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John E Tidwell

Dr. John E. Tidwell, Major Professor

We have read this thesis
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Dr. Stephen H. Richards

Lee D. Han

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Pedestrian and Motorist Comprehension of Pedestrian Laws and Traffic Control Devices

A Thesis Presented

for the

Master of Science

Degree

The University of Tennessee, Knoxville

Devin P. Doyle

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Dedication

This thesis is dedicated to my parents, Sue and Peter Doyle, and all of my siblings, Kelly Love, Sean Doyle, Shannon Hardebeck, Erin Spining, Kerry Connor, and Flynn Doyle. The continuing love and support of my parents has provided me with the courage to attain this goal. More importantly, their compassion and understanding has guided me far beyond the walls of any classroom and taught me more than any degree ever could. Without the encouragement from them and each of my brothers and sisters, this thesis would not have been completed.

Acknowledgments

I would like to offer my deepest thanks to Dr. John Tidwell whose willingness to support me in my endeavors has allowed me to complete this thesis. His guidance on a professional and personal level has been immeasurable. I would also like to thank the remaining members of my committee, Dr. Stephen Richards and Dr. Lee Han. Both Dr. Richards and Dr. Han have made lasting impressions that have helped to mold me into not only a better engineer but a better individual as well. In addition to these individuals, I would like to thank Dr. Arun Chatterjee and Dr. Frederick Wegmann whose encouragement to enter the Master's Program has been greatly appreciated.

I wish to show my appreciation to Ms. Carolyne Parson who assisted in the tedious job of entering the data collected in this study. Without her help and great smile, I would surely have collapsed from the "burn-out"syndrome which slowed my progress on more than one occasion.

Abstract

This study was conducted to evaluate the comprehension of pedestrian safety issues by both pedestrians and motorists. It included a nationwide survey of individuals who were asked various questions related to assessments of pedestrian accident involvement, pedestrian legal issues, and pedestrian traffic control devices. Visitors at selected driver license examination stations in each of the contiguous states were asked to complete the questionnaires. In addition to these locations, questionnaires were distributed by the American Association of Retired Persons (AARP) because of the overrepresentation of elderly pedestrians in fatal pedestrian accidents. These questionnaires were completed by participants in the AARP defensive driving training courses. There were a total of 3,595 questionnaires returned from the examination stations and 1,231 questionnaires returned from the 55 Alive courses. The responses were examined to determine if all of the respondents understood the rights and obligations as pedestrians and motorists. The data was disaggregated based on their personal experience with pedestrian issues and the demographic information collected from the respondents to determine if significant differences exist between the various response groups. It was found that a high percentage of respondents are knowledgeable of the laws governing pedestrian and vehicle interaction. There are, however, a number of respondents that are unclear about the meanings of important traffic control devices and about specific safe pedestrian habits. This was also true for the respondents' subjective assessment of the problem of pedestrian collisions.

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Chapter One

Introduction to Pedestrian Issues

Introduction

With the growing availability of automobiles, pedestrian issues and concerns are often given little attention by the practicing transportation profession *(1)*. This explosive growth in auto ownership, however, reinforces the need to increase public awareness in the area of pedestrian safety. In 1992 there were 5,546 reported pedestrian fatalities and approximately 94,000 pedestrian injuries throughout the United States. These numbers accounted for 14.1 percent and 2.8 percent of all traffic related fatalities and injuries, respectively *(2)*.

Because pedestrian collisions tend to be more severe in nature, it is imperative that engineers and planners be cognizant of potential problems. Professionals in the field of transportation research have committed an extensive amount of time and effort over the past twenty years evaluating and identifying problems. In 1980, the Pedestrian Committee of the Transportation Research Board identified and ranked a set of problem statements that demand continuous attention. This set of problem statements was presented in the Transportation Research Circular 217 *(3)*. "Pedestrian comprehension of traffic control devices" was presented as one of the highest priority areas in need of future research. As recently as 1990, the committee again ranked comprehension of traffic control devices on its list of priority safety issues. There have been no subsequent comprehensive studies related to this subject.

It is widely accepted that there are two priority groups requiring close examination. These are the young and elderly pedestrians. Their overrepresentation in injury and fatal pedestrian collisions, respectively, demands the attention of researchers *(4)*. If safety specialists can gain an understanding of what these groups see as their responsibilities as pedestrians, appropriate countermeasures can be implemented to reduce their crash experience.

Through a review of related literature, it was found that the majority of studies since the publication of Circular 217, have been conducted to assess general pedestrian conflict characteristics and behavior. Davis examined pedestrian accident conflicts and characteristics as a means of developing an accident prediction model *(5)* . Studies by Witkowski *(6)*, Knoblauch *(7)*, and Cheng *(8)*, looked at general characteristics and contributing factors as a means of conducting a broad accident analysis. Others have conducted extensive research related to pedestrian conflicts and behavior at intersections. These include studies performed by Cynecki *(9)* and Berger and Robertson *(10)*. Robertson *(11)* and Zegeer *(12)* conducted studies evaluating the effectiveness of alternative pedestrian traffic control devices.

The literature review produced only the following four studies that involved pedestrian surveys: Robertson *(11)*, Reiss *(13)*, Bailey *(14)*, and Rouphail *(15)*. Each of these used brief questionnaires to determine pedestrian comprehension of specific traffic control devices or laws. For example, Bailey studied one specific group of pedestrians, children between 5 and 14 years of age. Rouphail studied one specific segment of pedestrian safety, midblock crosswalks. No comprehensive investigation

of pedestrian and motorist understanding of traffic control devices has been conducted.

Study Overview

The purpose of this study was to evaluate the comprehension by pedestrians and motorists of both traffic control devices and legal obligations required for proper pedestrian/vehicle interaction. The evaluation was conducted in the form of a questionnaire distributed to both motorists and pedestrians. To insure a complete representation of nationwide comprehension, data were collected from each of the contiguous states.

The first goal of this study was to identify target groups that may be statistically overrepresented in their misunderstandings of pedestrian signs, signals, markings, and laws. This consists of analyzing the data by gender, age, education, exposure, and experience of the respondents, as well as, differences in responses based on population size of the cities conducting the survey. The second goal was to identify traffic control devices, legal issues, and other issues that may be misunderstood by a large percentage of all respondents. As a result of this effort, safety planners will have an increased awareness of where some pedestrian problems may exist and be able to structure programs accordingly

The study methodology consisted of four basic tasks: a Literature Review; Questionnaire Development; Data Collection; and Data Analysis. Each of these tasks is discussed briefly.

Task 1: Literature Review

At the beginning of the study, an extensive literature review was conducted to determine if previous research investigating pedestrian comprehension of traffic control devices and laws had been performed. The review identified several pedestrian studies related to pedestrian and vehicle interaction. It also revealed several limited surveys that pertained to the thesis topic. These studies are referenced in the introduction of this chapter.

Task 2: Questionnaire Development

Task 2 consisted of developing a questionnaire that focused on the important issues of pedestrian and motorist interaction. Input was received from the American Automobile Association's Foundation for Traffic Safety, the Federal Highway Administration (FHWA), and the National Highway Traffic Safety Administration (NHTSA), divisions of the United States Department of Transportation. With the assistance of these three organizations, it was resolved that the questionnaire should be divided into four categories based on the types of information to be collected:

1. Demographic information related to the respondents;
2. Respondents' subjective assessment of the problems;
3. Respondents' knowledge of pedestrian laws regarding proper pedestrian/vehicle interaction; and
4. Respondents' knowledge of traffic control devices.

The questions were then divided between two separate questionnaires because

of the amount of information being sought. The basic content of the questionnaires focuses on the comprehension of right-of-way at both midblock crossings and intersections, issues related to general pedestrian movements, such as walking or jogging along the roadway, and traffic control devices.

Task 3: Data Collection

Driver license examination stations were selected to facilitate the distribution of the questionnaires to the public. The examination stations were selected for two basic reasons: (1) they provide a relatively convenient means of collecting large volumes of data, and (2) most individuals visiting the stations are motorists. Because everyone is a pedestrian at some time, conducting the study at driver license examination stations assured a sample that would include the opinions of both motorists and pedestrians. Although it has been recognized that there may exist a need for investigation of young pedestrians, this is a complicated task and is beyond the scope of this study. With the assistance of the American Association of Retired Persons (AARP), questionnaires were also distributed to participants in the 55 Alive defensive driving training courses in each state. In addition to sampling the public, each state was asked to complete a questionnaire containing the legal questions from each questionnaire. These responses were to be based on that state's laws. This was done to investigate compliance with the *Uniform Vehicle Code* and *Model Traffic Ordinance (16)*.

Task 4: Data Analysis

Because there were 3,595 questionnaires from the examination stations and 1,231 questionnaires from the 55 Alive courses returned, responses were large enough to insure that within a 95 percent confidence level (±5%), the aggregated responses truly reflect the knowledge of all visitors at the selected examination stations and 55 Alive courses. The responses were disaggregated into six groups based on the following information:

1. *Experience* – used to determine if involvement or knowledge of someone's involvement in a pedestrian collision affected the responses;
2. *Education* – used to determine if previous education related to pedestrian safety affected the responses;
3. *Gender* –used to determine if the gender of the respondent affected the responses;
4. *Age* –used to determine if the age group of the respondent (under 50 years and 50 years and older) affected the responses;
5. *Knowledge of the Manual* –used to determine if studying the driver's manual affected the responses; and
6. *City Size* –used to determine if the population size of the urban area where the questionnaire was completed affected the response.

The aggregated groups were tested using the chi–square statistical test. This was determined to be an appropriate analytical test because the data collected are of a categorical, non–normal nature. The statistical package, Statistical Analysis Software (SAS), was used to analyze these groups using a 95 percent level of confidence that the responses were ±5% of the true proportion of all individuals at the examination stations and 55 Alive courses.

Organization of the Thesis

The remaining chapters in the thesis address the literature review, the study methodology, and the results. Chapter Two discusses the findings of the literature review. A review of pedestrian collision characteristics and trends is presented. Detailed discussions of each of the studies are included in order to reveal the lack of comprehensive research on the subject of pedestrian comprehension of laws and traffic control devices.

Chapter Three outlines the study methodology in greater detail. It includes discussions on the questionnaire development, site selection, and analytical procedures. Each of the questions asked on the two questionnaires are discussed. Greater detail is also provided on how the study sites were selected.

The results of Questionnaire I and Questionnaire II are presented in Chapters Four and Five, respectively. Discussion is provided for each of the disaggregated groups. The analysis based on city size was conducted only for the driver license examination station questionnaires, not the AARP samples.

Chapter Six discusses the legal portion of the questionnaires. It presents the findings of the state responses to the legal questions. A review of each state's annotated codes and statutes was also conducted. The responses from the states are compared with the states' codes and then with the *Uniform Vehicle Code* and *Model Traffic Ordinance*.

Chapter Seven presents the conclusions reached from the analyses of the data. Recommendations are made for future research and safety programs.

Chapter Two

Literature Review

Characteristics of Pedestrian Collisions

Prior to developing the questionnaire, an analysis of current trends and characteristics of pedestrian collisions was conducted. This was done to assist in identifying the problem areas where a lack of understanding on either the part of the typical pedestrian or motorist might exist. Since 1975 the total number of annual fatalities has fluctuated, although there has been a downward trend since 1979. Figures show that the number of fatalities has dropped from 47,087 in 1988 to 39,235 in 1992. A summary of reported fatalities and estimated injuries obtained from the Fatal Accident Reporting System (FARS) and the National Accidents Sampling System/General Estimates System (GES) is shown in Table 2.1 *(2)*.

Pedestrian fatalities have displayed a consistent downward trend since 1979 following a brief upward trend beginning in 1975 (Figure 2.1). Over the past fourteen years, pedestrian fatalities have dropped from 8,096 to 5,546. It should also be noted that the ratio of pedestrian fatalities to all traffic fatalities has shown a gradual reduction since 1975. The percentage of pedestrian fatalities peaked again briefly in 1982 when pedestrian fatalities accounted for 16.7 percent of all traffic fatalities. Since that time, the percentage has dropped steadily to the current percentage of 14.1 *(2)*.

The injury data are based on estimates calculated by the GES, which began

Table 2.1

Persons Killed or Injured, by Person Type, 1975–1992

Year	Non-Pedestrian		Pedestrian		Total
	Number	Percent of Total	Number	Percent of Total	
Killed					
1975	37,009	*83.1*	7,516	*16.9*	44,525
1976	38,096	*83.7*	7,427	*16.3*	45,523
1977	40,146	*83.9*	7,732	*16.1*	47,878
1978	42,536	*84.5*	7,795	*15.5*	50,331
1979	42,997	*84.2*	8,096	*15.8*	51,093
1980	43,021	*84.2*	8,070	*15.8*	51,091
1981	41,464	*84.1*	7,837	*15.9*	49,301
1982	36,614	*83.3*	7,331	*16.7*	43,945
1983	35,763	*84.0*	6,826	*16.0*	42,589
1984	37,232	*84.1*	7,025	*15.9*	44,257
1985	37,017	*84.5*	6,808	*15.5*	43,825
1986	39,308	*85.3*	6,779	*14.7*	46,087
1987	39,645	*85.5*	6,745	*14.5*	46,390
1988	40,217	*85.4*	6,870	*14.6*	47,087
1989	39,026	*85.6*	6,556	*14.4*	45,582
1990	38,117	*85.5*	6,482	*14.5*	44,599
1991	35,707	*86.0*	5,801	*14.0*	41,508
1992	33,689	*85.9*	5,546	*14.1*	39,235
Injured					
1988	3,306,000	*96.8*	110,000	*3.2*	3,416,000
1989	3,172,000	*96.6*	112,000	*3.4*	3,284,000
1990	3,126,000	*96.8*	105,000	*3.2*	3,231,000
1991	3,009,000	*97.2*	88,000	*2.8*	3,097,000
1992	3,310,000	*97.2*	94,000	*2.8*	3,404,000

Source: "Traffic Safety Facts 1992," National Highway Traffic Safety Administration, U.S. Department of Transportation, Washington, D.C. (1993).

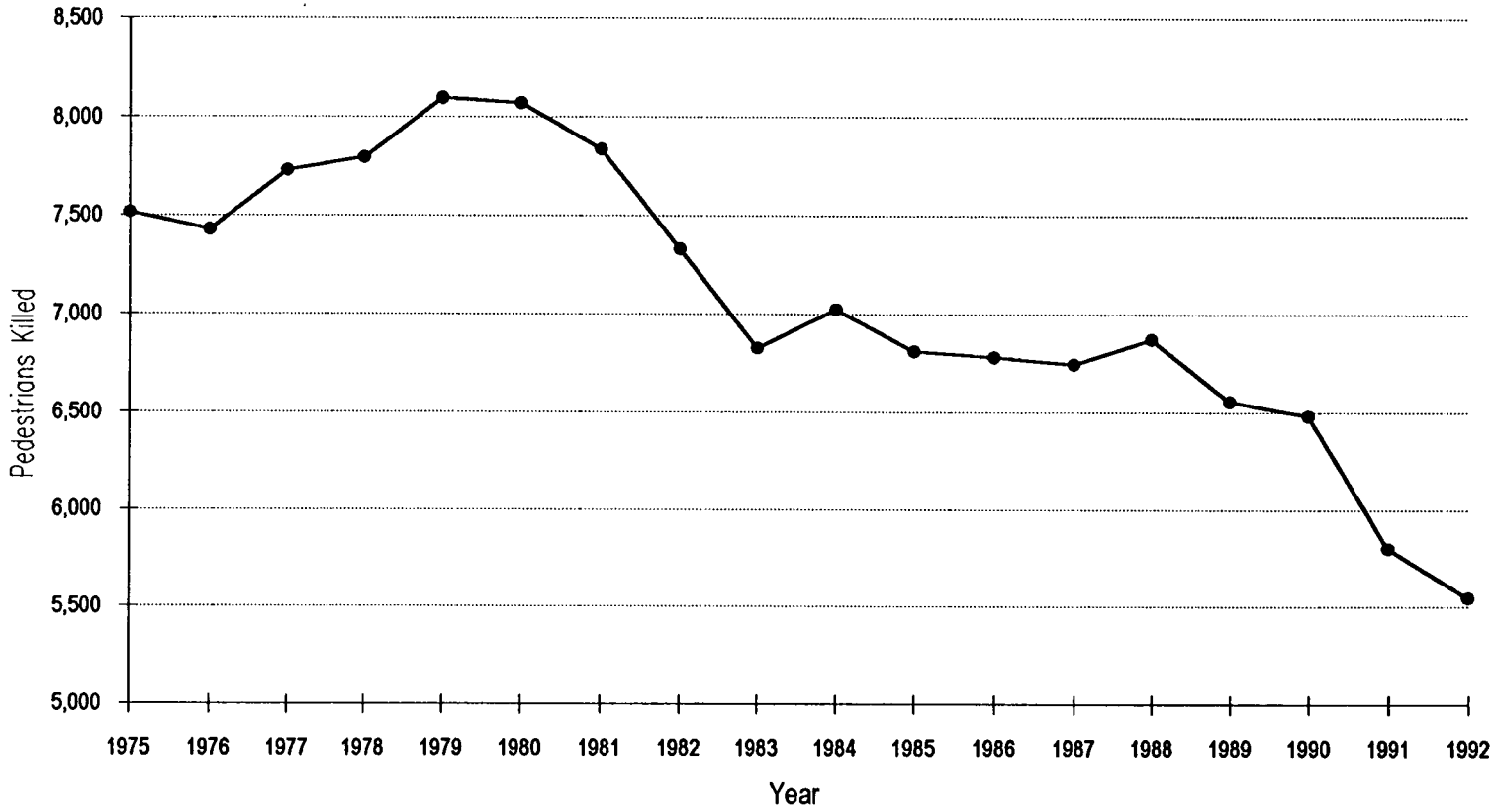


Figure 2.1. Total Pedestrians Killed, 1975–1992

Source "Traffic Safety Facts 1992," National Highway Traffic Safety Administration, U.S. Department of Transportation, Washington, D.C. (1993).

operation in 1988. The GES was designed and developed by NHTSA and has the primary function of estimating annual summary crash data based on a sampling it receives from selected cities across the country. Because these are estimated figures and rounding differences may occur, some figures may not sum to the expected total values. The GES estimated last years total pedestrian injuries to be nearly 94,000. This represents 2.8 percent of all traffic related injuries. A quite disturbing observation reveals that the ratio of pedestrian fatalities to all traffic fatalities is considerably higher than the ratio of pedestrian injuries to all traffic injuries. This fact emphasizes the severity of pedestrian collisions *(2)*.

