vehicles.

Most advance stop lines in St. Petersburg are located within 5 feet of the crosswalk. Here, a motorist stops for the light in the crosswalk.

In previous research, Van Houten (1998) and Van Houten and Malenfant (1992) found that painting ASLs 20 feet prior to a crosswalk over multiple lanes, significantly improved motorists yielding to pedestrians. More specifically, relocating ASLs to 20 feet and installing prompting signs resulted in a 90 percent reduction in motor-vehicle pedestrian conflicts (Van Houten and Malenfant, 1992).

The crosswalk assessment found that most intersections with ASLs were located within 5 feet of the crosswalks. ASLs were installed at 10 signalized and 6 unsignalized crosswalk intersections from August through December 1999 (see Table 3.2).

A real threat for pedestrians crossing streets with multiple lanes is being struck by a second vehicle in an alternate lane after the first vehicle stops to yield.

Table 3.2 Location of Advance Stop Lines: Signalized and Unsignalized Intersections

Signalized Intersections	Unsignalized Intersections
Central Ave & 2nd St.	38th Ave betw 2nd & 3rd St
Central Ave & 3rd St	83rd Ave N, east of 9th St
Central Ave & 6th St	9th St, south of 83rd Ave N
1st Ave N & 2nd St	58th St N & Burlington Ave
1st Ave N & 4th St	32nd St & Central Ave
1st Ave N & 5th St	9th St S & 3rd Ave S
2nd Ave N & 3rd St	
2nd Ave N & 4th St	
1st Ave S & 3rd St	
1st Ave S & 4th St	
1st Ave S & 5th St	

An example of an advance stop line relocated 20 feet in front of the crosswalk.

Pedestrians cross during the all-red phase at a crosswalk installed with a lead pedestrian interval device.

ASLs were installed 20 feet from crosswalks located in areas with lower traffic speeds and 40 feet from the crosswalks on roads with traffic speeds exceeding the posted speed limits. Motorists prompting signs with the message, "Yield here for Pedestrian", were also installed at locations with ASLs. The City Department of Transportation and Parking Services made engineering improvements at several additional crosswalks as part of the City's on-going pedestrian safety improvement initiative.

Lead Pedestrian Intervals

Lead pedestrian intervals (LPIs) create a three-second all-red phase allowing pedestrians to start crossing prior to the release of turning vehicles and are effective in reducing pedestrian-vehicle conflicts at signalized intersections (Van Houten, et al., 1999). LPIs were installed at four locations in the downtown area

Previous research in Pinellas County found that the use of animated eyes that scan from side to side during the WALK indicator increased the number of pedestrians looking for

A pedestrian crosses at a crosswalk equipped with scanning eye pedestrain heads.

(see Table 3.3). These intersections were selected based on high pedestrian volume and input from the City Department of Transportation and Parking Services.

Table 3.3 Location of Lead Pedestrian Intervals

LPI Locations
1st Ave N & 4th St
1st Ave N & 5th St
Central Ave & 2nd St
1st Ave S & 4th St

Scanning Eyes on Pedestrian Signal Heads

Pedestrian signals incorporating the use of scanning eyes prompt pedestrians to look both ways before crossing the street at signalized intersections. Previous research in Pinellas County found that the use of animated eyes that scan from side to side during the WALK indicator increased the number of pedestrians looking for turning vehicles (Van Houten et al., 1999). A total of 8 pedestrian signals incorporating the scanning eyes were installed at various crosswalks in downtown St. Petersburg to further evaluate their impact on pedestrians. Four devices were installed at 3rd St and 1st Ave N and 4 at the intersection of 4th St and Central Ave. This brings the total of scanning eyes on pedestrian signal heads to 20 in downtown St. Petersburg.

Pedestrian Prompting Signs

Many crashes involving pedestrians occur due to improper behavior by the pedestrian such as crossing the street when vehicles are moving through the crosswalk, darting into the roadway or appearing suddenly in the vehicle's path, crossing the street through small vehicle gaps or against the signal, and failing to use traffic control devices. Prompting signs instruct and direct pedestrians to use proper techniques when crossing a street and are very effective in reducing pedestrian-motor vehicle conflicts.

A total of 50 pedestrian prompting signs were installed at several crosswalks in April 1999 (see Table 3.4). Two types of prompting signs were installed. Signs installed at unsignalized

Prompting signs instruct and direct pedestrians to use proper techniques when crossing a street and are very effective in reducing pedestrian-motor vehicle conflicts.

Table 3.4 Intersections with Pedestrian Prompting Signs Installed

Signalized Crosswalks	Unsignalized Crosswalks
8th St N & 1st Ave N	38th Ave N between 2nd St & 3rd St
1st St NE & 2nd Ave	Central Ave between 8th St & 9th St
16th St & Central Ave	8th St N & 2nd Ave N
Central Ave & 34th St N	9th St N between 77th Ave N & 83rd Ave N
9th St & 9th Ave N	
9th St N & 62nd Ave	
4th St N & 38th Ave	
9th St S & 22nd Ave	
16th St S & 7th Ave S	

Examples of pedestrian prompting signs displaying the extended arm technique. The sign on the left is for crosswalks at unsignalized intersections, while the sign on the right was placed at signalized crosswalks.

crosswalks encouraged pedestrians to wait before stepping out in the street while signaling their intentions to cross the road, then thanking the drivers. Signs installed at signalized crossings urged pedestrians to wait for the WALK signal, then extend arm to alert drivers and continue to look for vehicles while crossing the street. Both signs featured a pictogram of a pedestrian with his/her arm extended and only one foot off the curb.

Motorists Prompting Signs

Occasionally, motorists use poor judgment around pedestrians and are often not aware of their obligation to yield to pedestrians at crosswalks. From August through October 1999, a total of 38 motorists prompting signs were installed at various crosswalks to educate drivers about their responsibility to yield to pedestrians (see Table 3.5). These signs also act as a warning for drivers who may be cited for failing to yield to pedestrians during enforcement blitzes.

Prompting signs with the messages, “Yield Here for Pedestrians” and “Yield to Pedestrians” were installed at several crosswalks at signalized and unsignalized intersections. Some prompting signs had arrows pointing to the road where drivers must stop while others had circular signs atop reading “New” to alert drivers.

Table 3.5 Intersections with Motorist Prompting Signs Installed

Intersections
Central Ave & 2nd St (3 signs)
Central Ave & 3rd St (3 signs)
Central Ave & 6th St (4 signs)
Central Ave & 32nd St
1st Ave N & 2nd St (2 signs)
1st Ave N & 6th St (3 signs)
1st Ave S & 6th St (3 signs)
2nd Ave N & 3rd St (3 signs)
2nd Ave NE & Beach St (4 signs)
3rd Ave S & 9th St
62nd Ave N & 9th St (4 signs)
62nd Ave N & 16th St (4 signs) school crossing
62nd Ave S & 22nd St (1 sign) school crossing
77th Ave N & 9th St (4 signs)
Burlington Ave & 58th St

Special Pedestrian Safety Improvements

As previously mentioned, the City of St. Petersburg made several engineering improvements at crosswalks as part of the City's ongoing pedestrian safety improvement initiative. During the study period, the City adopted the campaign, "Courtesy Promotes Safety", to promote traffic safety awareness citywide. Special pedestrian safety improvements were made at several crosswalks in conjunction with improvements at program crosswalks. Some of these special improvements are discussed next.

