Pedestrian and Bicycle Crash Types of the Early 1990's

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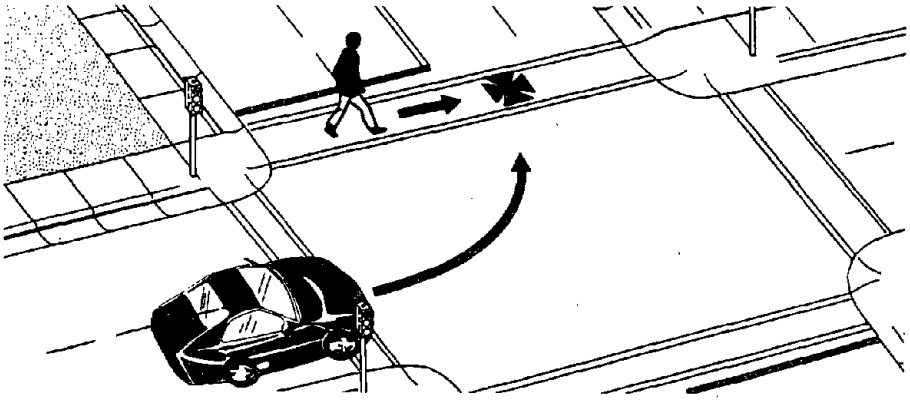

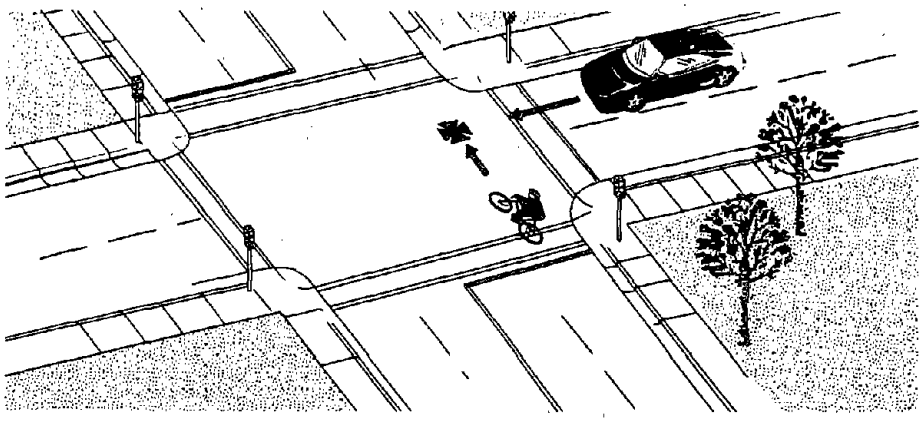

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FOREWORD

Pedestrians and bicyclists comprise more than 14 percent of all highway fatalities each year. In some large urban areas, pedestrians account for 50 percent of traffic fatalities. Estimates for 1994 indicate that 150,000 pedestrians and bicyclists were injured in traffic crashes, and many injuries are not reported to recordkeeping authorities. The National Highway Traffic Safety Administration (NHTSA) developed a system of "typing" pedestrian and bicyclists crashes, defined by specific sequences of events. Each crash type has precipitating actions, predisposing factors, and characteristic populations and/or locations that can be targeted for intervention.

The research documented in this report is the result of the application of NHTSA's crash typology to a sample of 5,000 pedestrian and 3,000 bicycle-motor vehicle crashes from five states with the purpose of refining and updating the crash type distributions. Particular attention was given to roadway and locational factors in order to identify situations where engineering and/or educational or regulatory countermeasures might be effectively implemented to reduce the frequency of the crashes.

The information contained in this report should be of interest to State and local bicycle and pedestrian coordinators, transportation planners, and transportation engineers involved in safety and risk management. Other interested parties include those in education, enforcement, and the medical profession.

Jeffrey F. Paniati, Acting Director
Office of Safety and Traffic Operations Research
and Development

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16. Abstract

The purpose of this research was to apply the basic NHTSA pedestrian and bicyclist typologies to a sample of recent crashes and to refine and update the crash type distributions with particular attention to roadway and locational factors. Five thousand pedestrian- and 3,000 bicycle-motor vehicle crashes were coded in a population-based sample drawn from the States of California, Florida, Maryland, Minnesota, North Carolina, and Utah. Nearly a third of the pedestrians were struck at or near (within 16 m (50 ft) of an intersection. Midblock events were the second major pedestrian crash type grouping, representing over a fourth (26 percent) of all crashes. The bicycle-motor vehicle crash types distributed as: (1) parallel paths - 36 percent, (2) crossing paths - 57 percent, and (3) specific circumstances - 6 percent. Most frequent parallel path crashes were motorist turn/merge into bicyclist's path (34.4 percent) of all parallel path crashes), motorist over- taking (24.2 percent), and bicyclist turn/merge into motorist's path (20.6 percent). Most frequent crossing path crashes were motorist failed to yield (37.7 percent of crossing path crashes), bicyclist failed to yield at an intersection (29.1 percent), and bicyclist failed to yield midblock (20.5 percent). Future safety considerations should be systemwide and include an examination of intersections and other junctions, well designed facilities, and increased awareness of pedestrians and bicyclists by motor vehicle drivers.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
	LENGTH			
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
	AREA			
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yards	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
	VOLUME			
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
NOTE: Volumes greater than 1000 l shall be shown in m^3.				
	MASS			
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1.8	Celcius temperature	°C
	ILLUMINATION			
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
	FORCE and PRESSURE or STRESS			
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
	LENGTH			
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
	AREA			
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
	VOLUME			
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.71	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
	MASS			
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
	TEMPERATURE (exact)			
°C	Celcius temperature	1.8C + 32	Fahrenheit temperature	°F
	ILLUMINATION			
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
	FORCE and PRESSURE or STRESS			
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

* SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.

(Revised September 1993)

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CHAPTER 1. INTRODUCTION

BACKGROUND

It is relatively easy to describe why a study like this one is important. Approximately 6,500 pedestrians and 900 bicyclists are killed each year as a result of collisions with motor vehicles (NHTSA, 1990). As a group, pedestrians and bicyclists comprise more than 14 percent of all highway fatalities each year. Pedestrians account for as much as 40 to 50 percent of traffic fatalities in some large urban areas. The 1991 General Estimates System data indicate that 92,000 pedestrians and 67,000 bicyclists were injured in this type of crash. Many more injuries are not reported to record keeping authorities. A study by Stutts, et al. (1990) showed that fewer than two-thirds of bicycle-motor vehicle crashes serious enough to require emergency room treatment were reported on State motor vehicle crash files.

The development of effective countermeasures to help prevent pedestrian and bicyclist crashes is hindered by insufficient detail on computerized State motor vehicle crash files. Analysis of existing crash file data can provide information on *where* pedestrian and bicyclist crash events occur (city street, two-lane rural highway, intersection location, etc.), *when* they occur (time of day, day of week, etc.), and *to whom* they occur (age of victim, gender, level of impairment, etc.), but can provide very little information about the actual sequence of events leading to the crash.

To address this situation, National Highway Traffic Safety Administration (NHTSA) developed a system of "typing" pedestrian and bicyclist crashes. Each identified crash type is defined by a specific sequence of events, and each has precipitating actions, predisposing factors, and characteristic populations and/or locations that can be targeted for interventions. The original pedestrian accident typology was developed and applied during the early 1970's (Snyder and Knoblauch, 1971; Knoblauch, 1975; Knoblauch, 1977; Knoblauch, Moore and Schmitz, 1978). Cross and Fisher (1977) later developed a similar typology for bicycle crashes. Example pedestrian - motor vehicle crash types include:

- Pedestrian darts out into traffic in a midblock area.
- Pedestrian struck from behind while walking or running along the road in the same direction of traffic.
- Vehicle making a turn at an intersection strikes a pedestrian.
- Pedestrian struck by a backing vehicle.

Example bicycle-motor vehicle crash types include:

- Motorist left turn facing the bicyclist.
- Bicyclist left turn in front of traffic.

- Motorist drive out from a driveway or alley.

- Bicyclist ride out from a stop sign or flashing red signal.

A more complete listing of the various pedestrian and bicyclist crash types is presented in appendix A.

Based on the identified crash types, a number of educational and regulatory countermeasures were developed and field-evaluated during the late 1970's and early 1980's. However, little attention has been paid to the development of engineering interventions to address specific crash types.

In addition, it was felt that the frequencies and/or distributions of these types may have changed since the original typing schemes were developed such that further refinement of the crash types may now be advisable. There is also a need to better describe these pedestrian and bicycle accident types with respect to the roadway conditions and features where they occur. With many newly appointed pedestrian-bicycle coordinators in the States as a result of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), as well as the increased presence of these coordinators at the local level, it is also probably time to develop simpler crash typing schemes for both pedestrian and bicycle crashes, such that more coordinators and other evaluators would be interested and have an easier way of tracking such crashes over time.

The purpose of this research was to apply the basic NHTSA pedestrian and bicyclist typologies to a sample of recent crashes and to refine and update the crash type distributions with particular attention to roadway and locational factors. An important objective was to allow for the development of an updated data base for identifying engineering-based and perhaps other interventions for reducing the frequency of pedestrian- and bicyclist-motor vehicle crashes and their resulting injuries.

SPECIFIC AIMS

The goal of the overall project was to use the information gained from typing pedestrian and bicycle crashes, along with other crash detail, to identify current situations under which these crashes take place. This should lay the groundwork for the future development of new and innovative interventions for reducing the frequency of these crashes. The specific study aims were to:

1. Identify and code according to NHTSA typologies a recent sample of approximately 5,000 pedestrian- and 3,000 bicycle-motor vehicle crashes.

2. Determine the specific roadway, locational, and other factors associated with each crash type.

3. Identify situations where engineering and/or educational or regulatory countermeasures might be effectively employed to reduce the frequency of pedestrian or bicycle crashes.

GENERAL APPROACH

The study was conducted in two phases. Phase I included the crash typing and analysis of pedestrian cases from North Carolina and recommendations for selecting the remaining data sample to be used in phase II. During the first phase, Highway Safety Research Center (HSRC) staff worked with FHWA staff and other researchers to identify potential data sources for the overall project. Candidate sources included NHTSA's Fatal Accident Reporting System (FARS) and General Estimates System (GES) data bases, FHWA's Highway Safety Information System (HSIS), the North Carolina crash data, and pedestrian and bicyclist crashes within selected States and localities in the United States.

In phase I, a representative sample was identified and hard copies of police accident reports obtained for a pilot sample of 1,700 North Carolina pedestrian-motor vehicle crashes. These were individually reviewed and typed according to the NHTSA scheme. Other factors such as type of roadway facility, location on the facility, presence of alcohol or other drugs, other contributing circumstances, etc. were coded for each case, added to the computer file of North Carolina crash data, and analyzed. Recommendations were then made pertaining to developing the remainder of the sample of data. Besides North Carolina, it was decided to obtain data from 1991 or 1992 for the States of California, Florida, Maryland, Minnesota, and Utah. Minnesota and Utah are two of the States used in the HSIS (managed by the HSRC). A stratified sample of both pedestrian- and bicycle-motor vehicle crashes was selected from each of the six States in an attempt to produce fairly equal numbers of crashes from rural and small communities, medium-sized communities and cities, and larger cities.

During phase II of the project, hard copies were obtained from the other selected States for the remaining samples of approximately 4,000 pedestrian crash reports and 3,000 bicycle crashes. The final sample of coded cases was evenly distributed across the 6 States (i.e., about 833 pedestrian and 500 bicycle cases per State). These data were also typed and analyzed. The expanded sample allowed more indepth focus on specific subpopulations of interest, for example, elderly pedestrians or the growing number of adult bicyclists.

The basic product of this effort was a descriptive study of pedestrian and bicyclist crashes with motor vehicles. Exposure data were not available. For the various crash types many crosstabulations were examined. As a measure of over- or underrepresentation, variables within a crash type were compared to their distribution over the entire sample of crashes (e.g., bicyclist age for wrong way bicyclist crashes versus bicyclist age for all crashes).

TASKS

Review NHTSA Ped/Bike Crash Typing. A specific way of coding both pedestrian and bicycle crashes (i.e., a typology) was developed many years ago by NHTSA. These crash types are now being used in the national GES data base but are rarely used in analyses of State accident data. In this task we reviewed the specific NHTSA ped/bike crash types through contacts with staff at NHTSA and the GES coding contractor. We followed the basic GES coding procedure in the actual coding of our sample of pedestrian and bicycle crashes, based on the existing Manual Accident Typing (MAT) approach (NHTSA, n.d.). (See appendix A for a complete list of MAT codes for these crashes.)

Identify and Obtain Pilot State Sample. North Carolina was the pilot State chosen for identifying and coding a sample of pedestrian cases. For the 1991 year, a random sample of approximately 1,700 out of 2,500 cases was identified and hard copies obtained from the Division of Motor Vehicles.

Develop Coding Method. HSRC staff became familiar with the NHTSA coding procedure through a visit to the GES coding contractor's headquarters and then subsequent review of training tapes and manuals. A Coding Variables List comprising main groups of variables was developed in concert with FHWA (See appendix B). For the pedestrian list, group 1 consisted of accident type information and was composed of the NHTSA accident type derived by the coder and the accident case number noted from the police report. Group 2 consisted of separate parameters describing crash locational characteristics, and group 3 consisted of parameters describing any special pedestrian equipment and whether the trip was school related. Each of these parameters contained a number of variables or conditions as possible codes.

Group 4 variables were a growing compendium of contributory crash causes for driver, vehicle, pedestrian, and roadway/environment categories. Based upon their analysis of the crash diagram and narrative, the coders compiled lists of factors pertinent to the crash.

The final variable to be coded was fault (group 5). Fault was assigned based upon the contributory causes and the coders' interpretation of prudent motorist and pedestrian behavior. Fault was assigned irrespective of whether the investigating police officer issued a citation or not.

The process of developing the coding method included 3 separate practice sessions in which the 5 project team members jointly coded 5 to 10 accident cases in each session, revising the Coding Variables List as definitions and other problems were identified. The Coding Variables List was also reviewed by FHWA, NHTSA, and selected expert consultants.

A similar process was used to develop the coding procedure for the bicycle crashes. Based on what was learned in the coding of the pedestrian crashes, the Coding Variables List for bicycle cases was much expanded compared to that for pedestrians and included items such as motor vehicle and bicycle pre-crash maneuver, the detailed bicyclist location, bike lane and sidewalk (if present) information, on-street parking, bicyclist characteristics,

intersection action details, and contributing factors associated with the driver, the bicyclist, the motor vehicle, the bicycle, and the roadway/environment. Fault was also coded as before. (See appendix B for detail.) The vast majority of the crashes were coded by four members of the project staff.

Code Pilot State Sample. Slightly more than 1,700 pedestrian cases were coded using North Carolina as the pilot State. Prior to analyzing the crash diagram and accompanying narrative description, other key informational variables recorded on the front of the North Carolina accident report form were briefly reviewed by the coders. These variables aided the coders in fully assessing the crash circumstances and included date, time, location, distance from intersection, vehicle maneuver/pedestrian action, and age and injury severity of the involved individuals. Twenty-three additional variables recorded on the back side of the North Carolina report form encompassing roadway information, driver/pedestrian physical condition, and vehicle speed data were also taken into consideration. Finally, it was noted whether any of 26 possible contributing circumstances (e.g., traffic signal violation, improper turn, safe movement violation) were recorded by the investigating officer. Having assimilated this information, the NHTSA accident type was then assigned (e.g., Code 220 - backing vehicle), followed by the roadway descriptors and other variables of interest. For each "weird" case, a short description was entered on a separate sheet to allow for later review.

Develop Coding Conventions. Several conventions or "ground rules" were established to ensure consistency during the pilot coding. All intentional acts such as "assault with vehicle" and suicide attempts were coded as a special subcategory of type 910, or "weird." Also coded (as a subcategory of type 910) were "vehicle strikes a building with occupant" situations, where the occupant struck inside the building was considered the pedestrian. In contrast, the above situations are typically deleted from the GES data base. "Lying in the lane" was also coded as a type 910 subcategory, whereas this situation is coded locationally as either a type 790 (Intersection - Other) or type 890 (Midblock - Other) for the GES data. By coding these cases as separate subcategories, they can be regrouped to allow direct comparisons back to the GES data.

Except for a very few unusual circumstances, fault was always assigned to the driver in type 210 accidents (driverless vehicle) and in cases in which the driver had been drinking. Similarly, fault was always assigned to at least the pedestrian for walking with traffic, instead of against traffic as is the law in many States. In some cases, fault was assigned to both the pedestrian and the driver, such as where both had been drinking.

Assess Reliability and Validity. Reliability between coders was established in several ways. The coders remained in constant dialogue throughout the coding process. Initially, the coders jointly coded 20 to 30 cases to ensure consistency. After several hundred cases had been coded, another 20 cases were jointly coded. Reliability between coders was quite good.

Approximately 50 percent of the first 1,700 coded pedestrian cases from North Carolina were also checked for accuracy by senior project team members. When discrepancies did occur, they were generally associated with police report forms where

available information was sketchy (such as no diagram and/or a short narrative description of the crash).

Similar procedures were followed for the bicycle case coding. In addition inter-rater reliability was checked by having each of the four main coders analyze and code a cross-section of cases that included approximately two of each crash type from both the pedestrian and bicycle samples. Cases from all States were included in this coding. The variables of crash type and fault were coded and analyzed using Cohen's kappa statistic.

The kappa statistics for both the bicycle and pedestrian crash types and fault codes were averaged for all two-pair coder combinations. The average values were:

Bicycle crash types	0.704
Pedestrian crash types	0.735
Bicycle fault types	0.575
Pedestrian fault types	0.668

Landis and Koch (1977) developed a scale for the strength of agreement between coders which ranges from "poor" to "almost perfect." The complete scale is shown below:

Kappa Value	Strength of Agreement
< 0.00	Poor
0.00 - .20	Slight
.21 - .40	Fair
.41 - .60	Moderate
.61 - .80	Substantial
.81 - 1.00	Almost perfect

The average Kappa values shown above for bicycle crash types, pedestrian crash types, and pedestrian fault types represented "substantial" agreement while the value for bicycle fault type represented "moderate" agreement.

Build Analysis File. As the coding proceeded, the data were entered at HSRC. When the coding and additional checking (human and software) were complete, the analysis file was built by adding "standard" variables from the crash report forms of the various States.

What follows are chapters that describe the findings from the data. Chapter 2 is an overview of pedestrian-motor vehicle crashes and chapter 3 focuses on the results of the crash type analysis. Chapters 4 and 5 are counterparts for bicycle-motor vehicle crashes. Chapter 6 is a summary of the most pertinent findings.

Because of many data elements available for analysis, this report contains a wealth of information pertaining to crash data. Although exposure data were not available for analysis, the crash patterns appear to be reflecting when, where, and how people bicycle, walk, and drive.

Project staff felt comfortable using the NHTSA crash typology, even though at times the police reports contained little detail. Detail about the roadway was generally sparse. Without wholesale improvement in police reporting for the roadway related variables, site visits may be necessary in future studies to accurately obtain this kind of detail.

CHAPTER 2. OVERVIEW OF PEDESTRIAN CRASHES

This chapter presents an overview of the 5,073 pedestrian-motor vehicle crashes identified from the 6 States. The variables reported include both those coded by the project team during its review of the crash reports and those available from the computerized crash files from each State. Variables have been grouped into the following categories:

- Pedestrian characteristics.
- Driver characteristics.
- Temporal/environmental factors.
- Locational factors.
- Roadway factors.
- Vehicle factors.
- Crash characteristics.
- Contributing factors.
- Fault.

Single variable frequencies are presented in summary tables, while relevant crosstabulations are discussed in the text. Overrepresentation and underrepresentation are sometimes discussed by noting where levels of a variable are higher or lower than their share based on all crashes. For example, if children less than age 10 are involved in 19 percent of all pedestrian-motor vehicle crashes, but 30 percent of pedestrian crashes occurring during the daytime, then this age group would be overrepresented in daytime crashes.

PEDESTRIAN CHARACTERISTICS

Variables describing the crash-involved pedestrian are summarized in table 1. Thirty percent of pedestrians struck by motor vehicles were children under 15 years of age, and half were under 25 years of age. An additional 30 percent were in the 25 to 44 year age range, and less than 10 percent were age 65 or above. These percentages agree closely with national estimates based on the 1991 GES data base (NHTSA, 1992). Compared to their representation in the overall U.S. population, young persons were overrepresented in pedestrian crashes while older adults and the elderly wereunderrepresented: according to 1991 U.S. Census data,only 22 percent of the U.S. population is under 15 years of age and 36 percent under 25 years of age. The same data shows adults ages 65 and above comprising 12.6 percent of the overall population, compared to their 9 percent representation in the crash population. As will be shown later, however, the elderly *were* overrepresented in pedestrian crashes resulting in fatal injuries.

Just over 60 percent of crash-involved pedestrians were male. The percentage of males was slightly higher in the under 10 age group (65 percent), but lower in the 65 and over age group (54 percent). Information on the pedestrian's race was available for North Carolina and Florida only, and shows a disproportionately higher involvement for blacks, particularly in the youngest age categories.

Table 1. Pedestrian characteristics.

	N	%
Age		
0-9	874	18.7
10-14	520	11.1
15-19	510	10.9
20-24	419	9.0
25-44	1391	29.7
45-64	532	11.4
65+	432	9.2
Total	4678	100.0
Gender		
Male	2923	61.1
Female	1858	38.9
Total	4781	100.0
Race[1]		
White	959	58.2
Black	594	36.0
Other	95	5.8
Total	1648	100.0
[1]Race information available for Florida and North Carolina only.		
Injury Severity		
Fatal (K)	293	6.1
Serious (A)	1317	27.4
Moderate (B)	1697	35.3
Minor (C)	1381	28.7
None (O)	265	2.5
Total	4953	100.0
Alcohol/Drug Use		
Alcohol	629	15.4
Other	212	5.2
None	3235	79.4
Total	4076	100.0
Physical Condition		
Normal	3392	89.3
Impaired - medicine/drugs	344	9.1
Ill	24	0.6
Fatigued, asleep	9	0.2
Other phys. imprmt	30	0.8
Total	3799	100.0
Pedestrian Special Equipment		
None indicated	4825	95.4
Manual wheelchair	10	0.2
Motorized wheelchair	13	0.3
Bicycle (pushing)	34	0.7
Scooter	12	0.2
Tricycle	1	0.0
Big wheel	3	0.1
Skateboard	24	0.5
In-line skates	17	0.3
Roller skates	10	0.2
Crutch/cane/walker	1	0.0
Stroller/cart (pushing)	32	0.6
Carrying child	14	0.3
Wearing headphones	5	0.1
Other	58	1.2
Total	5059	100.1

Pedestrian crashes are much more likely to result in serious injuries than other types of crashes. Six percent of pedestrians in our six-State sample of crashes were killed, and an additional 27 percent were seriously injured. For elderly pedestrians age 65 and older, the percentages were even higher: 15 percent killed and 31 percent seriously injured. One out of every five pedestrians killed in crashes was age 65 or above. Children under age 15 were less likely to be killed (3.6 percent fatal injuries), but suffered comparable serious injury rates (26 percent A-level injury). Males were also more likely to be seriously injured than females: 36 percent of male pedestrians were seriously injured or killed, compared to 30 percent of female pedestrians.

Fifteen percent of the pedestrians were judged by the investigating officer to be impaired by alcohol or drugs at the time of their crash and an additional 5 percent were described as otherwise impaired. Alcohol/drug involvement was highest in the 25 to 44 year age group, reported in 31 percent of their crashes. Twenty-three percent of 20 to 24 year-olds were reported to be impaired by alcohol/drugs, 19 percent of 45 to 64 year-olds, 9 percent of 15 to 19 year-olds, and only 6 percent of those 65 and older. It should be emphasized that the vast majority of these cases involve alcohol and are based on the officer's opinion at the scene of the crash rather than the results of chemical testing.

Males were about twice as likely to be judged impaired by alcohol or drugs as females (20 percent versus 8 percent). For those who were judged impaired, their likelihood of being fatally or seriously injured was greatly increased. Among those judged impaired, 12 percent were fatally injured and an additional 34 percent seriously injured. Corresponding percentages for the non-impaired were three percent and 26 percent.

A related variable, pedestrian physical condition, reveals that 9 percent of pedestrians were judged to be impaired by medicine or drugs at the time of their crash, and only very small numbers were otherwise impaired. The vast majority of pedestrians were described as "normal" in their physical condition.

An effort was made in the review of the hard copies of the pedestrian crash reports to identify any special equipment such as wheelchairs, skateboards, etc. that might have contributed to the crash event. While a range of items was identified, all appeared quite infrequently. A better assessment of such special situations depends on some way to estimate exposure. For example, one may hypothesize that wearing headphones increases crash risk. However, whether the five cases reported for this sample is "high" depends on the number of head phone wearers in the population (and, of course, on police reporting reliability as to the presence of headphones).

DRIVER CHARACTERISTICS

Characteristics of the motor vehicle operator in crashes with pedestrians are shown in table 2. For purposes of this discussion, comparisons have been drawn to the population of all crash-involved drivers as reported in the 1991 GES data base (NHTSA, 1992)

Table 2. Driver characteristics.

	N	%		N	%
Age			**Injury Severity**		
< 16	20	0.5	Fatal (K)	0	0.0
16-19	506	12.7	Serious (A)	23	0.5
20-24	568	14.3	Moderate (B)	62	1.5
25-44	1800	45.3	Minor (C)	72	1.7
45-64	743	18.7	None (O)	4065	96.3
65+	336	8.5	**Total**	4222	100.0
Total	3973	100.0			
			Alcohol/Drug Use		
Gender					
			No	3593	81.7
Male	2553	62.8	Yes	257	5.8
Female	1515	37.2	Other	550	12.5
Total	4068	100.0	**Total**	4400	100.0

The age distribution of drivers striking pedestrians was similar to that for all crash-involved drivers, except for a very slight underrepresentation at the youngest age levels countered by a slight overrepresentation at the upper age levels. Thus, whereas 27 percent of drivers striking pedestrians were ages 16 to 24, 29 percent of all crash-involved drivers were in this age range. Similarly, drivers 65 and older were involved in 8.5 percent of pedestrian crashes, but only 7 percent of all GES crashes.

The percentage of male drivers striking pedestrians was greater than females (63 percent versus 37 percent), but this difference is essentially identical to that found in the total population of crash-involved drivers.

As expected, few motor vehicle operators suffered injury as a result of their collision. Those that were injured were more likely to have been in a collision that also involved another motor vehicle or fixed object. Reported alcohol/drug use for drivers striking pedestrians was less than 6 percent. While this is about the same as that for all crash-involved drivers, it is considerably lower than the figure of 44 percent cited for fatal crashes (NHTSA, 1992; NHTSA, 1994).

TEMPORAL/ENVIRONMENTAL FACTORS

Temporal and environmental factors characterizing pedestrian crashes are summarized in table 3. The month with the highest percentage of pedestrian crashes was October, with May and December also being relatively high months. January, February and April had

Table 3. Temporal/environmental factors.

Month	N	%
January	347	7.2
February	371	7.7
March	385	8.0
April	366	7.6
May	435	9.0
June	391	8.1
July	396	8.2
August	413	8.6
September	426	8.8
October	469	9.7
November	401	8.3
December	430	8.9
Total	4830	100.1
Day of Week		
Monday	589	12.2
Tuesday	645	13.4
Wednesday	628	13.0
Thursday	712	14.7
Friday	697	14.4
Saturday	770	15.9
Sunday	789	16.3
Total	4830	99.9
Weekday/Weekend		
Weekday	3147	65.1
Weekend[1]	1684	34.9
Total	4831	100.0

[1]6 p.m. Friday - 6 a.m. Monday.

Time of Day	N	%
6:00 a.m. - 9:59 a.m.	547	11.6
10:00 a.m. - 1:59 p.m.	752	15.9
2:00 p.m. - 5:59 p.m.	1569	33.1
6:00 p.m. - 9:59 p.m.	1189	25.1
10:00 p.m. - 1:59 a.m.	498	10.5
2:00 a.m. - 5:59 a.m.	179	3.8
Total	4734	100.0
Light Condition		
Daylight	2898	60.6
Dawn/dusk	219	4.6
Dark, street lighted	1112	23.2
Dark, street unlighted	555	11.6
Total	4784	100.0
Weather Condition		
Clear	3404	71.0
Cloudy	931	19.4
Raining	341	7.1
Snow/sleet/hail	55	1.2
Fog/smog/smoke	33	0.7
Other	30	0.6
Total	4794	100.0
Road Condition		
Dry	3983	82.8
Wet	620	12.9
Other	206	4.3
Total	4809	100.0

relatively fewer pedestrian crashes. This likely reflects seasonal exposure differences as well as possible light condition effects. Young children (less than 10 years old) were somewhat overrepresented in the warmer weather months, whereas the elderly (65+) were overrepresented in the colder weather months, particularly December, February and March. Crashes in the colder weather months tended to result in less serious injuries than in the warmer weather months, although the differences were not great. There were no particular differences with regard to pedestrian gender.

Information on day of week reveals that pedestrian crashes were most likely to occur on Friday, Saturday, or Sunday. When the data are examined by weekday versus weekend (with weekend defined as 6 p.m. Friday until 6 a.m. Monday), 35 percent of crashes occurred during the weekend (about what would be expected based on percentage of total hours in the week). The 20 to 24 and 25 to 44 year age groups were overrepresented in weekend pedestrian crashes, as were males and crashes involving alcohol. Twenty-three percent of weekend crashes involved a pedestrian judged to be impaired by alcohol or drugs, compared to only 11 percent of weekday crashes. Weekend crashes also resulted in more serious injuries - 37 percent A+K injury for weekend crashes, compared to 31 percent A+K injury for weekday crashes.

Pedestrian crashes occurred most frequently during the late afternoon and early evening hours, times when exposure is likely highest and visibility may be a problem. Children under 15 years of age were particularly overrepresented in crashes during these time periods: 51 percent of their crashes occurred between 2 p.m. and 6 p.m. and an additional 24 percent between 6 p.m. and 10 p.m. In contrast, adults in the 20 to 24 and 25 to 44 year age groups were overrepresented in nighttime pedestrian crashes, with 32 percent of crashes involving 20 to 24 year-olds and 24 percent of crashes involving 25 to 44 year-olds occurring between 10 p.m. and 6 a.m. The elderly were overrepresented in crashes occurring during the middle of the day, from 10 a.m. until 2 p.m. (27 percent, compared to 16 percent for all age groups combined). Again, this finding is likely exposure-related.

Similar findings hold with respect to light condition. Sixty-one percent of pedestrian crashes occurred during daylight hours and an additional 5 percent during periods of dawn or dusk. For the remaining one-third of crashes that occurred after dark, most occurred on lighted streets or roadways. Children and the elderly were again more likely to be involved in daylight condition crashes, while adults, especially those in the 20 to 24 year age range, were more likely to be involved in non-daylight crashes. For these 20 to 24 year-old pedestrians, 56 percent of their crashes occurred under conditions of darkness.

Pedestrian crashes occurring after dark were also much more likely to involve alcohol and to result in serious injuries. Whereas only 15 percent of crashes overall involved alcohol, 35 percent of those occurring after dark involved alcohol. For those occurring after dark on unlighted streets, 20 percent resulted in fatal injury and 33 percent in (non-fatal) serious injury.

Weather and roadway surface conditions were the final variables examined with respect to temporal/environmental factors in pedestrian crashes. The vast majority (90 percent) of pedestrian crashes occurred under clear or cloudy weather conditions. Seven

percent occurred under rainy conditions, and only 2 percent under other conditions including snow, sleet, fog, etc. The same trends are mirrored in the roadway condition variable, where the majority (83 percent) of pedestrian crashes occurred on dry roads. Pedestrian crashes are about half as likely as motor vehicle crashes in general to occur during unfavorable weather and roadway conditions, a finding that is likely due to reduced pedestrian exposure during these periods.

LOCATIONAL FACTORS

Variables included in table 4 describe the nature of the location where pedestrian crashes occur. (More detailed roadway-related variables are presented in table 5.) As noted in chapter 1, a stratified sample of pedestrian crashes was selected from each of the 6 States to produce fairly equal numbers of crashes representing rural and small communities, medium-sized communities and cities, and larger cities. The final pedestrian sample divides roughly into thirds if split into the following population categories: (1) rural up to 10,000 population (33 percent), (2) 10,000 to 100,000 population (30 percent), and (3) 100,000 and above (38 percent).

Overall, about two-thirds of the pedestrian crashes were categorized as "urban" and one-third "rural." This distribution varied only slightly across the various age categories and for males versus females. Rural pedestrian crashes were more likely to result in serious or fatal injury than urban crashes (38 percent A+K versus 32 percent A+K), but were only slightly more likely to involve alcohol (17 percent versus 15 percent).

A relatively small but not insignificant proportion of pedestrian crashes was coded as occurring in a school zone based on information included in the police crash report. Not surprisingly, this percentage was higher for school age children - about 8 percent for those aged 10 to 19 compared to slightly less than 4 percent in the overall population.

Only 2 percent of pedestrian crashes occurred on freeways or on Interstate interchanges or ramps. This percentage was nearly double, however, for adults in the 25 to 44 year age group. Freeway crashes were much more likely than other crash types to result in serious or fatal injuries. For those crashes occurring on the freeway mainline, 32 percent were fatal, and for those occurring on interchange ramps 15 percent were fatal. Nearly half (45 percent) of freeway mainline pedestrian crashes occurred between 10 p.m. and 6 a.m. One-fourth of the pedestrians were judged to have been drinking as were 11 percent of drivers.

Nearly one of every seven reported pedestrian crashes occurred on private property, most often in a commercial or other parking lot. The elderly were overrepresented in commercial parking lot locations, while young adults ages 15 to 24 were overrepresented in non-commercial parking lot locations. Children under 10 years of age were overrepresented in collisions occurring in driveways, alleys and yards. The percentage of private property pedestrian crashes is likely an underestimate, due to underreporting by police officers and varying State level policies for recording such events. Among the six States comprising the sample base for the current study, the percentage of pedestrian crashes occurring on

Table 4. Locational factors.

	N	%
Locality		
Rural	1564	32.4
Urban	3265	67.6
Total	4829	100.0
School Zone		
Yes	184	3.6
No	4863	96.4
Total	5047	100.0
Population[1]		
Rural	808	24.0
< 2,500	111	3.3
2,500 - 9,999	183	5.4
10,000 - 24,999	342	10.2
25,000 - 49,999	360	10.7
50,000 - 99,999	294	8.7
100,000 - 249,999	398	11.8
250,000+	871	25.9
Total	3367	100.0
[1]Population data not specifically coded for Maryland and Utah.		

	N	%
Freeway/Interstate		
Non-freeway, non-Interstate	4961	97.9
Freeway, Interstate mainline	80	1.6
Freeway, Interstate Interchange/Ramp	22	0.4
Other	7	0.1
Total	5070	100.0
Private Property		
Not private property	4307	85.0
Commercial parking lot	232	4.6
Other parking lot	229	4.5
Private road/alley	43	0.9
Service station	37	0.7
Yard	23	0.5
Ped sidewalk, veh driveway	59	1.2
Ped & veh in driveway	103	2.0
Other private property	33	0.7
Total	5066	100.1

private property ranged from a low of 4 percent in California to a high of 25 percent in Florida.

ROADWAY FACTORS

Table 5 summarizes information on roadway-related factors in pedestrian crashes. The variables presented include both those available from the State motor vehicle crash files as well as additional information coded from the review of crash diagrams and narratives on the report hard copies. Since the coded variables included a separate category for non-road events, for consistency non-road cases were excluded from all of the roadway-related variables. Overall this table has higher proportions of missing or unknown information due to variables not being available on some of the State crash files and lack of detail in some of the crash report diagrams and narratives. Percentage distributions have been calculated

Table 5. Roadway factors.

	N	%
Road Class[1]		
Interstate	37	1.4
U.S. route	236	8.8
State route	560	20.9
County route	641	24.0
Local street	1112	41.6
Other	90	3.4
Total	2676	100.1
[1]CA & UT missing.		
Speed Limit		
40 km/h or less	943	24.9
48-56 km/h	1825	48.2
65-73 km/h	564	14.9
81+ km/h	456	12.0
Total	3788	100.0
(1 km = 0.62 mi)		
Road Configuration[2]		
Undivided	2006	84.4
Divided	363	15.3
Other	9	0.4
Total	2378	100.1
[2]CA, MD & UT missing.		
Number of Lanes[3]		
1 or 2 lanes	2006	60.0
3 or 4 lanes	1001	29.9
5 or 6 lanes	237	7.1
7+ lanes	102	3.0
Total	3346	100.0
[3]UT missing.		

	N	%
Road Surface[4]		
Asphalt	1888	91.4
Concrete	72	3.5
Gravel, sand, soil	36	1.7
Other	70	3.4
Total	2066	100.0
[4]CA, MN & UT missing.		
Road Character[5]		
Straight, level	2751	79.7
Straight, grade	410	11.9
Curve, level	115	3.3
Curve, grade	72	2.1
Other	104	3.0
Total	3452	100.0
[5]CA missing.		
Road Defects[6]		
No defects	3826	97.5
Under construction	47	1.2
Loose material	22	0.6
Low/soft shoulders	9	0.2
Holes, deep ruts	16	0.4
Other	3	0.1
Total	3923	100.0
[6]MN missing.		
Road Feature[7]		
No special feature	1902	49.6
Intersection of roadway	1571	41.0
Alley intersection	22	0.6
Public driveway	131	3.4
Private driveway	139	3.6
Bridge, underpass	12	0.3
Median crossing	16	0.4
Interchng ramp/service road	19	0.5
Railroad crossing	9	0.2
Other	10	0.3
Total	3831	99.9
[7]FL missing.		

Table 5. Roadway factors (continued).