Characteristics of Age Groups

Much focus has been placed on both the young and elderly age groups regarding pedestrian studies and programs. These groups are typically overrepresented in traffic fatalities and injuries. Table 2.2 summarizes the pedestrian fatalities and injuries by the age of the pedestrian. It also presents a normalizing rate based on the population of each age group so that comparisons can be made across the groups. The 1992 data show that there were approximately two fatalities and thirty–seven injuries to pedestrians for every 100,000 persons living in the United States*(2)*.

A 1975 study by Knoblauch *(17)* investigated the increased risk faced by young pedestrians. He sampled 2,044 pedestrian accident reports and estimated that 34 percent were pedestrians between the ages of 5 and 14 years. Reiss *(13)*, upon recognizing this trend, set out to determine where the problems where occurring among

Table 2.2

Pedestrians Killed or Injured and
Rates per 100,000 Population, by Age, 1992

Age (Years)	Number of Males	Number of Females	Total		
			Killed	Population (Thousands)	Rate
Killed					
<10	344	171	515	37,851	*1.36*
10–15	172	75	247	21,550	*1.15*
16–20	238	89	327	17,412	*1.88*
21–24	245	57	302	15,290	*1.98*
25–34	705	190	895	42,382	*2.11*
35–44	645	215	860	39,867	*2.16*
45–54	429	159	588	27,404	*2.15*
55–64	328	153	481	20,923	*2.30*
>64	712	555	1,267	32,242	*3.93*
Unknown	47	13	63	*	*
Total **	3,865	1,677	5,546	254,922	*2.18*
Injured * **					
<10	12,000	6,000	19,000	37,851	*50.20*
10–15	8,000	7,000	15,000	21,550	*69.61*
16–20	5,000	3,000	8,000	17,412	*45.95*
21–24	4,000	3,000	7,000	15,290	*45.78*
25–34	10,000	3,000	14,000	42,382	*33.03*
35–44	8,000	4,000	12,000	39,867	*30.10*
45–54	5,000	2,000	7,000	27,404	*25.54*
55–64	2,000	2,000	4,000	20,923	*19.12*
>64	4,000	4,000	7,000	32,242	*21.71*
Total	58,000	36,000	94,000	254,922	*36.87*

* Not applicable.

** Includes 4 pedestrians killed of unknown sex.

*** Because of rounding and estimation errors, rows and columns may not sum.

Source: "Traffic Safety Facts 1992," National Highway Traffic Safety Administration, U.S. Department of Transportation, Washington, D.C. (1993).

young pedestrians. He developed a survey that addressed several issues related to pedestrian safety. The survey consisted of both written and oral questions depending on the age group of the respondents. The youngest age groups were interviewed on an individual basis while proctors were provided for the middle school students. This was done so that greater care could be taken in making certain that the questions and procedures were understood by the children.

The study concluded that the levels of understanding and capabilities of making appropriate decisions increased with age. The youngest group had less exposure to pedestrian activities and thus, tended to cross at protected locations. At the same time, these students did not appear to relate to or understand traffic control devices other crossing guards. Reiss also found that children attending schools in urbanized areas more clearly understood the meanings of traffic control devices. This can most likely be attributed to an increased exposure to traffic signals and a need for pedestrian safety education.

Children continue to represent a high percentage of pedestrian fatalities and injuries. Figures from the 1992 summary data obtained from FARS and GES show that nearly 29 percent of all pedestrian fatalities and injuries occur to pedestrians between the ages of 5 and 14. Figure 2.2 graphically displays the variation associated with pedestrian injuries sustained by each age group. From the figure, it is evident that for injuries, the younger age groups are significantly overrepresented. In particular, the 15 and under age groups stand out as being clearly overrepresented.

The second age group that needs special attention is the elderly. Bailey *(14)*

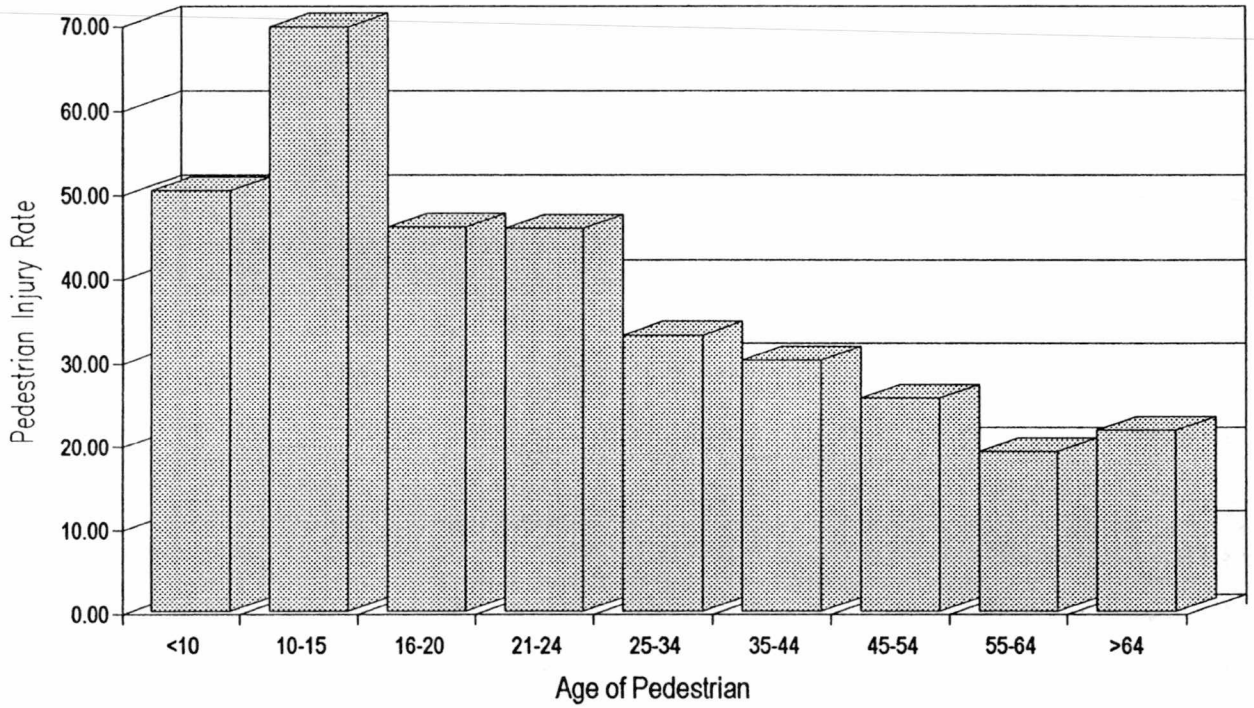


Figure 2.2. Pedestrian Injury Rates per 100,000 Population, by Age, 1992

Source "Traffic Safety Facts 1992," National Highway Traffic Safety Administration, U.S. Department of Transportation, Washington, D.C. (1993).

identified two major factors that affect the elderly pedestrians: environmental factors and physiological factors. The environmental factors include such things as weather and temporal conditions, traffic complexity, and street and curb conditions. Rain, snow, fog, dusk, and glare pose a particular problem to the elderly. These individuals are much more prone to being negatively affected by these conditions than the younger groups are. An increased level of complexity of traffic movements at intersections becomes a problem for this age group as well. Large intersections that serve high volumes of traffic with complex phasing schemes can be very imposing. At the same time, elderly pedestrians are not always cognizant of right turns on red and left turns on green. One study in Florida showed that 70 percent of elderly pedestrian fatalities occurred while the WALK signal was illuminated *(18)*. Poor pavement conditions, such as large cracks and potholes, can be hindrances to the elderly pedestrian. In addition to this, high curbs and poorly located storm sewer grates can be hazardous to pedestrians using walking aids *(14)*.

The physiological changes that affect the elderly can have grave repercussions on their ability to perceive and negotiate potential traffic hazards. Impaired vision, hearing, and cognition can become life threatening impairments at intersections. Poor vision may prevent an elderly pedestrian from seeing an oncoming vehicle or even a pedestrian signal on the opposite side of an intersection. Those with significant hearing losses will have a more difficult time using auditory senses to determine the location of vehicles. Salthouse's study *(19)* found that the greatest change that occurs as individuals age, however, is the deterioration of the reactive and the cognitive

abilities. The time needed for sensory and motor processes is reduced immensely and, thus, complicated crossing patterns or traffic control devices may become overwhelming. Through the use of a questionnaire administered to 76 elderly individuals, aged 56 and over, in Florida, Bailey found that less than one third (31 percent) understood the meaning of the flashing DON'T WALK message. A large percentage failed to understand the meaning of the international icon messages, such as the upheld hand. Of the sample group, 36 percent could not identify its meaning. The majority of the respondents indicated a preference for word messages over icons *(14)*.

Although figures for 1992 appear to maintain the assumption that further attention should be placed on the elderly pedestrian, the fact that they are underrepresented in all pedestrian collisions may indicate that they are not a high risk group. This group is highly overrepresented, however, in the fatal injury category (Figure 2.3). The fatality rate for the over 64 age group is about four fatalities per 100,000 persons. This is nearly double the national rate of 2.18 *(2)*.

Pedestrian Crossings at Intersections

The location of pedestrian collisions is a major issue that concerns traffic engineers and planners. In the past, there has been a considerable amount of emphasis placed on evaluating pedestrian behavior and characteristics at signalized and unsignalized intersections. While figures show that the number of non-intersection related pedestrian injuries and fatalities are much higher than those at intersections, it

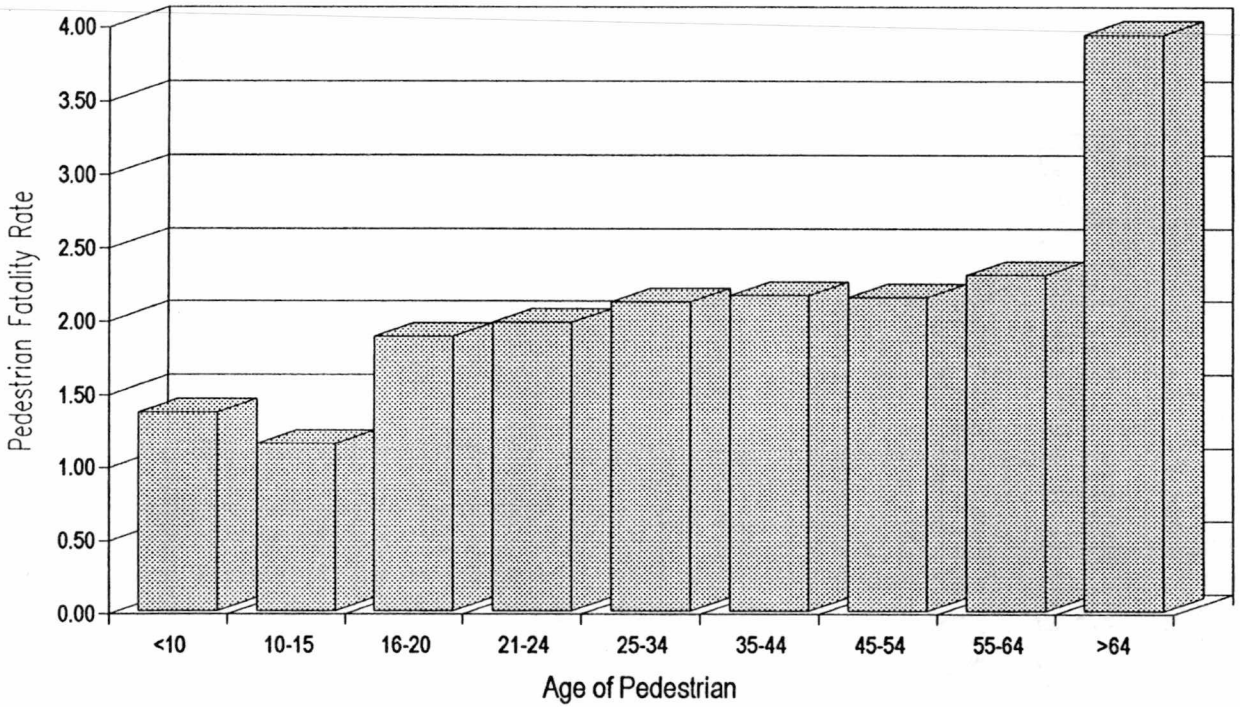


Figure 2.3. Pedestrian Fatality Rates per 100,000 Population, by Age, 1992

Source "Traffic Safety Facts 1992," National Highway Traffic Safety Administration, U.S. Department of Transportation, Washington, D.C. (1993).

is important to study both because of the inherent differences between the types of crossings. Figure 2.4 shows the relationship between the age of the pedestrian killed and the location for 1992 *(2)*. The number of elderly pedestrians injured or killed at intersections account for 58 percent and 28 percent, respectively, of all elderly pedestrian injuries and fatalities, ages 55 and over. The fatality figure is twelve percentage points above the national average and seems to indicate a need for investigation in this area. Several studies have concentrated on the implementation and evaluation of innovative pedestrian signals at intersections as an attempt to improve safety *(11, 12)*. Others have looked at the relationship of pedestrian/vehicle conflicts and pedestrian related collisions at intersections and non-intersection locations *(9, 10, 11)*. The 1992 figures show that the number of injuries at intersections are nearly the same as those at non-intersection crossings, with the only exception being the younger age groups (Figure 2.5).

Robertson *(11)* and Zegeer *(12)* performed detailed studies of pedestrian behavior at signalized intersections. Robertson's research consisted of a behavioral analysis of pedestrians who encountered an experimental pedestrian signal featuring the word message, DON'T START in place of the DON'T WALK message. The study compared this experimental site to a site using the word message, DON'T WALK, as designated by the *Manual on Uniform Traffic Control Devices* (MUTCD) *(20)*. From the observations, two conclusions were made. The first is that using the DON'T START message does not change pedestrian behavior. The second conclusion is that more effort needs to be placed on educating the public to being more aware of both

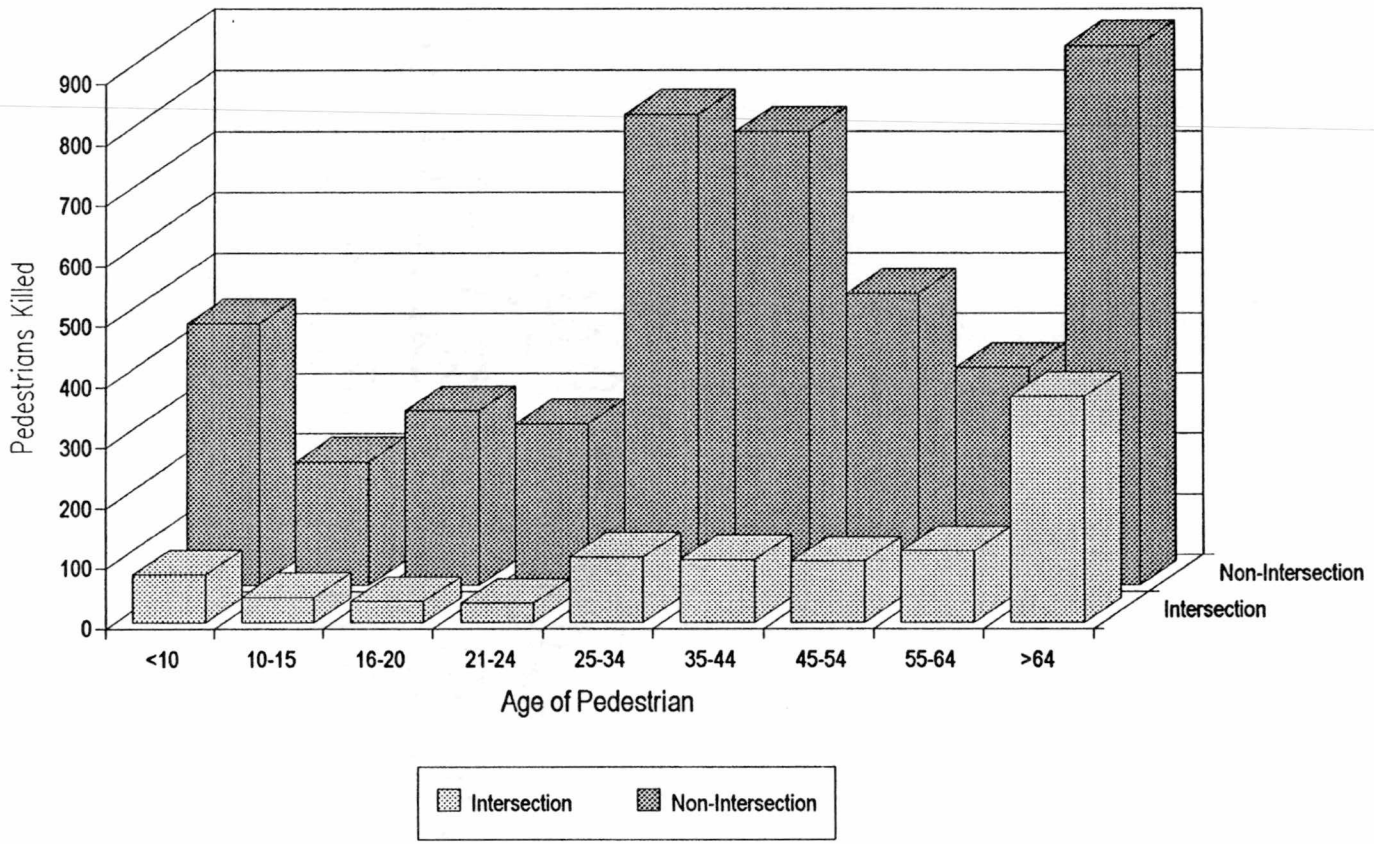


Figure 2.4. Pedestrians Killed, by Age and Location, 1992

Source "Traffic Safety Facts 1992," National Highway Traffic Safety Administration, U.S. Department of Transportation, Washington, D.C. (1993).