ITS Crosswalk Warning System

An intelligent transportation system (ITS) crosswalk warning system uses microwave sensors to detect pedestrians at a mid-block crosswalk. This intervention was installed at the mid-block crosswalk on Central Ave between 32^{nd} St and 33^{rd} St because pedestrian transit traffic makes it one of the busiest crosswalks in the city. The sensors activated flashing yellow beacons and a pedestrian signal to prompt motorists to yield to pedestrians at the crosswalk.

Half Signal at Senior Center

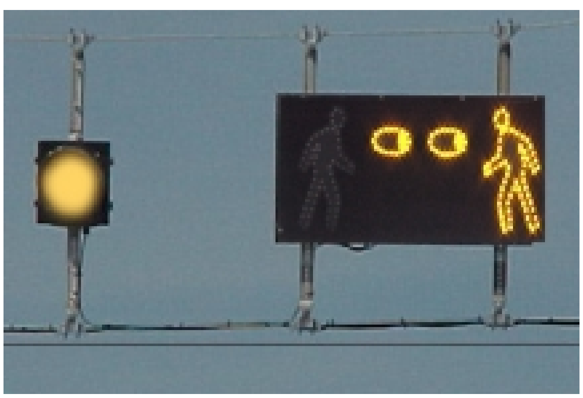
A half signal was installed at the mid-block crosswalk on 9^{th} St (MLK Blvd) and 3^{rd} St S linking a large senior apartment complex with a shopping center. The half signal stops traffic at crosswalks that are not located at intersections to allow pedestrians to safely cross the street.

Menorah Center

Special crosswalk markings and flashing beacons were installed on 58^{th} St N and Burlington Ave. Residents of the Menorah Center had complained that motorists did not yield to them when they tried to cross the street. Also, traffic was heavy along the corridor and motorists often exceeded posted speed limits.

A new crosswalk was installed that featured a 10-foot wide crosswalk with parallel lines and bars with a jog in the median to prompt pedestrians to make eye contact with motorists when they crossed the second half of the street. An advance stop line 40 feet from the crosswalk was also painted on each side of the crosswalk, and signs reading "Stop Here For Pedestrians " installed at each of the ASLs.

Yellow flashing beacons over the crosswalks were also installed and equipped with push buttons on each side of the crosswalks for pedestrians to activate when crossing. A small sign 10 '' x 12" that reads "*Press Button to Alert Drivers*" was attached to the pole holding the push button device. When the button was pressed, the flashing yellow lights were activated to prompt motorists to yield to pedestrians. Advance signs to alert drivers of the presence of flashing beacons were also installed on each side of the crosswalk.



Overhead signals to warn drivers of the presence of pedestrians in an approaching crosswalk.

Special improvements made at the Menorah Center include the relocation of advance stop lines, a redesigned crosswalk, and the installation of overhead signals and prompting signs.

Education Components

A second major component of the multidisciplinary program involved educating pedestrians, motorists, and general public about pedestrian safety. Table 3.6 lists the educational interventions that were implemented during the study period along with implementation dates. Some of these educational efforts included using electronic message boards for community feedback, developing pedestrian safety school lesson plans, and developing brochures, posters, and public service announcements. Each of the educational efforts is described next.

A second major component of the multidisciplinary program involved educating pedestrians, motorists, and general public about pedestrian safety.

Table 3.6 Education Components Implementation Dates

Intervention	Date(s) Implemented
Electronic message boards	December 1998 to September 1999
Feedback message on electronic message board	October and November 1999
School kit (brochures & lesson plan)	May and June 1999
Posters to schools	August 1999
Crossing guard workshops	August 1999
Senior and community brochures and posters	September 1999
Video PSA	September 1999
Radio PSA	September 1999
Movie preview PSA	July 1999 to January 2000
Water bill insert	October 1999

Electronic Message Boards

Electronic message boards were used to promote pedestrian safety in the community, inform the public about the multidisciplinary program, and provide feedback on the program's effects. In December 1998, nine electronic message boards were placed at various locations promoting the City's "Courtesy Promotes Safety" traffic safety initiative. The message boards were capable of displaying several screens, 8 seconds apart, and could be changed by computer using a cellular telephone. The SPPD selected the locations for the message boards and moved them repeatedly throughout the study period to maximize their impact.

Initially, the Triple E Committee decided to display one message per month to promote the monthly traffic safety theme. However, after the first six months, the display interval of the messages was changed to every two months. Table 3.7 shows the safety messages promoted throughout the program implementation.

The electronic message boards also served as sources for community feedback about the multidisciplinary program. The signs providing specific feedback were introduced in October 1999 and placed at various locations in and around the downtown area. Table 3.8 shows the feedback message displayed on the electronic message boards from October to November. Each week researchers posted the percentages of motorists yielding to pedestrians obtained from the data collected at the 15 crosswalks included in the program.

Table 3.7 Electronic Message Board Safety Messages

Electronic Message Board Displays	
Courtesy Promotes Safety Stop for Peds at Crosswalks Survive the Holidays	Courtesy Promotes Safety Help Stop Red Light Running
Courtesy Promotes Safety Please Slow Down,Life's Too Short Your Family Will Thank You	Courtesy Promotes Safety DUI Patrol Area Don't Drink (and Drive) Stay Alive
Courtesy Promotes Safety It's Bike Safety Time Lights are Real Fine Helmets are a Start Please do Your Part	Courtesy Promotes Safety See and Be Seen Please Yield to Peds

Table 3.8 Community Feedback Message and Reported Weekly Percentages

Display Message	Weekly Percentages 10/4/1999 to 11/12/1999
Courtesy Promotes Safety	48%
Drivers Yielding to Peds	51%
Last Week _____ %	56%
Best Week _____ %	54%
	61%
	70%

School Education Interventions

Several educational interventions targeted school-aged children. Researchers prepared a school intervention kit that included a teacher lesson plan, brochures, and posters, and met with school crossing guards about reinforcing good street-crossing behaviors demonstrated by the students.

Pedestrian Safety Brochure

A major objective of the education component was to communicate the use of extending the arm through various media (signs, brochures, posters, and PSAs). Researchers designed a full color brochure with 11 illustrations to address pedestrian safety at crosswalks. The brochure emphasized the importance of using an extended arm to signal to motorists of the pedestrian's intent to cross the street. Other safe street crossing behaviors highlighted included waiting for cars to stop before stepping into traffic, watching for cars while crossing the street, and thanking motorists who stop. In addition, the brochure contained messages for motorists such as coming to a complete stop at least 30 feet before a crosswalk, waiting until the pedestrian crossed at least one lane beyond their lane before proceeding, being on the watch for children, and never passing a stopped or slow vehicle at a crosswalk.

Teacher Lesson Plan

In May and June 1999, the pedestrian safety brochures were distributed along with a twenty-minute lesson plan to teachers to all Pinellas County elementary schools (i.e. students in grades K-5). Teachers distributed and reviewed the brochure with students and asked them to share the materials with their parents.

The interior of the pedestrian safety brochure instructs people how to safely cross the street.