	N	%
Traffic Control Device		
No control/other	2957	71.4
Stop sign	318	7.7
Yield sign	12	0.3
Traffic signal	804	19.4
Flashing signal	25	0.6
Human control	21	0.5
Total	4137	99.9
Sidewalk Presence		
None	2408	83.5
Ped side only	25	0.9
Non-ped side only	17	0.6
At least ped side	214	7.4
At least non-ped side	10	0.4
Both sides	211	7.3
Total	2885	100.1
Pedestrian Signal		
No/none indicated	4672	93.1
Ped signal	348	6.9
Total	5020	100.0
Pedestrian Marked Crosswalk		
Crosswalk indicated	979	20.9
No crosswalk indicated	3699	79.1
Total	4678	100.0
Lane Width		
< 3.0 m	95	9.3
3.0 m	124	12.1
3.3 m	102	9.9
3.6 m	281	27.4
3.9 - 4.8 m	181	17.6
5.2+ m	243	23.7
Total	1026	100.0
(1 m = 3.3 ft)		

	N	%
Shoulder Type		
No shoulder indicated	1266	48.8
Paved shoulder	287	11.1
Unpaved shoulder	437	16.9
Shoulder, type unknown	290	11.2
Curb and gutter	314	12.1
Total	2594	100.1
Pedestrian Side Shoulder Width		
1.2 m or less	91	21.8
1.5 - 2.7 m	209	50.0
3.0 m or more	118	28.2
Total	418	100.0
Median Width		
No median	4415	97.4
0.6 - 4.5 m	70	1.5
> 4.5 m	47	1.0
Total	4532	99.9
(1 m = 3.3 ft)		
Crossing Width to Median/Refuge		
No median	3685	94.9
Less than 7.6 m	79	2.0
≥ 7.6 m	118	3.0
Total	3882	99.9
(1 m = 3.3 ft)		
Total Crossing Width (Including Median)		
Less than 7.6 m	387	29.2
7.6 - 14.5 m	551	41.6
> 14.5 m	386	29.2
Total	1324	100.0
(1 m = 3.3 ft)		

excluding these unknown and missing cases as well as cases that occurred in non-road locations.

Information on road class was available for Florida, Maryland, Minnesota and North Carolina. Although road class definitions and frequencies varied somewhat across the States, overall 42 percent of pedestrian crashes were identified as occurring on local streets, 24 percent on county routes, and 21 percent on State routes. U.S. and Interstate routes were identified in only 9 percent and 1 percent of crashes, respectively. Children were overrepresented on local and county routes, older adults on U.S. and State routes, and younger adults (ages 25 to 44) on Interstate routes.

Speed limit information was available from all six State crash files, but again showed some variability across the States. For example, nearly half of the California and Maryland pedestrian crashes occurred on roadways with speeds of 40 km/h (25 mi/h) or less, while in Minnesota 80 percent occurred on roads with 48 to 56 km/h (30 to 35 mi/h) speed limits. Overall, just under three-fourths of pedestrian crashes occurred on roads with speed limits of 56 km/h (35 mi/h) or less. For children under the age of 15, this increased to 82 percent. As expected, pedestrians struck on the higher speed roadways were more likely to be seriously injured or killed, with A+K percentages ranging from 28 percent on the lowest speed roadways to 61 percent on the highest speed roadways.

Sixty percent of the road-related pedestrian crashes occurred on one-lane (e.g., single lane, one-way street) or two-lane roadways, and 90 percent on roadways with four or fewer lanes. As with the speed limit data, children were overrepresented on the one- and two-lane roadways (82 percent of crashes to children under 10, 65 percent of crashes for 10 to 14 year-olds). Also, the likelihood of serious (A+K) injury increased with number of travel lanes (32 percent A+K for 1 to 2 lanes, 38 percent A+K for 3 to 4 lanes, and 42 percent for 5+ lanes).

Other results from the roadway analysis showed that asphalt was by far the most common road surface material, and that the vast majority of pedestrian crashes occurred on straight, level stretches of roadway having no significant surface defects.

Information on specific road features at the pedestrian crash site was pulled from the crash files for some States and coded from report hard copies for others. In nearly half the cases no particular road feature was noted. Forty-one percent of the crashes occurred at roadway intersections, and an additional 8 percent at driveway or alley intersections. Children under 10 years of age were overrepresented in crashes occurring at private driveways, while slightly older children ages 10 to 14 were overrepresented at road intersection crashes. Older adults and especially senior age adults were overrepresented at both private driveways and road intersections.

Traffic control device was also a combination crash file/coded variable. In the majority of crashes no control was present. Traffic signals were present at 19 percent of the crash locations and stop signs at an additional 8 percent. Where traffic controls

were present, pedestrian injuries were less severe, presumably due to lower vehicle speeds.

The remaining roadway variables were all coded by project staff from the crash report hard copies based on information provided in the investigating officer's diagram and narrative description. Some States clearly require more detail than others, and even within a State there is variation in the level and quality of reporting such that, for example, fatal cases are investigated in much greater detail than non-fatal cases. Consequently there is a relatively high percent of "missing" or "unknown" information for many of these variables.

The presence of a sidewalk was coded for pedestrian crashes occurring at non-intersection roadway locations. Overall a sidewalk was noted on at least one side of the roadway in 17 percent of the pedestrian crashes (lower in North Carolina, Maryland and Utah, higher in Minnesota and California). Pedestrian signals were noted in 7 percent of crashes, and were again most common in Minnesota and California. Finally, marked crosswalks were identified in 21 percent of pedestrian crashes occurring on the roadway, and were particularly common in California (42 percent of crashes).

Lane width, shoulder type and width, median width, and total crossing width are all factors that can impact on pedestrian crash occurrence, and an attempt was made to code these variables from information provided in the crash diagram and narrative. In a large percentage of cases, however, the crash reports failed to provide this information. Lane width was reported for just under a fourth of the pedestrian crashes occurring on a roadway. For these cases, the most frequently reported lane width was 3.6 m (12 ft), although 3.0- and 3.3-m (10- and 11-ft) widths were also fairly heavily represented. The 24 percent of cases occurring on roadways 5.2 m (17 ft) or wider likely includes some roads where on-street parking was allowed.

Shoulders were identified for just over half of the pedestrian crashes occurring at non-intersection roadway locations. Unpaved shoulders were cited most frequently, with slightly lower percentages of paved shoulders and shoulders of unknown type. Curb and gutter was identified only about a third as often as shoulders. Information on shoulder width was available for less than a third of the cases where a shoulder presence was noted. For these 328 cases, 22 percent were 1.2 m (4 ft) wide or less, 50 percent 1.5 to 2.7 m (5 to 9 ft), and 28 percent 3.0 m (10 ft) or more. Shoulder width was not found to be associated with either the age of the pedestrian or pedestrian injury severity.

Roadway medians were present in less than 3 percent of pedestrian crashes. Contrary to shoulder presence, the presence of a median was associated with higher serious injury rates.

Finally, total crossing distance (which includes the presence of a median) was available for about a third of applicable cases. Crossing widths of 7.6 to 14.5 m (25 to 48 ft) were most common, and approximately equal numbers of cases involved

crossing distances of less than 7.6 m (25 ft) and those greater than 14.5 m (48 ft). Interestingly, roadways with crossing distances of less than 7.6 m (25 ft) were associated with the highest rate of serious and fatal pedestrian injuries - 48 percent, compared to 33 percent overall.

VEHICLE FACTORS

Two vehicle-related variables were examined - vehicle type (car, pickup truck, van, etc.) and point of contact (front, right side, rear, etc.). Nearly 70 percent of pedestrians were struck by passenger cars, 16 percent by pickup trucks, and 5 percent by vans (table 6).

Table 6. Vehicle factors.

Vehicle Type	N	%
Passenger car	3281	69.5
Pickup truck	752	16.2
Van[1]	229	4.9
Truck/tractor	87	1.9
Bus	34	0.7
Motorcycle/scooter/moped	33	0.7
Other	278	6.0
Total	4694	99.9

[1] Vans not identified as a separate vehicle type in CA, MD.

Point of Contact[2]	N	%
Front	1215	39.5
Right front	489	15.9
Left front	355	11.5
Right side	211	6.9
Left side	143	4.7
Rear	187	6.1
Right rear	74	2.4
Left rear	47	1.5
Other (Top bottom, multi, other)	355	11.5
Total	3076	100.0

[2] Rough approximation - includes no data from CA and some amount of variation in definitions within the other five States.

Larger trucks, busses and motorcycles were involved in relatively few cases. Unknown vehicle types generally represent hit-and-run crashes. Children and the elderly were somewhat more likely than other age groups to be struck by busses and young adults (age 25 to 44) by large trucks, but overall differences within age categories were minimal. Not surprisingly, large trucks and busses were also associated with more severe pedestrian injuries.

In two-thirds of the crashes, the pedestrian impacted either the front, right front, or left front of the vehicle. The side of the vehicle was impacted in about 12 percent of the crashes, and the rear (including left and right rear) in 10 percent of crashes. In the remaining 11 to 12 percent of cases, the pedestrian impacted the vehicle's hood, windshield, or other/multiple contact points. In general, pedestrians who contacted the front, top, or

underside of a vehicle were more seriously injured than those contacting the side or rear of the vehicle.

CRASH CHARACTERISTICS

A few additional variables describing the specific crash circumstances were coded from the police crash report hard copies (see table 7). One of these was the location of the pedestrian when struck. In nearly three-fourths of the cases the pedestrian was in the vehicle lane of travel, and in just over 6 percent of cases the pedestrian was at the edge of the travel lane or on the roadway shoulder. Nearly 1 out of 10 pedestrians was in a parking lot when struck either by a vehicle entering or exiting a parking space or traveling in a travel lane. Three percent of cases involved alleys or driveways, and slightly fewer than this sidewalks, walkways, or other off-road paths. An examination of pedestrian location by age of

Table 7. Crash characteristics.

	N	%		N	%
Pedestrian Location			**Pedestrian in Crosswalk**		
In travel lane	3755	74.2	Ped. in crosswalk	773	75.3
At edge of travel lane	136	2.7	Ped. not in crosswalk	253	24.7
On shoulder	185	3.7	**Total**	1026	100.0
Out of lane, shdr	26	0.5			
On sidewalk, wkwy, path	120	2.4	**School Trip Related**		
Road-rel., unk. location	50	1.0			
Alley, dvwy, other road	151	3.0	Not a school trip	4841	96.3
Parking lot - prkg space	220	4.4	Walk/ride to/from school	144	2.9
Parking lot - travel lane	179	3.5	Struck < boarding bus	7	0.1
Parking lot - unknown	73	1.4	Struck > exiting bus	10	0.2
On street parking space	47	0.9	Struck by bus - other	5	0.1
In median/ped island	21	0.4	Other	22	0.4
Other	95	1.9	**Total**	5029	100.0
Total	5058	100.0			

pedestrian showed that children were overrepresented in crashes where they were either in the travel lane or, for those under age 10, in a driveway or alley. Young adults were more likely to be struck when at the edge of a travel lane, on a road shoulder, or in a parking lot. Senior age adults were also overrepresented in parking lot locations.

Presence of a marked crosswalk was one of the roadway variables identified in table 5. For those cases where a crosswalk was noted, the pedestrian was in the crosswalk three-fourths of the time. Variation across age groups was small, ranging from 70 percent for children under age 10 to approximately 80 percent for young persons ages 10 to 19 and adults age 45 and over.

A final crash variable coded was whether the pedestrian was struck while traveling to or from school. Overall less than four percent of pedestrian crashes were identified as school trip related. However, for children under age 10, 7 percent were school trip related; for children ages 10 to 14, 15 percent; and for children ages 15 to 19, 9 percent. Most of these occurred while walking or riding to or from school and did not involve a school bus.

CONTRIBUTING FACTORS

A range of factors contributing to the occurrence of the pedestrian crash was identified from the information provided on the crash report form. Contributing factors were developed in four categories - pedestrian, motor vehicle driver, roadway/ environment, and vehicle. For each category an initial listing of factors was identified and other codes added during the course of the coding. Up to three factors were listed in each category for each crash report coded. The results reported in table 8 reflect the total number of times any given factor was coded and the percentage of all pedestrian cases involving that factor. For example, jaywalking was noted as one of the three possible pedestrian contributing factors in 157 cases, so that the percentage of pedestrians with jaywalking coded was 157/5,073 or 3.1 percent. Since up to three factors could be coded in each category, the percentages in table 8 add up to more than 100 percent.

Two-thirds of pedestrians (66 percent) were coded for at least one contributing factor. The most frequently coded pedestrian factors were:

- Ran into road 15.0 percent
- Failed to yield 11.8 percent
- Alcohol impaired 10.3 percent
- Stepped from between parked vehicles 7.1 percent
- Walk/run wrong direction 5.3 percent

Several of these pedestrian behaviors are associated with specific crash types, such as intersection or midblock dashes and walking along the road with traffic. Other contributing factors that were noted with some frequency include jaywalking (3.1 percent), stepping into the roadway (4.1 percent), failing to obey a traffic signal (3.0 percent), talking or standing in the road (3.1 percent), and lack of conspicuity (2.9 percent). Since conspicuity was only coded if the reporting officer made some documentation of the pedestrian not being visible to the motor vehicle driver (e.g., "pedestrian was wearing dark clothing" or "driver couldn't see the pedestrian standing at the edge of the roadway"), it is likely a conservative estimate of the problem, as is likely true for many of these contributing factors. Pedestrian actions that were only rarely cited as contributing factors included jogging in the road (15 cases), unsafe skateboard maneuver (13 cases), and unsafe rollerblade maneuver (6 cases). Without exposure data, however, the level of risk associated with such behaviors cannot be assessed.

Table 8. Contributing factors.

Pedestrian Contributing Factors	N	%[1]
None indicated	1719	33.9
Jaywalking (near intersection)	157	3.1
Ran into road	763	15.0
Stepped into road	207	4.1
Step from between parked vehicles	360	7.1
Failed to yield	599	11.8
Failed to obey signal	151	3.0
Unsafe movement	127	2.5
Alcohol impaired	524	10.3
Drug impaired	20	0.4
Vision/hearing impaired	32	0.4
Other physical disability	13	0.3
Other mental disability	19	0.4
Walk/run wrong direction	267	5.3
Talking/standing in road	158	3.1
Lying in road	32	0.6
Playing in road	78	1.5
Jogging in road	15	0.3
Unsafe skateboard maneuver	13	0.3
Unsafe rollerblade maneuver	6	0.1
Lack of conspicuity	147	2.9
Unsafe enter/exit vehicle	37	0.7
Fell from truck bed	1	0.0
Working on parked car	50	1.0
Leaning/clinging to vehicle	82	1.6
Pushing disabled vehicle	6	0.1
Other	72	1.4
Unknown	113	2.2
Roadway/Environment Factors		
None indicated	3801	74.9
Sun glare	53	1.0
Other glare	25	0.5
Dusk/darkness	162	3.2
Vision blockage	539	10.6
Construction zone	56	1.1
Glass/debris/etc.	7	0.1
Pothole/grate/etc.	8	0.2
Narrow roadway	2	0.0
Other	330	8.5
Unknown	36	0.7

Driver Contributing Factors	N	%
None indicated	2263	44.6
Hit and run	824	16.2
Exceeding safe speed	225	4.4
Exceeding speed limit	87	1.7
Reckless driving	171	3.4
Failure to yield to ped	762	15.0
Failure to signal	4	0.1
Ignored traffic sign	26	0.5
Ignored traffic signal	50	0.1
Avoiding veh/ped/obj	25	0.5
Safe movement	243	4.8
Improper backing	285	5.6
Improper passing	36	0.7
Improper turning	40	0.8
Right turn on red	84	1.7
Wrong direction	24	0.5
Improper lane use	35	0.7
Changing lanes	6	0.1
Pass stopped school bus	9	0.2
Improper parking	6	0.1
Fail to secure in park	93	1.8
Left engine running	12	0.2
Alcohol impairment	157	3.1
Drug impairment	3	0.1
Illness	5	0.1
Drowsy/fell asleep	4	0.1
Other phycial impairment	14	0.3
Inattention/distraction	213	4.2
No driver's license	70	1.4
Inexperience	21	0.4
Restric. non-compliance	3	0.1
Improper vehicle equipment	9	0.2
Assault by vehicle	63	1.2
No lights	5	0.1
Police pursuit	5	0.1
Failed to secure cargo	2	0.0
Other	72	1.4
Unknown	96	1.9
Vehicle Factors		
None indicated	4507	88.8
No inspection sticker	2	0.0
Oversized vehicle/load	4	0.1
Extended mirror	19	0.4
Defective brakes	15	0.3
Defective lights	4	0.1
Defective tires	12	0.2
Foggy/dirty windshield	16	0.3
Other	42	0.8
Unknown	457	9.0

[1]N/5073 (total number pedestrian cases with contributing factors). Since up to 3 factors could be coded in each category, the percentages add to more than 100 percent.

Eighty-seven percent of pedestrians under age 10 were cited for some contributing factor, compared to only 53 percent of adults ages 65 and over. The following patterns of overrepresentation were found:

- 0 to 9 years old - ran into street, ran from between parked vehicles, playing in street.

- 10 to 14 years old - ran into street, ran from between parked vehicles, failed to obey signal, unsafe skateboard and rollerblade maneuvers, unsafe entering/exiting, safe movement violation.

- 15 to 19 years old - failed to obey signal, unsafe skateboard maneuver, walking/running wrong direction, leaning/clinging to vehicle.

- 20 to 24 years old - alcohol impaired, walking/running wrong direction, talking/standing in road, lying in road, jogging in road.

- 25 to 44 years old - alcohol impaired, working on car in parking lot, talking/standing in road, lying in road.

- 45 to 64 years old - jaywalking, lack of conspicuity, alcohol impaired.

- 65+ years old - jaywalking, stepped into street, failed to yield.

Those pedestrian behaviors associated with higher serious injury rates included lying in road (83 percent A+K), lack of conspicuity (56 percent A+K), alcohol/drug impaired (47 percent A+K), stepping into street/failing to yield (45 percent A+K), and talking/standing in road (43 percent A+K).

In 55 percent of the cases one or more driver factors was identified as contributing to the crash. The following were most frequently cited:

• Hit-and-run	16.2 percent
• Failed to yield to pedestrian	15.0 percent
• Improper backing	5.6 percent
• Safe movement violation	4.8 percent
• Exceeding safe speed	4.4 percent
• Inattention/distraction	4.2 percent
• Reckless driving	3.4 percent
• Alcohol impairment	3.1 percent

Hit-and-run, although not a contributing factor in the causal sense, implies some degree of negligence on the part of the motor vehicle operator. It should be noted, however, that not all hit-and-run cases involved a driver who flagrantly left the scene of a crash; in some instances the driver was unaware that a pedestrian had been struck, and in other cases vehicle contact was minimal and the driver left only after assurance from the pedestrian that

he/she was not hurt. This is supported by the fact that 34 percent of hit-and-run crashes involved only minor injuries, compared to 28 percent for non hit-and-run crashes. Hit-and-run crashes were more likely to involve pedestrians in the 15 to 44 year age ranges, occur at nighttime on lighted or unlighted streets, and involve alcohol.

In general, beginning drivers ages 16 to 19 were overrepresented in inattention/ distraction, speeding, reckless driving, safe movement, and improper turning behaviors, and those ages 20 to 24 in hit-and-run, alcohol, speeding, and reckless driving behaviors. Senior drivers ages 65+ were more likely to be noted for inattention, failure to yield, improper backing, and safe movement violations. Drivers age 45 to 64, on the other hand, were only overrepresented in the "none indicated" category. Compared to female drivers, male drivers were more than twice as likely to be in collisions involving hit-and-run, alcohol, or vehicular assaults. Males also had higher percentages of crashes involving speeding, reckless driving, improper turning, driving without a license, and improper lane use. Female drivers were overrepresented in crashes involving failure to obey a traffic signal and right turn on red.

Roadway/environmental and vehicle contributing factors were less often identified. Roadway/environmental factors were identified in one-fourth of the pedestrian crashes. The most common factor cited was blocked vision, most often the result of bushes, trees, or other vegetation growing near the edge of a roadway or driveway. Very few crashes were associated with specific roadway conditions such as glass or other debris, or potholes and drainage grates. However, construction zones were the site of just over 1 percent of pedestrian crashes.

Vehicle factors contributed to 11 percent of the pedestrian crashes. Specific factors cited included extended side mirrors, foggy or dirty windshields, defective brakes, and defective tires. None of these factors appeared in more than half a percent of the total sample of cases.

FAULT

Based on all of the information provided on the crash report form, a judgment was made by the coders as to who was at fault in the crash - the pedestrian, the driver, both, or neither (see table 9). The pedestrian was judged to be solely at fault in 43 percent of the crashes. In an additional three percent of crashes the pedestrian was deemed at fault but the driver contribution was uncertain. The driver was assigned fault in 35 percent of cases, plus an additional 2 percent where the pedestrian contribution was uncertain. Both parties were judged at fault in 12 to 13 percent of crashes, and neither party in one percent. No assignment of fault could be made in the remaining three percent of cases.

Not surprisingly, children were more likely than adults to be the responsible party in a pedestrian crash. Seventy-four percent of pedestrians under 10 years of age were judged solely at fault, compared to 60 percent of children aged 10 to 14 and only 33 percent of pedestrians ages 15 and above. Male pedestrians were also more likely than female pedestrians to be culpable in a crash - 48 percent versus 37 percent.

Table 9. Crash culpability (fault).

	N	%
Pedestrian only	2189	43.2
Ped., driver unknown	170	3.4
Driver only	1764	34.8
Driver, ped. unknown	104	2.1
Both ped. and driver	633	12.5
Neither ped. nor driver	50	1.0
Both unknown, unable to determine	163	3.2
Total	5,073	100.2

It should be noted that, for the purposes of developing countermeasures to prevent pedestrian crashes, fault (or crash culpability) may not play a necessary or even useful role. To illustrate this point, consider the example of ice-cream vendor pedestrian crashes. The vast majority of these are "caused" by a young child running into the path of a passing motorist either before or after making an ice cream purchase. The child is clearly "at fault"; however, focusing countermeasure efforts at teaching a very young child to avoid this situation would likely be unproductive. Countermeasures targeted at the driver of the ice-cream truck (for example, encouraging vending only on quiet neighborhood streets) or the truck itself (for example, adding signs and blinking lights to warn motorists) would be a more effective approach. Probably the most effective countermeasure, however, would be passing, publicizing and enforcing a local ordinance requiring motorists to come to a full stop when meeting an ice cream truck that is vending, then passing only at a prudent speed while yielding right-of-way to pedestrians. The point here is that pedestrian crash culpability or "fault," while helpful in describing the various situations producing a pedestrian crash, plays a much more limited role in the development of effective countermeasures for preventing these crashes from occurring.

CHAPTER 3. PEDESTRIAN CRASH TYPES

As noted in the introduction, one of this project's primary objectives was to apply the pedestrian and bicycle accident typologies developed by NHTSA during the 1970's to a more recent sample of crashes. For the pedestrian crash typing, this involved reviewing the hard copies of each of our 5,073 police crash reports, including the investigating officers' diagrams and descriptions of the crash, and following the coding instructions outlined in the Manual Accident Typing (MAT) Coder's Handbook. This is the same basic procedure currently being used by a NHTSA contractor to "type" the pedestrian crashes identified through the General Estimates System.

A total of 37 distinct pedestrian crash types are identified in the MAT system. Each type is characterized by a specific sequence of causal events or pedestrian/driver actions preceding the crash occurrence. For example, in a "midblock dash" the pedestrian runs out into the street or roadway at a midblock location and the motorist is unable to react in time to avoid a collision; and in a "multiple threat at intersection" the pedestrian enters the roadway in front of standing or stopped traffic and is struck by a vehicle heading in the same direction as the stopped traffic. Appendix A contains a description of each of the original 37 pedestrian crash types.

In the crash typing carried out for the current project, several of the original crash types were further subdivided. For example, in coding crash type #210, pedestrian struck by driverless vehicle, we distinguished whether the pedestrian was originally the vehicle's driver (code #210) or was not the original driver (code #211). And as another example, when the pedestrian was struck while walking along the road with traffic, we distinguished whether the vehicle approached from in front of (#532) or behind (#534) the pedestrian. The "other — weird" category was also broken down into a number of distinct crash types, including lying in the travel lane, suicide attempt, assault with vehicle,and sitting/leaning/clinging to vehicle.

Table 10 shows the complete distribution of crash types coded for all six States. The types are listed and grouped according to the original NHTSA typology with the additional subcategories inserted. The percentages presented are column percents, so that the crash type distributions are shown for each State individually as well as for the overall sample.

Given the large number of crash types appearing in the table (61 in all), numbers and percentages in many of the cells are small. In the special circumstances category each of the crash types identified occurred in less than 1 percent of the cases overall. However, in certain locations in the United States these percentages may be significantly higher. For example, crashes where the pedestrian (most often a young child) is struck while going to or from an ice-cream truck or other vendor (Type 130) can only occur in urban areas where this type of vending takes place. Our sample included rural as well as urban areas and communities that may or may not have had ice-cream trucks and other vendors catering to children.

In the vehicle specific category, the most frequent crash type involved a backing vehicle (Type 220). This type accounted for nearly 7 percent of all pedestrian crashes.

Table 10. Distribution of pedestrian crash types by State.

	CA n (%)*	FL n (%)	MD n (%)	MN n (%)	NC n (%)	UT n (%)	Total n (%)
SPECIAL CIRCUMSTANCES							
110 Commercial bus-related	0 (0.0)*	4 (0.5)	4 (0.5)	9 (1.1)	2 (0.2)	3 (0.4)	22 (0.4)
120 School bus-related,	4 (0.5)	1 (0.1)	3 (0.4)	7 (0.8)	4 (0.5)	3 (0.4)	22 (0.4)
130 Vendor/ice-cream truck	20 (2.3)	6 (0.7)	7 (0.8)	4 (0.5)	3 (0.4)	0 (0.0)	40 (0.8)
140 Mailbox-related	2 (0.2)	3 (0.4)	0 (0.0)	7 (0.8)	3 (0.4)	1 (0.1)	16 (0.3)
150 Exiting/entering parked vehicle	8 (0.9)	1 (0.1)	4 (0.5)	7 (0.8)	6 (0.7)	7 (0.8)	33 (0.7)
VEHICLE SPECIFIC							
210 Driverless vehicle - ped. was driver	12 (1.4)	14 (1.7)	12 (1.4)	2 (0.2)	23 (2.7)	17 (2.1)	80 (1.6)
211 Driverless vehicle - ped. not driver	1 (0.1)	6 (0.7)	8 (1.0)	3 (0.4)	0 (0.0)	6 (0.7)	24 (0.5)
220 Backing vehicle	19 (2.1)	84 (10.1)	67 (8.0)	37 (4.4)	67 (7.8)	77 (9.3)	351 (6.9)
230 Hot pursuit	0 (0.0)	1 (0.1)	2 (0.2)	0 (0.0)	2 (0.2)	0 (0.0)	5 (0.1)
DISABLED/EMERGENCY VEH-RELATED							
310 Walking to/from disabled vehicle	2 (0.2)	3 (0.4)	1 (0.1)	1 (0.1)	1 (0.1)	1 (0.1)	9 (0.2)
320 Disabled vehicle related	28 (3.2)	10 (1.2)	21 (2.5)	7 (0.8)	30 (3.5)	9 (1.1)	105 (2.1)
330 Emergency/police veh. related	2 (0.2)	1 (0.1)	4 (0.5)	2 (0.2)	0 (0.0)	1 (0.1)	10 (0.2)
WORKING/PLAYING IN ROADWAY							
410 Working on roadway	13 (1.5)	21 (2.5)	12 (1.4)	10 (1.2)	9 (1.0)	4 (0.5)	69 (1.4)
420 Play vehicle-related	5 (0.6)	1 (0.1)	8 (1.0)	9 (1.1)	5 (0.6)	7 (0.9)	35 (0.7)
430 Playing in roadway	3 (0.3)	10 (1.2)	10 (1.2)	3 (0.4)	8 (0.9)	14 (1.7)	48 (0.9)
WALKING ALONG ROAD/ CROSSING EXPRESSSWAY							
510 Hitchhiking	0 (0.0)	3 (0.4)	4 (0.5)	2 (0.2)	6 (0.7)	0 (0.0)	15 (0.3)
520 Expressway crossing	9 (1.0)	8 (1.0)	1 (0.1)	1 (0.1)	5 (0.6)	1 (0.1)	25 (0.5)
531 Walking with traffic, struck from behind	15 (1.7)	58 (7.0)	34 (4.1)	41 (4.9)	88 (10.3)	21 (2.5)	257 (5.1)
532 Walking against traffic, struck from behind	2 (0.2)	15 (1.8)	12 (1.4)	12 (1.4)	28 (3.3)	7 (0.8)	76 (1.5)
533 Walking with traffic, struck from front	0 (0.0)	0 (0.0)	1 (0.1)	2 (0.2)	0 (0.0)	2 (0.2)	5 (0.1)
534 Walking against traffic, struck from front	2 (0.2)	2 (0.2)	2 (0.2)	0 (0.0)	0 (0.0)	1 (0.1)	7 (0.1)
539 Walking along rd. - side unknown	2 (0.2)	0 (0.0)	5 (0.6)	0 (0.0)	6 (0.7)	2 (0.2)	15 (0.3)

*Column percents.

Table 10. Distribution of pedestrian crash types by State (continued).

	CA n (%)	FL n (%)	MD n (%)	MN n (%)	NC n (%)	UT n (%)	Total n (%)
NOT IN ROAD							
610 Waiting to cross at/near curb - veh. turning	3 (0.3)	3 (0.4)	2 (0.2)	5 (0.6)	3 (0.4)	2 (0.2)	18 (0.4)
611 Waiting to cross at/near curb - veh. not turning	4 (0.5)	2 (0.2)	5 (0.6)	0 (0.0)	0 (0.0)	3 (0.4)	14 (0.3)
620 Ped. and veh. not in roadway	18 (2.0)	84 (10.1)	69 (8.3)	19 (2.3)	80 (9.3)	76 (9.2)	346 (6.8)
621 Ped. not in roadway, veh. left roadway	15 (1.7)	17 (2.0)	5 (0.6)	18 (2.2)	0 (0.0)	3 (0.4)	58 (1.1)
INTERSECTION-RELATED							
710 Multiple threat at intersection	13 (1.5)	5 (0.6)	10 (1.2)	9 (1.1)	7 (0.8)	20 (2.4)	64 (1.3)
720 Vehicle turn/merge	125 (14.1)	31 (3.7)	47 (5.6)	149 (7.8)	49 (5.7)	96 (11.6)	497 (9.8)
730 Intersection dash	54 (6.1)	66 (7.9)	67 (8.0)	75 (9.0)	35 (4.1)	66 (8.0)	363 (7.2)
740 Trapped	20 (2.3)	2 (0.2)	3 (0.4)	5 (0.6)	3 (0.4)	8 (1.0)	41 (0.8)
750 Ped. walks into veh., unknown	2 (0.2)	2 (0.2)	0 (0.0)	6 (0.7)	8 (0.9)	0 (0.0)	18 (0.4)
751 Ped. walks into veh., instantaneously	8 (0.9)	1 (0.1)	2 (0.2)	2 (0.2)	0 (0.0)	0 (0.0)	13 (0.3)
752 Ped. walks into veh., non-instantaneously	4 (0.5)	1 (0.1)	1 (0.1)	3 (0.4)	0 (0.0)	2 (0.2)	11 (0.2)
760 Driver violation, intersection	118 (13.3)	26 (3.1)	28 (3.4)	34 (4.1)	10 (1.2)	43 (5.2)	259 (5.1)
790 Intersection - Other	31 (3.5)	13 (1.6)	4 (0.5)	19 (23)	37 (4.3)	5 (0.6)	109 (2.1)
791 Standing in road at intersection	1 (0.1)	5 (0.6)	5 (0.6)	3 (0.4)	0 (0.0)	0 (0.0)	14 (0.3)
792 Instantaneous step into road	10 (1.1)	11 (1.3)	15 (1.8)	12 (1.4)	0 (0.0)	9 (1.1)	57 (1.1)
793 Misjudged gap when crossing	3 (0.3)	3 (0.4)	8 (1.0)	7 (0.8)	0 (0.0)	4 (0.5)	25 (0.5)
794 Walking in road prior to impact	19 (2.1)	42 (5.0)	35 (4.2)	46 (5.5)	0 (0.0)	17 (2.1)	159 (3.1)

Table 10. Distribution of pedestrian crash types by State (continued).

	CA n (%)	FL n (%)	MD n (%)	MN n (%)	NC n (%)	UT n (%)	Total n (%)
MIDBLOCK							
810 Multiple threat-midblock	6 (0.7)	8 (1.0)	6 (0.7)	3 (0.4)	9 1.1)	14 (1.7)	46 (0.9)
821 Dart-out, first half	37 (4.2)	3 (0.4)	42 (5.0)	41 (4.9)	11 (1.3)	42 (5.1)	176 (3.5)
822 Dart-out, second half	7 (0.8)	3 (0.4)	11 (1.3)	12 (1.4)	9 (1.1)	8 (1.0)	50 (1.0)
829 Dart-out, can't specify	2 (0.2)	0 (0.0)	1 (0.1)	1 (0.1)	1 (0.1)	1 (0.1)	6 (0.1)
830 Midblock dash	69 (7.8)	59 (7.1)	72 (8.6)	81 (9.7)	82 (9.6)	79 (9.6)	442 (8.7)
840 Ped. walks into vehicle - unknown	1 (0.1)	7 (0.8)	4 (0.5)	1 (0.1)	19 (2.2)	2 (0.2)	34 (0.7)
841 Ped. walks into veh. - instantaneously	8 (0.9)	5 (0.6)	2 (0.2)	6 (0.7)	0 (0.0)	0 (0.0)	24 (0.4)
842 Ped. walks into veh. - non-instaneously	3 (0.3)	8 (1.0)	4 (0.5)	1 (0.1)	0 (0.0)	2 (0.2)	18 (0.4)
890 Midblock - Other	31 (3.5)	18 (2.2)	13 (1.6)	23 (2.7)	112 (13.1)	12 (1.5)	209 (4.1)
891 Standing in road - midblock	9 (1.0)	5 (0.6)	13 (1.6)	12 (1.4)	0 (0.0)	8 (1.0)	47 (0.9)
892 Instantaneous step into road - midblock	11 (1.2)	13 (1.6)	19 (2.3)	10 (1.2)	0 (0.0)	7 (0.8)	60 (1.2)
893 Misjudged gap when crossing - midblock	11 (1.2)	4 (0.5)	10 (1.2)	3 (0.4)	0 (0.0)	7 (0.8)	35 (0.7)
894 Walking in road - midblock	35 (4.0)	47 (5.6)	50 (6.0)	26 (3.1)	0 (0.0)	39 (4.7)	197 (3.9)
OTHER OR INADEQUATE INFORMATION							
910 Other - weird	4 (0.5)	16 (1.9)	8 (1.0)	10 (1.2)	21 (2.4)	26 (3.1)	85 (1.7)
911 Lying in road	6 (0.7)	4 (0.5)	2 (0.2)	0 (0.0)	9 (1.0)	1 (0.1)	22 (0.4)
912 Suicide	1 (0.1)	1 (0.1)	1 (0.1)	0 (0.0)	1 (0.1)	2 (0.2)	6 (0.1)
913 Assault with vehicle	3 (0.3)	16 (1.9)	9 (1.1)	5 (0.6)	15 (1.7)	7 (0.8)	55 (1.1)
914 Domestic/dispute	13 (1.5)	10 (1.2)	13 (1.6)	17 (2.0)	7 (0.8)	16 (1.9)	76 (1.5)
915 Sitting/leaning/clinging to veh.	2 (0.2)	11 (1.3)	11 (1.3)	1 (0.1)	1 (0.1)	14 (1.7)	40 (0.8)
916 Result of vehicle-vehicle crash	21 (2.4)	9 (1.1)	11 (1.3)	6 (0.7)	14 (1.6)	0 (0.0)	61 (1.2)
917 Result of vehicle-object crash	4 (0.5)	12 (1.4)	3 (0.4)	0 (0.0)	6 (0.7)	0 (0.0)	25 (0.5)
920 Inadequate information	4 (0.5)	7 (0.8)	0 (0.0)	1 (0.1)	13 (1.5)	2 (0.2)	27 (0.5)
ALL CRASHES	885	832	833	838	858	827	5,073

Pedestrians were stuck by driverless vehicles in just over 2 percent of cases (Types 210 and 211). In the majority of these cases the pedestrian had been the driver of the vehicle and was struck after exiting. Disabled vehicle crashes represented another 2 percent of the total. In these, the pedestrian was most often struck while standing near or working on the disabled vehicle (Type 320), as opposed to walking to or from the vehicle (Type 310). Crashes involving someone working in the roadway (construction worker, trash collector, etc.) or playing in the roadway each involved another 1 to 2 percent of cases.

Overall approximately 8 percent of crashes occurred when the pedestrian was walking along the roadway. The most frequent situation was the pedestrian being struck from behind when walking with, rather than against, traffic (type 531, representing 5 percent of all crashes). Fewer than 2 percent of the crashes involved a pedestrian walking against traffic (Types 532 and 534). These data seem to indicate a much higher risk associated with walking with traffic, although without appropriate exposure data no definite conclusions can be drawn.

Nine percent of pedestrians were struck when they were not in the roadway. In the vast majority of these cases both the pedestrian and the vehicle were in an off-road location such as a parking lot or driveway (Type 620). A smaller percentage of cases involved a vehicle either leaving the road and striking the pedestrian, or striking a pedestrian waiting to cross at or near the curb.

Nearly a third of the pedestrians were struck while at or near [within 16 m (50 ft) of] an intersection. (Alleys and driveways were considered intersections only if controlled by a traffic signal.) Of these, about a third (or 10 percent overall) involved a turning vehicle (Type 720). Other frequent intersection crash types were the intersection dash, in which the motorist's view of the pedestrian was blocked until an instant before impact and/or the pedestrian was running (Type 730, 7 percent of crashes), and crashes occurring as the result of a driver violation (Type 760, 5 percent of crashes). The "intersection - other" category includes all those crashes which could not otherwise be classified (Type 790, 2 percent of crashes).

Midblock events were the second major pedestrian crash type grouping, representing over a fourth (26 percent) of all crashes. Most common were midblock dashes (type 830, 9% of crashes), defined to be situations where the pedestrian was running and the motorist's view was *not* obstructed. Midblock dart-outs (Types 821, 822 or 829), in which the motorist's view *was* obstructed until just before impact, occurred in just under 5 percent of cases. Most often these involved a pedestrian being struck before crossing the roadway half-way.