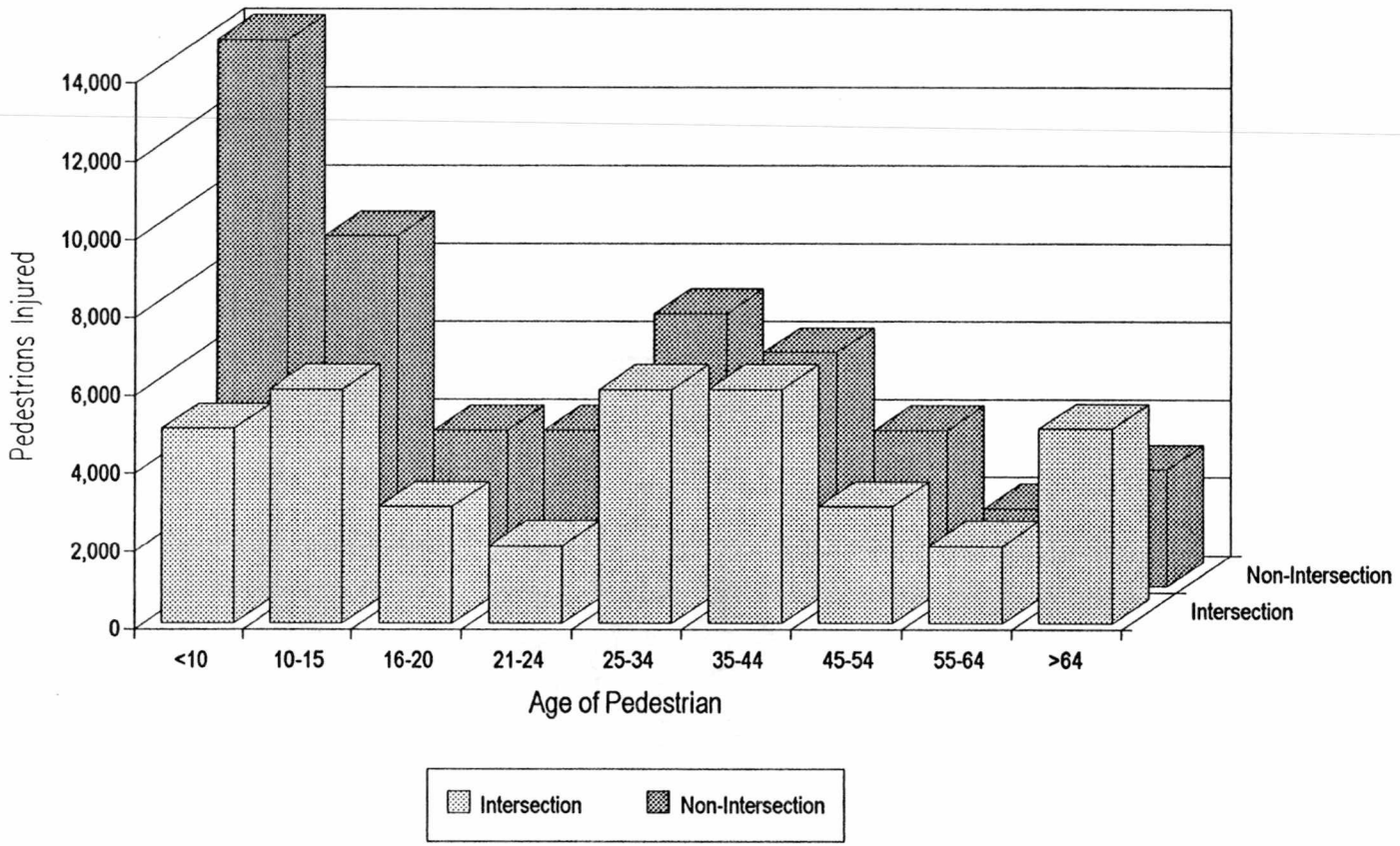


Figure 2.5. Pedestrians Injured, by Age and Location, 1992

Source "Traffic Safety Facts 1992," National Highway Traffic Safety Administration, U.S. Department of Transportation, Washington, D.C. (1993).

right and left turning vehicles. A brief pedestrian survey was also conducted and indicated that 91 percent of the respondents knew what action to take if standing on a curb facing a flashing DON'T WALK. For the case in which a pedestrian is already in the crosswalk when the DON'T WALK message begins to flash, the number of correct responses, to continue crossing, for the various test sites ranged from 59 to 90 percent *(11)*.

In a study similar to Robertson's, Zegeer *(12)* evaluated several experimental pedestrian signal displays and traffic signs. Focus was placed on traffic control devices that warned pedestrians and motorists of potential conflicts . Zegeer identified three alternatives that may reduce the number of pedestrian conflicts at intersections: new signs and signals, modification of existing devices or supplemental plates, and promotion of education and respect for traffic control devices. These alternatives are shown as a flowchart in Figure 2.6 *(12)*. The flowchart addresses the relationship between the observed behaviors at signalized intersections and appropriate remedial solutions.

Berger and Robertson *(10)* conducted a detailed study of 120 signalized and unsignalized intersections in order to identify the various types of pedestrian conflicts. The study included a total of 60 intersections that were determined to have a history of pedestrian accidents. Another group of 60 intersections which did not have a history of accidents was identified. These had similar geometric and traffic control characteristics as the first group of intersections. The research yielded a set of variables based on typical pedestrian behavior that was dependent on the accident

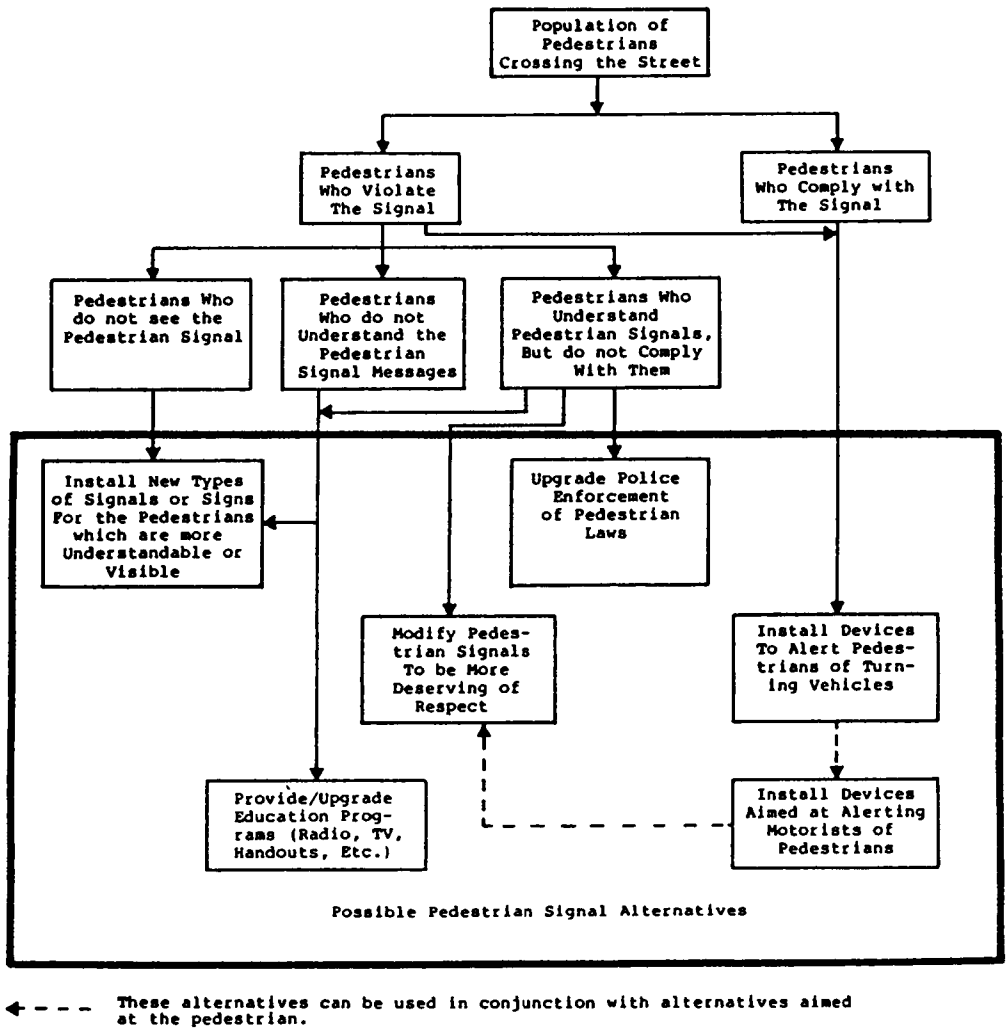


Figure 2.6. Breakdown of Pedestrian Signal Alternatives

Source: Zegeer, C.V., M.J. Cynecki, and K.S. Opiela, "Evaluation of Innovative Pedestrian Signalization Alternatives," in *Transportation Research Record 959: Pedestrian and Bicycle Facilities*, Transportation Research Board, Washington, D.C. (1984) pp. 7–18.

history of the intersection. At high pedestrian accident locations, unique pedestrian behaviors such as, reversing movement, hesitating, or running, were observed.

The list of behaviors identified by Berger and Robertson was used in several studies performed in the 1980's. In a field test, Cynecki *(9)* combined these behavioral characteristics with various severity levels of pedestrian conflicts based on subjective observations. The research developed a method for observing and ranking high pedestrian conflict locations. Davis *(5)* conducted a study that specifically investigated the relationship between pedestrian conflicts and pedestrian collisions. The goal of this research was to develop an accident prediction model based on observed pedestrian conflicts. A series of models were developed based on the number of conflicts, traffic volumes (pedestrian and vehicle), traffic control, pedestrian violations, and number of lanes. The study emphasized identifying geographic locations that have general problems, not specific pedestrian characteristics.

Pedestrian Crossings at Midblock Locations

As is shown in Figures 2.4 and 2.5, there are a significantly higher number of pedestrian injuries and fatalities at non–intersection locations. Only a few studies have examined midblock crossings. Of all of the studies reviewed, only those of Rouphail *(15)* and Zegeer *(21)* placed special emphasis on midblock crosswalks (MBC). Zegeer developed a method for first, conducting a hazard assessment of crossings in school speed zones and secondly, for identifying potential safety improvements based on these assessments. From the study observations, a list of common pedestrian behaviors in

school zones was developed. In addition to this, common operational and geometric deficiencies were noted. By examining the association of these two elements to pedestrian conflicts and collisions, a third list was developed which provides appropriate safety countermeasures or improvements to a specific location. The three lists are linked together using the flow chart shown in Figure 2.7.

Rouphail's study *(15)* evaluated user preference and compliance at MBCs. Two types of data were collected at 10 midblock crosswalks. These crosswalks were divided into two groups based on the type of control: signalized or unsignalized. The first set of data was strictly observational and included the number of conflicts and violations by both pedestrians and motorists. The results demonstrated that there is a significant difference between the number of motorist violations related to the type of MBC. Motorists at signalized MBCs had a higher level of compliance. The presence of signals at MBCs did not demonstrate any affect on the number of pedestrian violations, however. Rouphail found that over 14 percent of all pedestrians observed committed some type of violation. The second part of the study included a three question survey of motorists and pedestrians. The motorist survey was administered at special parking generators while the pedestrian survey was administered at each MBC site. The results showed that neither motorists nor pedestrians favor signalized midblock crosswalks. It also showed that 79 percent of pedestrians surveyed and 84 percent of motorists surveyed agree that pedestrians have the right–of–way at unsignalized MBCs.

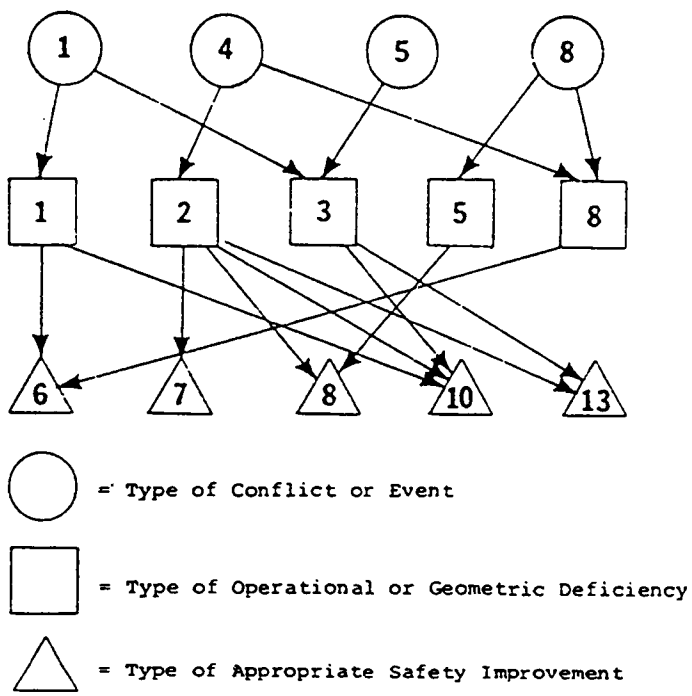


Figure 2.7. Flowchart of Interrelationships Between Conflicts, Locational Deficiencies, and Candidate Safety Improvements.

Source: Zegeer, C.V., D.A. Randolph, M.A. Flak, R.K. Bhatacharya, "Use of Pedestrian Conflict Analyses for Hazard Assessment in School Zones," in *Transportation Research Record 743*, Transportation Research Board, Washington, D.C. (1980) pp. 4–11.

Summary

There has been a considerable amount of research in the area of pedestrian behavior. The majority of these studies were related to analyzing pedestrian and vehicle conflicts. Of these, a large percentage concentrated specifically on pedestrian crossings at signalized intersections. While figures show that a large percentage of pedestrian injuries and fatalities occur at non–intersection locations, few studies have emphasized these areas. Even fewer studies have attempted to determine whether pedestrians and motorists know and understand their obligations and rights for safe interaction.

Other than the four brief surveys *(11, 13, 14, 15)*, no investigation has been conducted to comprehensively examine pedestrian and motorist comprehension of laws and traffic control devices related to their interaction. Collecting information on what the public believes to be their rights and obligations is considered to be an important component of pedestrian safety. This study was conducted to determine what individuals see as their duties and rights for proper pedestrian behavior.

Chapter Three

Questionnaire Development and Methodology

Study Objective

The study objectives were to measure pedestrian and motorist knowledge of proper interaction and to determine how well they understand the traffic control devices established for safe interaction between the two. The *Uniform Vehicle Code* and *Model Traffic Ordinance (16)* was used as the source for identifying proper pedestrian/vehicle interaction while the MUTCD *(20)* provides the interpretation and use of all traffic control devices.

Studies have shown that nearly one-third of all urban pedestrian collisions are of the dart-out type *(17, 22)*. This means that a pedestrian has left the curb without allowing the driver of a passing vehicle time to react. If pedestrians understand their obligations but fail to demonstrate this understanding, as these studies may indicate, increased enforcement and education of laws and traffic control devices must be maintained. The methodology for this study consisted of the development and distribution of two questionnaires related to pedestrian laws and traffic control devices.

Prior to developing the questionnaire, a decision was made regarding the sample population needed to gather this type of information. Because inferences from the data are to be made on a nationwide basis, information was collected from the 48 contiguous states. The questionnaires were distributed at two types of locations throughout the states: driver license examination stations and American Association

of Retired Persons (AARP) 55 Alive classes. Driver license examination stations were selected as the most appropriate location to distribute the questionnaires because most individuals visiting these stations are motorists. Because all motorists are pedestrians at some time, gathering responses from the examination stations assured the results of including the opinions of pedestrians, as well. Through the AARP organization, questionnaires were distributed to 55 Alive classes in each state. Studies have shown the older age group to be at a higher risk for pedestrian collisions and, thus, it was felt they should be addressed directly *(14, 23)*. Although the younger age groups are also at a higher risk, studying their comprehension of laws and traffic control devices is a much more complicated and involved task, as indicated by Reiss' study *(13)*. It was considered to be beyond the scope of this study

Questionnaire Development

The next step was to develop a questionnaire that focused on the important issues of pedestrian and motorist safety and awareness. After evaluating the types of information collected in other surveys, traffic control device usage outlined in the MUTCD, and related state laws, a preliminary questionnaire was drafted. The original questionnaire consisted of twenty–five questions. These questions pertained to specific traffic control devices included in the MUTCD and their meanings. It also contained questions related to the obligations of motorists and pedestrians while interacting. At this time, input was sought from professional safety groups in order to refine and simplify the questionnaire. Contacts were made with both the American Automobile

Association's Foundation for Traffic Safety, the Federal Highway Administration, and the National Highway Traffic Safety Administration. The questionnaires were also mailed to a contact in each state's Department of Motor Vehicles. With the combined assistance of these organizations, it was felt that a well designed and focused questionnaire could be developed. The overwhelming majority of responses conveyed a common concern about the length of the questionnaire. The Department of Motor Vehicle contacts, as well as the AAA and NHTSA contacts, felt that in order to obtain an adequate number of responses, the length should be no more than one legal page. Because each question was deliberately selected and was deemed equally important, the questions were divided between two questionnaires. By providing two separate short questionnaires, it was felt that a higher response rate could be yielded. Survey I is shown in Figure 3.1, and Survey II is shown in Figure 3.2. The information that was desired from these surveys was of four basic types. Each of the fourteen questions on Survey I and the fifteen questions on Survey II belong to one of these four types.

Type 1: Demographic Information

The first group of questions are related to demographic information of the respondent. These were the questions used to disaggregate the data for the statistical analysis. The gender and age of each respondent was requested. Because most of the questionnaires were distributed at driver license examination stations, respondents were also asked if they had recently reviewed their driver's manual. The city in which the

CITY _____
STATE _____

SURVEY I

PEDESTRIAN SAFETY QUESTIONNAIRE

WE NEED YOUR HELP!

This questionnaire is part of an effort to reduce pedestrian injuries and deaths. The project is funded by the AAA Foundation for Traffic Safety. The Pedestrian Safety Institute of The University of Tennessee's Transportation Center is the research agency.

Please note that your participation is entirely voluntary. It will not in any way affect the outcome of your drivers license test. Please do not put your name on the questionnaire. Your completing and returning this questionnaire will be considered your informed consent.

If you are willing to help us improve pedestrian safety, please answer these questions to the best of your ability. Thanks for your help.