A major objective of the education component was to communicate the use of extending the arm through various media (signs, brochures, posters, and PSAs).

"See and Be Seen" Poster

Researchers designed an 18 x 24-inch full color poster that depicts a child demonstrating the use of the extended arm before crossing the street. The poster emphasizes the importance of being seen by motorists at a crosswalk before trying to cross the street, waiting for the WALK signal, extending the arm to alert motorists, scanning from right and left, and thanking motorists with a friendly wave. Several posters were distributed to all county schools for placement in classrooms and hallways in August 1999.

Crossing Guard Program

Crossing guards were enlisted to tie together classroom interventions with safe street-crossing behavior. Because of their daily contact with children, crossing guards played a major role in promoting the use of extending the arm, scanning, and other safe crossing behaviors. Researchers prepared a two-page summary of suggestions on reinforcing students about safe street-crossing behavior and distributed the summary along with a supply of pens, brochures, and posters to all school crossing guards in Pinellas County during a workshop in August 1999. Crossing guards were asked to reinforce safe pedestrian behavior by distributing pens to children crossing the street safely.

The full color crosswalk safety poster was distributed to schools and senior centers throughout Pinellas County, Florida.

Community Education Interventions

Several educational interventions targeted special groups within the community such as senior citizens. Community educational efforts ranged from distributing brochures, posters, and bumper stickers, to developing radio and television public service announcements (PSAs).

Researchers designed a color poster that depicts a child demonstrating the use of the extended arm before crossing the street.

Brochures & Posters

Pedestrian safety brochures and the "See and Be Seen" posters were also distributed to senior citizen centers, community groups, the St. Petersburg Council of Neighborhood Associations (CONA) members, and the City's municipal departments in September 1999. A one-color version of the brochure was printed (100,000 copies) and distributed in the October 1999 municipal water bills.

Bumper Stickers

Bumper stickers are another medium to convey pedestrian safety messages. The Triple E Committee printed five thousand bumper stickers that read, "I Yield to Pedestrians" with a picture of a pedestrian extending his or her arm for distribution to interested parties and for special promotions. In September 1999, all city vehicles received bumper stickers to place on their rear vehicle bumper. The SPPD also distributed bumper stickers during an intensified pedestrian safety enforcement program in October 1999.

Public Service Announcements (PSAs)

A 30-second video, a radio spot, and a movie theater preview were produced to convey the safe street-crossing message as well as other traffic safety messages under the "Courtesy Promotes Safety" campaign.

In October, a local cable channel aired the video and distributed it to other channels for broadcasting. The video emphasized the use of the extended arm by pedestrians to signal their intentions to cross the street, waiting for cars to stop before stepping into the street, and looking both ways before crossing the street.

Radio Disney (WNMI AM 1380) in St. Petersburg prepared and broadcasted a radio message six times every day in September to coincide with the beginning of the school year. The message also focused on the use of the extended arm to signal drivers before crossing the street.

The movie theater preview played in 14 AMC theaters before each feature film from July 1999 to January 2000. This PSA involved displaying a series of three safety messages related to pedestrian safety, including "Keep Kids Alive, Driver 25," "Heed the Limits of Speed" and the pedestrian poster "See and Be Seen," before the start of feature films.

Press Releases and Media Coverage

Throughout the study period, the City Marketing and Promotions Department prepared press releases and media reports to inform the public about the "Courtesy Promotes Safety" campaign and pedestrian safety initiatives. The press conferences allowed officials to describe elements of the multidisciplinary effort, to encourage safe driver and pedestrian crosswalk behaviors, and to advise the public about the planned enforcement activities.

Enforcement Interventions

The final portion of the multidisciplinary program involved two enforcement events that were publicized through the media and press releases. Researchers worked closely with the SPDD and the Triple E Committee to design and implement two saturation enforcement programs directed toward motorists who fail to yield to pedestrians in crosswalks. This intensified campaign consisted of distributing informational flyers, bumper stickers, and issuing warning tickets. The second enforcement wave coincided with the national "Walk Our Children to School" day.

A saturated law enforcement campaign involves concentrating law enforcement to address a specific traffic issue such as seat belt use, drunk driving, or speeding. The intensified enforcement of traffic violations, combined with the high visibility of the officers, deters people from repeating the offense and the general public from committing the offense because of the increased chance of getting caught. One limitation of this type of intervention is that by themselves, short-term enforcement campaigns appear to have little impact on crashes and injuries. However, when combined with other types of interventions they may have a greater effect on reducing crashes and injuries (Britt, et al., 1995).

Yielding to Pedestrians Warning Program 1: December 18, 1998

The initial enforcement campaign involved educating and warning motorists of their obligations to yield to pedestrians, and advising pedestrians of their responsibilities when crossing the street. City police and members of the Volunteer Road Patrol distributed over 300 warnings and educational flyers to motorists and pedestrians violating crosswalk regulations.

Yielding to Pedestrians Warning Program 2: October 6, 1999

The second enforcement wave coincided with the "National Walk Our Children to School" day and other county-sponsored pedestrian safety events. Researchers, the SPPD, and the Triple E Committee collaborated with the MPO, the CTST, city and county officials, fire and rescue personnel, as well as parents and students to conduct and promote the events. In addition, other municipal law enforcement officers distributed pedestrian safety brochures throughout the county. As with the first warning program, city police officers distributed the educational flyers and bumper stickers and issued warnings to motorists failing to yield to pedestrians and pedestrians failing to observe crosswalk regulations.

Chapter 4: Program Evaluation

Introduction

The stadium business district in St. Petersburg, Florida has incorporated many pedestrian safety features.

Program evaluation results provide researchers with informed options for improving the multidisciplinary program. A major objective of the study involved assessing the effects of the multidisciplinary program on pedestrian safety in St. Petersburg. More specifically, researchers wanted to determine if the program increased motorists yielding to pedestrians at crosswalks and reduced the number of pedestrian motor-vehicle conflicts. In order to accomplish this objective, researchers collected baseline observational data prior to the implementation of interventions and compared that to the post-intervention observational data to determine the program's impact. These data were used to evaluate the extent to which the program achieved the stated goals of increasing citywide motorists yielding behavior from single digit levels to over 70 percent and reducing conflicts and crashes in crosswalks by 50 percent.

This chapter details the methodology used to evaluate the multidisciplinary program, presents the findings of the data analysis, and discusses the effects of specific interventions on improving pedestrian safety at crosswalks.

A scanning eyes pedestrian signal head at a crosswalk along Central Ave in downtown St. Petersburg, Florida.

Methodology

Researchers used a time series design approach to assess the efficacy of the multidisciplinary program. A time series design was used to determine differences between pre- and post-intervention observational data and allowed researchers to determine whether the interventions caused differences in motorists yielding behavior and pedestrian-motor vehicle conflicts.

Data on motorists yielding behavior and pedestrian motor-vehicle conflicts were collected at various times throughout the study period. Most of the results are displayed in two time periods, baseline and post-intervention. The first four weeks, from October through November 1998, encompassed the baseline data collection period. The last six weeks, September through October 1999, comprise the post-intervention time period. The post-intervention time period is longer than the baseline in an attempt to achieve similar numbers of observations because data collection during this period was not as intensive as during the baseline data collection.