As noted earlier, an attempt was made to identify some of the specific crash situations that would normally be coded only as "other" or "weird" (Type 910). This listing was developed after the initial coding of the North Carolina cases, but the North Carolina cases were subsequently recoded to include this additional level of detail. "Atypical" pedestrian crashes included those related to domestic or other disputes (76 cases), those involving purposeful vehicular assault (55 cases), those resulting or following from a vehicle-vehicle (61 cases) or vehicle-object (25 cases) crash, and those where the pedestrian had been sitting,

leaning against, or clinging to the vehicle (40 cases). In 22 instances the pedestrian was lying in the road prior to the crash, and six cases were identified as likely suicide attempts.

For all of the crash types there is some variability across States. This is to be expected, given the small cell sizes and differences between the States in population densities, development characteristics, reporting requirements for pedestrian crashes, and other factors impacting on the types of crashes that occur and the types that get reported on State motor vehicle crash files. For the most part, however, the *patterns* of crash frequencies are the same, so that the crash types occurring most frequently in the overall sample are also those that occur most frequently within each individual State.

FURTHER GROUPING OF PEDESTRIAN CRASH TYPES

The large number of crash types in table 10 makes it difficult to draw conclusions from the table and to examine the various crash types with respect to other variables of interest such as the age of the pedestrian, time of day when the crash occurred, roadway type, etc. To facilitate this process, the individual crash types have been grouped into 15 major subgroups that correspond closely to the original NHTSA crash typology. These subgroups and their associated crash types are listed below.

Subgroup	Crash Types
Bus-related	110, 120
Other vehicle-specific	130, 140, 150, 230
Driverless vehicle	210, 211
Backing vehicle	220
Disabled vehicle related	310, 320, 330
Working/playing in road	410, 420, 430
Walking along roadway	510, 520, 531, 532, 533, 534, 539
Not in road	610, 611, 620, 621
Intersection:	
Vehicle turning at int.	720
Intersection dash	730
Driver violation at int.	760
Other intersection	710, 740, 750, 751, 752, 790, 791, 792, 793,794
Midblock:	
Midblock dart/dash	821, 822, 829, 830
Other midblock	810, 840, 841, 842, 890, 891, 892, 893, 894
Miscellaneous	910, 911, 912, 913, 914, 915, 916, 917, 920

Table 11 shows the distribution of these crash types by State and overall. Again there is variability across the States. For example, backing crashes were more common in Florida and Utah, which also reported higher percentages of not-in-road pedestrian crashes. North

Table 11. Major pedestrian crash type subgroups by State.

Pedestrian Crash Type Subgroup	STATE						
	CA	FL	MD	MN	NC	UT	Total
Bus related	4 (0.5)	5 (0.6)	7 (0.8)	16 (1.9)	6 (0.7)	6 (0.7)	44 (0.9)
Other vehicle-specific	30 (3.4)	11 (1.3)	13 (1.6)	18 (2.1)	14 (1.6)	8 (1.0)	94 (1.9)
Driverless vehicle	13 (1.5)	20 (2.4)	20 (2.4)	5 (0.6)	23 (2.7)	23 (2.8)	104 (2.1)
Backing vehicle	19 (2.1)	84 (10.1)	67 (8.0)	37 (4.4)	67 (7.8)	77 (9.3)	351 (6.9)
Disabled vehicle related	32 (3.6)	14 (1.7)	26 (3.1)	10 (1.2)	31 (3.6)	11 (1.3)	124 (2.4)
Working/playing in road	21 (2.4)	32 (3.8)	30 (3.6)	22 (2.6)	22 (2.6)	25 (3.0)	152 (3.0)
Walking along roadway	30 (3.4)	86 (10.3)	59 (7.1)	58 (6.9)	133 (15.5)	34 (4.1)	400 (7.9)
Not in road	40 (4.5)	106 (12.7)	81 (9.7)	42 (5.0)	83 (9.7)	84 (10.2)	436 (8.6)
Vehicle turning at intersection	125 (14.1)	31 (3.7)	47 (5.6)	149 (17.8)	49 (5.7)	96 (11.6)	497 (9.8)
Intersection dash	54 (6.1)	66 (7.9)	67 (8.0)	75 (8.9)	35 (4.1)	66 (8.0)	363 (7.2)
Driver violation at intersection	118 (13.3)	26 (3.1)	28 (3.4)	34 (4.1)	10 (1.2)	43 (5.2)	259 (5.1)
Other intersection	111 (12.5)	85 (10.2)	83 (10.0)	112 (13.4)	55 (6.4)	65 (7.9)	511 (10.1)
Midblock dart/dash	115 (13.0)	65 (7.8)	126 (15.1)	135 (16.1)	103 (12.0)	130 (15.7)	674 (13.3)
Other midblock	115 (13.0)	115 (13.8)	121 (14.5)	85 (10.1)	140 (16.3)	91 (11.0)	667 (13.2)
Miscellaneous	58 (6.6)	86 (10.3)	58 (7.0)	40 (4.8)	87 (10.1)	68 (8.2)	397 (7.8)
ALL CRASHES	885	832	833	838	858	827	5,073

Carolina and, to a lesser extent, Florida had higher percentages of walking along the roadway pedestrian crashes. And as a final example, Minnesota was overrepresented in intersection-related crashes, particularly those involving turning vehicles, and in bus-related crashes. The overall patterns remain similar, however, with the most frequent crash types being the various intersection-related events and midblock crashes. Not in road, walking along the roadway, and backing vehicle were also relatively common crash types.

Figures 1 to 8 provide additional detail for eight of the most frequent pedestrian crash type categories. They include vehicle turn/merge (9.8 percent), intersection dash (7.2 percent), other intersection (10.1 percent), midblock dart-dash (13.3 percent), other midblock (13.2 percent), not in roadway/waiting to cross (8.6 percent), walking along roadway (7.9 percent), and backing vehicle (6.9 percent). Together these eight categories of crashes account for over three-fourths of all pedestrian crash events. (Similar diagrams and summaries for all of the individual crash types are presented in a companion document (Hunter, Stutts, and Pein, in press) to this report.)

Each figure includes one or more diagrams depicting the position and movement of the pedestrian and motor vehicle, based on the individual crash type or types comprising the category. The one exception is figure 8 for backing vehicle, which has individual diagrams based on a cross-tabulation of that crash type with the coded variable, pedestrian location. A box at the bottom of each figure shows variable levels which are overrpresented for that crash type compared to all pedestrian crashes. For example, figure 1 shows pedestrians aged 45 to 64 to be overrepresented in vehicle turn/merge crashes. This is because they comprised 21 percent of the pedestrians in turn/merge crashes, compared to only 11 percent of pedestrians in crashes overall.

The overrepresentation summaries are derived from the tables presented in the remaining sections of this chapter. These sections explore a variety of pedestrian, driver, location, environmental, roadway, and crash factors associated with the 15 major pedestrian crash type subgroups. Again the basic approach taken is to examine variable distributions within the crash subgroups and to look for patterns of over and underrepresentation compared to pedestrian crashes overall.

PEDESTRIAN CHARACTERISTICS

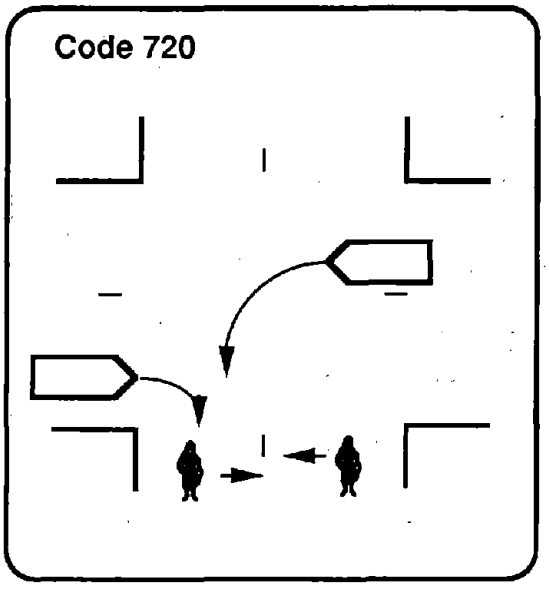
Pedestrian Age

Table 12 shows the age distribution of pedestrians involved in each of the 15 pedestrian crash subtypes and for all pedestrian crashes combined. Percentages in each row total 100 percent (except for slight variations due to rounding). Examining the table one can identify the ages of pedestrians most likely to be involved in each type of crash, as well as particular crash types where an age group is over or underrepresented. For example, bus-related crashes were most likely to involve children under age 20. And children under age 10, in addition to being overrepresented in bus related crashes, were also overrepresented in other vehicle-specific crashes, working/playing in road crashes, intersection dashes, and midblock darts and dashes.

Vehicle turn/merge at intersection

n=497; 9.8% of all crashes

18.4% are A + K crashes



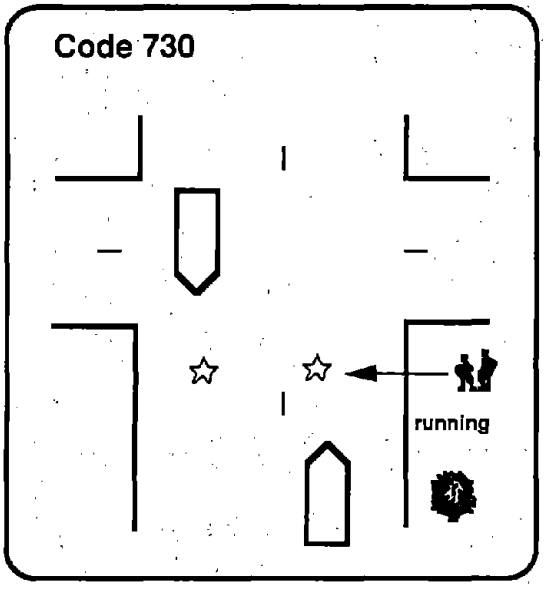
Overrepresented Variables	
Pedestrian Age	45-64; 65+
Pedestrian Gender	female
Driver Age	65+
Location	urban
Time of Day	6-10am; 10am-2pm
Light Condition	daylight
Traffic Control	signal; stop sign
Number of Lanes	3-4

Figure 1. Pedestrian struck by turning/merging vehicle at intersection.

Intersection dash

n=363; 7.2% of all crashes

33.6% are A + K crashes

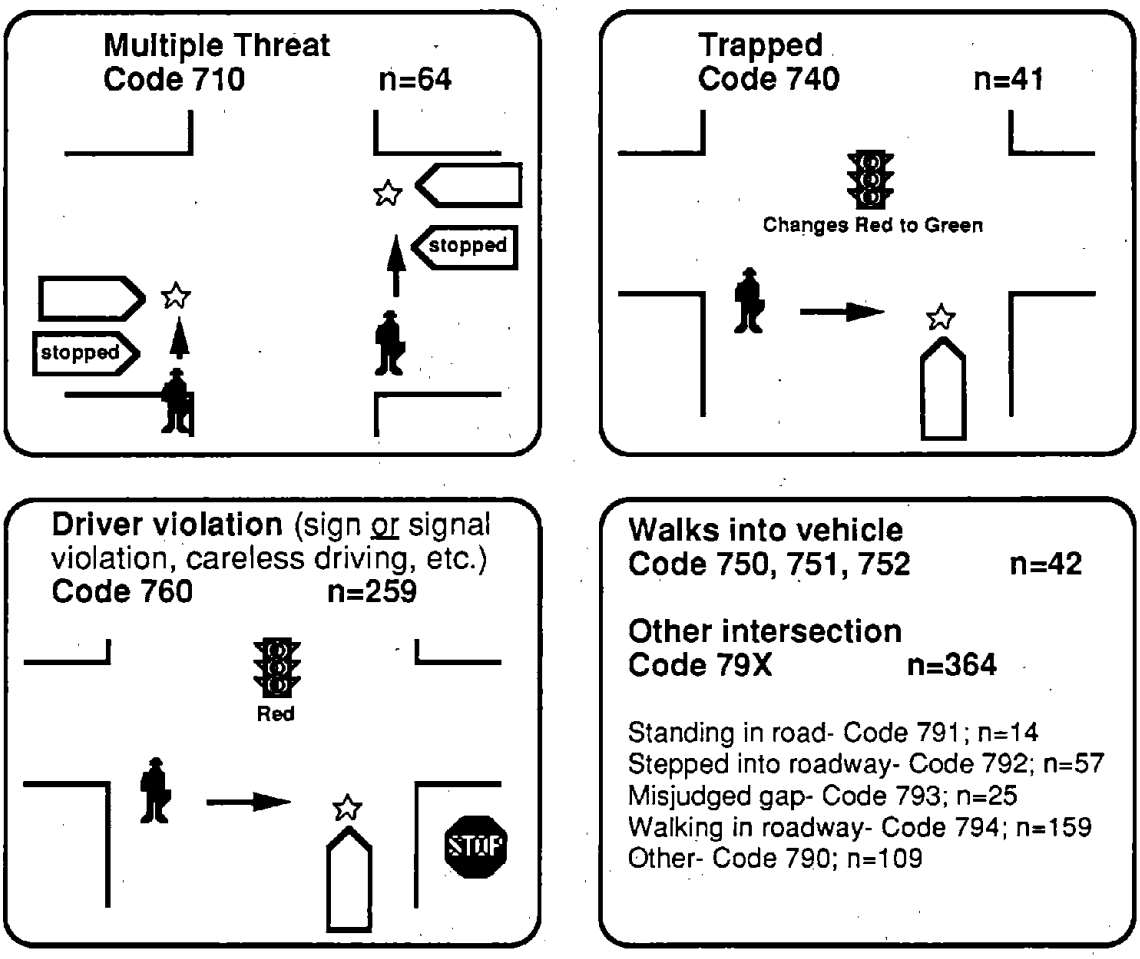


Overrepresented Variables	
Pedestrian Age	0-9; 10-14
Road Class	local
Time of Day	2-6pm
Light Condition	daylight
Traffic Control	signal

Figure 2. Pedestrian ran into intersection and/or motorist's view was blocked.

Other intersection

n=511; 10.1% of all crashes **36.2% are A + K crashes**



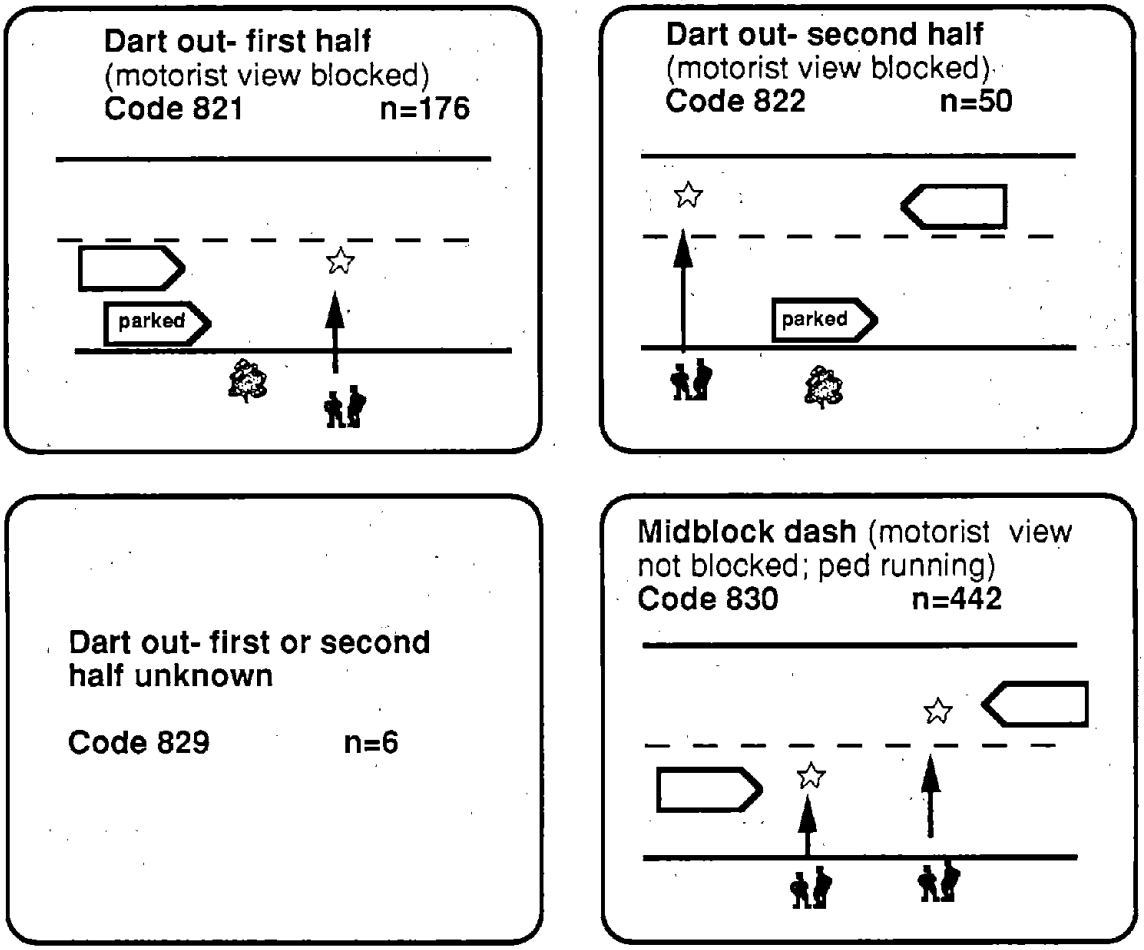
Overrepresented Variables

Pedestrian Age.....65+
Sobriety.....pedestrian alcohol
Light Condition.....dark, lighted
Road Class.....U.S./State route
Traffic Control.....signal
Number of Lanes.....3-4; 5-6

Figure 3. Other intersection.

Midblock Dart out/Dash

n=674; 13.3% of all crashes **35.6% are A + K crashes**



Overrepresented Variables

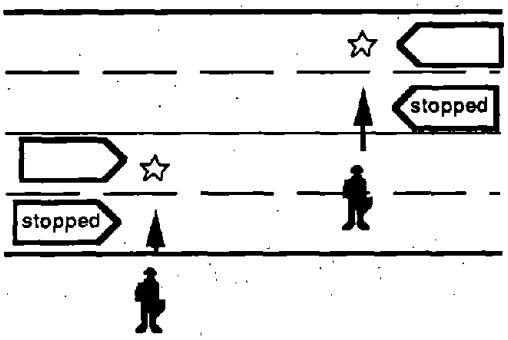
Pedestrian Age	0-9; 10-14
Time of Day	2-6pm
Light Condition	daylight
Number of Lanes	2

Figure 4. Pedestrian midblock dart out/dash.

Other midblock

n=667; 13.2% of all crashes **46.8% are A + K crashes**

Multiple Threat
Code 810 **n=46**



Walks into vehicle
Code 840, 841, 842 **n=76**

Other midblock
Code 89X **n=548**

Standing in road- Code 891; n=47
Stepped into roadway- Code 892; n=60
Misjudged gap- Code 893; n=35
Walking in roadway- Code 894; n=197
Other- Code 890; n=209

Overrepresented Variables

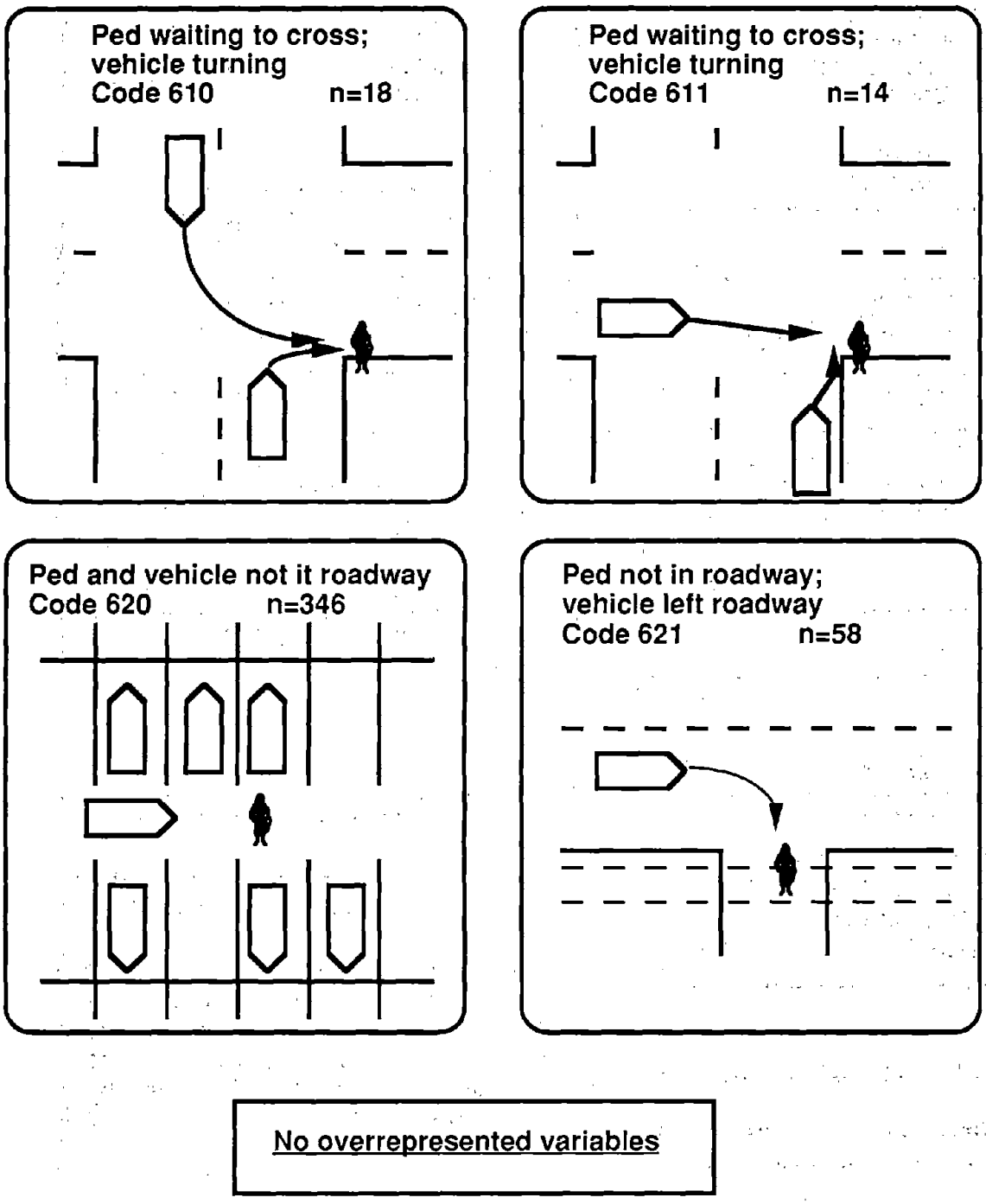
Sobriety·····pedestrian alcohol
Light Condition·····dark
Road Class·····State route
Number of Lanes·····3-4; 5-6

Figure 5. Other midblock.

Not in roadway / Waiting to cross

n=436; 8.6% of all crashes

28.3% are A + K crashes



No overrepresented variables

Figure 6. Pedestrian not in roadway / Waiting to cross.

Walking along roadway

n=400; 7.9% of all crashes

40.4% are A + K crashes

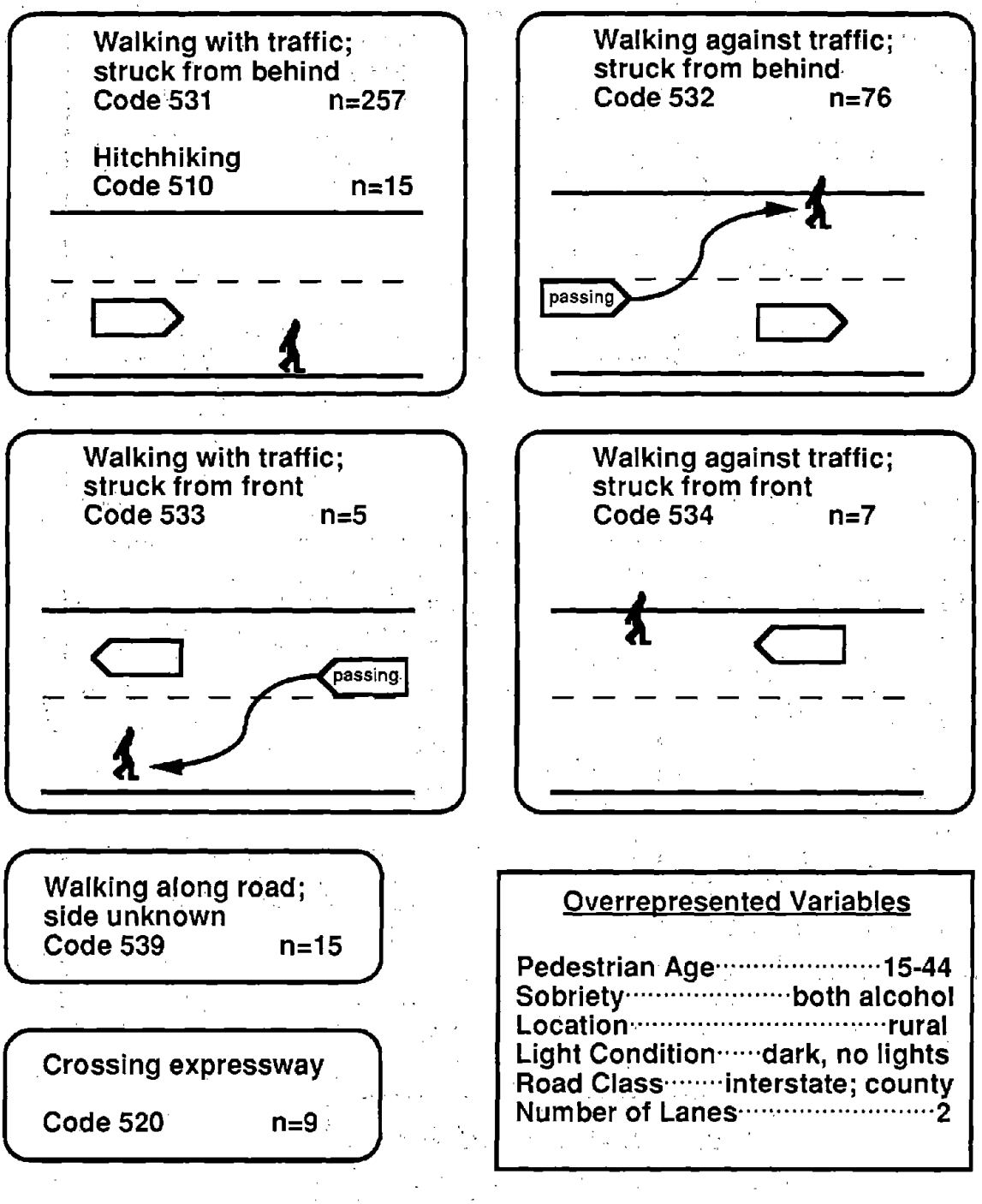
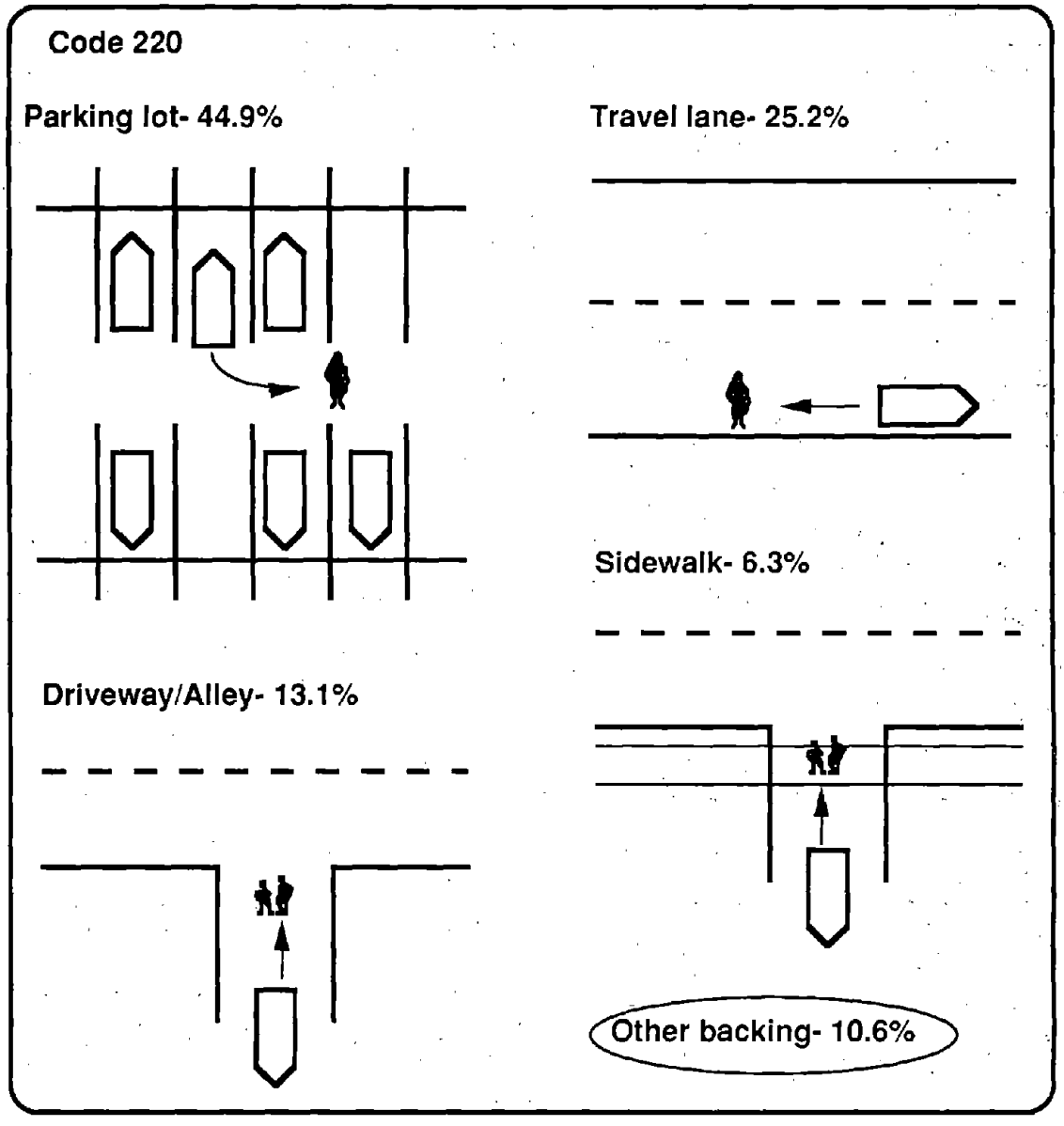


Figure 7. Pedestrian walking along roadway/crossing expressway.

Backing vehicle

n=351; 6.9% of all crashes

22.5% are A + K crashes



Overrepresented variables

Pedestrian Age.....65+
Pedestrian Gender.....female
Time of Day.....10am-2pm
Light Condition.....daylight

Figure 8. Pedestrian struck by backing vehicle.

Table 12. Pedestrian crash types by age of pedestrian.

	PEDESTRIAN AGE*						
Pedestrian Crash Type Subgroup	0-9	10-14	15-19	20-24	25-44	45-64	65+
Bus related	23.8	23.8	35.7	2.4	9.5	2.4	2.4
Other vehicle-specific	37.5	13.6	3.4	4.6	21.6	8.0	11.4
Driverless vehicle	13.7	1.4	6.8	9.6	37.0	16.4	15.1
Backing vehicle	15.4	3.2	7.5	12.5	30.1	12.5	18.6
Disabled vehicle related	2.5	1.7	7.6	14.4	53.4	15.3	5.1
Working/playing in road	31.7	14.8	6.3	7.0	25.4	12.0	2.8
Walking along roadway	1.3	6.9	17.4	14.3	43.7	11.5	4.9
Not in road	14.3	10.0	13.4	9.4	30.6	12.0	10.3
Vehicle turning at intersection	4.4	8.3	9.8	9.1	33.3	21.2	13.9
Intersection dash	40.6	23.1	13.2	2.9	13.5	4.1	2.6
Driver violation at intersection	7.9	13.0	11.1	9.1	33.6	11.1	14.2
Other intersection	8.5	14.9	9.5	8.9	31.0	12.6	14.7
Midblock dart/dash	55.2	16.2	6.0	4.1	12.5	2.9	3.2
Other midblock	14.1	7.8	9.7	8.9	33.3	15.3	10.9
Miscellaneous	4.1	7.5	18.5	14.6	40.3	9.4	5.5
ALL CRASHES	18.7	11.1	10.9	9.0	29.7	11.4	9.2

*Row percents. Cases with unknown age excluded.

Other findings with respect to pedestrian age include the following:

- Children ages 10 to 14 join children under age 10 in being overinvolved in bus-related crashes, intersection dashes, and midblock darts and dashes. Nearly two-thirds of all intersection dashes and 71 percent of all midblock darts and dashes involved children under age 15.
- Children ages 15 to 19 comprised over a third of all pedestrians injured in bus-related crashes. They are also overrepresented in walking along the roadway crashes and, to a lesser extent, not-in-road and intersection dash crashes.
- 20 to 24 year-olds were underrepresented in intersection dashes and midblock darts and dashes. They are overrepresented, however, in disabled vehicle and walking along roadway crashes.
- 25 to 44 year-olds were also overrepresented in disabled vehicle and walking along roadway crashes. Over half of disabled vehicle related crashes involve pedestrians in this age group, and 44 percent of walking along roadway crashes. Twenty-five to forty-four-year-olds also comprise over a third of pedestrians involved in driverless vehicle crashes.
- Older adults ages 45 to 64 were overrepresented in crashes involving turning vehicles at intersections and, to a lesser extent, in driverless vehicle and disabled vehicle related crashes.
- Senior adults ages 65+ were overinvolved in crashes involving a backing vehicle and in driverless vehicle and intersection related crashes (except for intersection dashes).

It is likely that many of these age-related outcomes reflect exposure levels. However, without additional data reasons for overinvolvement can only be surmised.

Pedestrian Gender

Table 13 distributes the various crash subtypes by the gender of the pedestrian. Whereas males comprised just over 60 percent of all pedestrian crash victims, they represented over 80 percent of pedestrians struck while working in the roadway, 73 percent of those struck in disabled vehicle-related crashes, and 71 percent of those struck while walking along the roadway. Females, on the other hand, were more likely to be involved in bus-related crashes, driverless vehicle crashes, vehicle turning at intersection crashes, and intersection crashes involving a driver violation.

Pedestrian Sobriety

Alcohol (or drug) use was noted for about 15 percent of pedestrians in crashes (table 14). Crash types most likely to involve alcohol or drug use included walking along the roadway (30 percent) and the general categories of other midblock and other intersection crashes (31 percent and 23 percent, respectively). Working/playing in road, driverless vehicle, and bus-related crashes were all very *unlikely* to involve drunk pedestrians.

Table 13. Pedestrian crash types by gender of pedestrian.

	GENDER*	
Pedestrian Crash Type Subgroup	Male	Female
Bus related	34.9	65.1
Other vehicle-specific	56.2	43.8
Driverless vehicle	44.6	55.4
Backing vehicle	52.3	47.7
Disabled vehicle related	72.5	27.5
Working/playing in road	80.4	19.6
Walking along roadway	70.6	29.4
Not in road	58.8	41.2
Vehicle turning at intersection	43.2	56.8
Intersection dash	69.7	30.3
Driver violation at intersection	48.4	51.6
Other intersection	58.6	41.4
Midblock dart/dash	65.4	34.6
Other midblock	67.5	32.5
Miscellaneous	65.9	34.1
ALL CRASHES	61.1	38.9

*Row percents. Cases with unknown gender excluded.

Table 14. Pedestrian crash types by pedestrian sobriety.

	SOBRIETY*		
Pedestrian Crash Type Subgroup	No Alcohol or Drugs	Alcohol or Drugs	Other
Bus related	97.1	2.9	0.0
Other vehicle-specific	87.2	5.1	7.7
Driverless vehicle	96.7	1.7	1.7
Backing vehicle	85.6	10.8	3.6
Disabled vehicle related	84.8	7.1	8.1
Working/playing in road	97.5	0.8	1.7
Walking along roadway	62.4	29.6	8.0
Not in road	85.0	10.6	4.4
Vehicle turning at intersection	91.1	5.3	3.6
Intersection dash	86.0	9.0	5.0
Driver violation at intersection	88.0	8.3	3.7
Other intersection	70.5	23.0	6.5
Midblock dart/dash	89.4	7.8	2.8
Other midblock	61.9	30.6	7.5
Miscellaneous	71.3	22.0	6.7
ALL CRASHES	79.4	15.4	5.2

*Row percents. Cases with unknown sobriety excluded.

Pedestrian Injury Severity

Using as a measure of crash severity the percentage of pedestrians seriously injured or killed (percentage A+K), the crash types in table 15 that were the most severe were:

	Percent A+K
Other midblock	46.8 percent
Disabled vehicle related	41.7 percent
Walking along roadway	40.4 percent
Driverless vehicle	37.8 percent

Less severe crashes were:

	Percent A+K
Vehicle turning at inters.	18.4 percent
Backing vehicle	22.5 percent
Bus-related	27.2 percent
Driver violation at inters.	27.8 percent

Speed is clearly a factor in these severity outcomes: crashes occurring along open stretches of roadway or at midblock locations are likely to involve higher speeds than crashes occurring at intersections. Also, backing vehicles and busses are likely to be moving at relatively slower speeds when they strike pedestrians.

DRIVER CHARACTERISTICS

Driver Age

Table 16 shows age distributions of the drivers of vehicles striking pedestrians. Drivers under age 16 (the legal age for operating a motor vehicle in most States) were only clearly overrepresented in driverless vehicle crashes. The typical situation here would be a young child left alone in a car unknowingly shifting gears or turning on the ignition to set it in motion. Beginning drivers, ages 16 to 19, were overrepresented in not-in-road crashes and bus-related crashes, both likely related to increased exposure to these situations.

The 20 to 24 year age group was slightly overrepresented in other vehicle-specific crashes and disabled vehicle-related crashes. The former includes vendor-related crashes, crashes occurring while entering or exiting a parked vehicle, mailbox-related crashes, and crashes occurring during a "hot pursuit." They were underrepresented in school bus and driverless vehicle crashes. Drivers age 25 to 44, on the other hand, were fairly evenly represented across all crash types.

Drivers in the 45 to 64 year age range were especially overrepresented in driverless vehicle crashes, and those age 65+ in intersection crashes where they were guilty of some driving violation such as failure to stop at a stop sign or failure to yield to a pedestrian in crosswalk. Senior drivers were also overrepresented in disabled vehicle related crashes (possibly because of greater difficulty seeing at nighttime) and crashes occurring when

Table 15. Pedestrian crash types by pedestrian injury severity.