1. Have you or someone you know ever been involved in a pedestrian accident, either as a pedestrian or as a driver?
   ____ I have ____ A family member has ____ Someone else I know has ____ No one I know has

2. Do you believe children are being taught about pedestrian safety in their school?
   ____ Yes ____ No

3. Pedestrians account for about what percentage of all traffic related deaths?
   ____ 1% ____ 5% ____ 10% ____ 15% ____ 20%

4. What do you believe is the single most likely reason why pedestrian accidents happen?
   ____ Driver error ____ Alcohol ____ Poor visibility
   ____ Pedestrian error ____ Other (specify) _____

5. In the downtown area of a large city you may legally cross a street only at a traffic signal or where there is a painted crosswalk.
   ____ TRUE ____ FALSE ____ DON'T KNOW

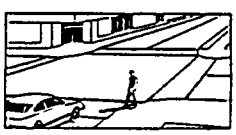
6. If a pedestrian is just beginning to cross the street in a crosswalk that does not have a pedestrian signal, you must slow down or stop to let the person finish crossing the road.
   ____ TRUE ____ FALSE ____ DON'T KNOW

7. Assume you have just started crossing a street on a "WALK" signal, but the signal quickly begins flashing "DON'T WALK". This means there isn't enough time to cross, and you should return to the curb.
   ____ TRUE ____ FALSE ____ DON'T KNOW

8. If sidewalks are provided, you may not legally jog on the road surface.
   ____ TRUE ____ FALSE ____ DON'T KNOW

9. Assume you are at an intersection with a pedestrian signal that has a button labeled "Push Button for WALK Signal". The signal will immediately change to "WALK" when you push the button.
   ____ TRUE ____ FALSE ____ DON'T KNOW

10. Assume you are at an intersection that lets you turn right on red after you stop. The pedestrian in the figure has just begun to cross at the crosswalk. He must wait and let you turn before he finishes crossing.
    ____ TRUE ____ FALSE ____ DON'T KNOW



11. This sign is placed approximately 200 ft. in advance of a crosswalk.
    ____ TRUE ____ FALSE ____ DON'T KNOW

12. Are you:
    ____ Male ____ Female

13. Your age is:
    ____ Under 20 ____ 20-29 ____ 30-39
    ____ 40-49 ____ 50-64 ____ Over 64

14. Have you reviewed your state's drivers license manual recently?
    ____ Yes ____ No

Please return this completed questionnaire to the person who gave it to you.
We appreciate your help very much.

Figure 3.1. Survey I

CITY _____ SURVEY II
STATE _____

PEDESTRIAN SAFETY QUESTIONNAIRE

WE NEED YOUR HELP!

This questionnaire is part of an effort to reduce pedestrian injuries and deaths. The project is funded by the AAA Foundation for Traffic Safety. The Pedestrian Safety Institute of The University of Tennessee's Transportation Center is the research agency.

Please note that your participation is entirely voluntary. It will not in any way affect the outcome of your drivers license test. Please do not put your name on the questionnaire. Your completing and returning this questionnaire will be considered your informed consent.

If you are willing to help us improve pedestrian safety, please answer these questions to the best of your ability. Thanks for your help.

1. Have you or someone you know ever been involved in a pedestrian accident, either as a pedestrian or as a driver?
   ____ I have ____ A family member has ____ Someone else I know has ____ No one I know has

2. Who do you feel should teach children about safe pedestrian habits?
   ____ School ____ Private Safety Organization
   ____ Home ____ Police
   ____ Church ____ Other (specify) _____

3. Have you ever received any advice about pedestrian safety either in school, on television or on the radio, in newspapers or in magazines, or in brochures or pamphlets?
   ____ Yes ____ No

4. About what percentage of all pedestrian deaths involve drunk pedestrians?
   ____ 5% ____ 10% ____ 20% ____ 40% ____ 50%

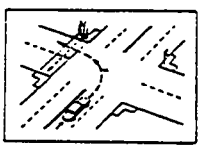
5. If there are no sidewalks, you should always walk on the right-hand side of the road with the traffic.
   ____ TRUE ____ FALSE ____ DON'T KNOW

6. If you are standing on the sidewalk at a painted crosswalk not at an intersection, traffic is not required to stop to let you cross the road.
   ____ TRUE ____ FALSE ____ DON'T KNOW

7. A "WALK" signal at an intersection means that you may cross the road safely because no cars will be driving through or turning into the crosswalk.
   ____ TRUE ____ FALSE ____ DON'T KNOW

8. Assume you are a motorist waiting to turn left at an intersection that does not have a left-turn arrow. When the light turns green, the pedestrians in the figure step into the crosswalk as you are turning. You must let the pedestrians finish crossing before you finish your turn.

   ____ TRUE ____ FALSE ____ DON'T KNOW



9. When you are driving in a school speed zone, you may resume your speed as soon as you can see the "END SCHOOL ZONE" sign.
   ____ TRUE ____ FALSE ____ DON'T KNOW

10. This sign is placed approximately 200 ft. in advance of a pedestrian crossing used by children to go to and from a school.
    ____ TRUE ____ FALSE ____ DON'T KNOW

11. Most pedestrian accidents in cities happen while a person is crossing the road at some place other than an intersection.
    ____ TRUE ____ FALSE ____ DON'T KNOW

12. If you wear white clothing while walking along a roadway at night, drivers will be able to see you from a safe distance.
    ____ TRUE ____ FALSE ____ DON'T KNOW

13. Are you:
    ____ Male ____ Female

14. Your age is:
    ____ Under 20 ____ 20-29 ____ 30-39
    ____ 40-49 ____ 50-64 ____ Over 64

15. Have you reviewed your state's drivers license manual recently?
    ____ Yes ____ No

Please return this completed questionnaire to the person who gave it to you.
We appreciate your help very much.

Figure 3.2. Survey II

individual completed the questionnaire was also obtained so that comparisons could be made based on city sizes. The first set of questions on each questionnaire were developed to collect background information on the respondent. These include: Survey I, Questions 1, 12, 13, and 14; and Survey II, Questions 1, 3, 13, 14, and 15.

Type 2: Assessment of the Problem

These questions were included to obtain general opinions and assessments of issues related to pedestrian safety. The types of information requested pertained to opinions concerning the education of children and assessments of the key problems related to pedestrian collisions. These include: Survey I, Questions 2, 3, and 4; and Survey II, Questions 2, 4, 11, and 12.

Type 3: Knowledge of Pedestrian Laws

The next set of questions address specific laws and conflicts that affect the behavior of pedestrians and motorists. These issues are related to the right-of-way at intersections and midblock crossings and to pedestrians walking on or along the roadway. These include: Survey I, Questions 5, 6, 8, and 10; and Survey II, Questions 5, 6, and 8.

Type 4: Knowledge of Pedestrian Traffic Control Devices

The final set of questions discuss the use of pedestrian related traffic control devices. These devices include pedestrian signals, crosswalk signs (Figure 3.3), and

Crossing Sign (W11A-2)

Advance Crossing Sign (W11-2)

School Crossing Sign (S2-1)

Advance School Crossing Sign (S1-1)

Figure 3.3. Pedestrian Crossing Signs

signs used in school zones. These include: Survey I, Questions 7, 9, and 11; and Survey II, Questions 7, 9, and 10.

After making all of the necessary changes, the questionnaires were pretested on three separate occasions at two different sites. This was done in order to make certain that all questions were easily understood. Each respondent was briefly interviewed about the complexity of the questions. Most comments and questions were general in nature and not directly related to the syntax of the questions. Opinions from the respondents were weighed carefully to make certain that the surveys were easily understood by the populations being examined. This was a particularly important aspect of the questionnaire development because individuals at sites in other states would not be able to ask for clarification of specific questions. The few comments that pertained to the wording of particular questions were examined and changes, when appropriate, were made. Each of the revisions was followed by a pretest in order to continuously insure the clarity and simplicity of all questions.

Site Selection and Data Collection

The information being sought through this research is intended to be used for safety planning and program development on a nationwide basis. It was felt that the most appropriate method for conducting a study that is useful to all states is to collect a sample of information from all states. Driver license examination stations were selected to facilitate the distribution of the surveys for two basic reasons: (1) they provide an easy means of collecting large volumes of data with little disruption to the

facility's purpose, and (2) those individuals visiting the examination stations are motorists and pedestrians. The responses from the examination stations were not limited to individuals being examined but include escort drivers and other visitors, as well.

The permission of each state's Department of Motor Vehicles (DMV) was received before proceeding with the selection of the specific sites used to distribute the surveys. A contact was established in each DMV either through the Chief Examiner's Office or the Traffic Safety Office. Each contact was asked to select two examination stations in their state that have considerably high customer volumes. This was done under the assumption that the DMV personnel possess a greater awareness of which stations would be the most cooperative and beneficial to the study.

There were three criteria that were to be met regarding the site selection. After reviewing the 1992 NHTSA pedestrian accident data, it was recognized that over 75 percent of all pedestrian injuries and fatalities occurred in urbanized areas *(24)*. Because this research focuses on the knowledge of pedestrians and motorists who interact on a daily basis, a request was made that at least one of the survey sites be located in the city of greatest population for that state. The second site was asked to be located in a city of large enough population that it demands a genuine need for pedestrian safety and awareness. The second criterium was that the selected sites be ones that operate on full-time schedules. This was requested based on the assumption that stations operating on this type of schedule have a higher volume of customers and could offer some assurance that the questionnaires would be completed and returned

in a timely manner. The final request was that the sites be carefully chosen so as not to provide any indirect bias to the study. After the sites were selected, twenty-five copies of each survey were distributed to each site contact.

Special emphasis was placed on the elderly in order to learn their knowledge of safe pedestrian and motorist interaction. With the assistance of the American Association of Retired Persons, surveys were distributed to 55 Alive classes in each state. The specific 55 Alive sites were chosen by each state's 55 Alive coordinator. The same criteria was requested of these site selections as was expected of the driver license examination stations. The city location for these classes was not provided, and, thus, the affect of city size could not be analyzed for these responses. These questionnaires were distributed on a voluntary basis by the 55 Alive coordinators during classes.

Data Analysis

All of the questionnaires were received and entered into a SAS computerized data file over the course of an eight month period (September 1992 - April 1993). From the driver license examination stations, a total of 3,595 questionnaires were completed. The 55 Alive classes returned a total of 1,231 completed questionnaires. Table 3.1 shows the distribution of questionnaires received based on the state and type. Based on the demographic information, exposure to pedestrian education, and conflict experience of each respondent, it was determined that no significant statistical differences exist between the groups completing Survey I and Survey II. The

Table 3.1

Number and Type of Responses by State

State	Driver License Examination Stations		AARP 55 Alive Courses		Combined Responses	
	Survey I	Survey II	Survey I	Survey II	Survey I	Survey II
Alabama	15	16	0	0	15	16
Alaska	0	0	0	1	0	1
Arizona	52	36	25	0	77	36
Arkansas	50	50	0	0	50	50
California	46	47	0	0	46	47
Colorado	24	25	0	24	24	49
Connecticut	24	25	0	25	24	50
Delaware	21	21	26	20	47	41
Florida	40	40	24	25	64	65
Georgia	49	50	0	26	49	76
Hawaii	0	0	17	25	17	25
Idaho	49	50	0	23	49	73
Illinois	47	44	60	31	107	75
Indiana	24	25	0	25	24	50
Iowa	49	48	22	25	71	73
Kansas	47	49	0	0	47	49
Kentucky	24	24	25	25	49	49
Louisiana	49	49	0	21	49	70
Maine	37	36	0	0	37	36
Maryland	49	48	24	19	73	67
Massachusetts	22	19	24	21	46	40
Michigan	50	49	0	0	50	49
Minnesota	22	24	0	25	22	49
Mississippi	50	49	25	24	75	73
Missouri	22	22	0	0	22	22
Montana	48	48	0	0	48	48
Nebraska	51	50	25	22	76	72
Nevada	47	39	23	25	70	64
New Hampshire	40	43	18	22	58	65
New Jersey	23	27	0	0	23	27
New Mexico	49	45	19	25	68	70
New York	37	34	24	25	61	59
North Carolina	42	41	0	0	42	41
North Dakota	50	50	0	24	50	74

Table 3.1 (continued)

Number and Type of Responses by State

State	Driver License Examination Stations		AARP 55 Alive Courses		Combined Responses	
	Survey I	Survey II	Survey I	Survey II	Survey I	Survey II
Ohio	36	36	0	24	36	60
Oklahoma	21	22	24	26	45	48
Oregon	47	47	0	0	47	47
Pennsylvania	33	32	20	25	53	57
Rhode Island	12	11	0	0	12	11
South Carolina	46	45	0	0	46	45
South Dakota	38	36	0	6	38	42
Tennessee	34	36	26	25	60	61
Texas	24	24	12	14	36	38
Utah	48	50	0	0	48	50
Vermont	9	9	0	0	9	9
Virginia	49	50	0	0	49	50
Washington	73	24	0	25	73	49
West Virginia	50	50	25	25	75	75
Wisconsin	14	17	0	24	14	41
Wyoming	49	49	0	20	49	69
Total	1,832	1,761	488	742	2,320	2,503

completed questionnaires were disaggregated and analyzed based on the following information:

1. Experience or knowledge of a pedestrian collision
2. Pedestrian Safety Education
3. Gender
4. Age
5. Knowledge of the Driver's Manual
6. City Size by Population Group

The responses in each of these aggregated groups were tested using the chi-square statistic. This was determined to be appropriate because the data being analyzed are categorical and non-normal. The tests were run to determine if significant differences exist between specific groups. Within a 95 percent level of confidence, assurance was made that a Type I error would not occur. The statistical package used to analyze the aggregated groups is SAS.

In addition to conducting a statistical analysis on the data, a legal review was performed related to the legal portions of the questionnaires. Contacts in each state responded to a questionnaire containing only those questions related to traffic laws. Because of gross inconsistencies and a number of "Don't Know" answers in the state responses, it was determined that a review of state codes and statutes should be conducted to verify the responses. A detailed discussion of the procedures, results, and conclusions of this investigation are presented in Chapter 6.

Chapter Four

Analysis of Survey I

Overview

The analysis of both Survey I and II was conducted on demographic and educational background information provided by the respondents. All responses to questions related to laws and traffic control devices were aggregated based on the responses to these demographic and educational questions. This was done to determine target groups that may have a greater misunderstanding of pedestrian laws and traffic control devices.

Data from seventy-seven urban areas were received in the study conducted at the driver license examination stations. These areas have populations ranging from 3,500 to 8.8 million. From these, a total of 1,832 completed Survey I questionnaires were returned. There were twenty states assisting in the distribution of Survey I to 55 Alive classes. A total of 489 Survey I questionnaires were returned from this group.

Results of Survey I

This section provides detailed information on each question asked on Survey I. The total number of responses for each of the fourteen questions will be given. A brief description of what was hoped to be gained by each question will also be discussed. Tables provided in Appendix A present the test results for all comparisons showing significant differences between groups. All tests that showed significant

differences in the responses between groups are addressed in greater detail. Although these results are statistically significant, for several of these groups it is impractical to design a pedestrian safety program to reflect these differences.

City

A unique two character code was established for each urban area participating in the survey. For the majority of the questionnaires, this item was already completed. Most of the sites had been selected prior to sending the surveys, but because of some complications, a few were chosen by the DMV contacts after being mailed out. The city code was used to identify these urban areas by their population size.

After entering all of the response data into SAS, a population code for each area was created to assist in analyzing the data by city size. Three population brackets were used for this analysis: under 100,000, 100,000–500,000, and over 500,000. The total number of responses for each population bracket are:

	Driver License Examination Stations	
Under 100,000	566	30.9%
100,000– 500,000	602	32.8%
Over 500,000	664	36.3%
Total	1,832	100.0%

There were 24 cities surveyed having populations under 100,000. These are considered to be small to moderate sized urban areas. Population areas between

100,000 and 500,000 are considered to be moderate to large sized cities and accounted for 27 of the cities studied. The "Over 500,000" population group includes the remaining 26 urbanized areas and consists of many of the larger metropolitan areas in the United States. It is felt that having an equally distributed data set for the various sized urban areas works well for this analysis. Over 84 percent of the urban areas sampled have populations in excess of 50,000.

Question 1

Have you or someone you know ever been involved in a pedestrian accident?

	Driver License Examination Stations		AARP	
No Response	10	0.5%	3	0.6%
I have	150	8.2%	44	9.0%
A family member has	171	9.3%	43	8.8%
Someone I know has	380	20.7%	72	14.7%
No one I know has	1,121	61.2%	327	66.9%
Total	1,832	100.0%	489	100.0%

Question one was common to both surveys and is used to test if experience with a pedestrian collision increased awareness or cognizance of pedestrian safety issues for the respondents. For the purpose of the evaluation, the first three responses were aggregated as one response, "having experience". The two groups, experience with pedestrian collisions and no experience with pedestrian collisions, are used as independent variables to determine their influence on the responses to other questions. Nearly 38 percent of all respondents at the driver license examination stations reported

having some experience with a pedestrian collision. For the AARP responses, this number dropped to 33%. Four tests for pedestrian collision experience as a factor showed differences. For each of these tests, however, respondents who had not experienced a pedestrian collision had a higher percentage of correct answers.

Question 2

Do you believe children are being taught about pedestrian safety in their school?

	Driver License Examination Stations		AARP	
No Response	53	2.9%	24	4.9%
Yes	1,175	64.1%	340	69.5%
No	604	33.0%	125	25.6%
Total	1,832	100.0%	489	100.0%

This question was asked to determine if the respondents feel that children are being taught about pedestrian safety in schools. The responses can possibly be used to get a feel for where the respondents think students are being educated on this matter. If a high percentage believe that children are being taught in schools, then many of these may not stress safety concerns at home. For the examination station responses, two–thirds of the respondents feel that students are being taught about pedestrian safety in their schools, and nearly three out of every four of the AARP respondents thought this to be true.

Question 3

Pedestrians account for about what percentage of all traffic related fatalities?