Tables 4.1 and 4.2 summarize the engineering interventions implemented at each site along with the number of observations conducted during the baseline and post-intervention periods. All of the observation sites received at least one engineering treatment.

Observational data were compiled by week, site, and intersection type (e.g. signalized or unsignalized). Frequencies and percentages were calculated and used to compare the baseline results with the post-intervention data. Researchers computed the percentage of motorists yielding to pedestrians and the percentage of pedestrians experiencing conflicts according to the following formulas:

% Motorists Yielding to Pedestrians

$$= \frac{\text{\# of motorists yielding}}{[\text{\# of motorists yielding} + \text{\# of motorists not yielding}]} \times 100$$

% Pedestrians Experiencing Conflicts

$$= \frac{\text{\# of conflicts}}{\text{\# of pedestrians}} \times 100$$

A comparison of the characteristics and number of pedestrian-related crashes in St. Petersburg with the previous years' data could not be made because the complete 1999 crash database was not available during the study period. As a result, researchers could not conclude that the program reduced pedestrian-related fatalities and injuries.

Findings

This section presents the results of the analyses used to determine if the multidisciplinary program effected changes in motorists yielding behavior and reduced pedestrian-motor vehicle conflicts.

Motorists Yielding to Pedestrians at Crosswalks

Increases in motorists yielding to pedestrians were expected to reflect the knowledge acquired by pedestrians and motorists about crosswalk behavior and regulations from the engineering, educational and enforcement components of the program.

Motorists yielding behavior at all observation sites located at signalized intersections increased from 60 percent during the baseline period to 62 percent during the post-intervention period.

Table 4.1 Summary of Intervention Efforts at Signalized Intersections

Signalized Intersection Location	Intervention Measures with Approximate Implementation Dates	Number of Observations Made	
		Baseline Period	Post-Intervention Period
1st St NE & 2nd Ave N	4/99 Pedestrian prompting signs	8	8
2nd St N & 1st Ave N	8/99-10/99 Advance stop lines, motorist prompting signs	7	9
3rd St N & 1st Ave N	7/99 Scanning eye pedestrian signal heads	8	7
3rd St N & 2nd Ave N	8/99-10/99 Advance stop lines, motorist prompting signs	7	8
4th St & Central Ave	7/99 Scanning eye pedestrian signal heads	6	10
4th St S & 1st Ave S	7/99 Lead pedestrian interval 8/99-10/99 Advance stop lines	8	8
4th St N & 2nd Ave N	8/99-10/99 Advance stop lines	7	8
8th St N & 1st Ave N	4/99 Pedestrian prompting signs	7	7
9th St N & 77th Ave N	8/99-10/99 Motorist prompting signs	7	8

Source: Data collection completed by the Center for Urban Transportation Research, University of South Florida, Tampa, November 1998, September – October 1999.

Table 4.2 Summary of Intervention Efforts at Unsignalized Intersections

Unsignalized Intersection Location	Intervention Measures with Approximate Implementation Dates	Number of Observations Made	
		Baseline Period	Post-Intervention Period
Central Ave between 8th St & 9th St	4/99 Pedestrian prompting signs	6	7
Central Ave between 32nd St & 33rd St	8/99-10/99 Special crosswalk markings, motorist prompting signs, advance stop lines 9/99 ITS crosswalk warning system with microwave sensors, directional scanning eyes & flashing beacons	7	9
8th St N & 2nd Ave N	4/99 Pedestrian prompting signs	8	7
9th St S & 3rd Ave S	8/99-10/99 Advance stop lines, motorist prompting signs	6	4
38th Ave N between 2nd St N & 3rd St N	4/99 Pedestrian prompting signs 8/99-10/99 Advance stop lines	6	10
9th St N between 77th Ave N & 83rd Ave N	4/99 Pedestrian prompting signs 8/99-10/99 Advance stop lines	6	9

Note: Baseline data collection comprised a time period of four chronological and actual weeks; Post-intervention data collection comprised a period of 6 chronological weeks, but an actual period of 4 to 5 weeks.
Source: Data collection completed by the Center for Urban Transportation Research, University of South Florida, Tampa, November 1998, September – October 1999.

Crosswalks at Signalized Intersections

Overall, motorists yielding behavior at all observation sites located at signalized intersections increased from 60 percent during the baseline period to 62 percent during the post-intervention period (see Figure 4.1). For the majority of the study period, the weekly cumulative averages of motorists yielding behavior at the 9 observation sites exceeded the baseline average of 60 percent.

Despite reaching yielding levels over 70 percent, most sites did not experience a sustained increase in motorists yielding behavior. Only one crosswalk, located at 4th St and 1st Ave S, sustained the 70 percent level throughout the study period (see Table 4.3). The largest percentage increase in motorists yielding behavior from baseline to post-intervention was observed at 8th St N and 1st Ave N (30 percent) and 2nd St N and 1st Ave N (24 percent). At some crosswalks, the yielding percentage declined after interventions were implemented. This may in part be attributed to the extremely high levels of yielding initially observed during baseline periods making it difficult to maintain these levels. Also, several interventions were implemented late in the study period not allowing for adequate time for the interventions' effect to be observed. Still some variation in motorists yielding to pedestrians may have resulted from the statistical regression to the mean rather than real increases in yielding. This phenomenon results when a series returns to a more central level after an extremely high or extremely low observation (Marcantonio and Cook, 1994).

Crosswalks at Unsignalized Intersections

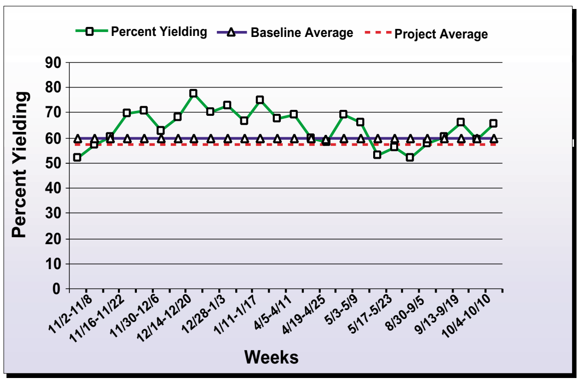
The overall percentage of motorists yielding to pedestrians at crosswalks located at unsignalized intersections increased from 3 percent during the baseline period to 24 percent during the post-intervention period (see Figure 4.2). Throughout the study period, weekly cumulative averages of motorists yielding at the 6 observation sites hovered around the baseline average of 3 percent.

Crosswalks at unsignalized intersections exhibited much lower yielding rates compared to crosswalks at signalized intersections ranging from 0 to 3 percent of motorists yielding to pedestrians during the baseline period (see Table 4.4). Most of the crosswalks at unsignalized intersections did experience small improvements in the percentage of motorists yielding to pedestrians by the post-intervention period. However, with the exception of one intersection, none of these approached the 70 percent goal.