	INJURY SEVERITY*				
Pedestrian Crash Type Subgroup	No Injury	C	B	A	Fatal
Bus related	2.3	25.0	45.5	22.7	4.5
Other vehicle-specific	0.0	24.7	43.8	25.8	5.6
Driverless vehicle	1.4	24.3	36.5	35.1	2.7
Backing vehicle	2.4	39.2	35.8	20.8	1.7
Disabled vehicle related	2.5	24.2	31.7	32.5	9.2
Working/playing in road	3.5	32.2	37.1	25.9	1.4
Walking along roadway	1.5	23.9	34.3	27.2	13.2
Not in road	3.3	31.9	36.4	24.7	3.6
Vehicle turning at intersection	2.4	44.6	34.5	16.6	1.8
Intersection dash	3.4	25.4	37.6	29.4	4.2
Driver violation at intersection	2.4	32.2	37.6	22.7	5.1
Other intersection	3.0	27.2	33.6	30.8	5.4
Midblock dart/dash	2.4	23.2	38.8	30.0	5.6
Other midblock	1.5	23.0	28.7	35.7	11.1
Miscellaneous	3.8	26.5	36.8	25.7	7.3
ALL CRASHES	2.5	28.7	35.3	27.4	6.1

*Row percents. Cases with unknown injury severity excluded.

Table 16. Pedestrian crash types by driver age.

Pedestrian Crash Type Subgroup	DRIVER AGE*					
	<16	16-19	20-24	25-44	45-64	65+
Bus related	0.0	14.6	9.8	46.3	24.4	4.9
Other vehicle-specific	0.0	9.6	17.8	49.3	13.7	9.6
Driverless vehicle	5.3	0.0	5.3	47.4	36.8	5.3
Backing vehicle	1.2	11.0	12.6	45.3	18.5	11.4
Disabled vehicle related	0.0	6.4	17.0	47.9	16.0	12.8
Working/playing in road	0.8	12.1	10.6	44.7	21.2	10.6
Walking along roadway	1.2	12.7	14.2	40.8	23.1	8.1
Not in road	0.7	15.9	14.5	46.0	15.9	6.9
Vehicle turning at intersection	0.0	9.1	12.6	48.4	17.8	12.1
Intersection dash	0.3	12.4	15.3	46.4	18.2	7.5
Driver violation at intersection	0.0	12.5	13.6	43.8	16.5	13.6
Other intersection	0.0	12.0	16.3	44.5	20.0	7.2
Midblock dart/dash	0.3	12.7	13.5	46.9	20.1	6.5
Other midblock	0.5	14.9	14.7	43.0	18.4	8.5
Miscellaneous	1.4	17.7	16.6	44.8	15.9	3.6
ALL CRASHES	0.5	12.8	14.3	45.3	18.7	8.4

*Row percents. Cases with unknown driver age excluded.

backing (possibly because of reduced attention and/or inability to maneuver themselves to see persons standing to the rear of their vehicle).

Driver Gender

The gender of the motor vehicle operators involved in pedestrian crashes is shown in table 17. The only crash type where male drivers were clearly overrepresented was walking along the roadway crashes. Females, on the other hand, were overrepresented in driverless vehicle crashes and, to a lesser extent, intersection dashes and midblock darts and dashes. Again, these patterns likely reflect differences in exposure.

Driver Sobriety

A final driver variable examined was driver sobriety or alcohol/drug involvement (table 18). Overall 6 percent of the drivers striking pedestrians were judged by the investigating officer to be under the influence of alcohol or drugs at the time of the crash. This is slightly lower than the 8 percent figure reported in the General Estimates System for all crash-involved drivers in 1991 (NHTSA, 1992). However, disabled vehicle related, walking along roadway, and "miscellaneous/unknown" crashes were all more likely to involve a drinking driver. Both disabled vehicle and walking along roadway crashes occur more frequently on rural roads, at nighttime, and on weekends, all factors associated with alcohol use. The "miscellaneous" category includes dispute-related, suicide, assault, and lying in road crash types, also associated with alcohol use.

LOCATION/ENVIRONMENT CHARACTERISTICS

Urban/Rural Location

Table 19 shows the distribution of crash types by urban/rural location. As noted above, disabled vehicle and walking along roadway crashes were more likely than other types of pedestrian crashes to occur on rural roadways. Intersection crashes, particularly those involving a driver violation or turning vehicle, were more likely to occur in urban areas. The remaining crash types tended to follow general pattern of two-thirds urban, one-third rural.

Private Property

One of the variables coded from the review of the hard copies of the police crash reports was whether the crash occurred on private property and the type of private property (parking lot, driveway, etc.). Most crash types occurred almost entirely on public roadways; however, three occurred predominantly on private property. These were:

	Percent Private Property
Not in road	78 percent
Backing vehicle	70 percent
Driverless vehicle	60 percent

Table 17. Pedestrian crash types by driver gender.

Pedestrian Crash Type Subgroup	DRIVER GENDER*	
	Male	Female
Bus related	65.9	34.1
Other vehicle-specific	60.8	39.2
Driverless vehicle	50.0	50.0
Backing vehicle	63.1	36.9
Disabled vehicle related	62.5	37.5
Working/playing in road	61.2	38.8
Walking along roadway	72.7	27.3
Not in road	67.0	33.0
Vehicle turning at Intersection	63.6	36.4
Intersection dash	56.7	43.3
Driver violation at intersection	58.9	41.1
Other intersection	62.3	37.7
Midblock dart/dash	57.9	42.1
Other midblock	62.9	37.1
Miscellaneous	70.4	29.6
ALL CRASHES	62.7	37.3

*Row percents. Cases with unknown driver gender excluded.

Table 18. Pedestrian crash types by driver sobriety.

	DRIVER SOBRIETY*		
Pedestrian Crash Type Subgroup	No Alcohol or Drugs	Alcohol or Drugs	Other
Bus related	93.0	4.7	2.3
Other vehicle-specific	77.1	7.2	15.7
Driverless vehicle	61.2	0.0	38.8
Backing vehicle	82.5	6.3	11.2
Disabled vehicle related	78.0	11.9	10.1
Working/playing in road	91.6	3.8	4.6
Walking along roadway	63.5	8.6	27.9
Not in road	77.0	7.3	15.8
Vehicle turning at intersection	83.0	2.9	14.0
Intersection dash	92.9	3.4	3.7
Driver violation at intersection	69.7	4.8	25.4
Other intersection	80.9	4.3	14.8
Midblock dart/dash	93.3	4.2	2.5
Other midblock	83.0	7.3	9.7
Miscellaneous	74.6	10.7	14.7
ALL CRASHES	81.7	5.8	12.5

*Row percents. Cases with unknown driver sobriety excluded.

Table 19. Pedestrian crash types by rural/urban location.

	LOCATION*	
Pedestrian Crash Type	Rural	Urban
Bus related	31.8	68.2
Other vehicle-specific	30.3	69.7
Driverless vehicle	39.2	60.8
Backing vehicle	37.8	62.2
Disabled vehicle related	43.8	56.2
Working/playing in road	39.0	61.0
Walking along roadway	43.8	56.2
Not in road	37.0	63.0
Vehicle turning at intersection	23.3	76.7
Intersection dash	29.1	70.9
Driver violation at intersection	20.3	79.7
Other intersection	28.2	71.8
Midblock dart/dash	31.8	68.2
Other midblock	33.9	66.1
Miscellaneous	32.0	68.0
ALL CRASHES	32.4	67.6

*Row percents. Cases with unknown location excluded.

Although not-in-road crashes include situations where a pedestrian is struck while standing at or near a curb (i.e., on public property), nearly half (47 percent) of these events occurred in parking lots and an additional 15 percent in driveways or on sidewalks where they cross driveways. Similarly, 45 percent of backing vehicle crashes occurred in parking lots and 17 percent in driveway/sidewalk locations. Finally, 35 percent of driverless vehicle crashes occurred in parking lots and 20 percent occurred entirely in driveways.

Day of Week

Certain crash types were more likely to occur on weekends and others on weekdays (table 20). Those more likely to occur on weekends included disabled vehicle related crashes and walking along roadway crashes. Those more likely to occur on weekdays included bus related, vehicle turning at intersection, driver violation at intersection, and working/playing in road crashes.

Time of Day

The time of the day when pedestrian crashes occur is shown in table 21. Bus related crashes were overrepresented in the early morning and late afternoon hours, coinciding with peaks in their exposure. Working/playing in road and vehicle turning at intersection crashes were overrepresented during the morning and early afternoon hours, from 6 a.m. until 2 p.m. Driverless vehicle crashes were especially frequent during the mid-morning to late afternoon hours, and backing crashes in the 10 a.m. - 2 p.m. slot. From 2 p.m. until 6 p.m. intersection dashes and midblock darts and dashes were overrepresented. Shifting to the nighttime hours, both disabled vehicle related and walking along roadway crashes were greatly overrepresented between the hours of 6 p.m. and 6 a.m. Also overrepresented during the 2 a.m. to 6 a.m. time period were not-in-road and other intersection and midblock crashes.

Light Condition

Results for light condition were similar (see table 22). Over 70 percent of bus-related, other vehicle-specific, driverless vehicle, backing vehicle, working/playing in road, vehicle turning at intersection, intersection dash, and midblock dart/dash crashes occurred during daylight hours. In contrast, only 34 percent of walking along roadway crashes and 40 percent of disabled vehicle related crashes occurred during daylight. Just under 42 percent of walking along roadway crashes, and 37 percent of disable vehicle related crashes, occurred on dark roadways with no street lights, compared to 12 percent for pedestrian crashes overall.

ROADWAY FACTORS

Road Class

Information on the road classification where pedestrian crashes occurred is presented in table 23. Disabled vehicle crashes were overrepresented on Interstate roadways, U.S.

Table 20. Pedestrian crash type by day of week.

	DAY OF WEEK*	
Pedestrian Crash Type Subgroup	Weekday	Weekend
Bus related	77.3	22.7
Other vehicle-specific	61.8	38.2
Driverless vehicle	68.9	31.1
Backing vehicle	68.1	31.9
Disabled vehicle related	55.4	44.6
Working/playing in road	71.9	28.1
Walking along roadway	55.3	44.7
Not in road	62.7	37.3
Vehicle turning at Intersection	76.6	23.4
Intersection dash	65.8	34.2
Driver violation at intersection	73.8	26.2
Other intersection	62.3	37.7
Midblock dart/dash	63.9	36.1
Other midblock	61.4	38.6
Miscellaneous	66.1	33.9
ALL CRASHES	65.2	34.8

*Row percents. Weekend defined from 6 p.m. Friday until 6 a.m. Monday.

Table 21. Pedestrian crash types by hour of day.

Pedestrian Crash Type Subgroup	HOUR OF DAY*					
	6 a.m. - 9:59 a.m.	10 a.m. - 1:59 p.m.	2 p.m. - 5:59 p.m.	6 p.m. - 9:59 p.m.	10 p.m. - 1:59 a.m.	2 a.m. - 5:59 a.m.
Bus related	20.5	9.1	50.0	13.6	4.6	2.3
Other vehicle-specific	3.4	21.4	39.3	23.6	10.1	2.3
Driverless vehicle	9.6	24.7	42.5	16.4	5.5	1.4
Backing vehicle	12.3	25.6	28.8	18.9	10.5	3.9
Disabled vehicle related	13.6	14.4	16.9	30.5	17.8	6.8
Working/playing in road	17.2	22.1	31.0	25.5	2.8	1.4
Walking along roadway	13.6	7.2	16.2	34.7	21.3	6.9
Not in road	11.1	19.9	36.5	19.9	8.3	4.3
Vehicle turning at intersection	18.8	22.3	36.7	17.2	3.7	1.2
Intersection dash	9.4	12.3	47.9	23.4	5.7	1.4
Driver violation at intersection	15.3	20.6	31.1	23.0	9.3	0.8
Other intersection	11.4	12.4	32.7	27.6	11.4	4.5
Midblock dart/dash	7.3	14.7	45.1	26.4	5.3	1.2
Other midblock	9.4	12.7	27.4	31.3	14.5	4.7
Miscellaneous	8.9	13.7	23.4	23.4	19.8	10.9
ALL CRASHES	11.5	15.9	33.1	25.1	10.5	3.8

*Row percents. Cases with unknown hour of day excluded.

Table 22. Pedestrian crash types by light condition.

	LIGHT CONDITION*			
Pedestrian Crash Type	Daylight	Dawn/Dusk	Dark, Street Light	Dark, No Street Light
Bus related	72.7	4.5	20.5	2.3
Other vehicle-specific	74.2	2.2	13.5	10.1
Driverless vehicle	82.4	4.1	4.1	9.5
Backing vehicle	72.0	3.2	19.1	5.7
Disabled vehicle related	40.0	6.7	16.7	36.7
Working/playing in road	74.7	8.2	11.6	5.5
Walking along roadway	33.5	5.5	19.4	41.6
Not in road	67.8	4.2	22.6	5.4
Vehicle turning at intersection	72.0	5.3	20.5	2.2
Intersection dash	70.9	4.5	20.4	4.2
Driver violation at intersection	63.1	2.7	32.9	1.2
Other intersection	53.8	4.4	34.8	7.0
Midblock dart/dash	73.4	5.7	14.7	6.2
Other midblock	46.8	3.4	32.1	17.7
Miscellaneous	49.5	3.8	28.6	18.1
ALL CRASHES	60.6	4.6	23.3	11.6

*Row percents. Cases with unknown light condition excluded.

Table 23. Pedestrian crash types by road class.

Pedestrian Crash Type Subgroup	ROAD CLASS*					
	Interstate	US Route	State Route	County Route	Local Street	Other
Bus related	0.0	3.1	15.6	25.0	37.5	18.8
Other vehicle-specific	2.1	4.3	17.0	21.3	40.4	14.9
Driverless vehicle	3.5	1.8	8.8	22.8	24.6	38.6
Backing vehicle	0.0	2.6	7.7	10.3	28.9	50.5
Disabled vehicle related	17.7	13.9	27.8	21.5	12.7	6.3
Working/playing in road	2.2	7.8	10.0	34.4	33.3	12.2
Walking along roadway	4.0	10.5	22.2	34.8	23.4	5.2
Not in road	0.0	2.9	8.4	10.5	20.5	57.7
Vehicle turning at intersection	0.0	10.0	18.3	22.3	28.3	21.1
Intersection dash	0.5	4.3	22.2	22.7	38.2	12.1
Driver violation at intersection	0.0	7.4	24.7	19.8	38.3	9.9
Other intersection	0.0	14.0	28.8	18.1	27.1	12.0
Midblock dart/dash	0.0	8.7	19.7	27.0	33.0	11.6
Other midblock	0.2	10.4	28.0	22.6	30.6	8.2
Miscellaneous	1.7	6.7	15.5	26.5	31.5	18.1
ALL CRASHES	1.3	8.2	19.9	22.8	29.1	18.6

*Row percents. Cases with unknown road class excluded.

routes, and State routes. Other (undefined) intersection crashes were also overrepresented on U.S. and State routes. Working/playing in road and walking along roadway crashes were particularly likely to occur along county routes, while bus-related, other vehicle-specific, and driver violation at intersection crashes were more likely than other crash types to occur on local streets. "Other" road type includes private property and off-road locations. Not-in-road, backing vehicle, and driverless vehicle crashes were all overrepresented in these types of locations.

Road Feature

Overall, 37 percent of pedestrian crashes occurred at roadway intersections (table 24). By definition, the four subcategories of intersection crashes overwhelmingly fell into this category. (The small percentage of crashes coded as "no special feature" may have occurred outside the normal boundaries of an intersection.) The only other crash types to occur frequently at intersections were bus-related crashes (41 percent intersection) and working or playing in the road crashes (26 percent intersection). Midblock, walking along the roadway, disabled vehicle, and other vehicle-specific crash types all occurred primarily on road segments with no special feature. And finally, driverless vehicle, backing vehicle, and not in-road crash types were all overrpresented in the "other road feature" category, which incorporates off-road locations.

Number of Lanes

Approximately twice as many pedestrian crashes occurred on 1-to-2-lane roadways as 3-to-4-lane roadways (table 25). Crash types overrepresented on the narrower roadways include other vehicle-specific, driverless vehicle, backing vehicle, working/playing in roadway, and walking along roadway crash types. Intersection-related crashes are overrepresented on 3-to-4-lane roadways, and disabled-vehicle related crashes on the 5-to-6- and 7+ lane roadways. The percentage distributions presented in the table pertain only to those crashes that occurred on or near a roadway, so that for several of the crash types (driverless vehicles, backing vehicle, and not in road), the distributions are based on a reduced number of cases.

Speed Limit

Speed limit data is presented in table 26. Nearly half of the pedestrian crashes occurred on streets or roadways with speed limits of 48 to 56 km/h (30 to 35 mi/h). For bus-related and vehicle turning at intersection crash types, the proportion increased to approximately two-thirds. Crash types overrepresented on the lower speed roadways [$\leq$ 40 km/h (25 mi/h)] included driverless vehicle, backing vehicle, other vehicle-specific, working/playing in road, and not in road crash types. Those overrepresented on higher speed roadways [81+ km/h (51 mi/h)] included disabled vehicle, walking along roadway, and driverless vehicle crashes. It should be noted that speed limit data was missing for 55 to 60 percent of the driverless vehicle, backing vehicle, and not in road crash types, again due to the fact that a high proportion of these crashes occurred in off-road locations.

Table 24. Pedestrian crash types by road feature.

Pedestrian Crash Type Subgroup	ROAD FEATURE*					
	No Special	Driveway Public	Driveway Private	Alley/ Driveway Intersection	Road Intersection	Other
Bus related	53.8	2.6	0.0	0.0	41.0	2.6
Other vehicle-specific	74.7	1.2	8.4	0.0	13.3	2.4
Driverless vehicle	34.5	6.0	16.7	1.2	4.8	36.9
Backing vehicle	19.1	8.6	14.6	0.4	9.0	48.3
Disabled vehicle related	71.8	0.9	0.9	0.0	14.5	11.8
Working/playing in road	60.0	0.0	5.8	1.7	25.8	6.7
Walking along roadway	86.9	1.9	1.3	0.0	7.6	2.2
Not in road	13.3	14.8	5.2	1.8	7.0	57.9
Vehicle turning at intersection	2.4	1.3	0.0	0.0	95.7	0.6
Intersection dash	4.7	0.7	0.0	0.0	93.6	1.0
Driver violation at intersection	2.6	0.0	0.0	0.0	97.0	0.4
Other intersection	8.5	0.2	0.2	0.0	90.6	0.5
Midblock dart/dash	89.8	1.8	4.4	1.5	1.0	1.5
Other midblock	88.2	2.5	2.0	0.5	3.4	3.3
Miscellaneous	18.3	54.7	7.9	0.0	19.9	3.5
ALL CRASHES	44.9	3.1	3.3	0.5	37.1	11.2

*Row percents. Cases with unknown road feature excluded.

Table 25. Pedestrian crash types by number travel lanes.

Pedestrian Crash Type Subgroup	TRAVEL LANES*			
	1 to 2 Lanes	3 to 4 Lanes	5 to 6 Lanes	7+
Bus related	71.4	22.9	2.9	2.9
Other vehicle-specific	88.2	10.5	1.3	0.0
Driverless vehicle**	87.5	10.0	0.0	2.5
Backing vehicle**	88.2	8.4	2.5	0.8
Disabled vehicle related	48.0	32.4	11.8	7.8
Working/playing in road	79.0	14.3	5.0	1.7
Walking along roadway	77.3	16.7	4.3	1.7
Not in road**	75.8	16.4	5.5	2.3
Vehicle turning at intersection	42.7	50.0	6.7	0.6
Intersection dash	58.0	31.8	8.7	1.5
Driver violation at intersection	50.5	38.6	8.7	2.2
Other intersection	37.8	48.8	10.3	3.1
Midblock dart/dash	72.0	20.9	4.9	2.2
Other midblock	52.8	35.2	10.9	1.1
Miscellaneous	74.4	19.4	5.4	0.8
ALL CRASHES	61.5	29.5	7.1	1.9

*Row percents. Cases with unknown travel lanes excluded.
**Large proportion of cases occurring off-road excluded.

Table 26. Pedestrian crash types by speed limit.

Pedestrian Crash Type Subgroup	SPEED LIMIT*			
	≤ 40 km/h	48 to 56 km/h	64 to 73 km/h	81+ km/h
Bus related	23.7	68.4	5.3	2.6
Other vehicle-specific	44.9	38.5	6.4	10.3
Driverless vehicle**	45.7	30.4	0.0	23.9
Backing vehicle**	50.0	38.7	2.8	8.5
Disabled vehicle related	4.7	24.3	16.8	54.2
Working/playing in road	39.2	36.8	8.0	16.0
Walking along roadway	14.3	32.7	16.2	36.8
Not in road**	49.5	33.5	7.5	9.6
Vehicle turning at intersection	20.8	65.8	11.9	1.6
Intersection dash	24.0	54.8	17.4	3.7
Driver violation at intersection	32.1	56.7	10.3	0.9
Other intersection	18.0	56.4	20.4	5.2
Midblock dart/dash	34.7	41.8	14.7	8.8
Other midblock	21.7	47.4	19.2	11.8
Miscellaneous	30.1	40.6	12.0	17.4
ALL CRASHES	27.0	46.9	14.3	11.8

*Row percents. Cases with unknown speed limit excluded.
**Large proportion of cases occurring off-road excluded.
(1 km = 0.62 mi)

Traffic Control

Nearly three-fourths of crashes occurred at locations with no traffic control device present (table 27). Intersection-related crashes were an obvious exception: 83 percent of vehicle turning crashes, 59 percent of driver violation crashes, and 34 percent of intersection dashes occurred at locations controlled by either a traffic signal or stop sign. These percentages are likely deflated some, due to the fact that the crash typing guidelines specify 15 m (50 ft) as the outer boundary for an intersection crash, whereas police officers may only have recorded the presence of a traffic control device if the pedestrian was struck within the intersection itself. Bus-related crashes were the only other crash type to involve over 20 percent of cases occurring at traffic signal or stop sign locations.

Detailed Pedestrian Location

Table 28 gives the detailed location of the pedestrian for each of the major crash type subgroups. Bus-related crashes, intersection-related crashes (including vehicle turning, intersection dash, driver violation and other), and midblock crashes (including darts and dashes and other) almost always involved a pedestrian being struck while in the travel lane. Disabled vehicle related crashes and walking along the roadway crashes, on the other hand, involved large percentages of pedestrians on the road shoulder or at the edge of a travel lane prior to being struck. For crashes occurring "not in road," half were in parking lots, 17 percent on sidewalks, and 15 percent in alleys or driveways. Driverless vehicle crashes were most likely to occur in parking lots (37 percent), followed by travel lanes (26 percent) and alleyways or driveways (20 percent). Backing vehicle crashes were similar: 45 percent parking lot, 23 percent travel lane, and 13 percent alley or driveway.

FAULT

Overall the pedestrian was judged to be solely at fault in 43 percent of the crashes and the driver solely at fault in 35 percent (table 29). Crash types where the pedestrian was particularly likely to be at fault include the following:

	Percent Pedestrian Solely at Fault
Midblock dart/dash	91.8 percent
Other midblock	60.4 percent
Intersection dash	90.6 percent
Other intersection	59.5 percent

Table 27. Pedestrian crash types by traffic control.

Pedestrian Crash Type Subgroup	TRAFFIC CONTROL*			
	No Control	Stop Sign	Stop/Go Signal	Other Traffic Control**
Bus related	79.1	11.6	9.3	0.0
Other vehicle-specific	90.6	4.7	4.7	0.0
Driverless vehicle	97.6	1.2	1.2	0.0
Backing vehicle	96.1	1.1	2.2	0.7
Disabled vehicle related	87.3	2.5	7.6	2.5
Working/playing in road	77.9	8.6	5.0	8.6
Walking along roadway	96.1	2.1	1.3	0.5
Not in road	94.3	3.1	0.9	1.7
Vehicle turning at intersection	15.5	20.0	63.3	1.2
Intersection dash	66.0	9.8	24.0	0.3
Driver violation at intersection	38.8	24.7	34.1	2.4
Other intersection	47.5	9.6	42.2	0.6
Midblock dart/dash	94.4	1.9	2.9	0.8
Other midblock	91.1	1.0	6.6	1.4
Miscellaneous	85.0	5.3	7.2	2.5
ALL CRASHES	74.4	7.0	17.3	1.4

*Row percents. Cases with unknown traffic control excluded.
**Flashing signal, yield sign, railroad crossing, official flagman.

Table 28. Pedestrian crash types by detailed pedestrian location.

	PEDESTRIAN LOCATION*					
Pedestrian Crash Type Subgroup	Travel Lane	Shoulder, Edge of Lane	Sidewalk	Alley, Driveway	Parking Lot	Other
Bus related	97.7	2.3	0.0	0.0	0.0	0.0
Other vehicle-specific	76.6	9.6	0.0	0.0	3.2	10.6
Driverless vehicle	26.2	5.8	1.0	20.4	36.9	9.7
Backing vehicle	22.6	2.6	6.3	13.1	44.9	10.6
Disabled vehicle related	58.1	30.7	0.0	1.6	1.6	8.1
Working/playing in road	79.0	7.9	0.0	1.3	1.3	10.5
Walking along roadway	53.0	41.2	0.3	0.3	0.0	5.2
Not in road	3.9	5.5	16.7	14.9	49.8	9.2
Vehicle turning at intersection	97.2	1.2	1.0	0.0	0.0	1.6
Intersection dash	100.0	0.0	0.0	0.0	0.0	0.0
Driver violation at intersection	98.5	0.8	0.0	0.0	0.0	0.8
Other intersection	98.8	0.2	0.0	0.0	0.0	0.0
Midblock dart/dash	99.3	0.0	0.0	0.3	0.0	0.4
Other midblock	96.7	1.2	0.0	0.0	0.5	1.6
Miscellaneous	50.1	10.4	4.7	3.1	13.0	18.7
ALL CRASHES	74.2	6.4	2.3	3.0	9.3	4.8

*Row percents. Cases with unknown pedestrian location excluded.

Table 29. Pedestrian crash types by party at fault.

Pedestrian Crash Type Subgroup	FAULT*						
	Driver Only	Driver; Pedestrian Unknown	Pedestrian Only	Pedestrian; Driver Unknown	Both	Neither	Unknown
Bus related	34.1	0.0	50.0	2.3	9.1	2.3	2.3
Other vehicle-specific	21.3	4.3	45.7	6.4	20.2	0.0	2.1
Driverless vehicle	89.4	0.0	1.9	0.0	3.8	4.8	0.0
Backing vehicle	67.8	3.7	10.3	0.3	13.4	0.6	4.0
Disabled vehicle related	62.9	0.8	8.9	3.2	21.0	1.6	1.6
Working/playing in road	36.8	0.7	50.7	2.6	6.6	0.0	2.6
Walking along roadway	18.0	2.8	28.8	12.8	34.5	0.2	3.0
Not in road	61.0	3.2	22.0	0.7	8.3	0.9	3.9
Vehicle turning at intersection	79.1	1.8	9.3	0.6	6.8	0.2	2.2
Intersection dash	0.6	0.0	90.6	2.2	6.6	0.0	0.0
Driver violation at intersection	87.6	3.9	0.4	0.4	6.6	0.0	1.2
Other intersection	12.6	3.3	59.5	5.5	11.4	0.4	7.3
Midblock dart/dash	1.0	0.2	91.8	1.8	5.0	0.2	0.0
Other midblock	11.5	2.2	60.4	5.3	16.0	0.5	4.1
Miscellaneous	39.3	2.0	21.7	3.3	18.9	7.1	7.8
ALL CRASHES	34.8	2.1	43.2	3.4	12.5	1.0	3.2

*Row percents. Cases with unknown fault excluded.

Those situations where the motor vehicle operator was more likely at fault include:

	Percent Driver Solely at Fault
Driverless vehicle	89.4 percent
Driver violation at intersection	87.6 percent
Vehicle turning at intersection	79.1 percent
Backing vehicle	67.8 percent
Not in road	61.0 percent

CHAPTER 4. OVERVIEW OF BICYCLE CRASHES

This chapter presents an overview of the 3,000 bicycle-motor vehicle crashes from the six States. The variables reported include both those coded by the project team during its review of the crash report form and the variables recorded on the computerized crash files from each State. Variables have been grouped into the following categories:

- Bicyclist characteristics.
- Driver characteristics.
- Temporal/environmental factors.
- Locational factors.
- Roadway factors.
- Vehicle factors.
- Crash characteristics.
- Contributing factors.
- Fault.

Single variable frequencies are presented in summary tables, while relevant crosstabulations are merely discussed in the text. Of the original 3,000 bicycle-motor vehicle crashes, 2,990 were successfully linked with State crash file data to provide additional variables for analysis. Missing data or items unable to be coded lead to different totals in the tables that are presented.

BICYCLIST CHARACTERISTICS

Variables describing the crash-involved bicyclist are summarized in table 30. Nearly half (45.1 percent) of the bicyclists in collisions with motor vehicles were children less than 15 years old, with an additional 15 percent age 15 to 19. About one-fourth of the bicyclists were age 25 to 44, compared to about 10 percent in the earlier Cross and Fisher study and perhaps reflecting increased ridership for this age group in the last decade or so. Compared to their representation in the overall U.S. population, young persons were overrepresented in bicycle-motor vehicle crashes while older adults and the elderly were underrepresented, as shown below:

Age	Percent of U.S. Population	Percent of Crash Sample
0-9	15	18
10-14	7	27
.	.	.
.	.	.
25-44	33	23
.	.	.
.	.	.
65+	13	2

As will be shown later, however, bicyclists older than age 44 were overrepresented with regard to serious and fatal injury.

Almost 80 percent of the crash-involved bicyclists were male. This pattern tends to be constant across age groups except for bicyclists above age 44, where the male percentage increases to about 88 percent. This tendency seems to have changed little over time and almost surely remains related to exposure.

Table 30. Bicyclist characteristics.

Age	N	%	Physical Condition	N	%
0-9	504	18.2	Normal	2295	96.1
10-14	745	26.9	Impairment - alc., drugs, medicine	72	3.0
15-19	406	14.6			
20-24	292	10.5	Asleep	2	0.1
25-44	641	23.1	Ill	9	0.4
45-64	134	4.8	Fatigued	1	0.0
65+	52	1.9	Other	10	0.4
Total	2774	100.0	**Total**	2389	100.0
Gender			**Bicycle Type**		
Male	2246	78.9	Standard	2967	99.0
Female	602	21.1	Adult tricycle	8	0.0
Total	2848	100.0	Recumbent	0	0.0
			Tandem	3	0.0
Injury Severity			Other	9	0.0
			Total	2987	99.0
Fatal (K)	46	1.6			
Serious (A)	473	16.6			
Moderate (B)	1315	46.1			
Minor (C)	830	29.1			
None (O)	188	6.6			
Total	2852	100.0			
Alcohol/Drug Use					
Alcohol	131	5.3			
Other	93	3.8			
None	2252	90.9			
Total	2476	100.0			

Fewer than 2 percent of the crashes resulted in a bicyclist fatality and an additional 17 percent in serious (A-level) injury. This A+K percentage total is considerably less than

for pedestrians (33 percent A+K). Bicyclists older than age 44 were overrepresented with regard to both fatal and serious injury, where "overrepresented" means this group had a considerably greater proportion of fatal and serious injuries than the proportion of fatal and serious injuries for all age groups combined. The terms "more than expected" and "more than their share" are also used in the text to reflect this kind of comparison. The 15 to 19 year old bicyclists seemed to suffer less serious injury than the other age groups.

About 5 percent of the bicyclists were judged by the investigating police officer to have been impaired by alcohol at the time of the crash, and an additional 4 percent impaired otherwise. Alcohol or drug/use was also coded for about 4 percent of the cases as a bicyclist contributing factor. It should be emphasized that most of these outcomes are based on the officer's opinion at the scene of the crash, and not on the results of any chemical tests administered. Alcohol use was highest in the 25 to 44 and 65+ age groups and for males. Bicyclists using alcohol or drugs were more likely to suffer serious and fatal injuries.

The vast majority of the bicyclists were described as "normal" physical condition. Impairment resulting from alcohol, drugs, medicine, etc. was cited in a few cases.

Almost all of the bicyclists were judged to be riding standard bicycles. Only a handful of adult tricycles, tandems, and other types were coded.

Staff attempted to code several bicyclist characteristics that yielded little useful data because the information was simply not available on the report form. A prime example is helmet use by the bicyclist. Overall, 2.8 percent of these crash-involved riders were coded as wearing a helmet (with another 2.1 percent unknown). The best detail concerning this item came from California, which was true for a number of items coded. About 6 percent of the California bicyclists were coded as wearing a helmet, but this percentage was felt to be conservative. In like fashion, little data were available pertaining to safety equipment used by the bicyclists, special equipment used (e.g., child seat — only two cases coded), and bicycle type.

DRIVER CHARACTERISTICS

Characteristics of the crash-involved driver are shown in table 31. The largest proportion of drivers were age 25 to 44, and 30 percent of the drivers were above age 44 (10 percent above age 64). The overall distribution is reasonably similar to that for drivers involved in crashes with pedestrians, as well as to the population of all crash-involved drivers as reported in the 1991 General Estimates System database (NHTSA, 1992). The percentage of male drivers was greater than females — 58 versus 42 percent, and again similar to that for pedestrian crashes.

As expected, injury severity was slight for drivers, with 98 percent sustaining no injury. Those injured were more likely to have been in a collision with another motor vehicle or a fixed object. Fewer than 2 percent of the drivers were judged by the investigating officer to have used alcohol or drugs, compared to about 6 percent for drivers striking pedestrians. Overall, 8 percent of crashes are reported to involve alcohol, although

Table 31. Driver characteristics.

	N	%
Age		
<16	5	0.2
16-19	263	10.8
20-24	336	13.8
25-44	1106	45.3
45-64	501	20.5
65+	233	9.5
Total	2444	100.1
Gender		
Male	1459	58.1
Female	1052	41.9
Total	2511	100.0
Injury Severity		
Fatal (K)	0	0
Serious (A)	9	0.4
Moderate (B)	16	0.6
Minor (C)	24	0.9
None (O)	2527	98.1
Total	2576	100.0
Alcohol/Drug Use		
Alcohol	48	1.8
Other	242	9.2
None	2328	88.9
Total	2618	99.9

this percentage is considerably higher for nighttime, weekend, and more serious crashes (NHTSA, 1992).

TEMPORAL/ENVIRONMENTAL FACTORS

Temporal and environmental factors characterizing bicycle crashes are summarized in table 32. Bicycle crashes have always tended to be more frequent in summer, and the months of June, July, and August each contained about 13 percent of the crashes. Exposure would certainly be a factor. Crash experience was appreciably less in cold weather months. These trends showed some variability by age group, with children less than 10 years old more heavily represented in crashes in April, May, and September, but not in summer. On

Table 32. Temporal/environmental factors.

Month	N	%
January	105	3.6
February	130	4.4
March	180	6.1
April	244	8.3
May	342	11.6
June	385	13.1
July	390	13.3
August	366	12.5
September	296	10.1
October	267	9.1
November	144	4.9
December	91	3.1
Total	2940	100.1
Day of Week		
Monday	440	15.0
Tuesday	386	13.1
Wednesday	450	15.3
Thursday	476	16.2
Friday	452	15.4
Saturday	374	12.7
Sunday	362	12.3
Total	2840	100.0
Weekday/Weekend		
Weekday	2065	70.2
Weekend	878	29.8
Total	2943	100.0

Time of Day	N	%
6:00 a.m. - 9:59 a.m.	274	9.4
10:00 a.m. - 1:59 p.m.	547	18.8
2:00 p.m. - 5:59 p.m.	1192	41.0
6:00 p.m. - 9:59 p.m.	739	25.4
10:00 p.m. - 1:59 a.m.	124	4.3
2:00 a.m. - 5:59 a.m.	30	1.0
Total	2906	99.9
Light Condition		
Daylight	2318	79.2
Dawn/dusk	169	5.8
Dark, street lights	329	11.2
Dark, no lights	111	3.8
Total	2927	100.0
Weather Condition		
Clear	2290	78.2
Cloudy	505	17.3
Raining	116	4.0
Snowing	5	0.2
Fog	4	0.1
Other	8	0.3
Total	2928	100.1
Road Condition		
Dry	2703	92.2
Wet	195	6.7
Other	33	1.1
Total	2931	100.0

the other hand, the 10 to 14 year olds were slightly overrepresented in summer. The 20 to 24 and 25 to 44 age groups were overrepresented in colder weather months (October-February). The pattern for those over age 64 had lower frequency and was quite varied. In regard to bicyclist injury severity, fatal injuries tended to be overrepresented in colder weather months (November-March). Male bicyclists were overrepresented in colder weather months and female bicyclists underrepresented.

Unlike pedestrian crashes, bicyclist crashes were not overrepresented on weekends. Patterns within age group were not distinctive. The 45 to 64 year old age group was slightly overrepresented on weekends, while those over age 64 were slightly overrepresented on weekdays. Gender of the bicyclist seemed to have no effect. Serious and fatal injuries were more prevalent on weekends. As might be expected, the alcohol-related crashes were heavily overrepresented on weekends, with half of these crashes occurring on weekends.

About two-thirds of the bicyclist crashes occurred during late afternoon and early evening hours (41 percent from 2 to 6 p.m. and 25 percent from 6 to 10 p.m.). Exposure is likely quite high during these hours, and visibility can be a problem. The pattern again varied by age group. Children less than 10 years old were overrepresented during late afternoon and early evening, while bicyclists 20 to 24 and 25 to 44 years old were overrepresented late at night. The 45 to 64 year old and the 65+ age groups were overinvolved from 6 to 10 a.m. and 10 a.m. to 2 p.m. These tendencies are again likely related to exposure.

The serious and fatal bicyclist injuries were more prevalent late night (10 p.m. to 2 a.m.) and early morning (2 to 6 a.m.). Males were heavily overrepresented during these time periods, as was the presence of alcohol and other drugs.

Almost 80 percent of the bicycle-motor vehicle crashes occurred under daylight conditions. The pattern here by age group was predictable — younger children overrepresented during daylight and those age 15 to 64 overrepresented during conditions of darkness. Children under 10 years old had more than their share of crashes during dawn or dusk. Serious and fatal injuries to the bicyclist were heavily overrepresented during conditions of darkness with no street lights. And as noted earlier, male bicyclists were much more likely than females to be riding under conditions of darkness.