	Driver License Examination Stations		AARP	
No Response	84	4.6%	40	8.2%
1%	100	5.5%	46	9.4%
5%	438	23.9%	102	20.9%
10%	552	30.1%	130	26.6%
15%	392	21.4%	94	19.2%
20%	266	14.5%	77	15.7%
Total	1,832	100.0%	489	100.0%

As Table 2.1 shows, over the past eighteen years, pedestrians have accounted for about 15 percent of all traffic related fatalities in the United States. In 1992 the total number of pedestrian injuries accounted for less than 3 percent of all traffic related injuries. These figures reflect the potential severity associated with pedestrian collisions. Because they are typically much more severe in nature, the public should have an increased awareness of the scope of pedestrian fatalities. The responses to Question 3 were aggregated into the following two groups: respondents selecting 1%, 5%, or 10%; and respondents selecting 15% or 20%. This was done under the assumption that respondents who underestimate the percentage of pedestrian fatalities may not be completely aware of the severity of pedestrian collisions. The results indicate that about 62 percent of both the examination station and AARP respondents underestimated the percentage of pedestrian fatalities. This indicates that there may be a lack of knowledge about the severity level of pedestrian collisions.

Two groups showed up as having statistically significant differences. For the

surveys distributed at the examination stations, a significantly smaller percentage of females underestimated the percentage of pedestrian fatalities. About 58 percent of the female respondents underestimated the problem. Sixty-seven percent of the male population sampled underestimated the problem. Statistical significant differences were also found related to the size of the urban area in which the questionnaire was completed. As the population size increases, the percentage of correct responses increases. Over 66 percent of the respondents in urban areas having populations under 100,000 underestimated the problem, compared to 58 percent from urban areas over 500,000 in population. While these differences are statistically significant, it is impractical develop pedestrian safety programs to target these groups.

Question 4

What do you believe is the single most likely reason why pedestrian accidents happen?

	Driver License Examination Stations		AARP	
No Response	25	1.4%	10	2.0%
Driver Error	485	26.5%	108	22.1%
Alcohol	439	24.0%	105	21.5%
Poor Visibility	158	8.6%	72	14.7%
Pedestrian Error	482	26.3%	182	37.2%
Other/Combination	243	13.3%	12	2.5%
Total	1,832	100.0%	489	100.0%

Although there is no measurable and definitive way to determine why pedestrian collisions occur, this question was asked as a means of investigating what the respondents perceive to be the cause. The responses from the examination stations

are primarily evenly divided between driver error, pedestrian error, and alcohol. The AARP respondents indicated a larger percentage of collisions occur because of pedestrian error. This is an interesting observation knowing that the 1992 combined rate of the pedestrians in the "Over 64 years" age group who were injured or killed is lower than the national rate (See Table 2.2).

Question 5

In the downtown area of a large city, you may legally cross a street only at a traffic signal or where there is a painted crosswalk.

	Driver License Examination Stations		AARP	
No Response	3	0.2%	1	0.2%
True	1,567	85.5%	458	93.7%
False	148	8.1%	19	3.9%
Don't Know	114	6.2%	11	2.3%
Total	1,832	100.0%	489	100.0%

This question was asked as a means of assessing whether pedestrians know what the law states about "jaywalking", crossing a roadway in an urbanized area outside of a crosswalk and away from an intersection. This question is discussed in detail in Chapter Six. The correct response, True, is based on §11–503 of the *Uniform Vehicle Code*. A large percentage of both the examination station and the AARP respondents responded correctly to this question. The only statistically significant difference detected on this issue was between these two groups. A significant number of older respondents from the 55 Alive courses answered correctly. No significant

difference was detected between the younger and older respondents at the examination stations.

Question 6

If a pedestrian is just beginning to cross the street in a crosswalk that does not have a pedestrian signal, you must slow down or stop to let the person finish crossing the road.

	Driver License Examination Stations		AARP	
No Response	8	0.4%	1	0.2%
True	1,686	92.0%	475	97.1%
False	86	4.7%	3	0.6%
Don't Know	52	2.9%	10	2.0%
Total	1,832	100.0%	489	100.0%

Both of the groups surveyed appear to understand §11–502 of the *Uniform Vehicle Code*. Pedestrians legally using a marked crosswalk or unmarked crosswalk at intersections have the right–of–way. They are, however, required to not suddenly leave a curb such that an approaching motorist does not have adequate time to react *(16)*. Statistical differences were detected between three of the groups tested. The AARP respondents had a significantly higher number of correct responses than the examination station respondents. The examination station respondents who have had some previous experience or close contact with someone involved in a pedestrian collision, had a smaller percentage of correct responses. Of the respondents who had reviewed their state's manual, ninety–five percent answered correctly. Ninety percent of those who had not reviewed the manual responded correctly. From this, it is

apparent that the underlying legal concerns of this question are well understood by the respondents.

Question 7

Assume you have just started crossing a street on a WALK signal, but the signal quickly begins flashing DON'T WALK. This means there isn't enough time to cross, and you should return to the curb.

	Driver License Examination Stations		AARP	
No Response	9	0.5%	1	0.2%
True	762	41.9%	227	46.4%
False	932	50.9%	233	47.6%
Don't Know	129	7.0%	28	5.7%
Total	1,832	100.0%	489	100.0%

Nearly half of all respondents do not clearly understand the meaning of the flashing DON'T WALK message on pedestrian signals. Forty-nine percent of the examination station respondents and 52 percent of the 55 Alive respondents answered incorrectly or indicated that they did not know the correct answer to this question. In the *Manual on Uniform Traffic Control Devices*, §4D-7 addresses the use of the pedestrian clearance interval, the flashing DON'T WALK. It states that "the duration (of the clearance interval) should be sufficient to allow a pedestrian crossing in the crosswalk to...travel to the center of the farthest travel lane" *(20)*. In the UVC, §11-203(b) says that once the upraised palm has been displayed, pedestrians shall not begin crossing, but that those pedestrians already crossing should complete their crossing to a sidewalk or a raised pedestrian median *(16)*.

As evidenced by the 55 Alive responses and the tests on the two age groups at the examination stations, the older sample population has a poorer understanding of the pedestrian clearance interval. For the "Over 50" age group at the examination stations, only 43 percent of the respondents answered correctly. A higher number of the young respondents answered correctly, 53 percent, but this maintains the conclusion that a clear misunderstanding exists on the part of many of the respondents, regardless of age. Again, the test of involvement or knowledge of a pedestrian collision was significant based on the responses from the AARP group. A larger percentage of respondents with no experience, 52 percent compared to 40 percent of those having experience, responded correctly.

Question 8

If sidewalks are provided, you may not legally jog on the road surface.

	Driver License Examination Stations		AARP	
No Response	16	0.9%	1	0.2%
True	990	54.0%	296	60.5%
False	323	17.6%	68	13.9%
Don't Know	503	27.5%	124	25.4%
Total	1,832	100.0%	489	100.0%

The *Uniform Vehicle Code* states in §11–506(a) that, when available, pedestrians must use sidewalks *(16)*. As jogging continues to grow in popularity, this question reveals some startling results. Over 45 percent of the examination station respondents and nearly 40 percent of the 55 Alive respondents either answered

incorrectly or did not know what the law states about this issue. These numbers should not be interpreted as saying that these percentages reflect the proportion of joggers using the roadway, but they do indicate a clear lack of knowledge of the laws governing this issue. The only exception to the UVC regulation is a Rhode Island law permitting the use of the roadway by joggers. This law is discussed in greater detail in Chapter 6.

For both the examination station and the AARP survey responses, statistical differences were found between the genders. Fifty-seven percent and 63 percent of the males responding at the examination stations and 55 Alive courses, respectively, answered correctly. This is compared to 52 percent and 59 percent of the responses by females at the corresponding locations. These differences do not justify developing special programs to target females. The various age groups also responded significantly different. A smaller percentage of the younger respondents at the examination stations answered correctly. Fifty-three percent of the "Under 50" age group and 61 percent of the "50 and over" indicated that joggers may not use the roadway when sidewalks are provided. In the test comparing the examination station responses to the 55 Alive responses, 61 percent of the AARP respondents correctly answering question 8 compared to 55 percent of the examination station respondents. The only other difference detected was between the group that reviewed their state's manual and the group that did not. For this group, fifty-seven percent of the examination station respondents who had reviewed their manual responded correctly. Fifty-two percent of the group not reviewing the manual responded correctly.

Question 9

Assume you are at an intersection with a pedestrian signal that has a button labelled "Push Button for WALK Signal". The signal will immediately change to WALK when you push the button.

	Driver License Examination Stations		AARP	
No Response	11	0.6%	1	0.2%
True	185	10.1%	48	9.8%
False	1,525	83.2%	390	79.8%
Don't Know	111	6.1%	50	10.2%
Total	1,832	100.0%	489	100.0%

This question was asked to determine if pedestrians are aware of how pedestrian actuated signals function. The concern is that pedestrians may not clearly understand that they must wait until the current traffic signal phases have terminated before the pedestrian WALK signal will be displayed. A large percentage of respondents from the two groups selected the correct answer for this question. Eighty-four percent of the examination station respondents and 80 percent of the AARP respondents answered correctly. The differences between these two groups is large enough to be significant using the chi-square statistic. However, it appears to be impractical to place emphasis on the older population with regards to this issue. No other significant differences were detected for this question.

Question 10

Assume you are at an intersection that lets you turn right on red after you stop. The pedestrian in the figure has begun to cross at the crosswalk. He must wait and let you turn before he finishes crossing. (See Figure 3.1)

	Driver License Examination Stations		AARP	
No Response	17	0.9%	1	0.2%
True	286	15.6%	65	13.3%
False	1,433	78.2%	399	81.6%
Don't Know	96	5.2%	24	4.9%
Total	1,832	100.0%	489	100.0%

This question addresses the issue of right-of-way at signalized intersections. This is discussed in §11-202(c.3) in the UVC. It states that vehicles turning right on red must yield to pedestrians lawfully in the crosswalk *(16)*. Seventy-nine percent of the respondents at the examination stations and 82 percent of the AARP respondents answered question 10 correctly. As the figure on the questionnaire shows, the pedestrian has already left the safety of the sidewalk and entered the crosswalk. If the vehicle is turning on red, it can be assumed that the pedestrian is crossing legally, facing the green signal. Sixteen percent of the examination station respondents indicated, however, that the pedestrian must stop and wait for the motorist to turn. Another 5 percent indicated that they do not know who has the right-of-way in this situation. Although these collisions may be less severe in nature because they involve slow moving turning vehicles, the potential exists for a serious injuries, particularly for the elderly. The "Over 64" age group is the only age group that is involved in a larger percentage of intersection accidents than non-intersection collisions *(2)*.

For the tests of significant differences, no differences were detected between the younger and the older respondents. The respondents at the examination stations who had reviewed the driver's manual had a higher percentage of correct responses.

Eighty–one percent of these respondents selected the correct answer, while 77 percent of the respondents who had not reviewed the manual responded correctly.

Question 11

This sign is placed approximately 200 ft. in advance of a crosswalk. (See Figure 3.3, W11A–2)

	Driver License Examination Stations		AARP	
No Response	22	1.2%	3	0.6%
True	1,067	58.2%	259	53.0%
False	308	16.8%	86	17.6%
Don't Know	435	23.7%	141	28.8%
Total	1,832	100.0%	489	100.0%

The MUTCD has provisions for two types of pedestrian crossing signs, crossing signs and advance crossing signs. The only difference in the symbols on these two signs is the absence of the two lines representing a crosswalk on the advanced crossing sign. This sign is placed well in advance of a crossing to warn motorists of nearby pedestrian crosswalks. Both of these signs are shown in Figure 3.3. Sections 2C–31 and 2C–32of the MUTCD discuss the use of these signs in detail *(20)*. The responses seem to indicate that the respondents to this question do not clearly understand the meaning of this sign. Only 17 percent of the respondents of both groups answered correctly. A large percentage of these groups also indicated that they do not know about the placement of this sign. If this sign is going to be used by traffic engineers, the message should be easily understood by the motorist.

A number of the groups showed statistically significant differences. For both the examination station respondents and the 55 Alive respondents, the male population had a higher percentage of correct responses. Nineteen percent of the males sampled in both groups answered correctly. For the respondents at the examination stations, both the younger respondents and the respondents who had reviewed the driver's manual had a higher percentage of correct responses. Eighteen percent of these two groups responded correctly. In addition to these groups, the respondents at the examination stations in urban areas of less than 100,000 population had a higher number of correct responses. In these urban areas, a total of 20 percent of the respondents answered question 11 correctly compared to 15 percent of the respondents in urban areas over 500,000 in population. Seventeen percent of the respondents in the moderately sized urban areas responded correctly. Most of these differences are impractical for determining target groups.

Questions 12, 13, and 14

Are you:

	Driver License Examination Stations		AARP	
No Response	13	0.7%	4	0.8%
Male	902	49.2%	190	38.9%
Female	917	50.1%	295	60.3%
Total	1,832	100.0%	489	100.0%

Your age is:

	Driver License Examination Stations		AARP	
No Response	13	0.7%	26	5.3%
Under 20	192	10.5%		NA
20–29	454	24.8%		NA
30–39	476	26.0%		NA
40–49	359	19.6%		NA
50–64	244	13.3%	113	23.1%
Over 64	94	5.1%	350	71.6%
Total	1,832	100.0%	489	100.0%

Have you reviewed your state's drivers license manual recently?

	Driver License Examination Stations		AARP	
No Response	26	1.4%	3	0.6%
Yes	807	44.1%	202	41.3%
No	999	54.5%	284	58.1%
Total	1,832	100.0%	489	100.0%

These questions were used to disaggregate the responses to determine if any significant differences exist between the groups. It is important for the safety community to know which groups are deficient in their comprehension of pedestrian laws and traffic control devices. This is particularly true for confusions that are detected between the sexes and, even more importantly, the various age groups. If one of the genders or age groups appears to have a lack of understanding of particular issues, advertising and education can be directed toward this group. It is also important to know if the drivers' manuals adequately address pedestrian safety issues.

Question 14 was used to determine if studying the manual has a positive influence on how the questions are answered.

Summary

The two major goals of evaluating Survey I were first, to determine if particular laws or traffic control devices appear to be unclear to the respondents and second, to determine if differences in the comprehension level exist among the various study groups. Questions 3 and 5 through 14 can be subdivided into three categories: respondents assessment of pedestrian collisions, pedestrian related laws, and pedestrian traffic control devices. Over 60 percent of the respondents at the examination stations and the 55 Alive course underestimated the percentage of pedestrian fatalities. Both female respondents and respondents in the larger urban areas had a higher percentage of correct responses related to their assessment of the severity of pedestrian collisions. The significant differences detected in the responses related to the second category, pedestrian laws, had higher percentages of correct responses from the male respondents and the older respondents. Those who had reviewed their state drivers' manual also tended to have a higher percentage of correct responses to the legal portion of the questionnaire. In general, the respondents to Survey I appear to have an understanding of the laws that govern the interaction of pedestrians and vehicles. The only issue that indicates some confusion relates to the use of the roadway by joggers. For the final category, traffic control devices, there seems to be a greater lack of comprehension from the respondents. Confusions related to the flashing DON'T WALK message and

the advance pedestrian crossing sign are evident in the results. For the various age groups, the younger respondents tended to have a higher percentage of correct responses when statistical differences were detected.

Chapter Five

Analysis of Survey II

Overview

Survey II collected demographic and educational background information from each of the respondents. The responses to these questions were used to create groups against which the remaining responses could be compared. Using the chi-square statistic, significant differences in the percentages of correct responses within these groups were detected.

A total of seventy-six urban areas with driver license examination stations participated in the study. This group of urbanized areas is nearly equal in size and distribution to those participating in Survey I. There were 1,763 completed Survey II questionnaires returned from the forty-eight States. Copies of Survey II were also distributed at thirty-two AARP 55 Alive courses. From this group, 742 questionnaires were completed.

Results of Survey II

Survey II contained a total of fifteen questions. The major difference between this questionnaire and Survey I is that it contains an additional question by which the responses could be aggregated. Question 3 asked the respondents if they had ever received advice about pedestrian safety. This questionnaire also contained the five questions on Survey I that were used to test for significant differences. Similar to

Chapter 4, the total number of responses for each of the questions will be provided along with a brief description of each. The underlying purpose of each question will also be addressed. Appendix B provides the detailed results of all tests that showed significant differences between groups.

City

The distribution of the population sizes of the urban areas where Survey II was completed was nearly equal to that of Survey I. Because of this, the population analysis brackets for the examination stations responses are identical. The three population brackets used for this analysis are: under 100,000, 100,000–500,000, and over 500,000. A population code of 1, 2, or 3 was assigned to each questionnaire depending on the urban area in which it was completed. A code of *1* refers to the under 100,000 population group, *2* refers to the 100,000–500,000 population group, and *3* refers to the over 500,000 group. These codes were assigned to each questionnaire after all of the responses had been entered into SAS. The total numbers of responses for each population bracket are:

	Driver License Examination Stations	
Under 100,000	565	32.1%
100,000– 500,000	590	33.4%
Over 500,000	608	34.5%
Total	1,763	100.0%

As with Survey I, a total of 24 urban areas surveyed have populations under 100,000 and are considered to be small to moderate sized urban areas. The urban areas with populations between 100,000 and 500,000 account for 27 of the cities. The largest population group, "Over 500,000" accounts for the remaining 25 urbanized areas. This group contains some of the largest metropolitan areas in the United States including: New York City, Los Angeles, Chicago, and Boston. Nearly 83 percent of these urban areas have populations over 50,000. All population figures were acquired from the 1990 U.S. Census Data.

Question 1

Have you or someone you know ever been involved in a pedestrian accident?

	Driver License Examination Stations		AARP	
No Response	16	0.9%	4	0.5%
I have	171	9.7%	79	10.6%
A family member has	195	11.1%	65	8.8%
Someone I know has	310	17.6%	125	16.8%
No one I know has	1,071	60.7%	469	63.2%
Total	1,763	100.0%	742	100.0%

This question was asked as means for evaluating the effect of either personally being involved in a pedestrian collision or knowing someone who has been. The original assumption was that individuals who have had some type of experience may be more prone to become better educated about the laws that control pedestrian and vehicle interaction. The first three responses have been aggregated to differentiate

between those individuals who have had some experience and those who have not. These two groups have been evaluated using the chi-square statistic to determine if statistical differences exist between them related to the percentage of correct responses. Nearly 40 percent of both the examination station respondents and the 55 Alive respondents indicated that they have had some previous experience with a pedestrian collision.

Question 2

Who do you feel should teach children about safe pedestrian habits?