The results suggest that the specialized interventions implemented at two unsignalized locations (Central Ave between 32nd St and 33rd St, and 9th St S & 3rd Ave S) produced significant improvements to motorists yielding be-

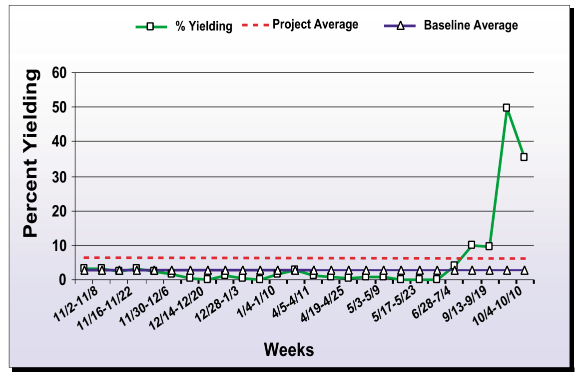
The overall percentage of motorists yielding to pedestrians at crosswalks located at unsignalized intersections increased from 3 percent during the baseline period to 24 percent during the post-intervention period.

Figure 4.1 Percent of Motorists Yielding to Pedestrians at Signalized Intersections



Source: Center for Urban Transportation Research, University of South Florida, Tampa.

Figure 4.2 Percent of Motorists Yielding to Pedestrians at Unsignalized Intersections



Source: Center for Urban Transportation Research, University of South Florida, Tampa.

Table 4.3 Motorists Yielding to Pedestrians at Crosswalks Located at Signalized Intersections: Baseline v. Post-Intervention Period

	Baseline Data Series Nov. 1998				Post-Intervention Data Series Sept.-- Oct. 1999			
Signalized Intersection Location	Total Pedestrians	Total Vehicles	Total Yielding	Percent Yielding	Total Pedestrians	Total Vehicles	Total Yielding	Percent Yielding
1st St NE & 2nd Ave N	30	34	20	59	13	13	7	54
2nd St N & 1st Ave N	41	58	32	55	20	22	15	68
3rd St N & 1st Ave N	77	107	59	55	32	44	24	54
3rd St N & 2nd Ave N	39	46	34	74	26	28	19	68
4th St & Central Ave	83	117	69	59	80	100	62	62
4th St S & 1st Ave S	72	87	56	64	48	52	37	71
4th St N & 2nd Ave N	51	42	29	69	22	23	14	61
8th St N & 1st Ave N	38	52	24	46	8	10	6	60
9th St N & 77th Ave N	23	39	25	64	11	13	6	46
All Sites	454	582	348	60	280	305	190	62

Source: Data compiled by the Center for Urban Transportation Research, University of South Florida, Tampa, November 1998, September – October 1999.

Table 4.4 Motorists Yielding to Pedestrians at Crosswalks Located at Unsignalized Intersections: Baseline vs. Post-Intervention Period

Unsignalized Intersection Location	Baseline Data Series Nov. 1998				Post-Intervention Data Series Sept.--Oct. 1999			
	Total Pedestrians	Total Vehicles	Total Yielding	Percent Yielding	Total Pedestrians	Total Vehicles	Total Yielding	Percent Yielding
Central Ave between 8th St & 9th St	80	332	8	2	69	233	7	3
Central Ave between 32nd St & 33rd St	126	587	17	3	186	585	174	30
8th St N & 2nd Ave N	47	181	4	2	8	38	0	0
9th St S & 3rd Ave S	74	467	15	3	89	89	89	100
38th Ave N between 2nd St N & 3rd St N	28	181	6	3	18	123	1	0.8
9th St N between 77th Ave N & 83rd Ave N	7	66	0	0	10	105	10	9
All Sites	362	1,814	50	3	380	1,173	281	24

Source: Data compiled by the Center for Urban Transportation Research, University of South Florida, Tampa, November 1998, September – October 1999.

havior. At the Central Ave intersection, the percentage of motorists yielding to pedestrians increased from 3 to 30 percent. At the 9th St intersection, yielding percentages improved from 3 to 100 percent. These two intersections were largely responsible for the overall increases in percentage yielding during the post-intervention period. Unfortunately, not all intersections exhibited such marked signs of improvement.

Pedestrian-Motor Vehicle Conflicts at Crosswalks

Researchers anticipated that the effects of multidisciplinary program would result in decreases in pedestrian-motor vehicle conflicts. Observational data collected on pedestrian-motor vehicle conflicts were used as proxy measures in place of crash report data.

The percentages of conflicts experienced by pedestrians at signalized sites ranged from 0 to 7 percent during the baseline period.

Crosswalks at Signalized Intersections

Overall, the percentage of pedestrian-motor vehicle conflicts at all observation sites located at signalized intersections increased slightly from 3 percent during the baseline period to 4 percent during the post-intervention period (see Figure 4.3). The weekly cumulative averages of pedestrian-motor vehicle conflicts at the 9 observation sites showed no clear patterns. Early in the project, conflicts reduced to almost zero then rose sharply after the introduction of some of the engineering and educational interventions. The erratic patterns of pedestrian-motor vehicle conflicts at these sites suggest that the results may be due to regression to the mean. As with the yielding data, the ability to isolate the program's effects was limited due to interventions being implemented during the last weeks of data collection.

The percentages of conflicts experienced by pedestrians at signalized sites ranged from 0 to 7 percent during the baseline period (see Table 4.5). By the end of the study period, the percentage of conflicts experienced by pedestrians at the majority of observation sites declined to zero. Six of the 9 signalized intersections reduced their percent conflicts by at least 50 percent or maintained a rate of 0 percent conflicts through the post-intervention period.

The largest percentage decreases were observed at 3rd St N and 2nd Ave N (100 percent) and 4th St S and 1st Ave S (71 percent). Significant increases were also noted at two intersections, however. The percentage of pedestrians experiencing conflicts at 3rd St N and 1st Ave N increased from 0 to 22 percent while conflicts doubled at 4th St N and 2nd Ave N (from 2 to 4.5 percent).

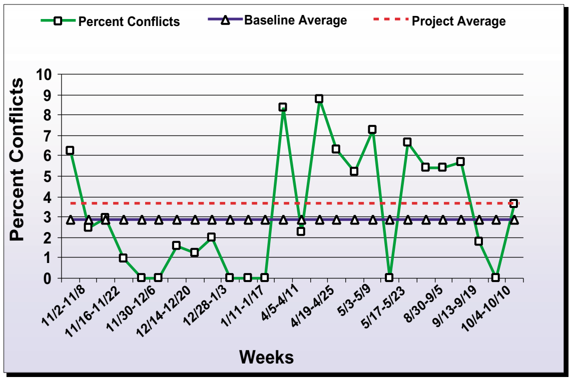
Crosswalks at Unsignalized Intersections

The overall percentage of pedestrian-motor vehicle conflicts at crosswalks located at unsignalized intersections declined from 4 percent during the baseline period to 0.3 percent during the post-intervention period (see Figure 4.4). Throughout the study period, weekly cumulative averages of pedestrian-motor vehicle conflicts at the 6 observation sites were below the baseline average of 4 percent. Crosswalks at unsignalized intersections experienced a vast improvement, exhibiting a sustained drop in the percentage of pedestrian-motor vehicle conflicts throughout the study period.

The percentages of conflicts experienced by pedestrians at unsignalized sites ranged from 0 to 6 percent during the baseline period (see Table 4.6). During the post-intervention period, all observation sites experienced a reduction in pedestrian-motor vehicle conflicts with 5 out of 6 sites experiencing no conflicts. At all of the unsignalized intersections, conflicts were reduced by at least 50 percent or maintained a rate of 0 percent conflicts.