Weather and roadway surface conditions were the final variables examined in this category. The vast majority of crashes occurred under either clear or cloudy weather conditions. Four percent occurred under rainy conditions, and less than 1 percent in snow and other situations. Similar results were noted in the road condition variable, where over 92 percent of the crashes occurred on dry roads.

LOCATIONAL CHARACTERISTICS

Variables included in the locational factors table (table 33) describe the urban/rural and population nature of the crash site, as well as whether the crash occurred on a freeway/Interstate road or on private property. (Variables pertaining more specifically to the roadway are described in the next section.)

Cases were stratified on population, and the attempt was to sample fairly equally from three main groups: (1) rural and small communities, (2) medium sized cities and communities, and (3) large cities. The sample divides somewhat into thirds if split into the following groups: (1) rural up to 10,000 population (30 percent), (2) 10,000 to 100,000

Table 33. Locational factors.

Locality	N	%
Rural	887	30.9
Urban	1981	69.1
Total	2868	100.0
Population[1]		
Rural	429	22.0
<2,500	54	2.8
2,500-9,999	101	5.2
10,000-24,999	189	9.7
25,000-49,999	286	14.7
50,000-99,999	166	8.5
100,000-249,999	249	12.8
250,000+	475	24.4
Total	1949	100.1

[1]Population data not specifically coded for Maryland and Utah

Freeway/Interstate	N	%
Non-freeway, non-Interstate	2,981	99.5
Freeway, Interstate mainline	2	0.1
Freeway, Interstate interchange/ramp	10	0.3
Other	2	0.1
Total	2995	100.0
Private Property		
Not private property	2,790	93.1
Commercial, retail parking lot	57	1.9
Housing parking lot	23	0.8
Public parking lot	18	0.6
Other parking lot	10	0.3
Driveway/alley/ private road	96	3.2
Other	3	0.1
Total	2997	100.0

population (32.9 percent), and (3) 100,000 and above (37.2 percent). Based on an urban/rural definition from the state databases, about two-thirds of the cases were from urban areas. Bicyclists aged 45 to 64 were overrepresented in crashes in rural areas (38 percent of their crashes versus 31 percent overall), but other than this group, the age pattern was quite close to what was expected based on all crashes. Serious and fatal crashes were more likely to occur in rural areas — 21.8 percent in rural areas versus 16.6 percent in urban areas. This likely relates to increased vehicular speeds in rural areas. Male bicyclists were overrepresented in rural crashes and female bicyclists in urban crashes.

Virtually all (99.5 percent) of the bicycle-motor vehicle crashes occurred on non-freeway or non-Interstate routes. About 7 percent of the crashes occurred on private property, and about half of these occurred where both vehicles were in driveways or alleys or on a private road. Bicyclists less than 10 years old were somewhat overrepresented in crashes in housing related parking lots and driveways, alleys, and private roads.

About 1 percent of the crashes were judged to take place in school zones, although this information was rarely mentioned on the police form. Similarly, 1 percent of the cases were coded as the bicyclist riding to or from school.

ROADWAY FACTORS

A wide range of data pertaining to the roadway is summarized in table 34. Overall this table has higher proportions of unknown information due to variables not being available on some of the State crash files and lack of detail in some of the crash report diagrams and narratives. Items labeled "not applicable" typically refer to non-road events (e.g., driveway, parking lot crashes). Percentage distributions have been calculated excluding unknown/missing data.

Information on road class was available for Florida, Maryland, Minnesota and North Carolina. Although road class definitions and frequencies varied somewhat across the States, overall the largest portion of bicycle crashes (34 percent) occurred on local streets, with county routes (28 percent) close behind. U.S. and State routes combined accounted for about one quarter of the total. Young children had more of their crashes on the local and county routes, while bicyclists aged 45 to 64 and 65 and over were overrepresented on higher speed routes. Interestingly, no gender or alcohol presence differences were reflected by the road class variable. There was a slight tendency for the more serious (A+K) crashes to occur on U.S. and State routes.

The typical roadway configuration was a two-lane undivided roadway with a speed limit of 56 km/h (35 mi/h) or less. About 80 percent of the roads were classified as straight and level by the investigating police officer. About 5.5 percent of the crashes took place on curves. Children less than 10 years old had almost 90 percent of their crashes on two-lane roads, while older bicyclists (age 20 and up) were overrepresented on the 4, 5, and 6+ lane roads. Class A injuries to bicyclists were overrepresented on three-lane roads and fatal injuries on roads with more than four lanes.

Where data were available in regard to lane width, the crashes were spread fairly evenly. Interestingly, about one-fourth of the crashes occurred on roads with lanes over 4.9 m (16 ft) wide. The older bicyclists (45 to 64 and 65+ years of age) were overrepresented in the widest lane category, as well as 3.1- to 3.4-m (10- to 11-ft) and 3.7-m (12-ft) lanes. (Some of these wide lanes may have contained parallel parking spaces that could not be discerned from the police diagram. Parking presence is discussed a bit later in this chapter.) Class A and fatal injuries were overrepresented on the 2.7-m (9-ft) or less and 3.1- to 3.4-m (10- to 11-ft) lanes and, to a lesser extent, on 3.7-m (12-ft) lanes. Serious and fatal injuries were thus underrepresented as lane widths became wider.

Differentially striped lanes were coded as present in 3.5 percent of the cases. Where present, the outside lane was 3.9 to 5.8 m (13 to 19 ft) wide 28 percent of the time and 6.1+ m (20+ ft) about 26 percent of the time. (Again, the presence of parking may not have been detectable in some of these cases.) Bicyclists less than 10 years old were overrepresented in the 3.9- to 5.8-m (13- to 19-ft) lanes.

Table 34. Roadway factors.

Road Class[1]	N	%
Interstate	3	0.2
U.S. route	138	8.0
State route	313	18.1
County route	475	27.5
Local street	582	33.7
Other	217	12.6
Total	1728	100.1

[1]Data missing from CA, UT

Speed Limit		
40 km/h or less	606	27.0
48-56 km/h	1234	50.1
65-73 km/h	396	16.1
81+ km/h	168	6.8
Total	2404	100.0

(1 km = 0.62 mi)

Road Configuration[2]		
Divided	237	16.3
Undivided	1181	81.5
Other	32	2.2
Total	1450	100.0

Road Feature		
No special feature/not applicable	793	26.5
Bridge	8	0.3
Public driveway	344	11.5
Private driveway	229	7.6
Alley intersection	70	2.3
Intersection of roadways	1402	46.8
Intersection of roadways related	108	3.6
Non-intersection median crossing	6	0.2
End/beginning of divided highway	2	0.1
Interchange ramp	8	0.3
Interchange service road	1	0.0
Railroad crossing	3	0.1
Bike/multi-use path intersects with road	7	0.2
Parking lot abuts road	5	0.2
Other	3	0.1
Total	2989	99.8

Road Character	N	%
Straight, level	2039	78.7
Straight, hillcrest	49	1.9
Straight, grade	340	13.1
Straight, bottom	20	0.8
Curve, level	83	3.2
Curve, hillcrest	8	0.3
Curve, grade	49	1.9
Curve, bottom	2	0.1
Total	2590	100.0

Road Defects		
No defects/not applicable	2337	95.4
Holes, ruts	9	0.4
Loose material on road	20	0.8
Obstruction in road	3	0.1
Under construction	13	0.5
Defective shoulders	9	0.4
Other	58	2.4
Total	2449	100.0

Road Surface[2]		
Asphalt	1347	92.5
Concrete	50	3.4
Gravel	24	1.7
Other	35	2.4
Total	1456	100.0

[2]Data missing or not matched from CA, MN, and UT

Traffic Control Device		
No control/not applicable	1712	57.7
Stop sign	739	24.9
Yield sign	9	0.3
Traffic signal	473	16.0
Flashing signal with stop sign	3	0.1
Flashing signal without stop sign	5	0.2
Railroad gate and flasher	1	0.0
Human control	4	0.1
Other	20	0.7
Total	2966	100.0

Table 34. Roadway factors (continued).

Shoulder Type	N	%
None indicated/not applicable	2176	74.5
Unpaved	89	3.1
Paved	131	4.5
Curb and gutter	384	13.2
Shoulder indicated, type unknown	142	4.5
Total	2922	99.8
Bicyclist Side Shoulder Width		
1.2 m or less	96	39.0
1.5 - 2.7 m	103	41.9
3.0 m or more	47	19.1
None indicated/not applicable	2176	--
Total	2422	100.0
(1 m = 3.3 ft)		
Bicyclist Side On-Street Parking		
None/not applicable	2528	87.9
Parallel parking	341	11.9
Diagonal parking	7	0.2
Total	2876	100.0
Number of Through Lanes		
1 lane	46	1.8
2 lanes	1656	64.9
3 lanes	69	2.7
4 lanes	614	24.1
5 lanes	56	2.2
6 or more lanes	109	4.3
Total	2550	100.0
Lane Width		
2.7 m or less	47	9.5
3.0 - 3.3 m	117	23.7
3.6 m	116	23.5
3.9 - 4.8 m	88	17.8
5.2 m or more	126	25.5
Total	494	100.0
(1 m = 3.3 ft)		

Differentially Striped Multi-Lane Road	N	%
No/not applicable	1971	96.5
Yes	72	3.5
Total	2043	100.0
Outside Lane Width		
Less than 3.6 m	75	26.0
3.6 m	59	20.4
3.9 - 5.8 m	81	28.0
6.1+ m	74	25.6
Total	289	100.0
(1 m = 3.3 ft)		
Total Number of Lanes		
1 lane	66	2.7
2 lanes	1486	60.1
3 lanes	136	5.5
4 lanes	361	14.6
5 lanes	279	11.3
6 or more lanes	146	5.9
Total	2474	100.1
Median Width		
No median/not applicable	2550	98.3
0.6 - 4.5 m	34	1.3
> 4.5 m	11	0.4
Total	2595	100.0
(1 m = 3.3 ft)		
Crossing Width to Median/Refuge		
No median/not applicable	2550	98.0
Less than 7.6 m	20	0.8
≥ 7.6 m	33	1.3
Total	2603	100.1
(1 m = 3.3 ft)		
Total Crossing Width (including median)		
< 7.6 m	223	32.8
7.6 - 14.5 m	294	43.2
> 14.5 m	164	24.1
Total	681	100.1
(1 m = 3.3 ft)		

In regard to road feature, almost half of the bicycle-motor vehicle crashes took place at roadway intersections, and another 3.6 percent were intersection-related. Almost 20 percent of the crashes occurred at driveways, with another 2 percent at alley intersections. Thus, close to three-fourths of all crashes occurred at junctions of some kind. About one-fourth of the crashes occurred at non-intersection locations with no distinguishing roadway features. At intersections, bicyclists aged 25 to 44 were slightly overrepresented and those less than 10 years old slightly underrepresented. Almost half of the crashes involving children less than age 10 occurred at private driveways. Young children were also overrepresented at alley intersections. Locations with no special feature (e.g, midblock locations) had more than their share of serious and fatal injuries. Private driveway locations had more than their share of Class A injuries.

No traffic control devices were present in about 60 percent of the cases. Stop signs were the controlling device in about one-fourth of the cases and traffic signals 16 percent of the time. This follows from the previous paragraph, where almost half the crashes occurred at roadway intersections. Young children were overrepresented at locations with no control and underrepresented at locations with traffic signals. Bicyclists 10 to 14 and 15 to 19 years old were overrepresented at stop sign locations, while bicyclists 20 to 24 and 25 to 44 years old were overrepresented at traffic signal locations. Serious and fatal injuries were slightly overrepresented at locations with no traffic control device.

Road defects were present about 5 percent of the time and included holes and ruts, loose material on the road, road under construction, defective shoulders, etc. Where data were available, about 95 percent of the crashes took place on roads with asphalt or concrete paving.

No shoulders were indicated about three-fourths of the time. Curb and gutter was noted in 13 percent of the cases and paved shoulders in less than five percent of the cases. Actual shoulder width on the bicyclist's side of the road was rarely available. Where available, just over 40 percent was coded as 1.5 to 2.7 m (5 to 9 ft) wide. Unpaved shoulders and shoulders where the type was unknown had more than their share of serious and fatal injuries. Although sample sizes were small, shoulders 3.1 m (10 ft) or more wide had more than their share of serious and fatal injuries.

Just under 90 percent of the crashes took place at sites with no on-street parking on the bicyclist's side of the road. Where noted, the vast majority of parking was the parallel type. Young children were overrepresented at sites with parallel or diagonal parking.

Besides number of through lanes present on the roadway, the total number of lanes present were coded. This would include turning lanes at intersections, five-lane roads with center two-way left turn lane, etc. About 60 percent had two lanes and 15 percent four lanes. Slightly over 17 percent had five or more lanes. The distribution for the total number of lanes varies from that of the number of through lanes in the expected fashion. As an example, a road with four traffic lanes and a center turn lane is coded as having four through lanes but five total lanes. Thus, one would expect the percentage of roads with four total lanes to be less than the percentage of roads with four through lanes because some of the

roads with four through lanes shift into a five-lane situation when all lanes are counted. In other words, a decrease in one part of the distribution results in an increase in another part of the distribution.

Children less than 10 and 10 to 14 years old had more crashes than expected at intersections with one or two lanes, while middle aged and older bicyclists had more crashes than expected at intersections with five or 6 lanes. Serious and fatal injuries were overrepresented at intersections with only one lane. Where data were able to be coded, the total crossing width at intersections (which includes the presence of a median) tended to reflect the same age and injury patterns as shown directly above. It should again be stated that the lack of appropriate exposure data makes interpretation difficult for many of these variables.

BICYCLIST-RELATED ROADWAY FACTORS

A few roadway variables were coded that pertain quite specifically to the bicyclist. These include the detailed location of the bicyclist, as well as bike lane and sidewalk data (table 35).

About two-thirds of the bicyclists were in a through travel lane at or close to the time of impact. Three percent were on the shoulder, and another 1.5 percent at the edge of the through lane. About 15 percent were in marked or implied crosswalks. About 2 percent each were in bike lanes or on sidewalks. Slightly over 3 percent were in parking lot locations. Overrepresentation by age groups was the following:

- 0 to 9 years old - alleys, driveways, other entering roadways; parking lots
- 10 to 14 years old - sidewalks; pedestrian crosswalks; alleys, driveways, other entering roadways; parking lots
- 15 to 19 years old - edge of through lane; shoulders; sidewalks; pedestrian crosswalks
- 20 to 24 years old - edge of through lane; bike lane
- 25 to 44 years old - shoulders; bike lanes
- 45 to 64 years old - shoulders

In regard to bicyclist injury severity, through lanes, the edges of through lanes, and shoulders tended to be locations that produced more than their share of A+K injuries, while sidewalks, bike lanes, pedestrian crosswalks, alleys and driveways, and parking lots were the opposite. Not surprisingly, it would thus appear that speed of traffic was related to these A+K injuries.

Table 35. Bicyclist-related roadway factors.

Detailed Bicyclist Location	N	%
Through travel lane	2029	68.1
Edge of through lane	46	1.5
Roadside out of through lane	8	0.3
On shoulder	88	3.0
On sidewalk	63	2.1
On path beside road	1	0.0
Right turn lane	12	0.4
Left turn lane	13	0.4
Merge lane	2	0.0
Two-way left turn lane	10	0.3
Bike lane	61	2.1
On-street parking space/lane	16	0.5
Ped. crosswalk - marked	197	6.6
Ped. crosswalk - implied	264	8.9
Road-related -- unsure of exact location	19	0.6
On multi-use path	5	0.2
Alley/driveway/other entering roadway	49	1.6
Parking lot - parking space related	23	0.8
Parking lot - travel lane	59	2.0
Parking lot - other	12	0.4
Other	4	0.1
Total	2981	99.9
Bike Lane Presence		
None	2861	97.2
Cyclist side only	11	0.4
Non-cyclist side only	2	0.1
At least cyclist side	38	1.3
At least non-cyclist side	0	0
Both sides	32	1.1
Total	2944	100.1

Bicyclist In Bike Lane	N	%
No/not applicable	2900	97.6
Yes	66	2.2
Exited bike lane	6	0.2
Total	2972	100.0
Bike Lane Width		
0.9 to 2.1 m	12	60.0
2.4+ m	8	40.0
Total	20	100.0
(1 m = 3.3 ft)		
Sidewalk Presence		
None/not applicable	2148	74.3
Cyclist side only	62	2.1
Non-cyclist side only	15	0.5
At least cyclist side	414	14.3
At least non-cyclist side	10	0.4
Both sides	242	8.4
Total	2891	100.0
Bicyclist Using Sidewalk		
No/not applicable	2456	84.0
Yes	465	15.9
Total	2921	99.9

Bike lanes were present in slightly under 3 percent of the cases and, when present, appeared to be on both sides of the road about 40 percent of the time. Bike lane presence may be somewhat conservative, in that coders almost exclusively had to rely on the crash diagram drawn by police. In this regard the California diagrams were generally quite good, especially in the larger cities. The bicyclist was coded as in or exiting a bike lane in about 2.5 percent of the cases. In the handful of cases where width was shown, the bike lane was 0.9 to 2.1 meters (3 to 7 ft) wide in 60 percent of the cases and 2.4 m (8 or more ft) wide in 40 percent of the cases. And as mentioned above, bike lane crashes tended to produce fewer than their share of A+K injuries.

Sidewalks were coded as not present in about three-quarters of the cases. When present, the sidewalk was on both sides of the roadway about one-third of the time. The bicyclist was coded as using the sidewalk (but no necessarily being struck in this location) in about 16 percent of the cases. Bicyclists aged 10 to 14 and 15 to 19 had more than their share of crashes on sidewalks. Overall, cashes where bicyclists were using a sidewalk produced less than their share of serious and fatal injuries.

VEHICLE FACTORS

Only two vehicle factors are reported (table 36). In regard to type of motor vehicle, about 70 percent of the bicyclists were struck by passenger cars and 15 percent by pickup

Table 36. Vehicle factors.

	N	%
Vehicle Type		
Passenger Car	1960	70.8
Van[1]	138	5.0
Pickup truck	418	15.1
Tractor trailer	37	1.3
Bus	23	0.8
Motorcycle/ moped/scooter	24	0.9
Other	168	6.1
Total	2768	100.0
[1]Vans not identified as a separate vehicle type in CA, MD.		
Point of Contact[2]		
Front	677	35.0
Right front	358	18.5
Left front	220	11.4
Right side	202	10.4
Left side	110	5.7
Right rear	86	4.5
Left rear	38	2.0
Rear	41	2.1
Top	12	0.6
Multiple or total	69	3.6
Other	121	6.3
Total	1934	100.1
[2]Rough approximation - includes no data from CA and some amount of variation in definitions within the other 5 States.		

trucks. Where the data were available, the front, right front, or left front were the contract points in about two-thirds of the cases. The sides of the motor vehicle were the contact point in about 16 percent of the cases.

CRASH CHARACTERISTICS

Variables associated with the crash are provided in table 37. The motor vehicle maneuver was proceeding straight ahead over 50 percent of the time. Right turns from either a stopped (9.5 percent) or moving (6.3 percent) position occurred in about 16 percent of the crashes, while left turns occurred about 10 percent of the time. The motor vehicle was entering the roadway about 5 percent of the time, and the vast majority involved an entry from a driveway or alley. Backing maneuvers were present in just under 2 percent of the cases. Although not listed as a row in this table, 11 of the approximate 3,000 cases were coded as an assault with the vehicle.

In over 40 percent of the backing maneuvers a child less than 10 years old was struck. Young children also tended to be involved in cases where the motor vehicle was slowing or stopping. Many times the driver would observe the child in the street and start reacting. About one-third of the cases where the motor vehicle was passing involved 10 to 14 year old bicyclists. Over 40 percent of the time a motor vehicle was making a left turn the crash-involved bicyclist was 25 to 44 years old. These results all appear to be reflecting patterns of riding and exposure (e.g., older riders more likely to be bicycling in traffic). In regard to bicyclist injury severity, the motor vehicle maneuvers of proceeding straight ahead and passing produced more than their share of A+K injuries.

The bicyclist was coded as proceeding straight ahead about 60 percent of the time. Traveling wrong-way long term occurred about 10 percent of the time. Bikes were entering the roadway in 6 percent of the cases and crossing midblock with a similar frequency. Left turns (6 percent) were more frequent than right turns (2 percent).

Bicycle maneuvers overrepresented by age groups included the following:

- 0 to 9 years old - left turns, entering the roadway, crossing midblock, swerving left or right
- 10 to 14 years old - right and left turns, entering the roadway, traveling the wrong way, crossing midblock, swerving left or right
- 15 to 19 years old - traveling the wrong way
- 25 to 44 years old - proceeding straight ahead
- 45 to 64 years old - right turns
- 65+ years old - left turns, swerving left or right

Table 37. Crash characteristics.

Motor Vehicle Maneuver	N	%
Starting in road to go straight	238	8.0
Proceeding straight, accelerating	50	1.7
Proceeding straight, constant speed or unknown	1303	43.7
Slowing, stopping	78	2.6
Stopped	67	2.3
Right turn from stopped position	282	9.5
Right turn from moving position	187	6.3
Left turn	311	10.4
Backing	57	1.9
Passing	120	4.0
Parked	52	1.7
Entering roadway parallel paths (e.g., from shoulder)	2	0.1
Entering roadway perpendicular paths (e.g., from driveway)	150	5.0
Other	83	2.8
Total	2980	100.0
Bicycle Maneuver		
Starting in road to go straight	50	1.7
Proceeding straight, accelerating	49	1.7
Proceeding straight, constant speed or unknown	1695	57.2
Slowing, stopping	35	1.2
Stopped	26	0.9
Right turn from stopped position	7	0.2
Right turn from moving position	54	1.8
Left turn	173	5.8
U-turn or unsafe turn	24	0.8
Passing	21	0.7
Changing lanes	37	1.3
Entering roadway parallel paths (e.g., from shoulder)	34	1.2
Entering roadway perpendicular paths (e.g., from driveway)	153	5.2
Traveling wrong way	280	9.5
Crossing midblock	175	5.9
Lost control	34	1.2
Swerved right	4	0.1
Swerved left	62	2.1
Playing in road	18	0.6
Other	32	1.1
Total	2963	100.2

Bicyclist Direction of Travel At/Near Impact	N	%
With traffic	1572	56.0
Against traffic	898	32.0
Crossing traffic	337	12.0
Total	2807	100.0
Bicyclist Intended Intersection Maneuver		
Straight	1653	88.1
Left	165	8.8
Right	58	3.1
Total	1876	100.0
Motorist Intended Intersection Maneuver		
Straight	983	51.1
Left	354	18.4
Right	587	30.5
Total	1924	100.0
Bicyclist Intersection Entering Condition		
With traffic, in street	918	51.0
With traffic, off street	136	7.6
Against traffic, in street	409	22.7
Against traffic, off street	338	18.8
Total	1801	100.1
Bicyclist Intersection Crossing Approach		
Cyclist from motorist's left	496	32.5
Cyclist from motorist's right	1032	67.5
Total	1528	100.0

Bicycle maneuvers that produced more than their share of serious and fatal injuries included left turns, entering the roadway, and swerving left or right.

The bicyclist predominant direction of travel just before or at impact was with traffic in 56 percent and against traffic in 32 percent of the cases. Crossing or entering traffic midblock occurred in 12 percent of the cases. Children less than 10 years old and 10 to 14 had more than their share of crashes when the bicyclist was crossing traffic. Crashes where the bicyclist was crossing traffic tended to produce more than their share of A+K injuries. Bicyclists 10 to 14 and 15 to 19 years old had more than their share of crashes involving riding against traffic.

When entering an intersection, bicyclists were traveling with traffic about 60 percent of the time and against traffic about 40 percent of the time. Off street refers to travel both on sidewalks and in crosswalks, primarily because the vast majority of bicyclists in crosswalks entered from sidewalks or from an off street location where a sidewalk would typically be placed.

When crossing the path of a motorist at an intersection, the bicyclist was struck twice as often when coming from the motorist's right. This includes the classic situation of a right turning motorist looking left for a gap in traffic, them moving into the intersection and striking a bicyclist proceeding the wrong way in traffic. This section on crash characteristics tends to reinforce the need for proper riding techniques by bicyclists.

CONTRIBUTING FACTORS

Numerous factors contributing to the occurrence of the bicycle-motor vehicle crash were identified from the information provided on the crash report form. These contributing factors were coded into the categories of bicyclist, bicycle, motor vehicle driver, motor vehicle, and roadway/environment. As with the pedestrian crash coding, an initial listing of factors was identified for each category, and other codes were added as identified during the course of the coding. Up to three factors were listed in each category for each crash coded. The results reported in table 38 reflect the total number of times any given factor was coded and the percentage of cases involving each factor (Note: table 38 reflects a combined list of contributing factors that appeared with some frequency. The complete list of factors for each category may be found in appendix B.) For example, 114 bicyclists had alcohol or drug use noted as one of their three possible contributing factors, so that the percentage of bicyclists coded with alcohol/drug use was 114/2,990 or 3.8 percent. Since more than one factor could be coded for each bicyclist, the percentages in table 38 add to more than 100 percent.

Over 70 percent of bicyclists were coded for at least one contributing factor. The most frequently coded bicyclist factors were:

- Failed to yield 20.7 percent
- Riding against traffic 14.9 percent
- Stop sign violation 7.8 percent
- Safe movement violation 6.1 percent

Table 38. Contributing factors to bicycle-motor vehicle crashes.

Bicyclist Factors	N	%[1]
None	701	23.4
Alcohol/drug use	114	3.8
Failed to yield	621	20.7
Stop sign violation	235	7.8
Traffic signal violation	140	4.7
Exceeding speed limit/safe speed	36	1.2
Improper lane change/use of imp. lane	53	1.8
Improper turn/no hand signal	145	4.8
Lack of conspicuity	153	5.1
Safe movement violation	182	6.1
Riding against traffic	446	14.9
Inattention	80	2.7
Reckless riding/no hands/stunt ride/race	41	1.4
Pass veh on rt/ride between stopped veh	42	1.4
Improper road or lane position	30	1.0
Swerved left	75	2.5
Came off sidewalk at intersection	153	5.1
Came off sidewalk at driveway	123	4.1
Improper passengers	52	1.7
Misjudged intent of other party	40	1.3
Didn't see vehicle (bicyclist claim)	137	4.6
Couldn't avoid crash (bicyclist claim)	73	2.4
Lost control	82	2.7
All other	327	10.9
Bicycle Factors		
No defects/none	2734	91.1
No/defective/ineffective brakes	92	3.1
No relevant lights	131	4.4
No/defective reflectors	28	0.9
All other	50	1.7

Driver Factors	N	%
None	1294	43.1
Alcohol/drug use	46	1.5
Yield violation	719	24.0
Stop sign/traffic signal violation	56	1.9
Exceeding speed limit/safe speed	65	2.2
Improper passing	65	2.2
Improper turn	91	3.0
Safe movement violation	62	2.1
Improper backing	48	1.6
Right on red	60	2.0
Hit and run	428	14.3
Inattention	60	2.0
Reckless driving	41	1.4
No license	43	1.4
Assault/possible assault with veh	40	1.3
Failed to look both ways	106	3.5
Didn't see cyclist	366	12.2
Couldn't avoid crash (driv. claim)	86	2.9
All other	322	10.7
Roadway/Environment Factors		
None	2471	82.4
Sun/other glare	41	1.4
Parked veh. vision obstruction	79	2.6
Moving or stopped veh. vision obstruction	91	3.0
Other vision obstruction	122	4.1
All other	280	9.4

[1]N/2990 (total number of bicycle cases with contributing factors). Since up to 3 factors could be coded on each category, the percentages add to more than 100 percent.

These all involve riding practices. Bicyclists riding against traffic are particularly vulnerable at intersections, especially for right turning vehicles from a perpendicular street.

Lack of conspicuity was coded in 5.1 percent of the cases, but probably could have been coded a much higher percentage of the time had more detail been available on the crash report form. (Overall about 20 percent of the crashes occurred during non-daylight conditions.) Bicyclists riding into an intersection from the sidewalk were cited in slightly more than 5 percent of the cases (and another 4 percent for coming off of a sidewalk at a driveway/alley location). Bicyclists riding in this location are not easily seen by drivers because the natural driver scanning pattern is in the roadway. Improper turn/no hand signal (4.8 percent) and traffic signal violations (4.7 percent) were also cited with some regularity.

Alcohol or drug use by bicyclists was noted in 3.8 percent of the cases, and the vast majority of these citations pertained to alcohol use. Almost 5 percent of the bicyclists claimed that they did not see the motor vehicle. Bicyclist actions only rarely cited as

contributing factors included reckless riding (41 cases), passing vehicles on right/riding between stopped vehicles (42 cases), and improper passengers (52 cases). Without appropriate exposure data, however, the level of risk associated with such behaviors cannot be assessed.

Patterns of bicyclist contributing factor overrepresentation by age group included the following:

- 0 to 9 years old - yield violation, stop sign violation, improper turn, safe movement violation, inattention, didn't see vehicle, couldn't avoid crash, lost control
- 10 to 14 years old - yield violation, stop sign violation, traffic signal violation, exceeding safe speed, improper lane change/use, improper turn, safe movement violation, inattention, reckless or stunt riding, swerved left, came off sidewalk at intersection, improper passengers, didn't see vehicle
- 15 to 19 years old - traffic signal violation, improper lane change/use, not conspicuous, riding against traffic, reckless or stunt riding, pass vehicle on the right/ride between stopped vehicles, improper road or lane position, came off sidewalk at intersection and at driveway, improper passengers, misjudged intent
- 20 to 24 years old - alcohol/drug use, traffic signal violation, exceeding safe speed, not conspicuous, reckless or stunt riding, pass vehicle on the right/ride between stopped vehicles, came off sidewalk at driveway, couldn't avoid crash
- 25 to 44 years old - alcohol/drug use, not conspicuous, pass vehicle on the right/ride between stopped vehicles, improper road or lane position
- 45 to 64 years old - alcohol/drug use, improper lane change/use, not conspicuous, improper road or lane position, misjudged intent of other party
- 65+ years old - alcohol/drug use, improper lane change/use, improper turn, swerved left, came off sidewalk at intersection, misjudged intent of other party

Bicyclist contributing factors that produced more than their share of A+K injuries included alcohol/drug use, stop sign violation, improper lane change/use, improper turn, not conspicuous, safe movement violation, improper road or lane position, and swerved left.

It was rare that any bicycle contributing factors were coded (less than one-tenth of the cases). When coded, the most frequent factors were:

- No relevant lights 4.4 percent
- No/defective/ineffective brakes 3.1 percent

No or defective reflectors were cited in just less than one percent of the cases.

Bicyclists age 15 and older were overrepresented in failing to have relevant lights, while children age 10 to 14 were overrepresented in failing to have adequate brakes. Bicyclists without relevant lights had more than their share of A+K injuries.

The most frequently coded driver contributing factors were:

- Failed to yield 24.0 percent
- Hit and run 14.3 percent
- Did not see bicyclist (driver claim or police conclusion) 12.2 percent
- Failed to look both ways 3.5 percent
- Improper turn 3.0 percent

Hit and run would typically not be a contributing factor in the sense of crash causation but nonetheless was identified in 14 percent of the cases. Not all cases were blatant hit and run events. At times the driver would stop immediately and ask about the condition of the bicyclist. If told the bicyclist was "ok," the driver might leave the scene. Sometimes a parent would then report the crash a few hours later. In cases like this the investigating police officer would usually mark the case as hit and run, and coders would do likewise.

Failed to yield was coded as a driver contributing factor in about one-fourth of the cases but was not always a clear-cut label when, for example, the bicyclist emerged from a sidewalk or was inconspicuous. Failure to see the bicyclist could have resulted from a visual obstruction, bicyclist lack of conspicuity, etc. This was not coded unless claimed by the driver or concluded by the investigating officer.

Alcohol or drug use by drivers was coded in fewer than 2 percent of the cases. Some 43 percent of the cases had no driver contributing factors.

An examination of driver contributing factors by age of bicyclist tended to portray patterns of exposure. For example, when a driver was backing improperly, a young child was most likely the crash-involved bicyclist. Drivers who claimed they could not avoid the crash tended to strike children 0 to 9 and 10 to 14 years of age. Drivers improperly passing were more likely to strike middle-aged and older bicyclists. Driver contributing factors that produced more than their share of A+K bicyclist injuries included alcohol/drug use,

exceeding the speed limit, improper passing, safe movement violations, reckless driving, and being unable to avoid the crash.

In regard to motor vehicle contributing factors, 91 percent of the cases had none and another 8 percent were coded as unknown. Thus, there were only scattered instances of defective tires, wheels, brakes, etc.

Roadway/environment factors were also seldom identified, coded as none in 82 percent of the cases. Vision obstructions were the most frequently coded items. It was very difficult to determine if weather-related variables were actually a contributing factor to the crash. Thus, these kinds of variables were treated more like inventory items and are reported earlier in the "Temporal/Environmental Factors" section of this chapter. The road condition was wet in about 7 percent of the cases.

Two points about these contributing factors should be emphasized. The percentages are likely conservative, due to a lack of detail on the crash report form, although California reports were a noteworthy exception. In addition, these should be viewed as possible contributing factors, based only on the information provided on the report form. A much more thorough crash reconstruction process would be necessary for a definitive identification of contributing factors.

FAULT

One of the reasons fault was coded is that the crash type subgroup titles appear to imply culpability on the part of either the bicyclist or motor vehicle driver (e.g., motorist failed to yield to the bicyclist). However, it is entirely possible that the bicyclist could have been solely or partially at fault in such a case (e.g., if the bicyclist were riding wrong-way, or against traffic, in the street).

The bicyclist was judged to be solely at fault in 50 percent of the cases, with another 3 percent where the bicyclist was at fault and the culpability of the driver was unclear (table 39). Drivers were judged to be solely at fault in 28 percent of the cases, with another 3 percent where the driver was at fault and the culpability of the bicyclist was unclear. Both the bicyclist and driver were considered at fault in 14 percent of the cases and neither at fault in less than one percent of the cases. Fault could not be ascertained in about two percent of the cases.

The likelihood of the bicyclist being responsible for the crash was greatest for the 0 to 9 and 10 to 14 year age groups. Conversely, when the crash-involved bicyclist was older, the motor vehicle driver was more likely to be at fault. Crashes where either both the bicyclist and motorist or neither the bicyclist or motorist were considered to be at fault tended to more likely involve younger bicyclists (less than age 20). Fault seemed to be basically unrelated to bicyclist injury severity.

Table 39. Crash culpability (fault).

	N	%
Driver only	829	27.7
Driver, bicyclist unknown	77	2.6
Bicyclist only	1493	49.8
Bicyclist, driver unknown	88	2.9
Both	421	14.1
Neither	14	0.5
Both unknown, unable to determine	74	2.5
Total	2996	100.1

CHAPTER 5. BICYCLE CRASH TYPES

This chapter on bicycle crash types will parallel the material presented in chapter 3 pertaining to pedestrian crash types. Hard copies of police crash reports from the States of California, Florida, Maryland, Minnesota, North Carolina, and Utah were used to "type" the bicycle-motor vehicle crashes. The officer's diagram and written description of the crash were of prime importance in identifying the type. The objective was 500 cases coded from each State for a total of 3,000 cases. The total matched to computerized State records was 2,990.

A total of 45 distinct bicycle-motor vehicle crash types are identified in the NHTSA Manual Accident Typing (MAT) for Bicyclist Accidents Coder's Handbook. Each type is characterized by a specific sequence of causal events or bicyclist/driver actions preceding the crash occurrence. For example, in a motorist drive out from a driveway or alley, the motorist usually enters the street from a right angle and fails to perceive the bicyclist in the traffic stream. Appendix A contains a description of all of the bicycle crash types. The HSRC staff found it possible to further subdivide some of the basic crash types (e.g., where a bicyclist was overtaking a motor vehicle, expand from a single overtaking code to three codes - bicyclist passing on left, passing on right, or not passing/unknown) which led to a total of 85 crash types actually being coded. To facilitate this process we changed the basic crash type code from two to three digits.

Table 40 shows the complete distribution of 85 crash types coded for all six States. The ordering of the table reflects three main crash type groups that include specific circumstances, the bicycle and motor vehicle on parallel paths, and the bicycle and motor vehicle on crossing paths. The values in parenthesis are column percentages based on a denominator of 2,990 total crashes.

With all the detail shown in Table 40, there are numerous rows with small numbers of crashes. The specific circumstances group accounted for about 7 percent of all crashes. Crashes occurring in parking lots or other non-roadway areas were the most frequent (types 291 through 293, almost 4 percent of the cases). Of these, the vast majority involved a motor vehicle originating from the non-roadway location. Motor vehicles backing into bicycles accounted for another 1.6 percent of the cases.

Crashes where the bicycle and motor vehicle were on parallel paths accounted for more than 35 percent of the crashes. These distributed into the following categories:

Motorist turned or merged into path of bicyclist	12.1 percent
Bicyclist turned or merged into path of motorist	7.3 percent
Operator on wrong side of street	2.8 percent
Motorist overtaking bicyclist	8.6 percent

Table 40. Complete distribution of bicycle crash types by State.