	Driver License Examination Stations		AARP	
School	1,296	35.9%	503	32.3%
Home	1,299	36.0%	632	40.6%
Church	161	4.5%	67	4.3%
Prvt. Safety Org.	225	6.2%	99	6.4%
Police	565	15.6%	251	16.1%
Public Television	27	0.7%	2	0.1%
Other	38	1.1%	2	0.1%
Total	3,611	100.0%	1,556	100.0%

The intent of this question was to determine who the respondents feel has the responsibility of educating children about pedestrian safety. This question is important because it may give some indication to whether children are being educated on this issue in their homes. *Respondents were not limited to selecting only one of the choices.* The total of 3,611 responses from the examination stations and 1,556 from the AARP groups indicate the total number of choices selected. For both of these

groups, over 70 percent of all responses indicated that education of children should take place in either the home or the school. Another 20 percent of the responses in each group felt that the police or some private safety organization should participate in the education process as well. The twenty-seven responses from the examination stations indicating public television as a medium for pedestrian safety were all provided as additional suggestions. This seems to imply that public television may be an important source of information for children regarding lessons of roadway safety.

Question 3

Have you ever received any advice about pedestrian safety either in school, on television or on the radio, in newspapers or in magazines, or in brochures or pamphlets?

	Driver License Examination Stations		AARP	
No Response	26	1.5%	13	1.8%
Yes	1,300	73.7%	535	72.1%
No	450	25.5%	194	26.1%
Total	1,763	100.0%	742	100.0%

Question 3 was used to determine if prior exposure to pedestrian safety issues influenced the way respondents answered the questionnaire. The analysis of how exposure to pedestrian advice affects the respondents knowledge of laws and traffic control devices is important. It can be used to assist in determining the effectiveness of casual education. Over 74 percent of the examination station respondents and 73 percent of the 55 Alive respondents indicated that they remembered receiving

information on pedestrian safety at some time. Statistically significant differences related to exposure were found for seven of the questions on Survey II. These are discussed for each of those questions showing differences in the percentage of correct responses.

Question 4

About what percentage of all pedestrian deaths involve drunk pedestrians?

	Driver License Examination Stations		AARP	
No Response	85	4.8%	105	14.2%
5%	293	16.6%	128	17.3%
10%	316	17.9%	145	19.5%
20%	389	22.1%	158	21.3%
40%	356	20.2%	105	14.2%
50%	324	18.4%	101	13.6%
Total	1,763	100.0%	742	100.0%

The correct response of 40% was obtained from the NHTSA report entitled, *Traffic Safety Facts 1992 (2)*. In 1992, over 36 percent of all pedestrian fatalities, over the age of 14, were pedestrians with blood alcohol concentrations (BAC) of 0.10 or higher, a BAC used in many states to determine if a driver is legally drunk. The annual variation of these percentages is shown in Table 5.1. Forty-three percent of all pedestrians fatally injured in 1992 had been drinking. After a steady decline in these figures through 1988, the percentage of fatally injured drunk pedestrians began and continues to increase. The issue of walking along a roadway while drunk does not seem to have been communicated well by the safety departments. Nearly 60 percent

Table 5.1

Pedestrians Killed, 14 Years and Older, by Blood Alcohol Concentration (BAC), 1982–1992

Year	BAC = 0.00		BAC = 0.00–0.09		BAC = 0.10+		Total
	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	
1982	3,266	*53.1*	482	*7.8*	2,405	*39.1*	6,153
1983	3,050	*53.4*	454	*8.0*	2,206	*38.6*	5,710
1984	3,234	*54.7*	431	*7.3*	2,242	*38.0*	5,907
1985	3,120	*54.7*	478	*8.4*	2,104	*36.9*	5,702
1986	3,171	*55.6*	464	*8.1*	2,067	*36.3*	5,702
1987	3,225	*56.4*	462	*8.1*	2,027	*35.5*	5,714
1988	3,373	*57.9*	426	*7.3*	2,026	*34.8*	5,825
1989	3,177	*56.2*	448	*7.9*	2,033	*35.9*	5,658
1990	3,204	*57.3*	385	*6.9*	2,006	*35.9*	5,595
1991	2,871	*57.4*	333	*6.7*	1,799	*36.0*	5,003
1992	2,735	*57.0*	333	*6.9*	1,731	*36.1*	4,799

Source: "Traffic Safety Facts 1992," National Highway Traffic Safety Administration, U.S. Department of Transportation, Washington, D.C. (1993).

of the respondents at the examination stations underestimated the problem of drunk pedestrian fatalities. For the AARP respondents, these figures are even higher with over 65 percent underestimating the correct percentage of drunk pedestrian fatalities.

Three tests detected statistical differences between various group responses to this question. The first of these, responses aggregated by population size, indicated that a higher percentage of respondents in the larger metropolitan areas correctly identified or overestimated the percentage of pedestrian fatalities. Fifty-five percent of the respondents in the largest of the sampled urban areas underestimated the figures while over 62 percent of the smallest urban respondents underestimated these figures. For the AARP group, a significantly higher percentage of respondents who had recently reviewed their state's driver's manual answered correctly. Almost 39 percent of these respondents made overestimations compared to 26 percent of the respondents not having reviewed the manual. Tests comparing the examination station responses to the AARP responses indicated that the latter had a significantly lower percentage of underestimated responses. Although these test results are statistically significant, they do not identify any group that can practically be given special attention on pedestrian safety issues.

Question 5

If there are no sidewalks, you should always walk on the right-hand side of the road with traffic.

	Driver License Examination Stations		AARP	
No Response	85	4.8%	2	0.3%
True	538	30.5%	100	13.5%
False	1,112	63.1%	615	82.9%
Don't Know	90	5.1%	25	3.4%
Total	1,763	100.0%	742	100.0%

The *Uniform Vehicle Code*, §11-506(C), addresses the legal responsibilities underlying this question. This is discussed in greater detail in Chapter 6, but the UVC states if no sidewalks are provided and if walking along a two way street, pedestrians shall walk along the left-hand side of the road *(16)*. Pedestrians who are not aware of the safety issues behind this law may be placing themselves in greater danger when walking along a road. Thirty-one percent of the examination station respondents indicated that walking with traffic rather than against traffic is the correct procedure. Another 5 percent did not know the proper side of the road on which to walk. For the 55 Alive respondents, the percentage of correct responses was much higher, over 83 percent.

Several tests for statistical differences were detected for the groups responding to this question. A higher percentage of correct responses was selected by the non-metropolitan urban areas, 68 percent of the areas with populations between 100,000 and 500,000 and 65 percent of the areas with populations under 100,000 answered this question correctly. Only 58 percent of the respondents in the larger areas knew the correct response. This may be attributed to the higher frequency of sidewalks in the more populated areas. Regardless, this is a basic pedestrian issue that should be

understood by all pedestrians. Fifty-nine percent of respondents who have had some previous experience with a pedestrian collision answered correctly. Of the group having no experience, 67 percent selected the correct response. Those respondents who indicated they have had some exposure to pedestrian safety advice had a higher percentage of correct responses. This is true for both the examination station respondents and the AARP respondents. Sixty-nine percent and 89 percent of the male respondents at the examination stations and the 55 Alive courses responded correctly. This is compared to 59 percent and 78 percent of the respective female respondents. The older respondents at the examination stations and the AARP respondents have a significantly higher percentage of correct responses. The final difference indicated that a higher percentage of those 55 Alive respondents who had not reviewed the driver's manual answered this question correctly. A brief review of all state's driver's manuals found that none addressed the issue of pedestrians walking along roadways.

Question 6

If you are standing on the sidewalk at a painted crosswalk not at an intersection, traffic is not required to stop to let you cross the road.

	Driver License Examination Stations		AARP	
No Response	23	1.3%	1	0.1%
True	540	30.6%	227	30.6%
False	1,061	60.2%	438	59.0%
Don't Know	139	7.9%	76	10.3%
Total	1,763	100.0%	742	100.0%

Traffic is not required to stop for pedestrians waiting on the curb to cross, and pedestrians are not to suddenly leave a curb in such a way that an approaching motorist does not have an adequate braking distance *(16)*. There appears to be a gross misunderstanding on the part of the respondents concerning the right-of-way at midblock crossings. About 70 percent of the respondents in both groups either do not know the correct answer or indicated that traffic must stop to let them cross. This seems to imply that pedestrians feel they have the right-of-way at midblock crosswalks whether they are on the sidewalk or in the crosswalk. This may give some indication as to why the number of non-intersection pedestrian collisions are much higher than intersection collisions (Figure 2.5). Because the severity of non-intersection injuries appears to be higher *(2)*, special efforts should be made to educate the public about the laws related to this issue.

There were two tests that showed statistical differences. Both, respondents at the examination stations who have not been exposed to pedestrian advice and those who had not reviewed their driver's manual, had a higher percentage of correct responses. This seems to indicate that this issue may not have been adequately addressed in safety programs.

Question 7

A WALK signal at an intersection means that you may cross the road safely because no cars will be driving through or turning into the crosswalk.

	Driver License Examination Stations		AARP	
No Response	11	0.6%	0	0.0%
True	819	46.5%	345	46.5%
False	889	50.4%	381	51.3%
Don't Know	44	2.5%	16	2.2%
Total	1,763	100.0%	742	100.0%

Because a pedestrian signal illuminates the WALK symbol, this does not imply that pedestrians are safe and need not be cognizant of turning vehicles. Zegeer *(25)* studied over 2,000 pedestrian collisions and found that over 37 percent that occurred at intersections involved either left or right turning vehicles. Slightly less than 50 percent of the respondents at the examination stations and the AARP safety courses incorrectly answered this question. The respondents may be feeling a false sense of security when they see the steady WALK indication at an intersection. Often times motorists are paying attention to traffic and neglect pedestrians legally crossing. It is important for both the pedestrians and the motorists to be cognizant of pedestrian and vehicle traffic at intersections. Statistical differences were detected for the examination station and the AARP respondents. In both cases, the male respondents had a higher percentage of correct responses. Fifty–six percent and 61 percent of the male sample at the examination stations and the 55 Alive course answered correctly, respectively. Only 46 percent and 44 percent of the respective female groups answered Question 7 correctly. These differences may be large enough to indicate that safety advertising and education related to this issue should focus on female pedestrians.

Question 8

Assume you are a motorist waiting to turn left at an intersection that does not have a left-turn arrow. When the light turns green, the pedestrians in the figure step into the crosswalk as you are turning. You must let the pedestrians finish crossing before you finish your turn. (See Figure 3.2)

	Driver License Examination Stations		AARP	
No Response	16	0.9%	1	0.1%
True	1,614	91.5%	700	94.3%
False	67	3.8%	24	3.2%
Don't Know	66	3.7%	17	2.3%
Total	1,763	100.0%	742	100.0%

This question is very similar to Question 7. The intent was to investigate whether pedestrians and motorists understand who has the right-of-way when a vehicle is turning at an intersection. The UVC says that all turning vehicles must yield the right-of-way to pedestrians lawfully using a crosswalk *(16)*. Although the responses from Question 7 seem to imply that many pedestrians are not aware of potential conflicts while crossing, it appears from these responses that most motorists are aware of their obligation to grant the right-of-way to the pedestrians while turning left.

Some statistically significant differences were identified between response groups. The respondents in the two larger population brackets had a higher percentage of correct responses. Ninety-five percent of the respondents in both groups answered correctly compared to 90 percent in the smallest bracket. Of the group at the examination station who had been exposed to some pedestrian safety advice, almost

95 percent selected the correct response compared to 86 percent of those having no exposure. Ninety percent of the respondents who had reviewed the manual answered correctly while only 90 percent of those not reviewing the manual chose the correct answer. While differences were detected, the relatively high percentages seem to indicate that most of the respondents know their basic obligations as motorists, and imply that specific target groups can not be identified based on these results.

Question 9

When you are driving in a school speed zone, you may resume your speed as soon as you can see the END SCHOOL ZONE sign.

	Driver License Examination Stations		AARP	
No Response	13	0.7%	1	0.1%
True	1,154	65.5%	551	74.3%
False	533	30.2%	168	22.6%
Don't Know	63	3.6%	22	3.0%
Total	1,763	100.0%	742	100.0%

The *Manual on Uniform Traffic Control Devices* addresses the use and meaning of this sign in §2B-13 and §7B-12. The manual says that this sign or a standard speed limit sign shall be used to mark the precise point where speeds are to change *(20)*. This implies that motorists must wait until they have reached this sign before they may resume their normal travel speed. Merely seeing this sign and being able to read its message from a distance does not satisfy the requirement of reaching or passing it. Thirty percent of the examination station respondents and 23 percent of the

AARP respondents selected the correct answer. School zone safety is an important issue particularly because young pedestrians account for such a large percentage of non-intersection injuries (Figure 2.5).

For the examination station group that had been exposed to pedestrian advice, a higher percentage of respondents answered correctly. The male respondents at the examination stations and the 55 Alive courses have a higher percentage of correct responses than the females. For the respective groups, 37 percent and 30 percent of the males responded correctly compared to 25 percent of the examination station and 17 percent of the AARP female respondents. In the tests of age groups, the younger respondents had a higher percentage of correct responses, as did the examination station respondents when compared to the AARP respondents. From these results, however, it is impractical to design a safety program to target these groups.

Question 10

This sign is placed approximately 200 ft. in advance of a pedestrian crossing used by children to go to and from a school. (See Figure 3.3, S2-1.)

	Driver License Examination Stations		AARP	
No Response	28	1.6%	2	0.3%
True	1,258	71.4%	550	74.1%
False	204	11.6%	53	7.1%
Don't Know	273	15.5%	137	18.5%
Total	1,763	100.0%	742	100.0%

This question is identical to Question 11 on Survey I with the exception that the sign used is the school crossing sign, S2–1, discussed in §7B–10 of the MUTCD. As with the pedestrian crossing sign, this sign is to be used at the exact location of the crossing used by school children *(20)*. The only difference between this sign and the advanced crossing sign is the use of the crosswalk lines in the symbol. These signs are shown in Figure 3.3. The National Committee on Uniform Traffic Control Devices has recognized a need for the two unique symbols and provides guidelines on their use. If motorists can not distinguish the difference between the advanced pedestrian crossing sign and the simple pedestrian crossing sign, then education of their meanings must be accomplished. As with Question 11 on Survey I, a high percentage of the respondents of both groups failed to recognize this difference. Only about 10 percent of all respondents answered correctly.

The only statistical difference, though small, was detected between the responses of the examination station and the AARP respondents. Twelve percent of the examination station respondents answered this correctly compared to 7 percent of the AARP respondents.

Question 11

Most pedestrian accidents in cities happen while a person is crossing the road at some place other than an intersection.

	Driver License Examination Stations		AARP	
No Response	39	2.2%	2	0.3%
True	1,195	67.8%	540	72.8%
False	231	13.1%	87	11.7%
Don't Know	298	16.9%	113	15.2%
Total	1,763	100.0%	742	100.0%

This question was asked as a way of determining what locations pedestrians and motorists see as being potentially more dangerous. As Tables 2.4 and 2.5 demonstrate, in general a larger percentage of pedestrian injuries and fatalities occur at non–intersection locations. The midblock and roadside pedestrian collisions tend to be more serious in nature. Because of this, it is important for both pedestrians and motorists to be especially careful and observant when crossing and driving at urban locations away from intersections. Thirty percent of the examination station and 27 percent of the 55 Alive respondents did not know the correct answer to this question.

Tests of statistical differences indicate that 74 percent of the respondents in moderately sized urban areas knew the correct response. Only 66 percent of the respondents from the smaller areas and 68 percent of those from the largest areas responded correctly. These test results are practically significant, however. Of the respondents at the 55 Alive courses, 77 percent of those who had no previous experience or knowledge of a pedestrian collision answered correctly, as opposed to 66 percent of those with experience or knowledge. The AARP female respondents had a higher percentage of correct responses, 75 percent compared to 70 percent for the males. At the examination stations, the older respondents and those who had reviewed

their driver's manual had more correct responses. Seventy-six percent of the older respondents and 72 percent of those reviewing the manual answered correctly. Only 68 percent of the younger respondents and 67 percent of those not reviewing the manual selected the correct answer.

Question 12

If you wear white clothing while walking along a roadway at night, drivers will be able to see you from a safe distance.

	Driver License Examination Stations		AARP	
No Response	30	1.7%	1	0.1%
True	1,216	69.0%	558	75.2%
False	396	22.5%	121	16.3%
Don't Know	121	6.9%	62	8.4%
Total	1,763	100.0%	742	100.0%

Because many individuals walk or jog in the evening hours, it is imperative that all pedestrians be informed of the hazards and risks of walking at night. Table 5.2 shows the relationship between pedestrian injuries and fatalities by the time of day that they occur. Almost 59 percent of all pedestrian fatalities occur between the hours of 6 p.m. and 3 a.m. As Table 5.3 indicates, pedestrians make up a larger percentage of all traffic fatalities during the months of extended darkness (November through February). Two studies have shown that at low speeds, wearing white clothing while walking at night does provide some increased safety, Blomberg *(26)* and Allen *(27)*. Blomberg found that at speeds over 35 mph, however, pedestrians wearing non-

Table 5.2

Pedestrians Killed or Injured, by Time of Day and Day of Week, 1992

Time of Day	Day of Week				Total *
	Weekday		Weekend		
	Number	Percent of Total	Number	Percent of Total	
Killed					
Midnight to 3 am	230	*7.2*	444	*19.0*	674
3 am to 6 am	145	*4.6*	188	*8.0*	333
6 am to 9 am	339	*10.7*	60	*2.6*	399
9 am to Noon	242	*7.6*	80	*3.4*	322
Noon to 3 pm	338	*10.6*	104	*4.4*	442
3 pm to 6 pm	624	*19.6*	166	*7.1*	790
6 pm to 9 pm	753	*23.7*	667	*28.5*	1,420
9 pm to Midnight	510	*16.0*	634	*27.1*	1,144
Total	3,181	*100.0*	2,343	*100.0*	5,546
Injured **					
Midnight to 3 am	1,000	*1.5*	3,000	*11.1*	4,000
3 am to 6 am	***	*0.6*	***	*1.7*	1,000
6 am to 9 am	9,000	*13.4*	***	*1.7*	9,000
9 am to Noon	7,000	*10.4*	2,000	*7.4*	8,000
Noon to 3 pm	13,000	*19.4*	5,000	*18.5*	17,000
3 pm to 6 pm	20,000	*29.9*	4,000	*14.8*	24,000
6 pm to 9 pm	12,000	*17.9*	7,000	*25.9*	19,000
9 pm to Midnight	6,000	*9.0*	5,000	*18.5*	11,000
Total	67,000	*100.0*	27,000	*100.0*	94,000

* Includes 22 pedestrians killed at unknown time of day or day of week.