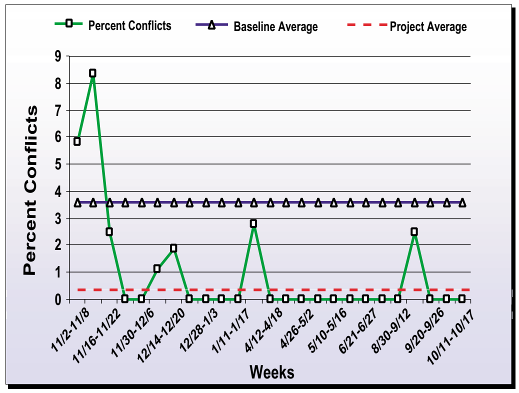
The overall percentage of pedestrian-motor vehicle conflicts at crosswalks located at unsignalized intersections declined from 4 percent during the baseline period to 0.3 percent during the post-intervention period.

Figure 4.3 Percent of Pedestrian-Motor Vehicle Conflicts at Signalized Intersections



Source: Center for Urban Transportation Research, University of South Florida, Tampa.

Figure 4.4 Percent of Pedestrian-Motor Vehicle Conflicts at Unsignalized Intersections



Source: Center for Urban Transportation Research, University of South Florida, Tampa.

Table 4.5. Pedestrian-Motorist Conflicts at Crosswalks Located at Signalized Intersections: Baseline v. Post-Intervention Period

	Baseline Data Series Nov. 1998				Post-Intervention Data Series Sept.--Oct. 1999			
Signalized Intersection Location	Total Pedestrians	Total Vehicles	Total Conflicts	Percent Conflicts	Total Pedestrians	Total Vehicles	Total Conflicts	Percent Conflicts
1st St NE & 2nd Ave N	30	34	0	0	13	13	0	0
2nd St N & 1st Ave N	41	58	3	7	20	22	1	5
3rd St N & 1st Ave N	77	107	0	0	32	44	7	22
3rd St N & 2nd Ave N	39	46	3	4	26	28	0	0
4th St & Central Ave	83	117	1	1	80	100	0	0
4th St S & 1st Ave S	72	87	5	7	48	52	1	2
4th St N & 2nd Ave N	51	42	1	2	22	23	1	4.5
8th St N & 1st Ave N	38	52	0	0	8	10	0	0
9th St N & 77th Ave N	23	39	0	0	11	13	0	0
All Sites	454	582	13	3	280	305	10	4

Source: Data collection completed by the Center for Urban Transportation Research, University of South Florida, Tampa, November 1998, September – October 1999.

Table 4.6. Pedestrian-Motorist Conflicts at Crosswalks Located at Unsignalized Intersections: Baseline v. Post-Intervention Period

Unsignalized Intersection Location	Baseline Data Series Nov. 1998				Post-Intervention Data Series Sept.--Oct. 1999			
	Total Pedestrians	Total Vehicles	Total Conflicts	Percent Conflicts	Total Pedestrians	Total Vehicles	Total Conflicts	Percent Conflicts
Central Ave between 8th St & 9th St	80	332	3	4	69	233	0	0
Central Ave between 32nd St & 33rd St	126	587	3	2	186	585	1	0.5
8th St N & 2nd Ave N	47	181	3	6	8	38	0	0
9th St. S & 3rd Ave S	74	467	3	4	89	89	0	0
38th Ave N between 2nd St N & 3rd St N	28	181	1	4	18	123	0	0
9th St N between 77th Ave N & 83rd Ave N	7	66	0	0	10	105	0	0
All Sites	362	1,814	13	4	380	1,173	1	0.3

Source: Data collection completed by the Center for Urban Transportation Research, University of South Florida, Tampa, November 1998, September – October 1999.

Discussion of Intervention Efforts and Site Results

This section discusses the effects of specific interventions on the individual observation site results. As previously mentioned, all observation intersections received at least one engineering intervention and many of observation sites received multiple interventions making it harder to isolate the effects of specific engineering interventions on improvements to pedestrian safety. Researchers also assessed the impact of single versus multiple interventions at crosswalks and evaluated the effects of the education and enforcement components.

Engineering Interventions

Advance Stop Lines Only

ASLs were placed at 8 of the observation intersections. The ASLs alone did not produce as promising improvements in pedestrian safety. The one intersection that received only ASLs, (4th St N and 2nd Ave N), experienced an overall decrease in motorists yielding and a 50 percent increase pedestrian-motor vehicle conflicts during the study period.

Advance Stop Lines and Motorist Prompting Signs

ASLs and motorist prompting signs were located at two signalized intersections (2nd St N & 1st Ave N, and 3rd St N & 2nd Ave N). Because these interventions target motorists, researchers anticipated increases in motorists yielding behavior and decreases in pedestrian-motor vehicle conflicts. Motorists yielding behavior increased at the 2nd St N & 1st Ave N site (from 55 to 68 percent) while decreasing slightly at the other observation site (74 to 68 percent). However, these intersections had two of the highest levels of motorists yielding percentages among all observation sites. Pedestrian-motor vehicle conflicts were also reduced at both intersections.

Advanced Stop Lines (ASLs) and Pedestrian Prompting Signs

ASLs and pedestrian prompting signs were located at two unsignalized intersections (38th Ave N between 2nd St N, and 3rd St N and 9th St N between 77th Ave N and 83rd Ave N). These combined interventions produced mixed results. At the first intersection, both motorists yielding behavior and pedestrian-motor vehicle conflicts decreased. At the second intersection, the percentage of motorists yielding increased while no conflicts were observed during the study period.

Lead Pedestrian Intervals (LPIs) and Advance Stop Lines

LPIs in combination with ASLs produced greater improvements to pedestrian safety in crosswalks than ASLs alone. Although LPIs were installed at four downtown intersections, only one signalized intersection (4th St S and

LPIs in combination with ASLs produced greater improvements to pedestrian safety in crosswalks than ASLs alone.

1st Ave S) included in the study also received ASLs. This site was the only site to reach and maintain motorists yielding levels above 70 percent through the post-intervention time period. In addition, pedestrian-motor vehicle conflicts were also reduced.

Pedestrian and Motorist Prompting Signs Only

Observation sites receiving only pedestrian prompting signs yielded mixed results (see Table 4.7). Two of the intersections experienced decreases in motorists yielding to pedestrians, while two experienced moderate increases. However, pedestrian-motor vehicle conflicts were eliminated at these sites perhaps as a result of more pedestrians reading the signs and waiting for the chance to cross the road safely.

Table 4.7 Yielding and Conflicts at Intersections Receiving Pedestrian Prompting Signs

Signalized (S) and Unsignalized (U) Intersections with Pedestrian Prompting Signs Only	Motorists Yielding to Pedestrians		Pedestrian--Motor Vehicle Conflicts	
	Baseline (%)	Post Intervention (%)	Baseline (%)	Post Intervention (%)
1st St NE & 2nd Ave N (S)	59	54	0	0
8th St N & 1st Ave N (S)	46	60	0	0
Central Ave between 8th St & 9th St (U)	2	3	4	0
8th St N & 2nd Ave N (U)	2	0	6	0

Source: Observation data collected by the Center for Urban Transportation Research, University of South Florida, Tampa, 11/98 to 10/99.