	CA n (%)	FLA n (%)	MD n (%)	MN n (%)	NC n (%)	UT n (%)	Total n (%)
SPECIFIC CIRCUMSTANCES							
Weird							
361 Motorist intentionally caused	1 (0.2)	4 (0.8)	1 (0.2)	1 (0.2)	6 (1.2)	3 (0.6)	16 (0.5)
362 Bicyclist intentionally caused	--	--	--	--	--	--	--
363 Bicyclist struck by falling cargo	0 (0.0)	0 (0.0)	1 (0.2)	0 (0.0)	0 (0.0)	1 (0.2)	2 (0.1)
364 Other weird	1 (0.2)	5 (1.0)	2 (0.4)	0 (0.0)	4 (0.8)	4 (0.8)	16 (0.5)
400 Bicyclist riding child's vehicle	0 (0.0)	0 (0.0)	5 (1.0)	1 (0.2)	1 (0.2)	9 (1.8)	16 (0.5)
110 Motor vehicle backing	4 (0.8)	9 (1.8)	10 (2.0)	9 (1.8)	10 (2.0)	5 (1.0)	47 (1.6)
Non-roadway Parking Lot, etc.							
291 M.V. originated non-roadway	2 (0.4)	27 (5.4)	27 (5.4)	5 (1.0)	20 (4.0)	19 (3.8)	100 (3.3)
292 M.V. originated roadway	0 (0.0)	5 (1.0)	1 (0.2)	0 (0.0)	1 (0.2)	1 (0.2)	8 (0.3)
293 M.V. origin unknown	0 (0.0)	0 (0.0)	0 (0.0)	3 (0.6)	0 (0.0)	1 (0.2)	4 (0.1)
PARALLEL PATHS							
Motorist Turned or Merged Into Path of Bicyclist							
350 Drive out - on street parking	4 (0.8)	0 (0.0)	0 (0.0)	2 (0.4)	1 (0.2)	3 (0.6)	10 (0.3)
220 Left turn in front of bicyclist	7 (1.4)	3 (0.6)	4 (0.8)	10 (2.0)	5 (1.0)	7 (1.4)	36 (1.2)
230 Left turn facing bicyclist	33 (6.6)	29 (5.8)	20 (4.0)	33 (6.6)	24 (4.8)	37 (7.4)	176 (5.9)
240 Right turn - other	13 (2.6)	8 (1.6)	4 (0.8)	13 (2.6)	3 (0.6)	11 (2.2)	52 (1.7)
241 Motorist overtaking - right turn	21 (4.2)	17 (3.4)	7 (1.4)	13 (2.6)	14 (2.8)	7 (1.4)	79 (2.6)
242 Bicyclist overtaking - right turn	3 (0.6)	1 (0.2)	1 (0.2)	2 (0.4)	3 (0.6)	2 (0.4)	12 (0.4)
Bicyclist Turned or Merged Into Path of Motorist							
030 Ride out from sidewalk	8 (1.6)	2 (0.4)	1 (0.2)	5 (1.0)	1 (0.2)	4 (0.8)	21 (0.7)
180 Left turn in front of traffic	16 (3.2)	21 (4.2)	26 (5.2)	21 (4.2)	25 (5.0)	21 (4.2)	130 (4.4)
190 Left turn facing traffic	4 (0.8)	5 (1.0)	2 (0.4)	6 (1.2)	6 (1.2)	2 (0.4)	25 (0.8)
210 Right turn from wrong side of street	5 (1.0)	5 (1.0)	2 (0.4)	5 (1.0)	12 (2.4)	4 (0.8)	33 (1.1)
215 Right turn, other	2 (0.4)	3 (0.6)	0 (0.0)	0 (0.0)	4 (0.8)	1 (0.2)	10 (0.3)

Table 40. Complete distribution of bicycle crash types by State (continued).

	CA n (%)	FLA n (%)	MD n (%)	MN n (%)	NC n (%)	UT n (%)	Total n (%)
Operator on Wrong Side of Street							
300 Head on, counteractive evasive actions	0 (0.0)	0 (0.0)	1 (0.2)	0 (0.0)	3 (0.6)	2 (0.4)	6 (0.2)
280 Wrong way motorist	0 (0.0)	0 (0.0)	1 (0.2)	1 (0.2)	0 (0.0)	1 (0.2)	3 (0.1)
260 Wrong way bicyclist	7 (1.4)	15 (3.0)	21 (4.2)	6 (1.2)	20 (4.0)	6 (1.2)	75 (2.5)
Motorist Overtaking Bicyclist							
130 Undetected bicyclist	7 (1.4)	9 (1.8)	7 (1.4)	2 (0.4)	12 (2.4)	2 (0.4)	39 (1.3)
150 Counteractive evasive actions	4 (0.8)	9 (1.8)	14 (2.8)	5 (1.0)	23 (4.6)	4 (0.8)	59 (2.0)
160 Misjudges passing space	6 (1.2)	8 (1.6)	6 (1.2)	8 (1.6)	5 (1.0)	4 (0.8)	37 (1.2)
170 Bicyclist path obstructed - other	2 (0.4)	0 (0.0)	2 (0.4)	0 (0.0)	1 (0.2)	0 (0.0)	5 (0.2)
390 Other, unable to specify	14 (2.8)	27 (5.4)	24 (4.8)	12 (2.4)	23 (4.6)	17 (3.4)	117 (3.9)
Bicyclist Overtaking Motor Vehicle							
270 Not passing or unknown	2 (0.4)	2 (0.4)	8 (1.6)	5 (1.0)	2 (0.4)	0 (0.0)	19 (0.6)
271 Passing on left	3 (0.6)	2 (0.4)	3 (0.6)	0 (0.0)	0 (0.0)	0 (0.0)	8 (0.3)
272 Passing on right	4 (0.8)	1 (0.2)	1 (0.2)	0 (0.0)	6 (1.2)	0 (0.0)	12 (0.4)
410 Strikes parked vehicle - other	10 (2.0)	5 (1.0)	2 (0.4)	1 (0.2)	4 (0.8)	0 (0.0)	22 (0.7)
411 Strikes parked vehicles - extended door	13 (2.6)	2 (0.4)	0 (0.0)	2 (0.4)	0 (0.0)	4 (0.8)	21 (0.7)
Motorist Loss of Control							
141 Mechanical - brakes, steering, etc.							
142 Road conditions							
143 Prior collision	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.2)	0 (0.0)	1 (0.0)
144 Alcohol or drug impairment	6 (1.2)	3 (0.6)	1 (0.2)	0 (0.0)	3 (0.6)	0 (0.0)	13 (0.4)
145 Oversteering or improper braking	0 (0.0)	1 (0.2)	1 (0.2)	0 (0.0)	1 (0.2)	2 (0.4)	5 (0.2)
146 Other/unknown							
Bicyclist Loss of Control							
201 Mechanical - brakes, steering, etc.	0 (0.0)	0 (0.0)	3 (0.6)	0 (0.0)	0 (0.0)	2 (0.4)	5 (0.2)
202 Road conditions	2 (0.4)	2 (0.4)	0 (0.0)	0 (0.0)	1 (0.2)	0 (0.0)	5 (0.2)
203 Prior collision	1 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.2)	0 (0.0)	2 (0.1)
204 Alcohol or drug impairment	0 (0.0)	0 (0.0)	1 (0.2)	0 (0.0)	6 (1.2)	0 (0.0)	7 (0.2)
205 Oversteering or improper braking	4 (0.8)	1 (0.2)	2 (0.4)	2 (0.4)	0 (0.0)	2 (0.4)	11 (0.4)
206 Other/unknown	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.2)	2 (0.4)	2 (0.4)	5 (0.2)
980 Parallel path - insufficient information	1 (0.2)	0 (0.0)	2 (0.4)	2 (0.4)	8 (1.6)	2 (0.4)	15 (0.5)

Table 40. Complete distribution of bicycle crash types by State (continued).

	CA n (%)	FLA n (%)	MD n (%)	MN n (%)	NC n (%)	UT n (%)	Total n (%)
CROSSING PATHS							
Bicyclist Did Not Clear Intersection	4	1	2	2	1	5	15
060 Trapped	(0.8)	(0.2)	(0.4)	(0.4)	(0.2)	(1.0)	(0.5)
	5	2	0	6	1	13	27
070 Multiple threat	(1.0)	(0.4)	(0.0)	(1.2)	(0.2)	(2.6)	(0.9)
Motorist Failed to Yield							
081 Drive out - driveway/alley, first half	45	44	21	22	24	36	192
	(9.0)	(8.8)	(4.2)	(4.4)	(4.8)	(7.2)	(6.4)
082 Drive out - driveway/alley, second half	1	0	0	1	1	2	5
	(0.2)	(0.0)	(0.0)	(0.2)	(0.2)	(0.4)	(0.2)
083 Drive out - driveway/alley, unknown	2	2	0	3	0	3	10
	(0.4)	(0.4)	(0.0)	(0.6)	(0.0)	(0.6)	(0.3)
121 Drive through at intersection, first half	11	5	2	6	2	3	29
	(2.2)	(1.0)	(0.4)	(1.2)	(0.4)	(0.6)	(1.0)
122 Drive through at intersection, second half	2	3	4	3	3	1	16
	(0.4)	(0.6)	(0.8)	(0.6)	(0.6)	(0.2)	(0.5)
123 Drive through at intersection, unknown	44	45	32	42	23	55	241
	(8.8)	(9.0)	(6.4)	(8.4)	(4.6)	(11.0)	(8.1)
091 Drive out - stop sign or flashing red light, first half	3	6	4	9	8	0	30
	(0.6)	(1.2)	(0.8)	(1.8)	(1.6)	(0.0)	(1.0)
092 Drive out - stop sign or flashing red light, second half	2	1	0	3	0	0	6
	(0.4)	(0.2)	(0.0)	(0.6)	(0.0)	(0.0)	(0.2)
093 Drive out - stop sign or flashing red light, unknown	25	15	8	29	1	30	108
	(5.0)	(3.0)	(1.6)	(5.8)	(0.2)	(6.0)	(3.6)
100 Right turn on red	2	4	2	1	0	2	11
	(0.4)	(0.8)	(0.4)	(0.2)	(0.0)	(0.4)	(0.4)
480 Drive out - intersection, other							
Bicyclist Failed to Yield, Midblock							
011 Ride out - residential driveway, first half	18	15	20	28	15	7	103
	(3.6)	(3.0)	(4.0)	(5.6)	(3.0)	(1.4)	(3.4)
012 Ride out - residential driveway, second half	3	6	19	11	8	1	48
	(0.6)	(1.2)	(3.8)	(2.2)	(1.6)	(0.2)	(1.6)
013 Ride out - residential driveway,unknown	0	0	0	2	0	0	2
	(0.0)	(0.0)	(0.0)	(0.4)	(0.0)	(0.0)	(0.1)
021 Ride out - commercial driveway, first half	3	7	10	12	10	7	49
	(0.6)	(1.4)	(2.0)	(2.4)	(2.0)	(1.4)	(1.6)
022 Ride out - commercial driveway, second half	1	2	3	3	6	2	17
	(0.2)	(0.4)	(0.6)	(0.6)	(1.2)	(0.4)	(0.6)
023 Ride out - commercial driveway, unknown	1	0	0	0	0	1	2
	(0.2)	(0.0)	(0.0)	(0.0)	(0.0)	(0.2)	(0.1)
041 Ride out - midblock, first half	7	5	18	8	14	12	64
	(1.4)	(1.0)	(3.6)	(1.6)	(2.8)	(2.4)	(2.1)
042 Ride out - midblock, second half	6	13	13	7	10	9	58
	(1.2)	(2.6)	(2.6)	(1.4)	(2.0)	(1.8)	(1.9)
043 Ride out - midblock, unknown	0	1	3	1	0	2	7
	(0.0)	(0.2)	(0.6)	(0.2)	(0.0)	(0.4)	(0.2)
044 Ride out - unsure if driveway, alley, shoulder, or curb	1	1	0	0	1	0	3
	(0.2)	(0.2)	(0.0)	(0.0)	(0.2)	(0.0)	(0.1)

Table 40. Complete distribution of bicycle crash types by State (continued).

	CA n (%)	FLA n (%)	MD n (%)	MN n (%)	NC n (%)	UT n (%)	Total n (%)
Bicyclist Failed to Yield, Intersection							
051 Ride out - stop sign, first half	27 (5.4)	28 (5.6)	27 (5.4)	35 (7.0)	54 (10.9)	20 (4.0)	191 (6.4)
052 Ride out - stop sign, second half	9 (1.8)	16 (3.2)	20 (4.0)	19 (3.8)	15 (3.0)	12 (2.4)	91 (3.0)
053 Ride out - stop sign, unknown	1 (0.2)	0 (0.0)	1 (0.2)	4 (0.8)	1 (0.2)	1 (0.2)	8 (0.3)
491 Ride out - not stop sign, first half	21 (4.2)	13 (2.6)	35 (7.0)	26 (5.2)	15 (3.0)	30 (6.0)	140 (4.7)
492 Ride out - not stop sign, second half	7 (1.4)	9 (1.8)	17 (3.4)	11 (2.2)	7 (1.4)	17 (3.4)	68 (2.3)
493 Ride out - not stop sign, unknown	0 (0.0)	1 (0.2)	1 (0.2)	1 (0.2)	0 (0.0)	0 (0.0)	3 (0.1)
Motorist Turning							
330 Left, cut the corner	2 (0.4)	4 (0.8)	3 (0.6)	2 (0.4)	1 (0.2)	2 (0.4)	14 (0.5)
340 Right, swing out too wide	2 (0.4)	1 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.4)	5 (0.2)
Bicyclist Turning							
310 Left, cut the corner	3 (0.6)	0 (0.0)	0 (0.0)	2 (0.4)	1 (0.2)	1 (0.2)	7 (0.2)
320 Right, swing out too wide	3 (0.6)	1 (0.2)	2 (0.4)	1 (0.2)	2 (0.4)	5 (1.0)	14 (0.5)
Crash Occurred at Intersection							
550 Stop sign or signal controlled	20 (4.0)	7 (1.4)	8 (1.6)	14 (2.8)	8 (1.6)	6 (1.2)	63 (3.1)
250 Neither stop sign nor signal Insufficient Information	5 (1.0)	2 (0.4)	4 (0.8)	3 (0.6)	0 (0.0)	9 (1.8)	23 (0.8)
990 Crossing path insufficient information	3 (0.6)	2 (0.4)	3 (0.6)	5 (1.0)	2 (0.4)	4 (0.8)	19 (0.6)
970 Unknown if parallel or crossing path	0 (0.0)	6 (1.2)	2 (0.4)	1 (0.2)	1 (0.2)	6 (1.2)	16 (0.5)
Total	499 (16.7)	499 (16.7)	498 (16.7)	499 (16.7)	497 (16.6)	498 (16.7)	2990 (100.0)

Bicyclist overtaking motor vehicle	2.7 percent
Motorist loss of control	0.6 percent
Bicyclist loss of control	1.8 percent
Total	35.5 percent

When the bicycle and motor vehicle were on parallel paths, the most frequent individual crash types were:

Motorist left turn facing the bicyclist (#230)	5.9 percent
Bicyclist left turn in front of traffic moving in the same direction (#180)	4.4 percent
Other situations involving a motorist overtaking a bicyclist (#390)	3.9 percent

Crashes where the bicycle and motor vehicle were on crossing paths accounted for 57 percent of the crashes. These distributed into the following categories:

Bicyclist did not clear intersection	1.4 percent
Motorist failed to yield	21.7 percent
Bicyclist failed to yield, midblock	11.7 percent
Bicyclist failed to yield, intersection	16.8 percent
Motorist turning	0.7 percent
Bicyclist turning	0.7 percent
Crash occurred at an intersection	2.9 percent
Insufficient information	1.1 percent
Total	57.0 percent

When the bicycle and motor vehicle were on crossing paths, the most frequent individual crash types were:

Motorist drive out from an intersection controlled by a stop sign or flashing red light, first half (#091)	8.1 percent
Motorist drive out from a driveway, alley, or other midblock location, first half (#081)	6.4 percent
Bicyclist ride out at an intersection controlled by a stop sign or flashing red signal (#051)	6.4 percent

As would be expected for these relatively low percentages, there is variability across the six States represented. Specific detail about groups of these crashes is provided later in this chapter.

COMPARISON TO EARLIER RESULTS BY CROSS AND FISHER

The most relevant previous research done on bicycle-motor vehicle crash types is the seminal study by Cross and Fisher (1977). Sampling areas for this earlier study were California (Los Angles area), Colorado (Denver/Boulder areas), Florida (Tampa/Orlando areas), and Michigan (Detroit/Flint areas). The sample was stratified based on bicyclist injury severity and crash location (equal numbers of urban and rural crashes). A non-fatal case could be rejected if an unobserved hit and run or if both the bicyclist and motor vehicle driver refused to be interviewed. No fatal cases were rejected. The study results were based on 919 crashes, 166 (18.1 percent) fatal and 753 (81.9 percent) non-fatal. Crash types were derived based on data obtained from the police crash report, visits to the crash site, and detailed interviews with the parties in the crash and witnesses.

The current study resulted from a sample drawn from six States regionally spread and stratified on population and was based exclusively on data obtained from crash reports. The crash types followed the current NHTSA bicycle-motor vehicle scheme used to code the General Estimates System data. The scheme includes more, as well as slightly revised, crash types than the earlier Cross and Fisher method. Notwithstanding the detail that was missed because there were no site visits and detailed interviews, it was decided to compare the results of the current study with those from the earlier Cross and Fisher study. This was accomplished by placing the relevant crashes in the current study into the crash type categories derived by Cross and Fisher.

Table 41 shows the percentage distributions of the crash types from the two studies. Although the two samples look reasonably similar, there are statistically significant differences between the non-fatal distributions examined either by class or by all rows (X^2 tests, $p = 0.00$). The fatal distributions were compared within each class using Fisher's Exact Test, and no statistically significant differences were found. There are several factors that could lead to differences in the non-fatal distributions. For example, the Cross and Fisher sample contains a much higher percentage of rural crashes. Bicyclist age from the two samples was equivalent for younger riders, with about 45 percent being fewer than 15 years old; however, the current study contained a higher proportion of riders older than age 25 (about 30 percent versus about 10 percent for Cross and Fisher). Gender of the rider matched well, with about 75 percent of the bicyclists being male. Lighting condition was similar, with about 15 percent of the current crashes occurring under conditions of darkness versus 17 percent for Cross and Fisher.

Some commentary about differences in the two samples follows. Overall, a small number of fatal crashes in the current sample leads to variability when compared to the earlier study. Within Problem Class A - Bicycle Rideout: Driveway, Alley, and Other Midblock, the current sample has a higher proportion of fatal crashes occurring at commercial driveways or alleys (Type 2) and at entries over shoulders or curbs (Type 4). For non-fatals within Problem Class A, the Cross and Fisher sample had more bicycle rideouts from a driveway/ alley apron (Type 3) but fewer rideouts over shoulders and curbs

Table 41. Crash type percentage distributions from the two studies.

	Cross Sample		Current Six-State Sample	
	Fatal (n=166)	Non-Fatal (n=753)	Fatal (n=41)	Non-Fatal (n=2,453)
Problem Class A - Bicycle Rideout: Driveway, Alley, and Other Midblock				
Type 1 - Bicycle Rideout: Residential driveway or alley	6.7	5.7	4.9	6.1
Type 2 - Bicycle Rideout: Commercial driveway or alley	2.4	3.2	7.3	2.5
Type 3 - Bicycle Rideout: Driveway/alley apron (pre-crash path parallel to roadway	2.4	2.5	0	0.9
Type 4 - Bicycle Rideout: Entry over shoulder/curb	3.6	2.5	9.8	5.1
Total Class A	15.1%	13.9%	22.0%	14.5%
Problem Class B - Bicycle Rideout: Controlled Intersection				
Type 5 - Bicycle Rideout: Intersection controlled by sign	7.8	10.2	4.9	11.3
Type 6 - Bicycle Rideout: Intersection controlled by signal	0.6	3.1	0	0.6
Type 7 - Bicycle Rideout: Intersection controlled by signal, multiple threat	2.4	2.0	2.4	1.1
Other Class B - Bicycle Rideout: Intersection controlled by signal, other	1.2	1.7	4.9	4.8
Total Class B	12.0%	17.0%	12.2%	17.7%

Table 41. Crash type percentage distributions from the two studies. (Con't)

	Cross Sample		Current Six-State Sample	
	Fatal (n=166)	Non-Fatal (n=753)	Fatal (n=41)	Non-Fatal (n=2,453)
Problem Class E - Bicyclist Unexpected Turn/Swerve				
Type 18 - Bicyclist Unexpected Left Turn: Parallel paths, same direction	8.4	8.4	7.3	5.1
Type 19 - Bicyclist Unexpected Left Turn: Parallel paths, facing approach	3.0	3.2	4.9	0.9
Type 20 - Bicyclist Unexpected Swerve Left: Parallel paths, same direction (unobstructed path)	3.6	1.5	0	1.4
Type 21 - Wrong-Way Bicyclist Turns Right: Parallel paths	1.2	1.1	2.4	1.3
Total Class E	16.2%	14.2%	14.6%	8.6%
Problem Class F - Motorist Unexpected Turn				
Type 22 - Motorist Unexpected Left Turn: Parallel paths, same direction	0.6	1.3	0	1.4
Type 23 - Motorist Unexpected Left Turn: Parallel paths, facing approach	0	7.6	4.9	6.8
Type 24 - Motorist Unexpected Right Turn: Parallel paths	1.8	5.6	2.4	5.5
Total Class F	2.4%	14.5%	7.3%	13.6%

Table 41. Crash type percentage distributions from the two studies. (Con't)

	Cross Sample		Current Six-State Sample	
	Fatal (n=166)	Non-Fatal (n=753)	Fatal (n=41)	Non-Fatal (n=2,453)
Problem Class G – Other				
Type 25 - Vehicles Collide at Uncontrolled Intersection: Orthogonal paths	0.6	2.8	0	0.9
Type 26 - Vehicles Collide Head-on, Wrong-way Cyclist	2.4	3.6	4.9	2.9
Type 27 - Bicyclist Overtaking	0.6	0.9	0	3.3
Type 28 - Head-On, Wrong-Way Motorist	1.8	0.8	0	0.1
Type 29 - Parking Lot, Other Open Area: Orthogonal Paths	0.6	0.8	0	0.2
Type 30 - Head-On, Counteractive Evasive Action	0	0.1	2.4	0.2
Type 31 - Bicyclist Cuts Corner When Turning Left: Orthogonal paths	0.6	0	2.4	0.2
Type 32 - Bicyclist Swings Wide When Turning Right: Orthogonal paths	0	0.3	0	0.6
Type 33 - Motorist Cuts Corner When Turning Left: Orthogonal paths	0	0.4	0	0.6
Type 34 - Motorist Swings Wide When Turning Right: Orthogonal paths	0	0.1	0	0.2
Type 35 - Motorist Driveout From On-Street Parking	0	0.3	0	0.4
Type 36 - Weird	0	1.1	0	1.3
Type 37 - Insufficient Information	7.2	0	0	1.9
Total Class G	13.8%	11.2%	9.8%	12.7%

Table 41. Crash type percentage distributions from the two studies. (Con't)

	Cross Sample		Current Six-State Sample	
	Fatal (n=166)	Non-Fatal (n=753)	Fatal (n=41)	Non-Fatal (n=2,453)
Problem Class C – Motorist Turn-Merge/Drive Through/Driveout				
Type 8 - Motorist Turn-Merge: Commercial driveway/alley	0	5.3	0	5.3
Type 9 - Motorist Turn-Merge/Drive Through: Intersection controlled by sign	1.2	10.2	2.4	10.9
Type 10 - Motorist Turn-Merge: Intersection controlled by signal	0	1.9	0	4.4
Type 11 - Motorist Backing from Residential Driveway	0	0.8	0	0.7
Type 12 - Motorist Driveout: Controlled Intersection	1.2	0.5	2.4	1.8
Total Class C	2.4%	18.7%	4.8%	23.0%
Problem Class D -- Motorist Overtaking/Overtaking - Threat				
Type 13 - Motorist Overtaking: Bicyclist not observed	24.6	4.0	12.2	1.4
Type 14 - Motorist Overtaking: Motor vehicle out of control	4.2	0.7	4.9	1.1
Type 15 - Motorist Overtaking: Counteractive evasive action	2.4	1.7	0	2.4
Type 16 - Motorist Overtaking: Misjudged space required to pass	1.8	2.0	7.3	1.4
Type 17 - Motorist Overtaking: Bicyclist's path obstructed	0.6	2.0	0	0.2
Type Unknown - Motorist Overtaking: Type Unknown	4.2	0.1	4.9	3.4
Total Class D	37.8%	10.5%	29.3%	9.8%

(Type 4). For Bicycle Rideouts at Controlled Intersections (Problem Class B), the Cross and Fisher non-fatal sample had a higher proportion of crashes at intersections controlled by signals (Type 6), while the current sample had more "Other Class B" crashes (likely due to less detail available on just the police form).

For problem Class C, involving motorists turning, merging, driving through, and driving out situations at driveways/alleys and intersections, the current sample has 4.4 percent of the non-fatal crashes occurring at signalized intersections (Type 10) versus 1.9 percent for the earlier sample. The current sample also has a higher proportion of non-fatals involving a motorist driveout from a controlled intersection (Type 12). For situations involving the motorist overtaking the bicyclist (Problem Class D), about twice as many fatals and non-fatals in the Cross and Fisher study involved drivers not observing the bicyclist (Type 13). The current study had a much lower proportion of non-fatal overtakings where the bicyclist's path was obstructed (Type 17). These differences may be a reflection of more rural crashes in the earlier study. For the current study, 7.3 percent of the fatal crashes occurred when the motorist misjudged the space required to pass the bicyclist (Type 16).

For bicyclists making unexpected turns or swerves (Problem Class E), higher proportions of non-fatal crashes occurred in the Cross and Fisher sample when the bicyclist made unexpected left turns either travelling with (same direction, Type 18) or against (facing, Type 19) traffic. The earlier study also contained higher proportions of fatals where the bicyclist unexpectedly swerved left while on parallel paths and in the same direction of the motor vehicle (Type 20). For motorists making unexpected turns (Problem Class F), the current sample had almost 5 percent of the fatal crashes occur when the motorist turned left in front of an oncoming (facing) bicyclist (Type 23).

Problem Class G contains a variety of situations. The older sample had more non-fatal crashes occurring at uncontrolled intersections when the bicycle and motor vehicle were at right angles (Type 25); more head-on, wrong way motorist crashes (Type 28); and more right angle crashes in parking lots and other open areas (Type 29). The current study contains higher proportions of head-on, wrong-way bicyclists in fatal crashes (Type 26, 4.9 percent of fatals) and overtaking bicyclists (Type 27) in non-fatal crashes.

The fact that the samples are relatively similar indicates that Cross and Fisher did an excellent job of developing the crash types and that the types are quite inclusive. Differences in the sample likely relate to rural/urban differences, age of the bicyclist, and other factors relating to exposure. The fatal distributions vary more than the non-fatal because of small sample size, especially given the current sample with only 41 fatal cases (or 1.6 percent of the cases) that fit the Cross and Fisher crash types (where fatals accounted for 18.1 percent of the cases).

FURTHER GROUPING OF BICYCLE CRASH TYPES

The data in table 40 can be more readily absorbed and understood when placed into larger groups. The distribution for the three main groups is as follows:

	n	Percent
Specific circumstances	209	7.0
Parallel paths	1,061	35.5
Crossing paths	1,720	57.5
	2,990	100.0

The three main groups subdivide into 15 major subgroups in the current NHTSA crash typing scheme. These subgroups and their associated crash types are shown below. The crash types are based on the HSRC 3-digit code used in table 40. Eliminating the last digit yields the NHTSA code - e.g., 361 equals 36, 220 equals 22, etc.).

Subgroup	Crash Types
Specific Circumstances	361, 363, 364, 364, 400, 110, 291, 292, 293
Parallel Paths	
Motorist turn/merge into path of bicyclist	220, 230, 240, 241, 242, 350
Bicyclist turn/merge into path of motorist	30, 180, 190, 210, 215
Wrong way operator	260, 280, 300
Motorist overtaking	130, 150, 160, 170, 171, 390
Bicyclist overtaking	270, 271, 272, 410, 411
Operator lost control	143, 144, 145, 201, 202, 203, 204, 205, 206
Crossing Paths	
Biyclist did not clear intersection	60, 70
Motorist failed to yield	81, 82, 83, 91, 92, 93, 100, 121, 122, 480
Bicyclist failed to yield, midblock	11, 12, 13, 21, 22, 23, 41, 42, 43, 44
Bicyclist failed to yield, intersection	51, 52, 53, 491, 492, 493
Motorist turning error	330, 340
Bicyclist turning error	310, 320
Intersection crash	250, 550
Unknown/Insufficient	970, 980, 990

The bicycle crash types distribute into the 15 subgroups as shown by State in table 42. For the parallel path cases, the most frequent crash types were:

Table 42. Major crash type subgroups by State.

Subgroup	State						
	CA	FL	MD	MN	NC	UT	Total
Specific Circumstances	8 (1.6)	50 (10.0)	47 (9.4)	19 (3.8)	42 (8.5)	43 (8.6)	209 (7.0)
Parallel Paths							
Motorist turn/merge into path of bicyclist	81 (16.2)	58 (11.6)	36 (7.2)	73 (14.6)	50 (10.1)	67 (13.4)	365 (12.2)
Bicyclist turn/merge into path of motorist	35 (7.0)	36 (7.2)	31 (6.2)	37 (7.4)	48 (9.7)	32 (6.4)	219 (7.3)
Operator on wrong side of street	7 (1.4)	15 (3.0)	23 (4.6)	7 (1.4)	23 (4.6)	9 (1.8)	84 (2.8)
Motorist overtaking the bicyclist	33 (6.6)	53 (10.6)	53 (10.6)	27 (5.4)	64 (12.9)	27 (5.4)	257 (8.6)
Bicyclist overtaking motor vehicle	32 (6.4)	12 (2.4)	14 (2.8)	8 (1.6)	12 (2.4)	4 (0.8)	82 (2.7)
Operator lost control	13 (2.6)	7 (1.4)	8 (1.6)	3 (0.6)	15 (3.0)	8 (1.6)	54 (1.8)
Crossing Paths							
Bicyclist did not clear intersection	9 (1.8)	3 (0.6)	2 (0.4)	8 (1.6)	2 (0.4)	18 (3.6)	42 (1.4)
Motorist failed to yield	137 (27.5)	125 (25.1)	73 (14.7)	119 (23.9)	62 (12.5)	132 (26.5)	648 (21.7)
Bicyclist failed to yield, midblock	40 (8.0)	50 (10.0)	86 (17.3)	72 (14.4)	64 (12.9)	41 (8.2)	353 (11.8)
Bicyclist failed to yield, intersection	65 (13.0)	67 (13.4)	101 (20.3)	96 (19.2)	92 (18.5)	80 (16.1)	501 (16.8)
Motorist turning error	4 (0.80)	5 (1.0)	3 (0.6)	2 (0.4)	1 (0.2)	4 (0.8)	19 (0.6)
Bicyclist turning error	6 (1.2)	1 (0.2)	2 (0.4)	3 (0.6)	3 (0.6)	6 (1.2)	21 (0.7)
Crash occurred at an intersection	25 (5.0)	9 (1.8)	12 (2.4)	17 (3.4)	8 (1.6)	15 (3.0)	86 (2.9)
Unknown/insufficient information	4 (0.8)	8 (1.6)	7 (1.4)	8 (1.6)	11 (2.2)	12 (2.4)	50 (1.7)

	n	% of Parallel Path Crashes	% of All Crashes
Motorist turned or merged into the Bicyclists path	365	34.4	12.2
Motorist overtaking the bicyclist	257	24.2	8.6
Bicyclist turned or merged into the motorist's path	219	20.6	7.3

For the crossing path cases, the most frequent crash types were:

	n	% of Parallel Path Crashes	% of All Crashes
Motorist failed to yield to bicyclist	648	37.7	21.7
Bicyclist failed to yield to motorist at an intersection	501	29.1	16.8
Bicyclist failed to yield to motorist, midblock	353	20.5	11.8

There was considerable variability in crash type by State. For example, specific circumstances crashes were less common in California and Minnesota, while crashes with the motorist turning/merging into the path of the bicyclist were more common. North Carolina had more motorist overtaking crashes, while California had more bicyclist overtaking crashes. In regard to crossing path events, Utah had a higher percentage of crashes where the bicyclist did not clear the intersection, while Maryland and North Carolina had lower percentages of crashes where the motorist failed to yield. In turn, Maryland had higher percentages of crashes where the bicyclist failed to yield either midblock or at an intersection.

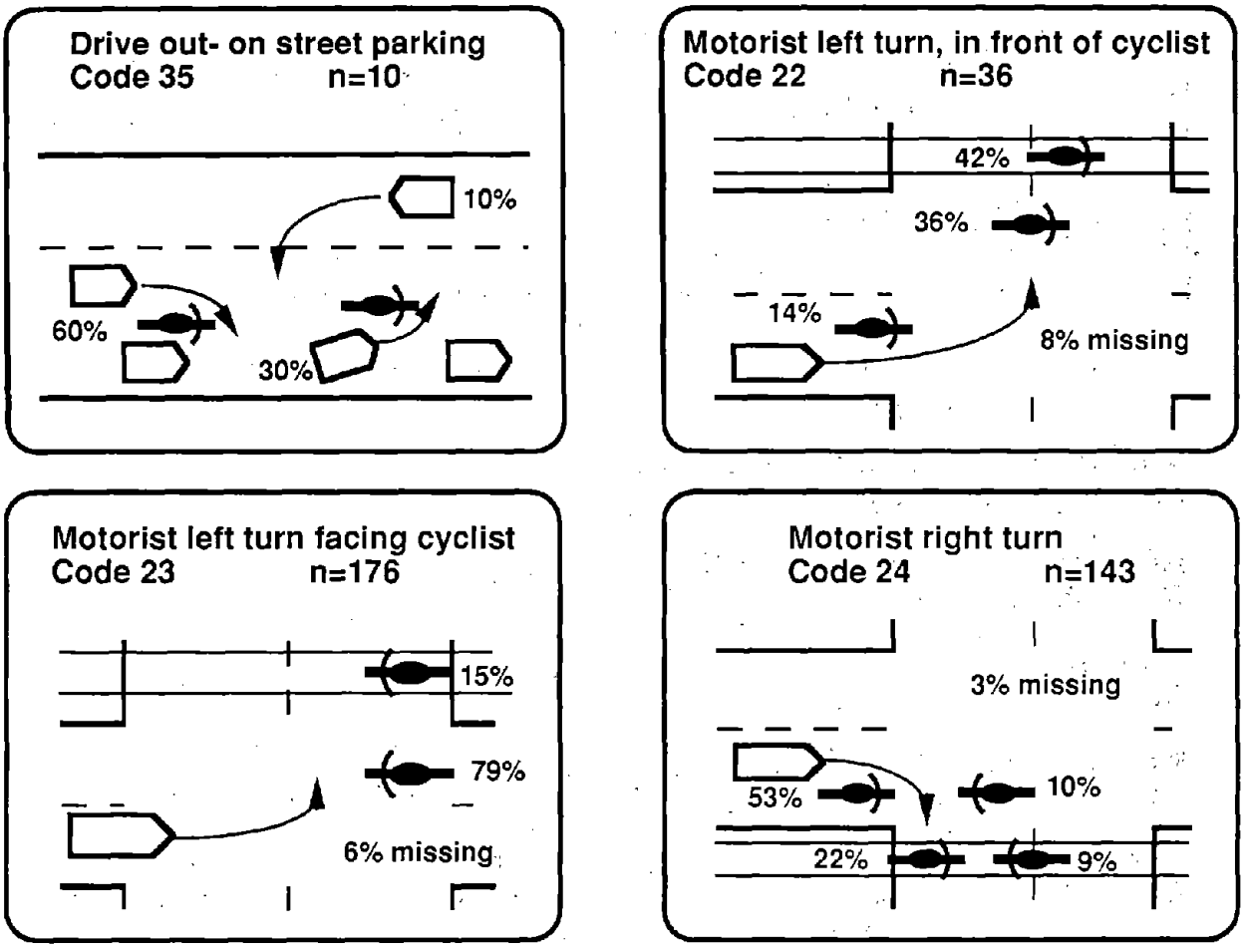
Figures 9 through 14 describe the parallel and crossing path crash types listed above and provide detailed information about the pattern of the crash and the placement of the motor vehicle and bicycle (where coded). For example, Figure 9 shows that four different kinds of events are included in the subgroup pertaining to a motorist turning or merging into the path of a bicyclist. These events are:

- Motorist driving out from on street parking (Code 35).
- Motorist turning left in front of a bicyclist going in the same direction as the motorist (Code 22).
- Motorist turning left in front of a bicyclist coming toward the motorist (Code 23).

Parallel Paths: Group 1

n=365; 12.2% of all crashes

17.1% are A + K crashes



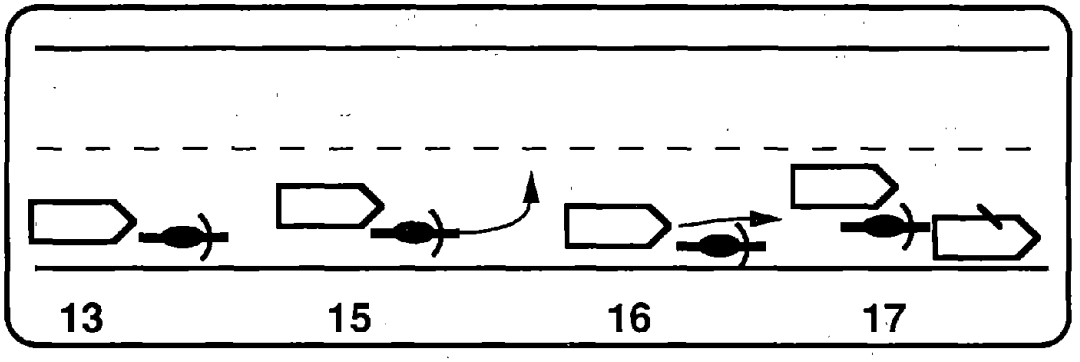
Overrepresented Variables	
Bicyclist Age	20-24; 25-44
Driver Age	65+
Location	urban
Time of Day	6-10am; 10am-2pm
Road Class	State roads
Number of Lanes	4,5,6+
Traffic Control	signal

Figure 9. The motorist turned or merged into the path of the cyclist.