** Because of rounding and estimation errors, rows and columns may not sum.

*** Less than 500.

Source: "Traffic Safety Facts 1992," National Highway Traffic Safety Administration, U.S. Department of Transportation, Washington, D.C. (1993).

Table 5.3

Persons Killed or Injured, by Month of Year, 1992

Month	Non-Pedestrian		Pedestrian		Total
	Number	Percent of Total	Number	Percent of Total	
Killed					
January	2,332	*82.0*	513	*18.0*	2,845
February	2,261	*84.7*	409	*15.3*	2,670
March	2,396	*85.9*	394	*14.1*	2,790
April	2,527	*86.2*	403	*13.8*	2,930
May	3,003	*87.3*	437	*12.7*	3,440
June	3,113	*88.7*	397	*11.3*	3,510
July	3,181	*87.6*	449	*12.4*	3,630
August	3,276	*87.5*	469	*12.5*	3,745
September	2,838	*85.6*	477	*14.4*	3,315
October	3,261	*86.4*	514	*13.6*	3,775
November	2,770	*85.4*	475	*14.6*	3,245
December	2,832	*85.7*	473	*14.3*	3,305
Total	33,790	*86.2*	5,410	*13.8*	39,200
Injured					
January	236,562	*95.8*	10,463	*4.2*	247,025
February	233,484	*96.6*	8,246	*3.4*	241,730
March	247,059	*97.1*	7,326	*2.9*	254,385
April	244,427	*96.8*	8,133	*3.2*	252,560
May	275,561	*96.8*	9,014	*3.2*	284,575
June	271,400	*97.1*	8,075	*2.9*	279,475
July	278,271	*97.5*	7,189	*2.5*	285,460
August	264,137	*97.2*	7,613	*2.8*	271,750
September	251,713	*96.9*	8,067	*3.1*	259,780
October	259,217	*96.7*	8,738	*3.3*	267,955
November	229,347	*96.2*	9,143	*3.8*	238,490
December	252,407	*96.4*	9,408	*3.6*	261,815
Total	3,043,585	*96.8*	101,415	*3.2*	3,145,000

Source: Cerrelli, E.C., "1992 Traffic Crashes, Injuries, and Fatalities – Preliminary Report," Report No. DOT HS 807 968, National Highway Traffic Safety Administration, Washington, D.C. (March 1993).

reflective white clothing could not be seen from a safe distance. This study also showed that retroreflective materials and flashlights were visible at much safer distances. Only 23 percent of the examination station respondents and 16 percent of the 55 Alive respondents correctly answered this question. Because wearing white clothing is better than dark clothing only at low speeds, the correct answer is that pedestrians can not be seen from a safe distance while wearing white.

There were no statistical differences detected between the respondents at the examination stations. These respondents did have a higher percentage of correct responses than the AARP respondents, however. Twenty-three percent of the examination station respondents selected the correct answer compared to 16 percent of the 55 Alive respondents. These differences are not large enough to constitute special safety programs for the elderly pedestrians. The male respondents at the 55 Alive courses also had a significantly higher percentage of correct answers. Twenty-one percent of the males answered this question correctly while only 13 percent of the females chose the correct answer. Although this is statistically significant, the difference is not practically different.

Questions 13, 14, and 15

Are you:

	Driver License Examination Stations		AARP	
No Response	21	1.2%	5	0.7%
Male	831	47.1%	325	43.8%
Female	911	51.7%	412	55.5%
Total	1,763	100.0%	742	100.0%

Your age is:

	Driver License Examination Stations		AARP	
No Response	20	1.1%	66	8.9%
Under 20	168	9.5%		NA
20–29	453	25.7%		NA
30–39	421	23.9%		NA
40–49	369	20.9%		NA
50–64	237	13.4%	191	25.7%
Over 64	95	5.4%	485	65.4%
Total	1,763	100.0%	742	100.0%

Have you reviewed your state's drivers license manual recently?

	Driver License Examination Stations		AARP	
No Response	35	2.0%	6	0.8%
Yes	806	45.7%	369	49.7%
No	922	52.3%	367	49.5%
Total	1,763	100.0%	742	100.0%

All of the responses to Survey II were disaggregated depending on the responses to these three questions. This was done to determine where deficiencies in

the comprehension of pedestrian laws and traffic control devices may lie. Once this has been accomplished, programs can be tailored to meet the needs of these deficient groups. These groups include differences detected based on the respondents' gender, age, and familiarity with the state's driver's manual. Over half of all respondents at both the examination stations and the 55 Alive courses were female. The responses to Question 14 were combined to create two distinct age groups. The first age group, under fifty, is considered to be the younger respondents, while the fifty and over group is referred to as the older respondents. Comparisons were also made between the responses at the examination stations and the AARP 55 Alive courses. Because 18 percent of the examination station responses included individuals over the age of fifty, assumptions can not be made that these responses differentiate the knowledge of the younger and older respondents. Question 15 was used to determine if reviewing the driver's manual influenced the responses.

Summary

The three categories of questions described in Chapter 4 also apply to the questions in Survey II. Questions 4, 11, and 12 are related to the respondents' assessment or opinions on particular pedestrian safety issues. A large percentage of the respondents underestimated the involvement of alcohol in pedestrian fatalities. The respondents also seemed to have a poor understanding of the ineffectiveness of wearing white clothing at night. Respondents in the larger urban areas appear to have a better understanding of where the problems lie. At the same time, the younger

respondents and those who had reviewed the manual seemed to have a slightly clearer perception of pedestrian problems.

For the questions related to legal issues, the responses seemed to show a misunderstanding related to two important pedestrian issues: walking against traffic and the right-of-way at midblock crosswalks. Those respondents who had been exposed to pedestrian safety advice tended to have higher percentages of correct responses. When statistically significant differences were detected for the responses aggregated by the gender of the respondent, these differences are typically not large enough to indicate that special pedestrian programs need to be directed toward a particular group. The older respondents also had a higher percentage of correct responses, while, reviewing the manual did not appear to have an overall positive influence on the knowledge of pedestrian laws.

The final category of questions, pedestrian traffic control devices, showed trends similar to Survey I. In general, there appears to be some misunderstandings related to the traffic control devices, particularly the WALK signal, the END SCHOOL ZONE sign, and the school crossing signs. For test of statistical differences, the younger respondents and the male respondents had higher percentages of correct responses to these questions. The results also seem to indicate that differences exist and are favorable to those respondents having been exposed to pedestrian advice and having reviewed the driver's manual.

Chapter Six

Legal Review

Purpose

One of the major objectives of this study was to evaluate the comprehension of laws that govern the interaction of pedestrians and motor vehicles. In order to do this, the laws of each state related to this topic must be known. The initial process used to collect information on the state laws consisted of contacting each state's Department of Motor Vehicles. A questionnaire with only the legal questions was sent to each of the DMV's and was asked to be completed based on the laws of that state. The questions included in this abbreviated questionnaire are: Survey I – Questions 5, 6, 8, and 10; and Survey II – Questions 5, 6, and 8. (Future references to specific questions will be given by the survey and question number. For example, Question 2.4 will be a reference to Question 4 on Survey II.) Each contact was also asked to attach appropriate portions of their codes and statutes.

Upon completing this task, it was recognized that either many of the states were not complying to a uniform standard of monitoring traffic control of pedestrians, or the questionnaire was completed with incorrect responses. Since the passage of the Highway Safety Act of 1966 *(28)*, all states are required to "develop and implement a program to achieve uniformity of traffic codes and laws" *(29)*. The *Uniform Vehicle Code* was deemed the appropriate document for the uniformity of traffic laws.

Because state laws are expected to conform to this code, its contents related to pedestrian issues will be addressed initially. A discussion of the states' responses will follow.

The *Uniform Vehicle Code* and *Model Traffic Ordinance*

In 1966 the United States government adapted the Highway Safety Act in order to focus attention on issues of highway safety. The Act produced a list of 18 standards developed and maintained by NHTSA by which all states are required to conform. Standard No. 6, *Codes and Laws (29)*, is directly related to the conformance of traffic codes and laws. The main objective of this standard is stated as follows:

> Each State shall develop and implement a program to achieve uniformity of traffic codes and laws throughout the state. The program shall provide at least that:
>
> I. There is a plan to achieve uniform rules of the road in all of its jurisdictions.
>
> II. There is a plan to make the State's unified rules of the road consistent with similar unified plans of other States. Toward this end, each State shall undertake and maintain continuing comparisons of all State and local laws, statutes and ordinances with the comparable provisions of the Rules of the Road section of the Uniform Vehicle Code.

It is the *Uniform Vehicle Code* (UVC) that sets the standards by which all states should comply. This document was used as the basis for determining the correct responses to all questions on the two questionnaires related to legal issues. The questions related to specific laws are shown in Figure 6.1.

PEDESTRIAN SAFETY QUESTIONNAIRE

Survey I

In the downtown area of a large city you may legally cross a street only at a traffic signal or where there is a painted crosswalk.
_____ TRUE _____ FALSE _____ DON'T KNOW

If a pedestrian is just beginning to cross the street in a crosswalk that does not have a pedestrian signal, you must slow down or stop to let the person finish crossing the road.
_____ TRUE _____ FALSE _____ DON'T KNOW

If sidewalks are provided, you may not legally jog on the road surface.
_____ TRUE _____ FALSE _____ DON'T KNOW

Assume you are at an intersection that lets you turn right on red after you stop. The pedestrian in the figure has just begun to cross at the crosswalk. He must wait and let you turn before he finishes crossing.
_____ TRUE _____ FALSE _____ DON'T KNOW

Survey II

If there are no sidewalks, you should always walk on the right-hand side of the road with the traffic.
_____ TRUE _____ FALSE _____ DON'T KNOW

If you are standing on the sidewalk at a painted crosswalk not at an intersection, traffic is not required to stop to let you cross the road.
_____ TRUE _____ FALSE _____ DON'T KNOW

Assume you are a motorist waiting to turn left at an intersection that does not have a left-turn arrow. When the light turns green, the pedestrians in the figure step into the crosswalk as you are turning. You must let the pedestrians finish crossing before you finish your turn.
_____ TRUE _____ FALSE _____ DON'T KNOW

Figure 6.1. Legal Portion of Survey I and Survey II

The legal portion can be subdivided into two categories: general pedestrian behavior and pedestrian/vehicle interaction. Questions 1.5, 1.8 and 2.5 are related to the general pedestrian activities. The remaining legal questions pertain to specific duties during the interaction of pedestrians and motor vehicles.

Many laws in the *Uniform Vehicle Code* are not directly related to the concept of right-of-way but address issues of safe pedestrian habits. Question 1.5 inquires about the legality of what has come to be known as "jaywalking". In large downtown areas where most intersections are signalized, the respondents may be unaware of their obligation to cross only at the signalized intersections or at marked crosswalks. Pedestrians are also required to perform safe walking habits such as using sidewalks where provided and facing traffic when walking along a roadway that does not have sidewalks *(16)*. The following sections in the UVC address these issues:

> **§11-503 - Crossing at other than crosswalks**
> (c) Between adjacent intersections at which traffic-control signals are in operation pedestrians shall not cross at any place except in a marked crosswalk.

> **§11-506 - Pedestrians on highways**
> (a) Where a sidewalk is provided and its use is practicable, it shall be unlawful for any pedestrian to walk along and upon an adjacent roadway.
> (c) Where neither a sidewalk nor a shoulder is available, any pedestrian walking along and upon a highway shall walk as near as practicable to an outside edge of the roadway, and, if on a two-way roadway, shall walk only on the left side of the roadway.

Questions 1.6 and 2.6 address the issues of right-of-way at midblock crosswalks, while 1.10 and 2.8 pertain to right-of-way issues at signalized intersections. Motorists are required to allow pedestrians legally in crosswalks to finish crossing the half of the roadway upon which the vehicle is located. They are not, however, required to stop at an unsignalized midblock crossing in order to let a pedestrian waiting on the sidewalk cross. These issues are addressed in the following UVC section:

> **§11-502 - Pedestrians' right of way in crosswalks**
> (a) When traffic control signals are not in place or not in operation the driver of a vehicle shall yield the right of way, slowing down or stopping if need be to so yield, to a pedestrian crossing the roadway within a crosswalk when the pedestrian is upon the half of the roadway upon which the vehicle is travelling, or when the pedestrian is approaching so closely from the opposite half of the roadway as to be in danger.
> (b) No pedestrian shall suddenly leave a curb or other place of safety and walk or run into the path of a vehicle which is so close as to constitute an immediate hazard.

The remaining two questions, 1.10 and 2.8 are related to the right-of-way obligations for turning vehicles at signalized intersections. These questions target the interaction of motorists and pedestrians crossing legally at intersections regardless of the presence of pedestrian signals. The two key issues raised relate to left turning motorists who are turning on a permissive green and right turning motorists turning right on red who are in conflict with pedestrians. These are addressed in the following section:

§11-202 - Traffic-control signal legend

(a) Green indication

1. Vehicular traffic facing a circular green may proceed straight through or turn right or left unless a sign at such place prohibits either such turn. But vehicular traffic, including vehicles turning right or left, shall yield the right of way to other vehicles and to pedestrians lawfully within the intersection or an adjacent crosswalk at the time such signal is exhibited.

(c) Steady red indication

3. Except when a sign is in place prohibiting a turn, vehicular traffic facing any steady red signal may cautiously enter the intersection to turn right, or to turn left from a one-waystreet into a one-waystreet, after stopping ... Such driver shall yield the right of way to pedestrians within the intersection or an adjacent crosswalk.

For these eight questions, the provisions outlined in the *Uniform Vehicle Code* have been applied as the correct responses for analysis purposes. This is considered to be an acceptable method based on the fact that each state's codes are required to be in or be in the process of becoming uniform with the general codes in the UVC.

State Responses and Codes

Upon collecting the final set of questionnaires, contact with each DMV was reestablished. A brief questionnaire containing the eight legal questions was mailed to the contact in each state's DMV. A request was made to attach portions of relevant state codes and statutes. Table 6.1 summarizes the findings from the thirty-six questionnaires returned. Of those, a total of sixteen contacts provided additional information in the form of state codes.

Table 6.1

State Responses to the Legal Portion of Each Questionnaire

State	Survey I Questions												Survey II Questions								
	#5			#6			#8			#10			#5			#6			#8		
	T	F	?	T	F	?	T	F	?	T	F	?	T	F	?	T	F	?	T	F	?
Alabama	x			x					x		x				x	x			x		
Arkansas	x			x					x		x			x		x			x		
California		x		x			x				x			x		x			x		
Colorado	x			x			x				x			x			x		x		
Connecticut	x			x			x				x			x		x			x		
Delaware	x			x			x				x			x		x			x		
Florida	x			x			x				x		x			x			x		
Georgia	x			x			x				x			x			x		x		
Idaho	x			x					x		x			x			x		x		
Iowa	x			x					x		x			x			x			x	
Kansas	x			x					x		x			x			x		x		
Kentucky	x			x				x			x					x			x		
Maine		x		x			x					x		x			x		x		
Maryland	x			x					x		x		x					x	x		
Michigan	x			x			x			x				x		x			x		
Mississippi	x			x				x			x			x			x		x		
Missouri		x			x			x			x		x			x				x	
Montana	x			x					x		x			x		x			x		
Nebraska	x			x					x		x			x		x			x		
Nevada		x		x			x				x			x		x			x		
New Hampshire	x			x			x				x			x		x			x		
New Mexico	x			x			x				x			x			x		x		
New York		x		x			x				x			x		x			x		
North Dakota	x			x			x				x		x			x			x		
Ohio	x				x		x				x			x		x			x		
Oregon	x			x					x		x			x			x		x		
Pennsylvania	x			x							x			x			x		x		
South Carolina	x			x					x		x			x		x			x		
South Dakota		x		x			x				x			x			x		x		
Tennessee	x			x					x		x			x			x		x		
Texas	x			x			x				x			x		x			x		
Utah	x			x			x				x			x		x			x		
Virginia	x			x			x				x			x			x		x		
West Virginia	x			x			x				x			x					x		

Table 6.1 (continued)

State Responses to the Legal Portion of Each Questionnaire

State	Survey I Questions												Survey II Questions								
	#5			#6			#8			#10			#5			#6			#8		
	T	F	?	T	F	?	T	F	?	T	F	?	T	F	?	T	F	?	T	F	?
Wisconsin		x		x				x			x			x			x		x		
Wyoming	x			x			x				x			x			x		x		
Total	29	7	0	34	2	0	20	4	11	1	34	1	4	30	1	19	15	1	34	2	0

From the great disparity in the responses, it was assumed that many of the state codes are not totally consistent with the UVC. After recognizing this problem, a comprehensive review was made of each state's codes and statutes to determine the validity of the responses. This review showed that many of the responses were reported inaccurately. Table 6.2 presents the revised findings from the legal review. Of all of the issues addressed through the survey, only three states had laws that did not conform to those provided in the UVC. Both the *South Dakota Codified Laws (30)* and the *Wisconsin Statutes Annotated (31)* allow pedestrians to cross at midblock locations even if a pedestrian is crossing between signalized intersections and outside of a marked crosswalk. The South Dakota and Wisconsin Laws, respectively, are stated as follows:

> **§32-27-4 Jaywalking - Duty to yield right-of-way to vehicles**
> Every pedestrian crossing a highway within a business or residence district at any point other than a pedestrian crossing, crosswalk or intersection shall yield the right-of-way to vehicles upon the highway.

> **§346.25 Crossing at place other than crosswalk**
> Every pedestrian or bicyclist crossing a roadway at any point other within a marked or unmarked crosswalk shall yield the right-of-way to all vehicles upon the roadway.