Five observation sites received motorists prompting signs along with other engineering treatments. Of these sites, the intersection at 9th St and 77th Ave N received only motorists prompting signs. Contrary to what was expected, motorists yielding to pedestrians decreased from the baseline percentage of 64 to the post-intervention percentage of 46 at this intersection.

Scanning Eyes Pedestrian Signal Heads

Scanning eyes pedestrian signal heads located at 3rd St N & 1st Ave N and 4th St & Central Ave produced mixed results. Motorists yielding to pedestrians increased from 59 to 62 percent at 4th St & Central Ave while decreasing slightly at 3rd St N & 1st Ave N. Researchers expected to see a decrease in pedestrian-motor vehicle conflicts at both locations because this intervention targets pedestrians. Unfortunately, this did not occur at both sites. The 3rd St N & 1st Ave N intersection experienced a large increase in pedestrian-motor vehicle conflicts from 0 to 22 percent. The other intersection reduced conflicts from 1 to 0 per-

Multiple interventions resulted in greater increases in yielding and fewer conflicts than intersections receiving one or two engineering interventions.

cent. These results suggest that the percentage of conflicts recorded at 3rd St N & 1st Ave N is anomalous, because the post-intervention percentage is much higher than that at any other intersection during either the baseline or post-intervention period.

Multiple Engineering Interventions

Multiple interventions resulted in greater increases in yielding and fewer conflicts than intersections receiving one or two engineering interventions. The site at Central Ave between 32nd St and 33rd St received multiple engineering interventions including ASLs, motorist prompting signs, special crosswalk markings, and an ITS crosswalk warning system. Results were some of the most dramatic in the study. Motorists yielding levels increased from 3 to 30 percent and pedestrian-motor vehicle conflicts were reduced from 2 to 0.5 percent. Also, the observation site at 9th St (MLK) and 3rd Ave S received ASLs, motorist prompting signs, and a half signal and yielded the best results among all observation sites. Motorists yielding to pedestrians increased from 3 to 100 percent and pedestrian-motor vehicle conflicts were reduced from 4 to 0 percent. Moreover, this site was the only unsignalized intersection to achieve a 70 percent yielding rate.

Education Interventions

The effects of the education interventions are difficult to isolate. Informing people about the pedestrian safety problem should motivate them to change driving and street crossing behavior resulting in increased percentages of motorists yielding and lower percentages of pedestrian-motor vehicle conflicts. Unfortunately, the program measurements did not tell researchers about who heard the PSAs, how people heard the messages, or if the messages had any effects on changing people’s street-crossing behavior. In addition, the measures did not provide feedback about the appropriateness of the media channels or the messages. Thus, researchers could not draw conclusions about the effects of the education components.

Enforcement Interventions

The percentage of motorists yielding to pedestrians at signalized intersections reached above the 70 percent level around the first enforcement campaign on December 19, 1998 (Figure 4.1). Corresponding reductions in pedestrian-motor vehicle conflicts at signalized intersections were also noted (Figure 4.3). However, similar results were not achieved at the unsignalized intersections.

The second enforcement effort on October 6, 1999 was not accompanied by the same increases in motorists yielding behavior and decreases in pedestrian conflicts. However, data collection continued only one week past the date of this intervention; the elevated percentages of motorists yielding for signalized intersections occurred in the next several weeks after the first enforcement campaign. Therefore, the results of the second enforcement blitz were inconclusive.

Summary

The goal of the evaluation was to determine if the multidisciplinary program improved pedestrian safety in St. Petersburg. Researchers used the measures of motorists yielding to pedestrians and pedestrian-motor vehicle conflicts to gauge the effects of the program. The time series design allowed researchers to compare the results from a baseline period of observations to a post-intervention period of observations at both signalized and unsignalized intersections.

In order to determine whether any part of the project attained the goal of increasing motorists yielding to pedestrians to over 70 percent, the percentages of motorists yielding were compared by looking at the data overall, by site, and by intervention. The same process was used to evaluate whether the program reduced pedestrian-motor vehicle conflicts by 50 percent.

The evaluation showed that in its entirety, the program was unable to increase motorists yielding to pedestrians at signalized and unsignalized intersections to over 70 percent despite early increases at the signalized sites. Moreover, only one signalized and one unsignalized observation site attained motorists yielding percentages over 70 percent by the post-intervention period.

Further, the program produced mixed results in the percentages of pedestrian-motor vehicle conflicts. Conflicts at signalized intersections increased during the data collection period, while conflicts at unsignalized intersections reduced. The majority of all sites displayed a reduction in conflicts by at least 50 percent, with two exceptions where percentage conflicts increased dramatically.

The most effective engineering interventions appear to be those coupled with other interventions. The strongest results in both motorists yielding to pedestrians and pedestrian-motor vehicle conflicts occurred at the sites with LPIs, ASLs, prompting signs, half signal, and an ITS warning system installed in combination with each other.

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Chapter 5: Conclusions

Examples of motorist prompting signs installed at crosswalks in St. Petersburg, Florida.

An electronic message sign in front of a parking garage to warn pedestrians of exiting cars.

Overview

This report provided an overview of the multidisciplinary program implemented in St. Petersburg, Florida to improve pedestrian safety. The program aimed to increase motorists yielding to pedestrians in crosswalks from single digits to 70 percent and reduce pedestrian-motor vehicle conflicts in crosswalks by 50 percent. Another program goal was to increase pedestrians' feelings of comfort and safety while crossing the street. The report documented the steps involved in assessing pedestrian safety in the community, prioritizing and selecting countermeasures to improve pedestrian safety, implementing engineering, education, and enforcement interventions, and evaluating the effectiveness of the program.

The results demonstrate that strategies combining engineering, education, and enforcement efforts are effective in increasing motorist awareness of yielding to pedestrians in crosswalks and reducing conflicts between motorists and pedestrians. The results also suggest that multiple engineering interventions at crosswalks are more effective than single interventions at achieving program goals. This research highlights the value of using a multidisciplinary approach to address a community traffic safety issue and can be used as a tool to help communities design an effective program to target traffic safety issues.

The chapter summarizes the research findings, discusses study limitations and provides recommendations for program improvements as well as further research.