Parallel Paths: Group 4

n=257; 8.6% of all crashes

29.4% are A + K crashes



Motorist overtakes undetected cyclist
Code 13 N=39

Motorist overtaking, counteractive evasive actions
Code 15 N=59

Motorist overtaking, misjudges passing space
Code 16 N=37

Motorist overtaking, cyclist path obstructed
Code 17 N=5

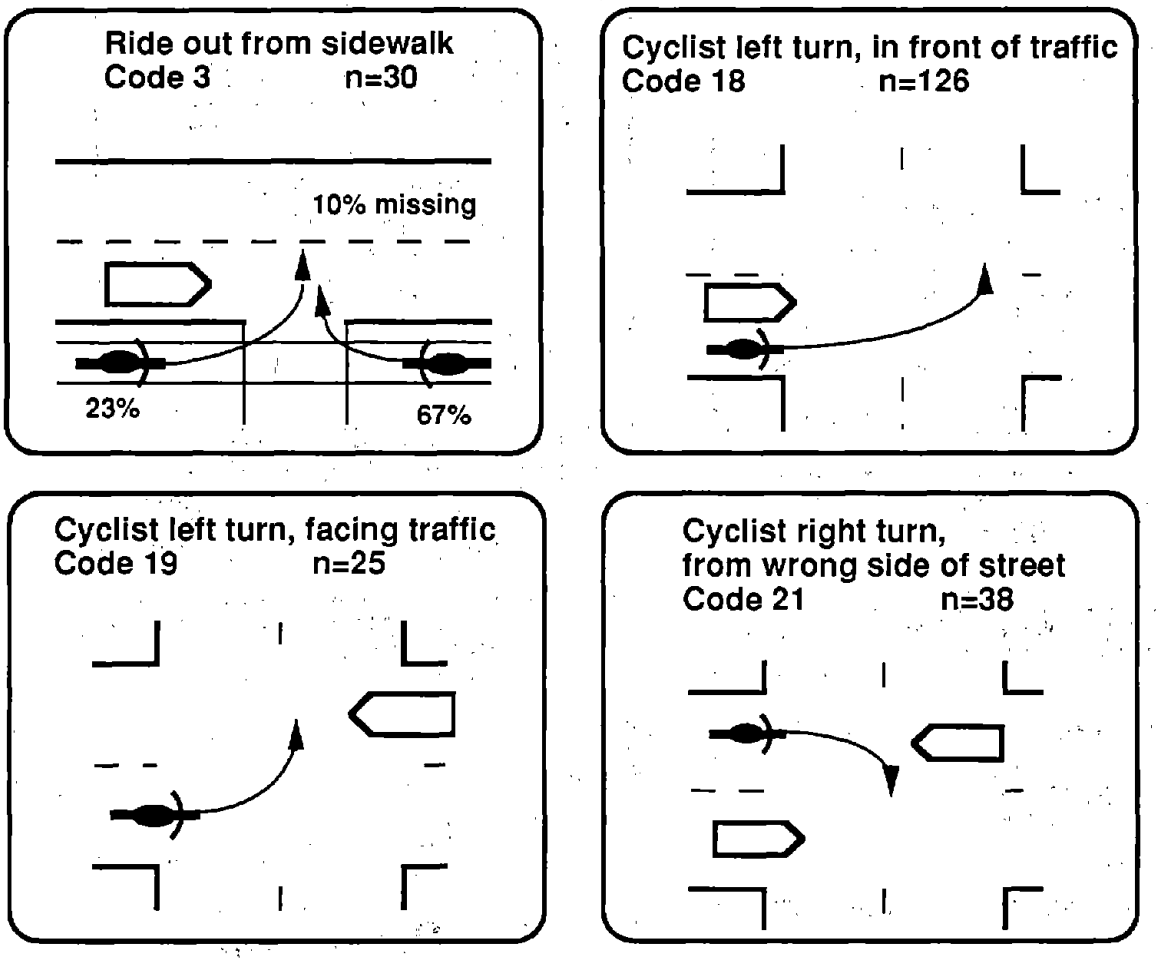
Motorist overtaking, other (not shown)
Code 39 N=117

Overrepresented Variables	
Bicyclist Age	25-44; 45-64;65+
Driver Age	16-19
Driver gender	male
Alcohol Use	both operators
Location	rural
Light Condition	darkness
Road Class	State/county
Number of Lanes	2

Figure 10. The motorist was overtaking the cyclist.

Parallel Paths: Group 2

n=219; 7.3% of all crashes 25.2% are A + K crashes



Overrepresented Variables

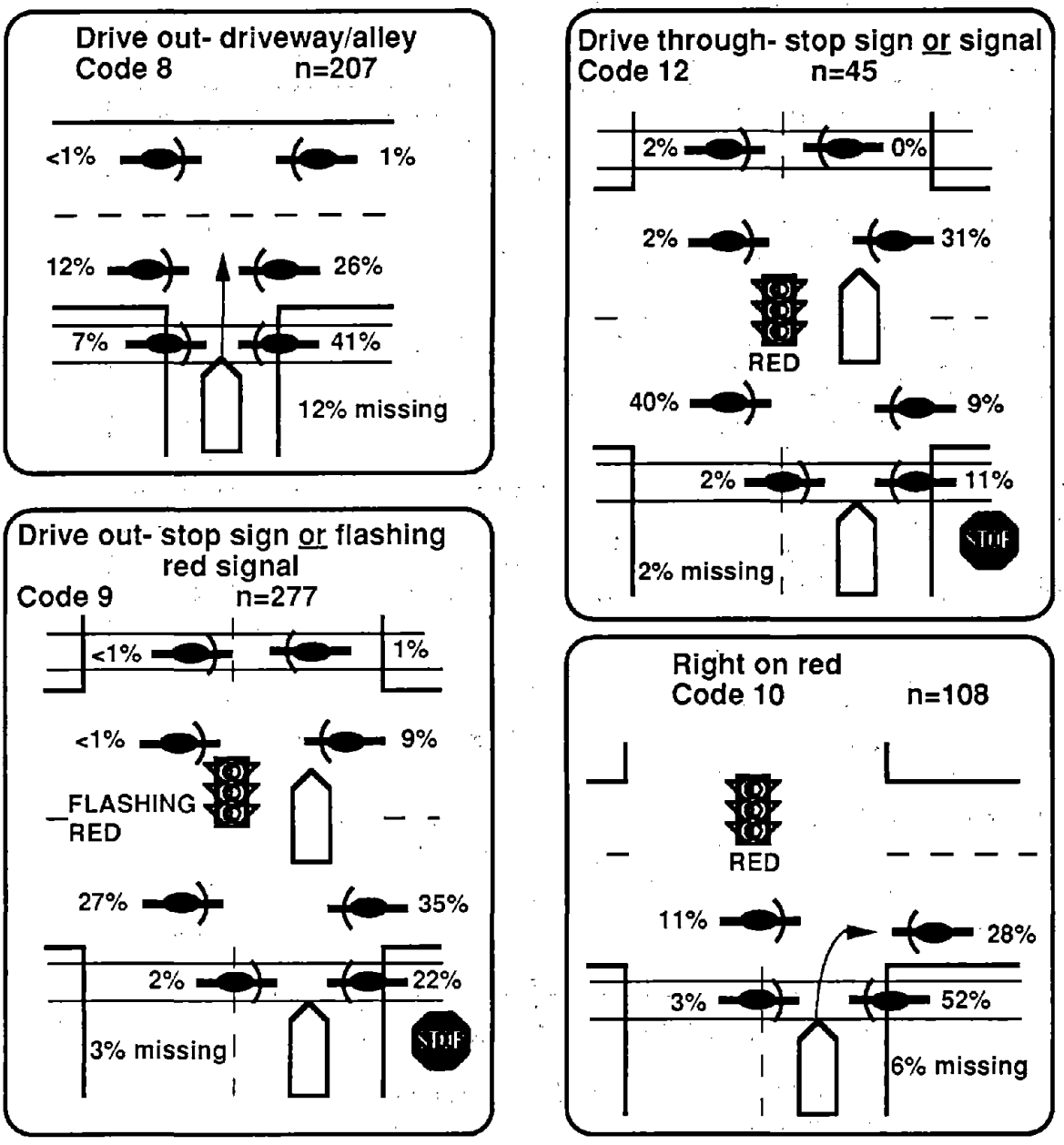
Bicyclist Age.....0-9; 10-14; 65+
Driver Age.....20-24
Location.....rural
Time of Day.....2-6pm
Light Condition.....daylight
Road Class.....State/county roads
Number of Lanes.....2

Figure 11. The cyclist turned or merged into the path of the motorist.

Crossing Paths: Group 2

n=648; 21.7% of all crashes

8.5% are A + K crashes



Drive out- intersection, other (not shown)
Code 48 n=11

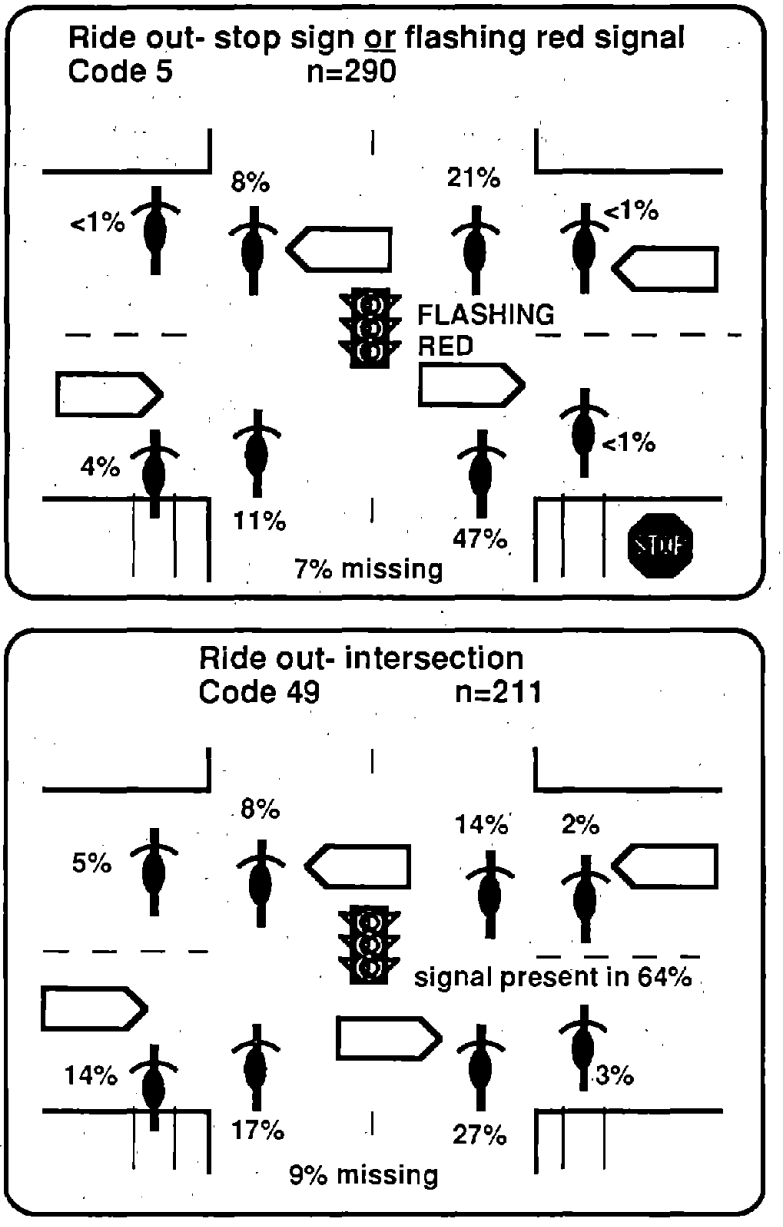
Overrepresented Variables

Bicyclist Age·····15-19; 25-44	Time of Day·····10am-2pm
Driver Gender·····female	Road Class···U.S.; State Roads
Location·····urban	Number of Lanes·····4,5,6+

Figure 12. The motorist failed to yield to the cyclist.

Crossing Paths: Group 4

n=501; 16.8% of all crashes 20.1% are A + K crashes



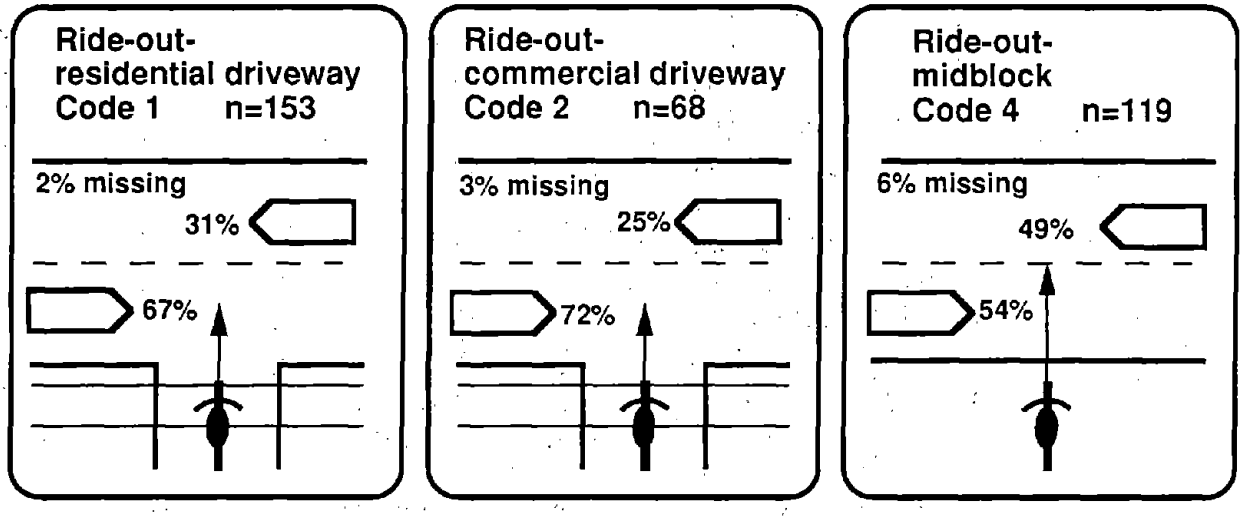
Overrepresented Variables			
Bicyclist Age	0-9; 10-14	Light Condition	daylight
Driver Age	45-64	Road Class	local streets
Driver Gender	female	Number of Lanes	2

Figure 13 . The cyclist failed to yield to the motorist at an intersection.

Crossing Paths: Group 3

n=353; 11.8% of all crashes

22.1% are A + K crashes



Overrepresented Variables

Bicyclist Age	0-9; 10-14
Time of Day	2-6pm
Light Condition	daylight
Road Class	local/county
Number of Lanes	2
Traffic Control	none

Figure 14. The cyclist failed to yield to the motorist, midblock.

- Motorist turning right and striking a bicyclist going either in the same or opposing directions (Code 24).

Vehicle placement was coded for many of the individual crash types. For example, when the motorist made a left turn in front of a bicyclist going in the same direction as the motorist (Code 22, upper right), the bicyclist placement was the following:

- Traveling in the same lane with the motorist in 14 percent of the cases.
- Traveling the wrong way in the opposing traffic lane in 36 percent of the cases.
- Traveling in a marked or implied crosswalk in 42 percent of the cases.
- Unknown in eight percent of the cases.

Thus, for Codes 22, 23, and 24 the bicyclist was struck while in a marked or implied crosswalk in 42 percent, 15 percent, and 31 percent of the cases, respectively. (Detailed information regarding individual bicycle crash types is contained in a companion document (Hunter, Pein and Stutts, in press) to this report).

The "Overrepresented Variables" box indicates more involvement than expected for any particular variable when compared to all crashes. For example, Figure 9 shows that bicyclists aged 20 to 24 were Overrepresented in crashes where the motorist turned or merged into the path of the bicyclist. This derives from the fact that bicyclists aged 20 to 24 were involved in 21.3 percent of these motorist turn/merge crashes as opposed to making up 10.5 percent of the overall sample of crash-involved bicyclists. The remaining variables in the box reflect similar findings.

The sections that follow explore a variety of bicyclist, driver, location/environmental, roadway, and crash factors associated with the 15 major subgroups.

BICYCLIST CHARACTERISTICS

Tables in this section pertain to the characteristics of the bicyclists involved in the 15 major crash type subgroups and the severity of the crashes as reflected in the level of injury sustained by the bicyclist. The approach is to examine the distribution of these variables within each of the crash type subgroups, and to search for over or underrepresentation of the selected variable levels based on all crashes.

Bicyclist Age

Table 43 shows the age distribution for the crash-involved bicyclists. The percentages are row percents and total 100 percent when summed except for slight variations due to rounding. By themselves they provide a quick profile of the ages of bicyclist most likely to be involved in each crash type subgroup. When compared with each other and with the age

Table 43. Age distribution of bicycle crash types.

	Age*						
Subgroup	0-9	10-14	15-19	20-24	25-44	45-64	65+
Specific Circumstances	33.5	27.0	9.0	9.6	15.0	4.2	1.8
Parallel Paths							
Motorist turn/merge into path of bicyclist	2.7	13.3	14.5	21.3	42.6	3.9	1.8
Bicyclist turn/merge into path of motorist	23.4	41.3	13.3	4.6	10.1	4.1	3.2
Operator on wrong side of street	17.3	25.9	13.6	8.6	27.2	3.7	3.7
Motorist overtaking the bicyclist	8.8	18.1	11.2	11.7	35.7	10.4	4.0
Bicyclist overtaking motor vehicle	8.0	10.7	17.3	20.0	36.0	6.7	1.3
Operator lost control	21.7	15.2	6.5	10.9	32.6	13.0	0.0
Crossing Paths							
Bicyclist did not clear intersection	9.8	36.6	22.0	12.2	14.6	0.0	4.9
Motorist failed to yield	5.8	23.7	22.1	12.4	27.9	5.8	2.3
Bicyclist failed to yield, midblock	41.4	33.3	9.9	3.6	8.1	3.3	0.3
Bicyclist failed to yield, intersection	27.1	36.8	13.1	7.5	12.4	2.4	0.7
Motorist turning error	11.1	33.3	11.1	11.1	27.8	5.6	0.0
Bicyclist turning error	31.8	31.8	13.6	4.6	9.1	9.1	0.0
Crash occurred at an intersection	24.3	28.4	13.5	8.1	21.6	2.7	1.4
Unknown/insufficient information	21.4	23.8	16.7	2.4	26.2	7.1	2.4
ALL CRASHES	18.2	26.8	14.7	10.5	23.0	4.9	1.9

*Row percents. Cases with unknown age excluded.

distribution for all crash type subgroups combined shown at the bottom of the table, they reveal crash types where a particular age group is over or underrepresented. For example, the table shows that 33.5 percent of bicyclists in specific circumstance crashes are children less than 10 years old, while over 41 percent of those in crashes where the bicyclist fails to yield at a midblock location are less than the age of 10. Since children in this age group are involved in only 18.2 percent of all bicyclist crashes, these percentages represent overinvolvement in these crash types.

Other bicyclist age-related findings include:

- Besides the crash types mentioned above, children less than age 10 were clearly overrepresented in crashes where the bicyclist failed to yield at an intersection, and the bicyclist made a turning error. Children less than age 10 were slightly overrepresented in crashes where the bicyclist turned or merged into the path of the motorist, the operator lost control, the crash occurred at an intersection, and there was insufficient information available to place the crash in another category.

- Bicyclists 10 to 14 years old were overinvolved in crashes where they turned or merged into the path of a motor vehicle, the bicyclists did not clear the intersection before the traffic signal turned green for cross traffic, the bicyclist failed to yield at both midblock and intersection locations, there was a motorist turning error, and there was a bicyclist turning error.

- Bicyclists 15 to 19 years old were overrepresented in crashes when the bicyclist did not clear the intersection, and the motorist failed to yield.

- 20 to 24 year old bicyclists were overinvolved in crashes where the motorist turned or merged into the path of the bicyclist, and the bicyclist was overtaking.

- 25 to 44 year old bicyclists were somewhat similar to the previous group with overinvolvements for motorist turn/merge, wrong way operator,[1] motorist overtaking, bicyclist overtaking, operator lost control, motorist failed to yield, motorist turning error, and insufficient information.

- 45 to 64 year old overinvolvements included motorist overtaking, operator lost control, bicyclist turning error, and insufficient information.

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[1]For this comparison and others to follow, virtually all of the wrong way operators were bicyclists. See table 40.

- Bicyclists aged 65 and older were overrepresented in bicyclist turn/merge, wrong way operator, motorist overtaking, and the bicyclist did not clear the intersection.

It seems likely that these age-related outcomes reflect exposure of the bicyclist to the referenced situation.

Bicyclist Gender

Table 44 distributes the various types by the gender of the bicyclist. Whereas males comprise around 79 percent of all crash-involved bicyclists, they represent 96 percent of bicyclists in crashes where there was a bicycling turning error. Males were also slightly overinvolved in the following types of crashes:

- Motorist turn/merge.
- Wrong way operator.
- Motorist overtaking.
- Bicyclist overtaking.
- Operator lost control.

Female/bicyclists were clearly overrepresented when the bicyclist failed to clear the intersection before the traffic signal turned green for cross traffic.

Bicyclist Sobriety

Overall, use of alcohol or drugs by bicyclist occurred in about five percent of all crashes. Crash types most likely to involve alcohol or drug use on the part of the bicyclist are identified in table 45 and include wrong way operator, motorist overtaking, bicyclist overtaking, operator loss of control, and cases with insufficient information.

Bicyclist Injury Severity

Using the percentage of bicyclists seriously injured or killed (% A+K) as a measure of crash severity, the crash types that were the most severe (table 46) were:

	% A+K
Parallel Paths	
Operator lost control	34.6
Wrong way operator	32.1
Motorist overtaking	29.4
Bicyclist turn merge	25.2

Table 44. Bicyclist gender for bicycle crash types.

	Gender*	
Subgroup	Male	Female
Specific Circumstances	77.7	22.4
Parallel Paths		
Motorist turn/merge into path of bicyclist	82.8	17.3
Bicyclist turn/merge into path of motorist	77.6	22.4
Operator on wrong side of street	81.3	18.8
Motorist overtaking the bicyclist	84.5	15.5
Bicyclist overtaking motor vehicle	82.7	17.3
Operator lost control	83.3	16.7
Crossing Paths		
Bicyclist did not clear intersection	61.0	39.0
Motorist failed to yield	75.4	24.6
Bicyclist failed to yield, midblock	79.2	20.8
Bicyclist failed to yield, intersection	77.3	22.7
Motorist turning error	77.8	22.2
Bicyclist turning error	95.7	4.4
Crash occurred at an intersection	76.6	23.4
Unknown/insufficient information	80.4	19.6
ALL CRASHES	78.8	21.2

*Row percents. Cases with unknown gender excluded.

Table 45. Bicyclist sobriety for bicycle crash types.

Subgroup	Sobriety*		
	No Alcohol or Drugs	Alcohol or Drugs	Other
Specific Circumstances	93.4	3.0	3.6
Parallel Paths			
Motorist turn/merge into path of bicyclist	93.7	4.2	2.1
Bicyclist turn/merge into path of motorist	91.9	3.5	4.6
Operator on wrong side of street	81.3	13.3	5.3
Motorist overtaking the bicyclist	84.9	9.8	5.3
Bicyclist overtaking motor vehicle	85.7	9.1	5.2
Operator lost control	80.5	17.1	2.4
Crossing Paths			
Bicyclist did not clear intersection	96.8	3.2	0.0
Motorist failed to yield	95.0	2.5	2.5
Bicyclist failed to yield, midblock	90.2	4.7	5.1
Bicyclist failed to yield, intersection	90.5	5.4	4.2
Motorist turning error	100.0	0.0	0.0
Bicyclist turning error	94.7	0.0	5.3
Crash occurred at an intersection	92.4	4.6	3.0
Unknown/insufficient information	77.8	13.9	8.3
ALL CRASHES	91.0	5.2	3.8

*Row percents. Cases with unknown sobriety excluded.

Table 46. Bicycle injury severity for bicycle crash types.

Subgroup	Injury Severity*				
	No Injury	C	B	A	Fatal
Specific Circumstances	9.1	29.7	48.6	12.0	0.6
Parallel Paths					
Motorist turn/merge into path of bicyclist	6.9	28.9	47.1	16.2	0.9
Bicyclist turn/merge into path of motorist	3.7	25.7	45.3	22.0	3.3
Operator on wrong side of street	0.0	24.7	43.2	28.4	3.7
Motorist overtaking the bicyclist	5.6	19.8	45.2	24.6	4.8
Bicyclist overtaking motor vehicle	8.8	25.0	58.8	7.5	0.0
Operator lost control	0.0	21.2	44.2	32.7	1.9
Crossing Paths					
Bicyclist did not clear intersection	2.4	31.7	53.7	9.8	2.4
Motorist failed to yield	8.5	37.0	46.1	8.2	0.3
Bicyclist failed to yield, midblock	5.8	23.3	48.8	19.5	2.6
Bicyclist failed to yield, intersection	7.7	28.6	43.6	19.3	0.8
Motorist turning error	5.6	33.3	44.4	16.7	0.0
Bicyclist turning error	14.3	19.1	42.9	19.1	4.8
Crash occurred at an intersection	4.9	41.5	37.8	15.9	0.0
Unknown/insufficient information	4.4	45.7	39.1	10.9	0.0
ALL CRASHES	6.6	29.1	46.1	16.6	1.6

*Row percents. Cases with unknown injury severity excluded.

Crossing Paths	
Bicyclist turning error	23.8
Bicyclist failed to yield, midblock	22.1
Bicyclist failed to yield, intersection	20.1

Thus the most severe crash types were all of the parallel path variety, where speed is likely greater than at intersections.

DRIVER CHARACTERISTICS

Driver Age

Table 47 shows the age distribution for the crash involved motorists. Findings of interest include the following:

- Younger drivers, age 16 to 19, were overrepresented in wrong way operator crashes, motorist overtaking, motorist turning error, intersection crashes, and crashes with insufficient information.

- Drivers age 20 to 24 were overinvolved in specific circumstance crashes, motorist turning error, and bicyclist turning error crashes.

- Drivers age 25 to 44 were overinvolved in crashes where the bicyclist was overtaking, operator lost control, bicyclist turning error, and intersection crashes.

- Drivers between 45 and 64 years of age were overrepresented in crashes where there was a wrong way operator, bicyclist did not clear the intersection, and bicyclist failed to yield at an intersection.

- Drivers age 65 and over were overinvolved in crashes where the motorist turned or merged into the path of the bicyclist, crashes at intersections, and crashes with insufficient information.

Driver Gender

Table 48 distributes the various crash types by the gender of the motor vehicle driver. Whereas males comprise 58 percent of all crash-involved drivers, they represent almost 80 percent of the drivers in crashes where an operator lost control. Male drivers were also overinvolved in the following crash types:

- Wrong way operator.

Table 47. Driver age for bicycle crash types.

	Driver Age*					
Subgroup	< 16	16-19	20-24	25-44	45-64	65+
Specific Circumstances	0.7	9.7	22.8	42.1	15.9	9.0
Parallel Paths						
Motorist turn/merge into path of bicyclist	0.6	10.6	13.8	40.4	21.2	13.5
Bicyclist turn/merge into path of motorist	0.0	11.6	15.7	43.5	19.4	9.7
Operator on wrong side of street	0.0	14.3	11.4	41.4	24.3	8.6
Motorist overtaking the bicyclist	0.6	15.0	11.3	41.9	21.3	10.0
Bicyclist overtaking motor vehicle	0.0	11.1	9.3	59.3	14.8	5.6
Operator lost control	0.0	7.3	12.2	51.2	22.0	7.3
Crossing Paths						
Bicyclist did not clear intersection	0.0	9.5	9.5	42.9	28.6	9.5
Motorist failed to yield	0.2	9.1	12.5	47.8	21.0	9.5
Bicyclist failed to yield, midblock	0.0	11.5	16.2	46.7	19.9	5.6
Bicyclist failed to yield, intersection	0.0	9.3	12.5	45.5	23.4	9.3
Motorist turning error	0.0	23.1	23.1	38.5	7.7	7.7
Bicyclist turning error	0.0	5.0	25.0	50.0	10.0	10.0
Crash occurred at an intersection	0.0	14.1	8.5	52.1	12.7	12.7
Unknown/insufficient information	0.0	21.7	8.7	39.1	13.0	17.4
ALL CRASHES	0.2	10.8	13.8	45.2	20.5	9.5

*Row percents. Cases with unknown age excluded.

Table 48. Driver gender for bicycle crash types.

	Gender*	
Subgroup	Male	Female
Specific Circumstances	61.7	38.3
Parallel Paths		
Motorist turn/merge into path of bicyclist	53.9	46.1
Bicyclist turn/merge into path of motorist	59.9	40.1
Operator on wrong side of street	66.2	33.8
Motorist overtaking the bicyclist	71.3	28.7
Bicyclist overtaking motor vehicle	56.9	43.1
Operator lost control	78.1	22.0
Crossing Paths		
Bicyclist did not clear intersection	50.0	50.0
Motorist failed to yield	55.5	44.5
Bicyclist failed to yield, midblock	57.9	42.1
Bicyclist failed to yield, intersection	55.5	44.5
Motorist turning error	64.3	35.7
Bicyclist turning error	71.4	28.6
Crash occurred at an intersection	47.2	52.8
Unknown/insufficient information	59.3	40.7
ALL CRASHES	58.0	42.0

*Row percents. Cases with unknown gender excluded.

- Motorist overtaking.
- Motorist turning error.
- Bicyclist turning error.

Female drivers were overrepresented in these crash types:

- Bicyclist did not clear intersection.
- Intersection crashes.

Driver Sobriety

Crash types most likely to involve alcohol or drug use on the part of the driver are identified in table 49 and include specific circumstances, wrong way operator, motorist overtaking, and crashes where an operator lost control.

LOCATION/ENVIRONMENT CHARACTERISTICS

Urban/Rural Location

Table 50 examines the location of the various crash types. As noted earlier, about 70 percent occurred in urban areas. Crash types overrepresented in urban areas included:

- Motorist turn merge.
- Bicyclist overtaking.
- Motorist failed to yield.
- Bicyclist turning error.

Crash types overrepresented in rural areas included:

- Bicyclist turn/merge.
- Wrong way operator.
- Motorist overtaking.
- Operator lost control.
- Bicyclist did not clear intersection.
- Motorist turning error.

Private Property

About 7 percent of the crashes occurred on private property. Of the private property events, about 2 percent took place in commercial/retail parking lots and about 3 percent where both the bicyclist and motor vehicle were in a driveway, alley, or private road. Specific circumstances, or basically weird, crashes were overrepresented in both of these private property locations. Motorist failing to yield and bicyclist turning error crash types were also overrepresented on driveways/alleys/private roads.

Table 49. Driver sobriety for bicycle crash types.

Subgroup	Sobriety*		
	No Alcohol or Drugs	Alcohol or Drugs	Other
Specific Circumstances	86.0	2.4	11.6
Parallel Paths			
Motorist turn/merge into path of bicyclist	90.1	1.3	8.6
Bicyclist turn/merge into path of motorist	97.2	0.5	2.4
Operator on wrong side of street	85.0	2.5	12.5
Motorist overtaking the bicyclist	72.0	4.2	23.8
Bicyclist overtaking motor vehicle	80.0	0.0	20.0
Operator lost control	66.7	24.4	8.9
Crossing Paths			
Bicyclist did not clear intersection	100.0	0.0	0.0
Motorist failed to yield	86.7	2.0	11.4
Bicyclist failed to yield, midblock	95.0	0.3	4.7
Bicyclist failed to yield, intersection	96.9	1.1	2.0
Motorist turning error	76.5	0.0	23.5
Bicyclist turning error	91.3	0.0	8.7
Crash occurred at an intersection	95.9	0.0	4.1
Unknown/insufficient information	58.3	0.0	41.7
ALL CRASHES	88.9	1.8	9.2

*Row percents. Cases with unknown sobriety excluded.

Table 50. Rural/urban for bicycle crash types.

	Gender*	
Subgroup	Rural	Urban
Specific Circumstances	32.2	67.8
Parallel Paths		
Motorist turn/merge into path of bicyclist	22.8	77.2
Bicyclist turn/merge into path of motorist	37.7	62.3
Operator on wrong side of street	41.0	59.0
Motorist overtaking the bicyclist	48.8	51.2
Bicyclist overtaking motor vehicle	17.1	82.9
Operator lost control	37.5	62.5
Crossing Paths		
Bicyclist did not clear intersection	45.2	54.8
Motorist failed to yield	24.8	75.2
Bicyclist failed to yield, midblock	33.1	66.9
Bicyclist failed to yield, intersection	29.7	70.3
Motorist turning error	50.0	50.0
Bicyclist turning error	8.7	91.3
Crash occurred at an intersection	28.6	71.4
Unknown/insufficient information	29.2	70.8
ALL CRASHES	30.9	69.1

*Row percents. Cases with unknown rural/urban excluded.

Time of Day

Table 51 examines time of day for the various crash types. The time periods of 2 to 6 p.m. and 6 to 10 p.m. were shown earlier to be associated with an increased frequency of bicyclist crashes. The crash types most overrepresented in these time periods were:

2 to 6 p.m	6 to 10 p.m
• Bicyclist turn/merge.	• Specific circumstances.
• Bicyclist failed to yield, midblock.	• Wrong way operator.
• Bicyclist turning error.	• Operator lost control.
	• Motorist turning error.

These represent somewhat expected findings. For example, alcohol and conspicuity problems could be associated with the 6 to 10 p.m. crashes. The 2 to 6 p.m. events are crash types associated with younger riders, who would likely be riding during this time period.

Motorist overtaking crashes were overrepresented from 10 p.m. to 2 a.m. and 2 a.m. to 6 a.m., whereas bicyclist overtaking crashes were overrepresented from 6 to 10 a.m. Bicyclists not clearing the intersection were overinvolved from 6 to 10 a.m. and 10 a.m. to 2 p.m.

Light Condition

About 80 percent of the crashes occurred during daylight (table 52). The crash types overrepresented during daylight tended to pertain to the bicyclist: bicyclist turn/merge, bicyclist overtaking, bicyclist did not clear intersection, bicyclist failed to yield midblock, and bicyclist turning error. Crashes where an operator lost control were associated with the conditions of dawn/dusk, dark with street lights, and dark with no street lights. Other crash types overrepresented in the two conditions of darkness included wrong way operator, motorist overtaking, and motorist turning error.

Weekday versus Weekend

Weekend was defined as 6 p.m. Friday until 6 a.m. Monday, and about 30 percent of the crashes occurred during this period. Crash types most overrepresented during weekends included:

- Wrong way operator.
- Operator lost control.
- Bicyclist turning error.
- Intersection crash.

Table 51. Hour of day for bicycle crash types.

Subgroup	Hour*					
	10 pm - 1:59 am	2 am - 5:59 am	6 am - 9:59 am	10 am - 1:59 pm	2 pm - 5:59 pm	6 pm - 9:59 pm
Specific Circumstances	2.9	0.0	6.3	16.9	41.6	32.4
Parallel Paths						
Motorist turn/merge into path of bicyclist	5.4	1.4	12.6	20.9	39.0	20.6
Bicyclist turn/merge into path of motorist	0.9	1.8	7.7	17.7	47.5	24.4
Operator on wrong side of street	9.9	1.2	3.7	19.8	32.1	33.3
Motorist overtaking the bicyclist	9.7	2.4	7.3	15.3	35.9	29.4
Bicyclist overtaking motor vehicle	1.2	0.0	19.3	16.9	41.0	21.7
Operator lost control	12.5	2.1	2.1	18.8	29.2	35.4
Crossing Paths						
Bicyclist did not clear intersection	4.8	0.0	14.3	31.0	38.1	11.9
Motorist failed to yield	3.7	0.6	11.9	23.1	40.9	19.7
Bicyclist failed to yield, midblock	3.2	0.3	5.6	15.9	46.9	28.0
Bicyclist failed to yield, intersection	2.2	0.9	9.1	17.5	41.4	29.1
Motorist turning error	10.5	0.0	21.1	5.3	21.1	42.1
Bicyclist turning error	0.0	0.0	10.0	25.0	50.0	15.0
Crash occurred at an intersection	1.3	3.9	9.1	14.3	42.9	28.6
Unknown/insufficient information	12.2	2.0	10.2	16.3	34.7	24.5
ALL CRASHES	4.2	1.0	9.5	18.9	41.0	25.4

*Row percents. Cases with unknown hour of day excluded.

Table 52. Light condition for bicycle crash types.

Subgroup	Light Condition*			
	Daylight	Dawn/ Dusk	Dark, Street Light	Dark, No Street Light
Specific Circumstances	78.7	6.8	9.7	4.8
Parallel Paths				
Motorist turn/merge into path of bicyclist	79.4	6.3	13.2	1.2
Bicyclist turn/merge into path of motorist	85.6	6.3	4.1	4.1
Operator on wrong side of street	69.9	4.8	14.5	10.8
Motorist overtaking the bicyclist	65.1	5.6	13.9	15.5
Bicyclist overtaking motor vehicle	86.8	2.4	7.2	3.6
Operator lost control	66.7	8.3	16.7	8.3
Crossing Paths				
Bicyclist did not clear intersection	83.3	2.4	14.3	0.0
Motorist failed to yield	80.2	5.1	12.6	2.2
Bicyclist failed to yield, midblock	84.4	6.4	8.1	1.2
Bicyclist failed to yield, intersection	81.6	6.1	10.8	1.5
Motorist turning error	63.2	5.3	15.8	15.8
Bicyclist turning error	95.7	0.0	4.4	0.0
Crash occurred at an intersection	77.9	9.1	11.7	1.3
Unknown/insufficient information	65.3	4.1	26.5	4.1
ALL CRASHES	79.2	5.8	11.3	3.7

*Row percents. Cases with unknown light condition excluded.

- Insufficient information crashes.

Weekday counterparts included bicyclist not clearing the intersection and motorist failing to yield.

Road Condition

Wet roadway conditions were present in about 7 percent of the cases. Most frequent crash types on wet roads were motorist failed to yield and bicyclist failed to yield at an intersection. Crash types overrepresented during these conditions were wrong way operator, bicyclist overtaking, and motorist turning error.

ROADWAY FACTORS

Road Class

Table 53 shows road class data, with about a third of the crashes occurring on local streets and another one-fourth on county routes. Various overrepresentation patterns were present:

- Local streets - bicyclist overtaking, bicyclist turning error, and insufficient information crashes.
- County routes - bicyclist turn/merge, wrong way operator, motorist overtaking, operator lost control, bicyclist failed to yield midblock, and motorist turning error.
- State routes - bicyclist did not clear intersection and intersection crashes.
- U.S. routes - bicyclist did not clear intersection.

The same tendencies were present when speed limits were examined, in that speed limits are closely correlated with road class.

Road Feature

About half of the crashes took place at intersections or were intersection-related, with another one-fifth occurring at driveways or alleys. About one-fourth occurred at places with no special feature. Crash type overrepresentation patterns by road feature (table 54) were not unexpected:

Table 53. Road class for bicycle crash types.