The third state law that does not conform to the UVC pertains to Question 1.8. The *General Laws of Rhode Island, 1956 (32)* specifically addressed the issue of pedestrians walking and jogging in the roadway. In Rhode Island, joggers are allowed

Table 6.2

State Laws Related to the Legal Portion of Each Questionnaire

State	Survey I Questions												Survey II Questions								
	#5			#6			#8			#10			#5			#6			#8		
	T	F	?	T	F	?	T	F	?	T	F	?	T	F	?	T	F	?	T	F	?
Alabama	x			x			x				x			x		x			x		
Arkansas	x			x			x				x			x		x			x		
Arizona	x			x			x				x			x		x			x		
California	x			x			x				x			x		x			x		
Colorado	x			x			x				x			x		x			x		
Connecticut	x			x			x				x			x		x			x		
Delaware	x			x			x				x			x		x			x		
Florida	x			x			x				x			x		x			x		
Georgia	x			x			x				x			x		x			x		
Idaho	x			x			x				x			x		x			x		
Illinois	x			x			x				x			x		x			x		
Indiana	x			x			x				x			x		x			x		
Iowa	x			x			x				x			x		x			x		
Kansas	x			x			x				x			x		x			x		
Kentucky	x			x			x				x			x		x			x		
Louisiana	x			x			x				x			x		x			x		
Maine	x			x			x				x			x		x			x		
Maryland	x			x			x				x			x		x			x		
Massachusetts	*			x			*				x			*		x			x		
Michigan	x			x			x				x			x		x			x		
Minnesota	x			x			x				x			x		x			x		
Mississippi	x			x			*				*			x		x			x		
Missouri	x			x			x				x			x		x			x		
Montana	x			x			x				x			x		x			x		
Nebraska	x			x			x				x			x		x			x		
Nevada	x			x			x				x			x		x			x		
New Hampshire	x			x			x				x			x		x			x		
New Jersey	x			x			x				x			x		x			x		
New Mexico	x			x			x				x			x		x			x		
New York	*			x			x				x			x		x			x		
North Carolina	x			x			x				x			x		x			x		
North Dakota	x			x			x				x			x		x			x		
Ohio	x			x			x				x			x		x			x		
Oklahoma	x			x			x				x			x		x			x		

Table 6.2 (continued)

State Laws Related to the Legal Portion of Each Questionnaire

State	Survey I Questions												Survey II Questions								
	#5			#6			#8			#10			#5			#6			#8		
	T	F	?	T	F	?	T	F	?	T	F	?	T	F	?	T	F	?	T	F	?
Oregon	x			x			x				x			x		x			x		
Pennsylvania	x			x			x				x			x		x			x		
Rhode Island	x			x				x			x			x		x			x		
South Carolina	x			x			x				x			x		x			x		
South Dakota		x		x			x				x			x		x			x		
Tennessee	x			x			x				x			x		x			x		
Texas	x			x			x				x			x		x			x		
Utah	x			x			x				x			x		x			x		
Vermont	x			x			x				x			x		x			x		
Virginia	x			x			x				x			x		x			x		
Washington	x			x			x				x			x		x			x		
West Virginia	x			x			x				x			x		x			x		
Wisconsin		x		x			*				x			x		x			x		
Wyoming	x			x			x				x			x		x			x		
Total	44	2	0	48	0	0	44	1	0	0	47	0	0	47	0	48	0	0	48	0	0

* State's laws either do not address this particular issue or grant municipalities the authority to pass legislation on such issues.

to run in the roadway even where sidewalks are provided. The law does provide standards, however, that must be met for jogging that takes place during the hours of darkness. The Rhode Island law requires that pedestrians running in the during hours of darkness to wear retroreflective material that is visible from at least 500 feet. This law is addressed in the following two sections:

> **§31-18-10. Walking in street prohibited.**
> Where sidewalks are provided it shall be unlawful for any pedestrian to walk along and upon the adjacent roadway. Where sidewalks are provided it shall be lawful for a person to run or jog along and upon an adjacent roadway and if said person shall begin to walk he/she shall walk upon an available sidewalk.

> **§31-18-11. Walking, jogging, or running on left.**
> Any person jogging or running during the time from one-half hour after sunset to one-half hour before sunrise, shall, in addition, wear reflective material which is visible by low-beam headlamps from a distance of at least five hundred (500) feet, provided that in no event, shall the failure to wear reflective clothing be considered as contributing negligence.

Several state codes do not address the issues raised in some of the legal questions. Others, such as the *Massachusetts General Laws Annotated (33)* and the *Consolidated Laws of New York (34)*, give provisions for municipalities to implement pedestrian traffic regulations as deemed appropriate by that municipality. Neither states' codes deny a pedestrian the right to walk or jog in the roadway. Both, however, grant the authority to adopt and amend laws regulating the use of public ways by pedestrians. The *Massachusetts General Laws Annotated* and the *Consolidated Laws*

of New York address this topic in §18A and §1642, respectively.

It is interesting to note the wide variety of responses received from the various Departments of Motor Vehicles. It became apparent that even the DMV staff is at times uncertain of what constitutes legal pedestrian behavior. This legal review provided the basic information needed to properly analyze the data. At the same time, it reinforces the need for increased education of proper pedestrian behavior and motor vehicle interaction.

Chapter Seven

Conclusions and Recommendations

Summary and Conclusions

This study was conducted to evaluate the comprehension of pedestrian related laws and traffic control devices by both pedestrians and motorists. The methodology consisted of conducting a survey of these groups on various issues related to their interaction. Driver license examination stations and AARP members were used as the distribution centers for the surveys. Two surveys were used in the study and were sent to various locations throughout the forty-eight contiguous states. For Survey I, a total of 1,832 questionnaires were returned from the examinations stations and 489 from the 55 Alive courses. There were a total of 1,763 completed Survey II forms returned from the examinations stations and 742 from the 55 Alive courses. Thirty-six respondents in the Department of Motor Vehicle offices returned the legal portion of the questionnaires.

The two questionnaires had four basic types of questions: demographic, problem assessment, pedestrian laws, and pedestrian traffic control devices. The responses from the two groups were disaggregated based on the demographic information collected. The correct answers for each of the questions were acquired from various sources. Answers for the questions related to statistics and assessments were obtained from government publications and government sponsored studies. For the questions related to pedestrian and motorist laws, the analysis consisted of a

detailed study of the *Uniform Vehicle Code* and *Model Traffic Ordinance*, as well as each states codes and statutes. Although some states have minor deviations from these codes, the UVC was used as the ultimate guideline knowing that all states are to comply with the basic requirements provided in it. The remaining questions related to traffic control devices are addressed in the *Manual on Uniform Traffic Control Devices*. Following this, the demographic groups were then tested for significant differences using the chi-square test statistic.

There were four questions across the two surveys that addressed assessments of pedestrian issues. These include the general problem of pedestrian fatalities, drunk pedestrians, the prevailing locations for pedestrian collisions, and pedestrians walking during the hours of darkness. Overall, the respondents at both the examination stations and the 55 Alive courses did not appear to assess the problem of pedestrian safety very well. The respondents may not recognize the extent of pedestrian collisions. More than 60 percent of the respondents underestimated the correct percentage of pedestrian fatalities. An almost equal percentage underestimated the involvement of drunk pedestrians in fatal pedestrian collisions. Between 70 and 75 percent of all respondents indicated that individuals can be seen from safe distances if they wear white at night. This is only true for vehicles travelling at low speeds. As speeds increase beyond 35 mph, the stopping sight distance increases dramatically *(26)*. The respondents seemed to have a better knowledge of where pedestrian collisions occur most often. Sixty-nine percent of the examination station respondents correctly identified non-intersection crossings while 73 percent of the AARP respondents

correctly answered this question.

A total of seven questions were asked that relate to pedestrian and motorist laws. Of these seven, four address the issue of right-of-way at crosswalks. The respondents from both groups appear to be aware of the laws that govern the right-of-way when a pedestrian is already crossing in a crosswalk. However, a problem may exist for pedestrians waiting on the curb to cross at midblock crosswalks. Upon reviewing several state's drivers' manuals, it appears as though the issue of right-of-way is covered extensively. Of the three issues raised related to safe pedestrian habits, only the issue of crossing only at intersections and crosswalks while in urbanized areas appears to be clearly understood by a large percentage of the respondents.

Between 79 and 97 percent of all group responses to questions on the subject of right-of-way while a pedestrian is in a crosswalk indicated that pedestrians have the right-of-way. About 60 percent of the respondents believe that traffic is required to stop and let a pedestrian cross at a midblock crosswalk even when the pedestrian is waiting on the curb. Eighty-six percent of the examination station respondents and 94 percent of the AARP respondents know that pedestrians in urbanized areas are not to cross between signalized intersections where no crosswalks are in place. While over 45 percent of the respondents at the examination stations do not know that pedestrians may not jog on the road surface if sidewalks are provided. Another 31 percent indicated that pedestrians should walk with traffic rather than against traffic when sidewalks are not provided. For the tests of statistical differences, it appears that exposure to pedestrian safety advice may have some positive influence on how the

legal questions were answered.

The final portion of the data analysis pertained to those questions related to pedestrian traffic control devices. The remaining six questions on the two questionnaires involved issues related to both pedestrian signs for motorists and pedestrian signals. The respondents have a poor understanding the meaning of many of the pedestrian related traffic signs. Respondents were asked about the location of the pedestrian crossing signs (W11A-2 and S2-1). Eighty-three percent of the respondents at the examination stations and 82 percent of the AARP respondents could not identify exactly where these signs are used. Between 23 and 30 percent of the respondents in the various groups, may not comprehend the full intent of the END SCHOOL ZONE sign. These individuals indicated that normal speeds may be resumed as soon as this sign comes into view.

The respondents do not appear to clearly understand the intent of the WALK and flashing DON'T WALK signals. Only half of all respondents knew the correct meaning of the flashing DON'T WALK signal. Forty-seven percent of the respondents from both groups indicated that a steady WALK signal at an intersection means that no cars will be driving through or turning into the crosswalk. The only issue related to pedestrian signals that solicited a positive response is related to actuated pedestrian signals. Most of the respondents seemed to understand that pedestrian actuated signals will not immediately change to WALK when activated.

Recommendations

From the survey results, there are several recommendations that can be made related to safe pedestrian and vehicle interaction. Each of these recommendations addresses one or more issues raised in the responses to the two questionnaires. There appears to be a need for increased education concerning the severity and frequency of pedestrian collisions. From the analysis of the responses, it is apparent that engineers need to focus attention on the evaluation of traffic control devices. In addition to these concerns, recommendations for future research have been identified.

From the results of the study, it is evident that education concerning pedestrian safety should focus on the severity and frequency of pedestrian collisions. Pedestrian safety programs should include discussions on the following hazards: the dangers of being a drunk pedestrian; the importance of wearing retroreflective material when walking at night; and the safe habits when walking along a road. Pedestrians are to walk on the left, facing traffic and to use sidewalks when they are provided. Such programs should also include material related to pedestrian signals. These should convey the meaning of the flashing DON'T WALK message, to continue walking to the nearest sidewalk or refuge and the idea that a steady WALK signal does not restrict turning vehicles from driving through a crosswalk. Motorists should be educated on the difference in the meanings of the crossing signs and the advance crossing signs, as well as, the meaning of the END SCHOOL ZONE sign.

Engineers should focus attention on evaluating the symbols and messages used in pedestrian signs and signals. Alternative informational signs at pedestrian actuated

signals may demand continued research. Possible changes in the pedestrian crossing signs should be evaluated and studied to insure that the distinct meanings are conveyed. Both school zone signing and motorist behavior within the school zones need continued research as well.

From the literature review and study of current trends, it is evident that the young pedestrians, 15 years and under, are highly overrepresented. While they are underrepresented in fatal pedestrian collisions, they are involved in a disproportionately high number of injury pedestrian collisions. There have only been a few detailed studies in recent years on the behavior of children's crossing habits. This is an area that demands much attention. The elderly have typically been a group that has demanded much attention in relation to pedestrian collisions. Although they are overrepresented in fatal collisions, they are underrepresented in pedestrian collisions on the whole. Future research may need to be focused on why this may be and may need to examine the past assumption that they are a high-risk group.

Pedestrian safety should be an ongoing concern for traffic engineers, planners, and researchers. Proper installation of pedestrian traffic control devices and adequate sidewalks should be monitored. In addition to this, continued education and research of pedestrian related laws, traffic control devices, and general safety issues can be used to maintain safe interaction of pedestrians and vehicles.

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Appendices

Appendix A

Statistical Results Indicating Significant Differences in the Responses from Survey I

Table A.1

Summary Data for Tests Showing Significant Differences on Survey I.

Questionnaire Completed at ...	Aggregation Question *	Test Question **	Degrees of Freedom	Chi-Square Value	Probability
Examination Station	Gender	Percent of All Traffic Deaths	1	13.799	0.000
Examination Station	City Size	Percent of All Traffic Deaths	2	8.156	0.017
***	***	Cross Only at Signal or Crosswalk	2	23.672	0.000
Examination Station	Experience	Must Stop for Pedestrian in Crosswalk	2	11.628	0.004
Examination Station	Driver's Manual	Must Stop for Pedestrian in Crosswalk	2	21.573	0.000
***	***	Must Stop for Pedestrian in Crosswalk	2	18.726	0.000
AARP 55 Alive	Experience	Flashing DON'T WALK	2	6.565	0.038
Examination Station	Gender	Flashing DON'T WALK	2	14.137	0.001
Examination Station	Gender	Jogging on Road Surface	2	11.421	0.003
AARP 55 Alive	Gender	Jogging on Road Surface	2	7.098	0.029
Examination Station	Gender	Jogging on Road Surface	2	10.234	0.006
Examination Station	Driver's Manual	Jogging on Road Surface	2	12.370	0.002
***	***	Jogging on Road Surface	2	6.701	0.035
***	***	Push Button for WALK Signal	2	10.227	0.006
Examination Station	Driver's Manual	Turning Right on Red Must Yield	2	6.236	0.044
Examination Station	Gender	Advance Crosswalk Sign	2	28.504	0.000
AARP 55 Alive	Gender	Advance Crosswalk Sign	2	6.627	0.036
Examination Station	Age	Advance Crosswalk Sign	2	9.279	0.010
Examination Station	City Size	Advance Crosswalk Sign	4	15.364	0.004

* These are the questions by which the responses were disaggregated.

** These are the questions for which the disaggregated groups showed significant differences.

*** These are the significant differences detected between the examination station and the AARP respondents.

Appendix B

Statistical Results Indicating Significant Differences

in the Responses from Survey II

Table A.2

Summary Data for Tests Showing Significant Differences on Survey II.

Questionnaire Completed at ...	Aggregation Question *	Test Question **	Degrees of Freedom	Chi-Square Value	Probability
AARP 55 Alive	Driver's Manual	Percent of Drunk Pedestrians	1	11.654	0.001
Examination Station	City Size	Percent of Drunk Pedestrians	2	6.437	0.040
***	***	Percent of Drunk Pedestrians	1	13.095	0.000
Examination Station	Experience	Walk on Right-Hand Side of Road	2	11.411	0.003
Examination Station	Pedestrian Advice	Walk on Right-Hand Side of Road	2	20.580	0.000
AARP 55 Alive	Pedestrian Advice	Walk on Right-Hand Side of Road	2	7.525	0.023
Examination Station	Gender	Walk on Right-Hand Side of Road	2	17.279	0.000
AARP 55 Alive	Gender	Walk on Right-Hand Side of Road	2	15.992	0.000
Examination Station	Age	Walk on Right-Hand Side of Road	2	6.022	0.049
AARP 55 Alive	Driver's Manual	Walk on Right-Hand Side of Road	2	7.138	0.028
Examination Station	City Size	Walk on Right-Hand Side of Road	4	22.498	0.000
***	***	Walk on Right-Hand Side of Road	2	92.233	0.000
Examination Station	Pedestrian Advice	Standing on Sidewalk at Crosswalk	2	8.044	0.018
Examination Station	Gender	WALK Means No Turning Vehicles	2	17.210	0.000
AARP 55 Alive	Gender	WALK Means No Turning Vehicles	2	22.877	0.000
Examination Station	Pedestrian Advice	Turning Left With Peds. in Crosswalk	2	44.317	0.000
Examination Station	Driver's Manual	Turning Left With Peds. in Crosswalk	2	7.727	0.021
Examination Station	City Size	Turning Left With Peds. in Crosswalk	4	11.214	0.024
Examination Station	Pedestrian Advice	END SCHOOL ZONE Sign	2	27.313	0.000
Examination Station	Gender	END SCHOOL ZONE Sign	2	29.909	0.000
AARP 55 Alive	Gender	END SCHOOL ZONE Sign	2	18.175	0.000
Examination Station	Age	END SCHOOL ZONE Sign	2	10.068	0.007
Examination Station	Driver's Manual	END SCHOOL ZONE Sign	2	7.751	0.021

Table A.2 (continued)

Summary Data for Tests Showing Significant Differences on Survey II.

Questionnaire Completed at ...	Aggregation Question *	Test Question **	Degrees of Freedom	Chi-Square Value	Probability
***	***	END SCHOOL ZONE Sign	2	17.206	0.000
***	***	School Pedestrian Crossing Sign	2	13.204	0.001
AARP 55 Alive	Experience	Location of Pedestrian Accidents	2	16.079	0.000
AARP 55 Alive	Gender	Location of Pedestrian Accidents	2	6.003	0.050
Examination Station	Gender	Location of Pedestrian Accidents	2	9.741	0.008
Examination Station	Driver's Manual	Location of Pedestrian Accidents	2	7.410	0.025
Examination Station	City Size	Location of Pedestrian Accidents	4	18.842	0.001
AARP 55 Alive	Gender	Wearing White Clothing at Night	2	8.927	0.012
Examination Station	Driver's Manual	Wearing White Clothing at Night	2	11.746	0.003
***	***	Wearing White Clothing at Night	2	13.819	0.001

* These are the questions by which the responses were disaggregated.

** These are the questions for which the disaggregated groups showed significant differences.

*** These are the significant differences detected between the examination station and the AARP respondents.

Vita

Devin Patrick Doyle was born in Nashville, Tennessee on July 31, 1969. He is the sixth child in a family of seven and the fifth to receive a degree from the University of Tennessee, Knoxville. Currently, he is an uncle to ten nieces and nephews. While growing up in Nashville, Devin attendend Christ the King, a parochial elementary school, and later graduated from Father Ryan High School in 1987. Following this, he entered the Civil Engineering Program at the University of Tennessee and received his Bachelor of Science degree in spring of 1992. He then enrolled in the Masters Program in the Department of Civil Engineering and was employed as a Research Assistant by The University of Tennessee Transportation Center where he had the opportunity to work on a variety of traffic and transportation projects. He completed his studies and received the Masters of Science degree in August of 1994.