Summary of Findings

As part of the community assessment, researchers summarized pedestrian crash trends, identified areas with high concentrations of pedestrian-motor vehicle crashes, identified pedestrian safety concerns in the community, inventoried crosswalk conditions, selected intersections for field evaluation and collected baseline data. The community assessment yielded the following findings:

- January, March, and May were the months with the highest numbers of fatal pedestrian crashes.
- Senior citizens (65 years and older) accounted for 44 percent of fatalities from 1995 to 1997.
- 46 percent of fatal pedestrian crashes occurred between 6 PM and 12 AM.
- In 1998, pedestrians 19 and younger accounted for almost 40 percent of all pedestrian-related crashes.
- One-third of crashes in 1998 took place within 50 feet of a crosswalk and over 50 percent occurred within 100 feet of a crosswalk.
- Community concerns about pedestrian-related issues included children as pedestrians, risky driver behavior, risky pedestrian behavior, and visually challenged persons as pedestrians.
- Two-thirds of pedestrians surveyed felt safe at signalized crosswalks, while only about 13 percent felt safe at unsignalized crosswalks.
- About one-half of pedestrians surveyed felt that pedestrians obeyed crosswalk regulations, and less than 10 percent felt that motorists observed crosswalk regulations.
- The majority of the 264 signalized and 45 unsignalized crosswalks audited had markings in good or fair condition; about 20 percent of all intersections had markings in poor condition.
- 40 percent of signalized crosswalks had pedestrian signal heads in place.
- During the baseline period, signalized intersections had 60 percent of all motorists yielding to pedestrians; in contrast, unsignalized intersections had 3 percent of all motorists yielding to pedestrians.
- At signalized intersections, 3 percent of pedestrians experienced conflicts during the baseline period; at unsignalized intersections, 4 percent of pedestrians experienced conflicts.

The success of implementing the engineering, education, and enforcement components was largely due to the cooperative efforts of the Triple E Committee, city departments, law enforcement, and the community. Several interventions were implemented including:

Engineering Components

- Advance stop lines (ASLs) from August to October 1999
- Lead pedestrian intervals (LPIs) in July 1999
- Scanning eyes on pedestrian signal heads in July 1999
- ITS scanning eyes at parking garage exit in July 1999
- ITS crosswalk warning system from August to September 1999
- Half signal in September 1999
- Pedestrian prompting signs in April 1999
- Motorist prompting signs from August to October 1999

Education Components

- Electronic message boards from December 1998 to September 1999
- Feedback message on electronic message boards from October to December 1999
- School kit (brochures and lesson plan) in May and June 1999
- Posters to schools in August 1999
- Crossing guard workshops in August 1999
- Senior and community brochures and posters in September 1999
- Video and radio PSAs in September 1999
- Movie preview PSA from July 1999 to January 2000
- Water bill insert in October 1999

Enforcement Interventions

- Yielding to pedestrians warning program #1 on December 19, 1998
- Yielding to pedestrians warning program #2 on October 6, 1999

Researchers analyzed data on motorists yielding behavior and pedestrian-motor vehicle conflicts collected during the baseline and post-intervention period and examined overall patterns and patterns by site and intervention. Some of the key findings of the program evaluation included:

- Motorists yielding to pedestrians at signalized intersections increased from 60 percent during the baseline period to 62 percent during the post-intervention period, but did not reach the goal of 70 percent yielding except for a brief period.
- Motorists yielding to pedestrians at unsignalized intersections did not reach the 70 percent yielding level, but did increase from 3 percent yielding during the baseline period to 24 percent yielding overall during the post-intervention period.
- Two intersections, one signalized and one

unsignalized, achieved the goal of 70 percent yielding or more during the post-intervention period.

- Pedestrian-motor vehicle conflicts at signalized intersections increased from 3 percent during the baseline period to 4 percent during the post-intervention period.

- Pedestrian-motor vehicle conflicts at unsignalized intersections decreased from 4 percent to 0.3 percent, reaching the goal of reducing conflicts by 50 percent.

- Only two signalized intersections, among all of the observation sites, did not experience a reduction in pedestrian-motor vehicle conflicts by 50 percent or more as a result of the intervention (s).

- Intersections receiving multiple engineering interventions achieved the best results in increasing motorists yielding and decreasing pedestrian-motor vehicle conflicts.

- Improvements to pedestrian's feeling of comfort and safety while crossing the street could not be assessed because the post-survey was not administered at the program's end.

Study Limitations

The time series design allowed researchers to determine if the interventions caused any measurable effects on yielding levels and conflicts. The design is further strengthened with the knowledge of the exact point of the intervention. Without this information, it is impossible to link changes in response to the exact point when the intervention was introduced (Marcantonio and Cook, 1994). Several weaknesses compromised the strength of the research design.

First, interventions were introduced at different times over the ten-month period and diffused throughout the city. Therefore, it was hard to identify clear implementation points. The longer a program or intervention takes to be implemented, the harder it is to determine whether the program caused the effects observed or if there are plausible alternative explanations.

Second, at least one intervention was implemented at all observation sites leaving researchers without a control or comparison group of observation sites. Therefore, the patterns of yielding and conflict behaviors at intersections without interventions could not be observed, making it difficult to determine if the variation present in the data was a result of the program.

Another limitation of the data involves the number of observations taken during the baseline and the post-intervention time periods. Data collection was much more intensive during the baseline period than the post-intervention time periods. This resulted in large differences between the sample sizes. While researchers did extend the chronological length of the post-intervention period in an attempt to achieve similar samples, some of the interventions were still being implemented during the post-intervention data collection period obscuring the effects of the intervention.

Finally, due to the time schedule for program implementation, there was little time available for post-intervention observations. Data collection continued until a little over a week after the second enforcement campaign and some of the education interventions continued past the dates of data collection. Therefore, the effects observed during the post-intervention period do not necessarily reflect any sustained changes or effects experienced in St. Petersburg.

Recommendations

While strong conclusions about the overall effectiveness of the multidisciplinary program could not be drawn, study results provide direction for future actions to improve pedestrian safety in St. Petersburg, Florida. The following details recommended suggestions in the categories of engineering, education, enforcement, and further research and action.

Engineering

The program evaluation showed that observation sites with multiple engineering interventions focusing on both pedestrians and motorists achieved the best results in motorists yielding to pedestrians and pedestrian-motor vehicle conflicts. Therefore, this study recommends that interventions such as advance stop lines, motorist and pedestrian prompting signs, and lead pedestrian intervals be installed at intersections with high pedestrian crash rates. In addition, because of the moderate success at increasing yielding rates and reducing conflicts at intersections with only motorists or pedestrian improvements, efforts should be made to implement both motorists-and pedestrian-centered interventions at crosswalks.

Education

The effectiveness of the education components could not be determined under the current evaluation design. However, educational campaigns are standard components of most injury prevention efforts; therefore, it is recommended that further efforts to educate the public about crosswalk regulations and pedestrian safety continue. In addition, because young and older pedestrians constitute a large percentage of pedestrians injured and killed, the City should continue to target these high-risk groups in educational messages to improve pedestrian safety. Finally, it is recommended that a methodology be designed to evaluate further educational efforts to determine the most effective ways to target these groups and reach the public with pedestrian safety messages.

Enforcement

Although data collection did not continue long enough after the second campaign to determine its effects on pedestrian safety, the first enforcement campaign appeared to have created an increase in motorists yielding for a short period of time. Therefore, it is recommended that periodic warning and citation campaigns be used as an effective tool to inform pedestrians and motorists about their obligations to obey crosswalk and pedestrian safety laws.

Further Research and Action

Several suggestions for further action and research were drawn from the study. First, while the Triple E Committee remains largely independent, it provides a good base for local efforts to improve pedestrian safety and to organize other safety efforts, and should be supported. Second, it is recommended that the 1999 pedestrian-related crash data be analyzed to determine if the program affected crash trends in St. Petersburg. Finally, crash trends and characteristics should be monitored to aid in the direction of future pedestrian safety efforts and to detect any changes in those patterns.

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