Subgroup	Road Class*					
	Interstate	US Route	State Route	County Route	Local	Other
Specific Circumstances	0.8	3.4	5.1	17.1	33.3	40.2
Parallel Paths						
Motorist turn/merge into path of bicyclist	0.0	10.1	23.1	19.6	36.2	11.1
Bicyclist turn/merge into path of motorist	0.0	9.4	21.6	34.5	28.8	5.8
Operator on wrong side of street	0.0	9.3	14.8	33.3	38.9	3.7
Motorist overtaking the bicyclist	0.0	8.6	21.9	42.3	21.4	5.9
Bicyclist overtaking motor vehicle	0.0	5.7	14.3	17.1	54.3	8.6
Operator lost control	0.0	7.7	15.4	38.5	34.6	3.9
Crossing Paths						
Bicyclist did not clear intersection	0.0	21.4	35.7	21.4	14.3	7.1
Motorist failed to yield	0.3	8.8	22.2	22.8	29.2	16.7
Bicyclist failed to yield, midblock	0.0	6.3	13.4	34.8	37.5	8.0
Bicyclist failed to yield, intersection	0.3	7.5	15.3	24.1	39.0	13.9
Motorist turning error	0.0	0.0	0.0	66.7	33.3	0.0
Bicyclist turning error	0.0	0.0	0.0	0.0	100.0	0.0
Crash occurred at an intersection	0.0	10.3	25.6	25.6	28.2	10.3
Unknown/insufficient information	0.0	7.4	14.8	22.2	55.6	0.0
ALL CRASHES	0.2	8.0	18.1	27.5	33.7	12.5

*Row percents. Cases with unknown road class excluded.

Table 54. Road feature for bicycle crash types.

Subgroup	Road Feature*					
	No Special	Driveway Public	Driveway Private	Alley Intersection	Intersect Road	Intersect Road Rel
Specific Circumstances	69.0	9.4	13.6	3.3	3.8	0.9
Parallel Paths						
Motorist turn/merge into path of bicyclist	5.4	18.9	8.2	0.0	65.6	2.0
Bicyclist turn/merge into path of motorist	57.5	5.0	9.5	0.5	20.4	7.2
Operator on wrong side of street	78.3	4.8	0.0	1.2	8.4	7.2
Motorist overtaking the bicyclist	85.8	1.6	0.4	0.0	8.5	3.6
Bicyclist overtaking motor vehicle	67.5	6.0	3.6	0.0	16.9	6.0
Operator lost control	73.5	2.0	4.1	0.0	12.2	8.2
Crossing Paths						
Bicyclist did not clear intersection	2.4	2.4	0.0	0.0	92.9	2.4
Motorist failed to yield	0.3	23.5	5.4	1.5	67.5	1.8
Bicyclist failed to yield, midblock	31.4	20.6	30.2	12.8	0.0	4.9
Bicyclist failed to yield, intersection	0.2	0.0	0.6	0.4	94.8	4.0
Motorist turning error	0.0	0.0	0.0	10.5	79.0	10.5
Bicyclist turning error	0.0	4.4	0.0	8.7	65.2	21.7
Crash occurred at an intersection	1.3	2.6	1.3	0.0	92.3	2.6
Unknown/insufficient information	40.9	2.3	0.0	2.3	52.3	2.3
ALL CRASHES	26.9	11.7	7.8	2.4	47.6	3.7

*Row percents. Cases with unknown road features excluded.

- Intersections - motorist turn/merge, bicyclist did not clear intersection, motorist failed to yield, bicyclist failed to yield at intersection, motorist turning error, bicyclist turning error, and intersection crash.
- Public driveways - motorist turn/merge, motorist failed to yield, and bicyclist failed to yield midblock.
- Private driveways - specific circumstances, and bicyclist failed to yield midblock.

Number of Through Lanes

About 55 percent of the crashes took place on roads with 2 through lanes, and another 20 percent on roads with 4 through lanes. Crash type overrepresentation patterns by number of lanes (table 55) were the following:

- 2-lane roads - bicyclist turn/merge, wrong way operator, motorist overtaking, bicyclist overtaking, bicyclist failed to yield midblock, bicyclist failed to yield at an intersection, and bicyclist turning error.
- 4, 5, and 6-lane roads - motorist turn/merge, bicyclist did not clear intersection, and motorist failed to yield.
- 1-lane roads - specific circumstances and motorist turning error.

The patterns were almost identical for the variable that described the total number of lanes on the road or at intersections, where midblock two-way left turn lanes and intersection turning lanes would be included.

Lane Width

Lane width information was available or able to be coded for less than 20 percent of the cases. Where available, crash type frequencies were about equivalent for lane widths for 3.0 to 3.3 m (10 to 11 ft), 3.6 m (12 ft), and greater than 4.8 m (16 ft). Crash type overrepresentation patterns were interesting but varied (table 56):

- 2.7 m (9 ft) or less - wrong way operator, motorist overtaking, and operator lost control.
- 3.0 to 3.3 m (10 to 11 feet) - bicyclist turn merge, wrong way operator, motorist overtaking, operator lost control, and bicyclist did not clear intersection.

Table 55. Number of lanes for bicycle crash types.

Subgroup	Lanes*						All Other
	1	2	3	4	5	6+	
Specific Circumstances	11.5	34.5	1.0	3.4	0.0	0.0	49.8
Parallel Paths							
Motorist turn/merge into path of bicyclist	0.8	43.3	2.7	35.3	3.6	4.9	9.3
Bicyclist turn/merge into path of motorist	1.8	69.0	2.7	20.1	0.5	1.8	4.1
Operator on wrong side of street	1.2	78.6	2.4	11.9	0.0	2.4	3.6
Motorist overtaking the bicyclist	0.4	68.5	1.6	17.9	1.2	3.9	6.6
Bicyclist overtaking motor vehicle	1.2	63.4	1.2	12.2	1.2	2.4	18.3
Operator lost control	1.9	53.7	5.6	22.2	0.0	5.6	11.1
Crossing Paths							
Bicyclist did not clear intersection	0.0	7.1	4.8	45.2	2.4	31.0	9.5
Motorist failed to yield	0.6	41.9	2.3	26.3	3.4	5.9	19.6
Bicyclist failed to yield, midblock	1.1	68.8	1.7	14.7	0.9	1.7	11.1
Bicyclist failed to yield, intersection	0.2	66.5	3.2	16.4	1.6	2.0	10.2
Motorist turning error	5.3	63.2	0.0	21.1	0.0	0.0	10.5
Bicyclist turning error	0.0	76.2	0.0	8.7	65.2	21.7	19.1
Crash occurred at an intersection	0.0	45.4	2.3	22.1	3.5	3.5	23.3
Unknown/insufficient information	2.0	62.0	0.0	14.0	2.0	0.0	20.0
ALL CRASHES	1.6	55.3	2.3	20.5	1.9	3.7	14.9

*Row percents. Cases with unknown number of lanes excluded.

Table 56. Lane width for bicycle crash types.

	Lane Width (meters)*					
Subgroup	Unknown	≤ 2.7	3.0-3.3	3.6	3.9-4.8	> 4.8
Specific Circumstances	87.7	0.0	4.7	2.8	2.8	1.9
Parallel Paths						
Motorist turn/merge into path of bicyclist	86.1	0.3	2.2	3.3	2.8	5.3
Bicyclist turn/merge into path of motorist	76.6	1.8	8.4	4.0	2.2	7.1
Operator on wrong side of street	78.1	4.9	6.1	3.7	2.4	4.9
Motorist overtaking the bicyclist	69.9	5.1	11.3	8.2	3.5	2.0
Bicyclist overtaking motor vehicle	81.9	1.2	0.0	3.6	4.8	8.4
Operator lost control	70.0	6.0	14.0	6.0	2.0	2.0
Crossing Paths						
Bicyclist did not clear intersection	78.6	0.0	7.1	9.5	2.4	2.4
Motorist failed to yield	88.4	0.3	1.6	3.2	2.4	4.3
Bicyclist failed to yield, midblock	80.1	2.6	5.0	4.4	4.7	3.2
Bicyclist failed to yield, intersection	82.3	2.1	2.5	4.0	3.7	5.4
Motorist turning error	84.2	0.0	5.3	5.3	5.3	0.0
Bicyclist turning error	86.4	0.0	0.0	0.0	4.6	9.1
Crash occurred at an intersection	92.4	0.0	1.3	3.8	0.0	2.5
Unknown/insufficient information	90.0	0.0	0.0	0.0	4.0	6.0
ALL CRASHES	82.6	1.7	4.1	4.1	3.1	4.5

*Row percents. Cases with unknown lane widths excluded.

(1 m = 3.3 ft)

- 3.6 m (12 ft) - motorist overtaking, operator lost control, and bicyclist did not clear intersection.
- 3.9 to 4.8 m (13 to 16 ft) - bicyclist overtaking, bicyclist failed to yield midblock, motorist turning error, and bicyclist turning error.
- > 4.8 m (16 ft) - bicyclist turn/merge, bicyclist overtaking, and bicyclist turning error.

The most frequent crash types on the wider lanes appeared to involve bicyclist problems.

Traffic Control Device

No traffic control device was present for about 60 percent of the crashes, with stop signs present 25 percent of the time and traffic signals 16 percent of the time. Crash type overrepresentation for this variable followed the expected pattern, with crossing or intersection-related events associated with stop signs and traffic signals and parallel path events more associated with no control present (table 57).

Detailed Bicyclist Location

The detailed location of the bicyclist at or near the time of impact was in a through travel lane about 70 percent of the time. Some interesting crash type overinvolvements with this variable are shown in table 58 and include the following:

- Through travel lane - bicyclist turn/merge, wrong way operator, motorist overtaking, bicyclist overtaking, bicyclist failed to yield midblock, bicyclist failed to yield at an intersection, bicyclist turning error, and crashes with insufficient information.
- Shoulder - wrong way operator, motorist overtaking, and operator lost control.
- Sidewalk - specific circumstances, motorist failed to yield, and motorist turning error.
- Bike lane - motorist turn/merge, bicyclist overtaking, operator lost control, and motorist turning error.
- Marked pedestrian crosswalk - bicyclist did not clear intersection, motorist failed to yield, and intersection crash.
- Implied pedestrian crosswalk - motorist failed to yield, and intersection crash.
- Alley, driveway, other entering roadway - specific circumstances, motorist turning error, and bicyclist turning error.

Table 57. Traffic control for bicycle crash types.

Subgroup	Control*		
	No Control	Stop Sign	Stop/Go Signal
Specific Circumstances	92.9	5.2	1.9
Parallel Paths			
Motorist turn/merge into path of bicyclist	60.3	11.4	28.3
Bicyclist turn/merge into path of motorist	91.1	4.0	4.9
Operator on wrong side of street	90.5	8.3	1.2
Motorist overtaking the bicyclist	93.3	1.6	5.2
Bicyclist overtaking motor vehicle	81.5	7.4	11.1
Operator lost control	83.3	10.4	6.3
Crossing Paths			
Bicyclist did not clear intersection	2.4	0.0	97.6
Motorist failed to yield	32.2	47.1	20.7
Bicyclist failed to yield, midblock	96.0	2.9	1.1
Bicyclist failed to yield, intersection	14.9	60.2	24.9
Motorist turning error	61.1	27.8	11.1
Bicyclist turning error	69.6	30.4	0.0
Crash occurred at an intersection	15.8	46.1	38.2
Unknown/insufficient information	63.6	22.7	13.6
ALL CRASHES	58.6	25.3	16.2

*Row percents. Cases with unknown traffic control excluded.

Table 58. Detailed bicyclist location for bicycle crash types.

Subgroup	Detailed Bicyclist Location*								
	Thru Lane	Edge thru lane	Shoulder	Sidewalk	Bike lane	Ped Crosswalk Marked	Ped Crosswalk Implied	Alley/ Driveway	Parking Lot
Specific Circumstances	25.7	1.4	3.3	5.1	0.5	0.0	5.6	15.9	42.5
Parallel Paths									
Motorist turn/merge into path of bicyclist	64.8	1.7	2.8	3.7	6.5	8.5	11.4	0.6	0.0
Bicyclist turn/merge into path of motorist	95.9	1.4	2.3	0.0	0.0	0.5	0.0	0.0	0.0
Operator on wrong side of street	83.1	6.0	7.2	0.0	2.4	1.2	0.0	1.2	0.0
Motorist overtaking the bicyclist	85.5	4.0	8.1	0.0	2.4	0.0	0.0	0.0	0.0
Bicyclist overtaking motor vehicle	83.1	5.2	3.9	0.0	5.2	0.0	0.0	0.0	2.6
Operator lost control	69.6	4.4	13.0	2.2	8.7	0.0	2.2	0.0	0.0
Crossing Paths									
Bicyclist did not clear intersection	41.5	0.0	0.0	0.0	0.0	56.1	2.4	0.0	0.0
Motorist failed to yield	50.0	1.4	4.6	5.4	2.6	13.6	21.8	0.3	0.2
Bicyclist failed to yield, midblock	92.4	0.6	0.3	0.6	0.3	0.6	4.1	1.2	0.0
Bicyclist failed to yield, intersection	84.2	0.2	0.0	0.0	0.2	7.2	8.2	0.0	0.0
Motorist turning error	70.6	0.0	0.0	5.9	5.9	5.9	0.0	11.8	0.0
Bicyclist turning error	87.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	0.0
Crash occurred at an intersection	53.4	1.4	0.0	0.0	2.7	19.2	21.9	1.4	0.0
Unknown/insufficient information	90.9	0.0	0.0	0.0	0.0	9.1	0.0	0.0	0.0
ALL CRASHES	70.2	1.6	3.0	2.2	2.1	6.8	9.1	1.7	3.3

*Row percents. Cases with unknown location details excluded.

- Parking lot - specific circumstances.

Two other variables noted either the presence of a sidewalk or that the bicyclist was using the sidewalk sometime before the crash. Both variables showed motorist turn merge, motorist failed to yield, and intersection crashes as being overrepresented.

CRASH CHARACTERISTICS

Bicycle Maneuver

The most frequent bicyclist maneuvers were proceeding straight, traveling the wrong direction, entering the roadway, crossing midblock, and left turns. The crash type overrepresentations for the maneuvers were basically what would have been expected (table 59):

- Proceeding straight - motorist turn/merge, bicyclist did not clear intersection, motorist failed to yield, bicyclist failed to yield at an intersection, and intersection crashes.
- Wrong way - wrong way riding and motorist failed to yield.
- Crossing midblock - bicyclist failed to yield midblock.
- Left turns - bicyclist turn/merge and bicycle turning error.
- Entering the roadway - bicyclist turn/merge and bicyclist failed to yield midblock.

Motorist Maneuver

The most frequent motorist maneuvers were proceeding straight, right turns, and left turns. Patterns of crash type overrepresentation for the motorist maneuvers (table 60) also were reasonably predictable:

- Proceeding straight - bicyclist turn/merge, wrong way riding, bicyclist did not clear intersection, bicyclist failed to yield midblock and at intersection.
- Right turns - motorist turn/merge, motorist failed to yield, motorist turning error, and intersection crashes.
- Left turns - motorist turn/merge and motorist turning error.

Table 59. Bicycle maneuver for bicycle crash types.

Subgroup	Maneuver*								
	Straight	Slow/ Stopped	Right Turn	Left Turn	Enter Roadway	Wrong Way	Cross Midblock	Swerve Lt/Rt	All Other
Specific Circumstances	59.8	5.7	1.9	3.8	4.3	5.3	2.9	0.0	16.3
Parallel Paths									
Motorist turn/merge into path of bicyclist	91.4	0.6	1.4	1.4	1.1	2.8	0.6	0.0	0.8
Bicyclist turn/merge into path of motorist	1.8	0.0	8.8	43.2	14.5	3.1	3.1	7.9	17.6
Operator on wrong side of street	23.8	3.6	0.0	0.0	0.0	65.5	1.2	0.0	6.0
Motorist overtaking the bicyclist	66.4	3.9	0.4	2.0	0.4	0.4	0.0	17.6	9.0
Bicyclist overtaking motor vehicle	63.9	3.6	0.0	2.4	0.0	2.4	0.0	0.0	27.7
Operator lost control	38.0	6.0	0.0	0.0	0.0	2.0	0.0	6.0	48.0
Crossing Paths									
Bicyclist did not clear intersection	90.5	0.0	0.0	0.0	0.0	4.8	4.8	0.0	0.0
Motorist failed to yield	75.0	0.6	0.2	1.5	0.5	21.8	0.5	0.0	0.0
Bicyclist failed to yield, midblock	18.2	0.3	0.9	1.4	35.2	0.9	42.6	0.0	0.6
Bicyclist failed to yield, intersection	75.3	2.7	2.7	5.8	1.7	7.1	0.8	0.0	4.0
Motorist turning error	57.9	31.6	0.0	0.0	0.0	5.3	0.0	0.0	5.3
Bicyclist turning error	4.4	4.4	56.5	30.4	0.0	0.0	0.0	0.0	4.4
Crash occurred at an intersection	71.3	2.5	1.3	5.0	5.0	7.5	0.0	0.0	7.5
Unknown/insufficient information	64.0	0.0	0.0	2.0	2.0	2.0	0.0	0.0	30.0
ALL CRASHES	59.9	2.0	2.0	5.8	6.3	9.4	5.9	2.2	6.6

*Row percents. Cases with unknown bicycle maneuver excluded.

Table 60. Motor vehicle maneuver for bicycle crash types.

Subgroup	Maneuver*								
	Straight	Slow/ Stopped	Right Turn	Left Turn	Backing	Passing	Parked	Entering Roadway	All Other
Specific Circumstances	42.9	6.7	5.7	3.8	26.7	0.5	2.4	1.4	10.0
Parallel Paths									
Motorist turn/merge into path of bicyclist	1.4	0.0	37.1	56.0	0.0	0.6	0.0	0.6	4.4
Bicyclist turn/merge into path of motorist	86.3	3.1	0.5	2.2	0.0	6.2	0.0	0.5	1.3
Operator on wrong side of street	76.2	13.1	3.6	1.2	0.0	0.0	0.0	2.4	3.6
Motorist overtaking the bicyclist	53.1	0.8	0.8	1.2	0.0	39.1	0.4	0.0	4.7
Bicyclist overtaking motor vehicle	9.5	25.0	7.1	7.1	0.0	0.0	48.8	0.0	2.4
Operator lost control	48.0	12.0	4.0	4.0	2.0	4.0	8.0	0.0	18.0
Crossing Paths									
Bicyclist did not clear intersection	88.1	0.0	2.4	7.1	0.0	0.0	0.0	0.0	2.4
Motorist failed to yield	31.3	5.7	37.8	5.4	0.0	0.0	0.0	19.0	0.8
Bicyclist failed to yield, midblock	88.4	3.4	1.7	0.9	0.0	0.0	0.0	4.3	1.4
Bicyclist failed to yield, intersection	88.8	2.5	4.8	3.5	0.0	0.2	0.0	0.0	0.2
Motorist turning error	0.0	0.0	31.6	68.4	0.0	0.0	0.0	0.0	0.0
Bicyclist turning error	43.5	34.8	8.7	8.7	0.0	0.0	0.0	4.4	0.0
Crash occurred at an intersection	48.8	15.0	20.0	8.8	0.0	0.0	1.3	1.3	5.0
Unknown/insufficient information	62.0	2.0	6.0	4.0	0.0	0.0	0.0	0.0	26.0
ALL CRASHES	53.2	4.8	15.7	10.4	1.9	4.0	1.7	5.1	3.2

*Row percents. Cases with unknown motor vehicle maneuver excluded.

Bicyclist Direction of Travel At/Near Impact

Bicyclist were travelling in the same direction (with) traffic in a little over half the cases and against traffic in about one-third of the cases. The remainder involved the bicyclist crossing traffic. Thus, quite a few of the overrepresented crash types (table 61) pertained to moving with the flow of traffic. When the bicyclist was moving against traffic, the overinvolvements were wrong way riding, motorist failed to yield, and intersection crashes. Only one crash type was overinvolved when the bicyclist was crossing traffic, that of bicyclist failed to yield midblock.

Intended Intersection Maneuver

The bicyclist's intent was to travel straight through the intersection just under 90 percent of the time, moving left (9 percent) or right (3 percent) considerably less often. Crash type overinvolvements were few (table 62):

- Straight through - motorist turn/merge, bicyclist did not clear intersection, and motorist failed to yield.
- Left - bicyclist turn/merge, wrong way riding, motorist overtaking, motorist turning error, and bicyclist turning error.
- Right - bicyclist turn/merge, operator lost control, motorist turning error, and bicyclist turning error.

The intersection maneuver intents of motorists were different from the above, with 51 percent straight through, 30 percent right, and 18 percent left. Of interest was the fact that motorist turn/merge, bicyclist overtaking, and motorist turning error crashes were overrepresented when the motorist intended to go left, and wrong way riding and motorist failed to yield crashes when the motorist intended to go right (table 63).

CONTRIBUTING FACTORS

Driver

Frequent driver contributing factors were failures to yield and hit and run. Crash types overrepresented in driver failure to yield instances besides motorist failed to yield were motorist turn/merge and bicyclist did not clear intersection. For the hit and run instances, crash types observed more than expected included specific circumstances, wrong way riding, motorist overtaking, operator lost control, motorist turning error, and cases with insufficient information.

Bicyclist

Frequent bicyclist contributing factors were failure to yield and riding against traffic. Crash types overrepresented in bicyclist failure to yield instances were bicyclists failure to

Table 61. Bicycle direction of travel at or near impact for bicycle crash types.

Subgroup	Direction*		
	With Traffic	Against Traffic	Crossing Traffic
Specific Circumstances	59.0	27.9	13.1
Parallel Paths			
Motorist turn/merge into path of bicyclist	86.1	12.8	1.1
Bicyclist turn/merge into path of motorist	72.0	20.9	7.1
Operator on wrong side of street	3.6	95.2	1.2
Motorist overtaking the bicyclist	99.2	0.8	0.0
Bicyclist overtaking motor vehicle	95.2	4.8	0.0
Operator lost control	81.3	16.7	2.1
Crossing Paths			
Bicyclist did not clear intersection	70.7	24.4	4.9
Motorist failed to yield	33.5	65.9	0.6
Bicyclist failed to yield, midblock	10.8	7.0	82.2
Bicyclist failed to yield, intersection	63.9	34.1	1.9
Motorist turning error	88.9	11.1	0.0
Bicyclist turning error	63.6	36.4	0.0
Crash occurred at an intersection	39.4	57.8	2.8
Unknown/insufficient information	76.2	19.1	4.8
ALL CRASHES	56.0	32.0	12.0

*Row percents. Cases with unknown direction of travel excluded.

Table 62. Bicyclist intended intersection maneuver.

Subgroup	Intended Maneuver*		
	Straight Through	Left	Right
Specific Circumstances	91.7	4.2	4.2
Parallel Paths			
Motorist turn/merge into path of bicyclist	97.6	0.9	1.5
Bicyclist turn/merge into path of motorist	16.4	71.2	12.3
Operator on wrong side of street	83.3	16.7	0.0
Motorist overtaking the bicyclist	80.0	20.0	0.0
Bicyclist overtaking motor vehicle	90.0	10.0	0.0
Operator lost control	83.3	0.0	16.7
Crossing Paths			
Bicyclist did not clear intersection	97.4	2.6	0.0
Motorist failed to yield	97.3	2.7	0.0
Bicyclist failed to yield, midblock	84.0	11.1	4.9
Bicyclist failed to yield, intersection	85.9	10.4	3.8
Motorist turning error	66.7	25.0	8.3
Bicyclist turning error	0.0	36.4	63.6
Crash occurred at an intersection	88.6	8.6	2.9
Unknown/insufficient information	90.9	9.1	0.0
ALL CRASHES	88.1	8.8	3.1

*Row percents. Cases with unknown intended maneuver excluded.

Table 63. Motorist intended maneuver for bicycle crash types.

Subgroup	Intended Maneuver*		
	Straight Through	Left	Right
Specific Circumstances	63.4	19.5	17.1
Parallel Paths			
Motorist turn/merge into path of bicyclist	1.2	59.6	39.2
Bicyclist turn/merge into path of motorist	82.2	11.0	6.9
Operator on wrong side of street	40.0	20.0	40.0
Motorist overtaking the bicyclist	77.4	9.7	12.9
Bicyclist overtaking motor vehicle	22.2	50.0	27.8
Operator lost control	50.0	12.5	37.5
Crossing Paths			
Bicyclist did not clear intersection	82.1	18.0	0.0
Motorist failed to yield	25.2	11.2	63.6
Bicyclist failed to yield, midblock	94.8	1.4	3.8
Bicyclist failed to yield, intersection	89.4	4.9	5.7
Motorist turning error	0.0	68.4	31.6
Bicyclist turning error	60.0	26.7	13.3
Crash occurred at an intersection	58.2	13.4	28.4
Unknown/insufficient information	64.3	14.3	21.4
ALL CRASHES	51.1	18.4	30.5

*Row percents. Cases with unknown intended maneuver excluded.

yield midblock and at intersections and intersection crashes. When the bicyclist was riding against traffic, wrong way riding crashes were obviously overrepresented, along with motorist failure to yield and intersection crashes. The motorist failure to yield might have occurred if a bicyclist came off of a sidewalk and was riding in a pedestrian crosswalk at an intersection.

Alcohol or drug use by the bicyclist was coded as a contributing factor in less than 4 percent of the cases. For these cases, overrepresented crash types included wrong way riding, motorist overtaking, bicyclist overtaking, operator lost control, and cases with insufficient information.

The Bicycle

Contributing factors pertaining to the bicycle itself and coded with some frequency included no relevant lights (4 percent of cases) and no/defective/ineffective brakes (3 percent) of cases. Where there were no relevant lights, crash types overrepresented included motorist turn/merge, wrong way riding, motorist overtaking, operator lost control, and motorist turning error. When there were brake problems, the counterpart crash types were bicyclist overtaking, operator lost control, and bicyclist failed to yield at an intersection. In the case of brake problems, the bicyclist tended to tell the investigating officer that the brakes failed or were not working properly. Many times, particularly for the California cases, the operator then attempted to test the brakes and wrote a statement about their effectiveness in the narrative.

FAULT

The bicyclist was judged to be solely at fault in 50 percent of the cases, with another 3 percent where the bicyclist was at fault and the culpability of the driver was unclear (table 64). Drivers were judged to be solely at fault in 28 percent of the cases, with another 3 percent where the driver was at fault and the culpability of the bicyclist was unclear. Both the bicyclist and driver were considered at fault in 14 percent of the cases and neither at fault in less than 1 percent of the cases. Fault could not be ascertained in about 2 percent of the cases.

Crash types overrepresented as the fault of the bicyclist included:

- Bicyclist turn/merge into the path of the motorist.
- Wrong way bicyclist.
- Bicyclist overtaking a motor vehicle.
- Operator loss of control.
- Bicyclist failed to yield either at midblock or an intersection.
- Bicyclist turning error.

Crash types overrepresented as the fault of the motor vehicle driver included:

- Specific circumstances (weird, non-roadway, etc.).
- Motorist turn/merge into the path of the bicyclist.

Table 64. Fault for bicycle crash types.

	Fault*						
Subgroup	Both Unknown	Driver Only	Driver; Bicyclist Unknown	Bicyclist Only	Bicyclist;Driver Unknown	Both	Neither
Specific Circumstances	3.7	37.4	3.7	40.1	2.3	11.5	1.4
Parallel Paths							
Motorist turn/merge into path of bicyclist	1.1	67.9	2.8	13.9	1.1	13.3	0.0
Bicyclist turn/merge into path of motorist	0.9	0.4	0.9	89.9	4.0	4.0	0.0
Operator on wrong side of street	0.0	4.8	1.2	65.5	10.7	17.9	0.0
Motorist overtaking the bicyclist	2.7	50.8	6.3	24.6	4.7	10.9	0.0
Bicyclist overtaking motor vehicle	0.0	19.1	2.4	64.3	2.4	9.5	2.4
Operator lost control	0.0	36.0	0.0	60.0	0.0	0.0	4.0
Crossing Paths							
Bicyclist did not clear intersection	4.8	35.7	0.0	26.2	4.8	19.1	9.5
Motorist failed to yield	1.4	42.9	3.7	17.2	1.6	33.2	0.0
Bicyclist failed to yield, midblock	0.6	1.7	0.3	87.8	3.1	6.5	0.0
Bicyclist failed to yield, intersection	0.0	0.2	0.2	94.0	2.3	3.1	0.2
Motorist turning error	5.3	79.0	5.3	0.0	0.0	10.5	0.0
Bicyclist turning error	0.0	4.4	0.0	87.0	4.4	4.4	0.0
Crash occurred at an intersection	12.5	6.3	7.5	46.3	8.8	16.3	2.5
Unknown/insufficient information	58.0	8.0	8.0	10.0	8.0	8.0	0.0
ALL CRASHES	2.5	27.7	2.6	49.8	2.9	14.1	0.5

*Row percents. Cases with unknown lane widths excluded.

- Motorist overtaking.
- Operator loss of control.
- Bicyclist not clearing a signalized intersection.
- Motorist failed to yield.
- Motorist turning error.

Crash types overrepresented as the fault of both the bicyclist and the driver included:

- Wrong-way operator.
- Bicyclist not clearing a signalized intersection.
- Motorist failed to yield.

CHAPTER 6. DISCUSSION

The preceeding chapters have presented a wealth of information about pedestrian- and bicycle-motor vehicle crashes. The information in chapters 3 and 5 pertains almost exclusively to crash type groups consistently used by NHTSA. (Detail on individual crash types for both pedestrians and bicyclists will be published as companion documents (Hunter, Pein and Stutts, in press; Hunter, Stutts and Pein, in press) to this report.) The following points are offered as summaries of the crash type data for pedestrians and bicyclists and for the overall study.

SUMMARY FOR PEDESTRIAN-MOTOR VEHICLE CRASHES

1. Compared to their representation in the overall U.S. population, young persons (under 25 years of age) were overrepresented in pedestrian crashes with motor vehicles, while older adults (ages 25 to 44) and the elderly (age 65+) were underrepresented. Elderly pedestrians in crashes, however, were over twice as likely to be killed — 15 percent versus 6 percent — compared to young persons.

2. Collisions with motor vehicles led to serious and fatal injuries to pedestrians in over 33 percent of the crashes.

3. Alcohol or drug use was noted in about 15 percent of pedestrian crashes overall, but increased to 31 percent for pedestrians in the 25 to 44 year age group. Alcohol/drug crashes were also more frequent on weekends and during hours of darkness.

4. Pedestrian crashes occurred most frequently during the late afternoon and early evening hours, times when exposure is likely highest and visibility may be a problem.

5. About two-thirds of the crashes were categorized as urban. Fifteen percent of the pedestrian crashes reported occurred on private property, primarily in commercial or other parking lots. The elderly were overrepresented in commercial parking lot crashes, young adults in non-commercial parking lot crashes, and children under age 10 in collisions occurring in driveways, alleys or yards.

6. Nearly 60 percent of the road-related crashes occurred on two-lane roadways. Serious and fatal injuries to pedestrians were directly proportional to speed limit and number of lanes.

7. Forty-one percent of crashes occurred at roadway intersections, and an additional eight percent at driveway or alley intersections.

8. The pedestrian was judged to be solely at fault in 43 percent of the crashes. Running into the road, failure to yield, alcohol impairment, stepping from between parked vehicles, and walking or running in the wrong direction (with traffic) were the most

frequently cited pedestrian contributing factors. Younger pedestrians were more likely to be at fault.

9. Motor vehicle drivers were judged to be solely at fault in 35 percent of the crashes. Driver hit-and-run and failure to yield were the most frequently cited driver contributing factors, followed by improper backing, safe movement violations, and exceeding safe speed. Only 3 percent of motor vehicle drivers striking pedestrians were judged to have been impaired by alcohol.

10. Over three-fourths of pedestrian crashes fell into one of the following eight crash type categories: vehicle turn/merge (9.8 percent), intersection dash (7.2 percent), other intersection (10.1 percent), midblock dart/dash (13.3 percent), other midblock (13.2 percent), not in roadway/waiting to cross (8.6 percent), walking along roadway (7.9 percent), and backing vehicle (6.9 percent). These and the other seven major crash type categories discussed in this report varied with respect to the pedestrian, driver, locational/environmental, and roadway factors that characterized them. It is critically important for individual States and communities to develop a better understanding of the particular traffic situations endangering their residents.

SUMMARY FOR BICYCLE-MOTOR VEHICLE CRASHES

1. The basic bicycle-motor vehicle crash patterns are similar to those seen in the late 1970's. Intersections, driveways, and other junctions continue to be locations where about three-fourths of the crashes occur. Emerging facilities should be designed with this fact in mind.

2. Compared with their representation in the overall U.S. population, young bicyclists under the age of 15 (and particularly ages 10 to 14) were overrepresented in crashes with motor vehicles, while older adults (ages 25 to 44) and the elderly (age 65+) were underrepresented. However, bicyclists older than age 44 were overrepresented with regard to serious and fatal injury.

3. Collisions with motor vehicles led to serious and fatal injuries to bicyclists in just over 18 percent of the crashes.

4. Alcohol or drug use was noted in about 5 percent of bicycle crashes overall but increased to 15 percent for bicyclists in the 25 to 44 age group. This may be an emerging problem. Alcohol-drug crashes were more frequent on weekends and during hours of darkness.

5. About two-thirds of the bicyclist crashes occurred during late afternoon and early evening hours. Exposure is likely quite high during these hours, and visibility can be a problem.

6. About two-thirds of the crashes were categorized as urban. About 7 percent occurred on private property. Bicyclists less than 10 years old were somewhat overrepresented in crashes in housing related parking lots, driveways, alleys, and private roads.

7. About 60 percent of the road-related crashes occurred on two-lane roadways. Roads with narrower lanes and roads with higher speed limits were associated with more than their share of serious and fatal injuries to bicyclists.

8. Bicyclists were judged to be at fault in about half of these crashes with motor vehicles. Bicyclists need training about how to ride in traffic. Failure to yield, riding against traffic, stop sign violations, and safe movement violations were the most frequently cited bicyclist contributing factors. The likelihood of the bicyclist being responsible for the crash was greatest for the younger bicyclists. When the crash-involved bicyclist was older, the motor vehicle driver was more likely to be at fault.

9. Motor vehicle drivers were judged to be solely at fault in 28 percent of the cases. Failure to yield, hit and run, and failure to see the bicyclists were the most frequently cited driver contributing factors.

10. The bicycle-motor vehicle crashes distributed into the three main categories as

Parallel path events	36 percent
Crossing path events	57 percent
Specific circumstances	7 percent

The most frequent parallel path crashes were motorist turn/merge into bicyclist's path (12.2 percent), motorist overtaking the bicyclist (8.6 percent), and bicyclist turn/merge into motorist's path (7.3 percent). The most frequent crossing path crashes were motorist failed to yield to bicyclist (21.7 percent), cyclist failed to yield at an intersection (16.8 percent), and bicyclist failed to yield midblock (11.8%). These six individual crash types accounted for almost 80 percent of all bicycle-motor vehicle crashes.

PROJECT SUMMARY AND RECOMMENDATIONS

1. Much of what is reported in this study seems strongly connected to basic walking, riding, and driving patterns — in other words, related to exposure. Future studies of pedestrians and bicyclists and related facilities should be planned with this need in mind.

2. As a measure of accountability, it is recommended that local and State pedestrian-bicycle coordinators continually track crashes in their jurisdictions. A simplified crash typing procedure that coordinators can easily use should be prepared and disseminated.

3. With the current increased interest in both bicycling and walking, crash investigators at the State and local levels should be urged to report completely on any bicyclist and pedestrian crashes, and particularly for roadway related variables.

4. A system-wide approach will be necessary to make safety gains as well as reach the goals of the National Bicycling and Walking Study (Federal Highway Administration, 1994), namely: (1) to double the number of trips made by bicycling and walking, and (2) to reduce by 10 percent the number of bicyclists and pedestrians injured and killed in traffic collisions. Engineering, education, and enforcement approaches are vital to improved safety. There is a continuing need to establish the mindset that bicyclists and pedestrians are worthy and viable users of our transportation system.

APPENDIX A

U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

Manual Accident Typing for Pedestrian Accidents

Coder's Handbook

MANUAL ACCIDENT TYPING (MAT) CODES FOR PEDESTRIAN CRASHES

GROUP/DESCRIPTION	TYPE	SUBTYPE	CODE
1. Motorist struck pedestrian going to/from or crossing near a bus or bus stop; ice-cream vendor; rural residential mailbox; exiting/entering a stopped or parked vehicle.			
Ped was struck while crossing in front of a commercial bus standing at a marked bus stop.	Commercial Bus-Related	None	110
Ped was struck going to/from a school bus or school bus stop.	School Bus-Related	None	120
Ped was struck while going to/from an ice-cream vendor and striking vehicle was on same street as vendor.	Vendor/Ice Cream Truck	None	130
Ped was struck while going to/from a private residence mailbox/newspaper box.	Mailbox-Related	None	140
Ped was in the process of exiting/entering parked or stopped vehicle, and was struck in traffic lane next to stopped/parked vehicle.	Exiting/Entering Parked Vehicle	None	150
2. Striking Vehicle Was: Driverless; Backing; in Pursuit, Being Pursued, or an Emergency Vehicle			
The ped was struck by a vehicle that was moving without a driver at the controls or was set into motion by the actions of a child.	Driverless Vehicle	None	210
The ped was struck by a vehicle that was backing up.	Backing Vehicle	None	220
The ped was struck by a vehicle on an emergency/police mission, or by a vehicle being pursued.	Hot Pursuit	None	230

GROUP/DESCRIPTION	TYPE	SUBTYPE	CODE
3. Ped Was Struck by Motorist While Going To/From or While Near/Next To: A Disabled Vehicle, an Active Police/ Emergency Vehicle			
The ped was struck walking to or from a disabled vehicle (e.g., to get help, gas, etc.)	Walking To or From Disabled Vehicle	None	310
The ped was struck while working or standing near, a disabled vehicle in or along the roadway. (No emergency vehicle present.)	Disabled Vehicle-Related	None	320
The ped was struck while near an active emergency or police vehicle	Emergency/ Police Vehicle-Related	None	330
4. Ped Was Struck While Working or Playing in Roadway or On a Play Vehicle			
The ped (e.g., police/emergency personnel, flagman, traffic guard, or member of a roadway/construction maintenance crew) was struck while working on, in, over, or under the roadway.	Working on Roadway	None	410
The ped was struck while riding a play vehicle (e.g., wagon, sled, skateboard; NOT bicycle, "Big Wheel" type vehicle, or tricycle).	Play Vehicle-Related	None	420
The ped was struck while playing on foot in roadway. Ped was playing in roadway prior to vehicle's appearance	Playing in Roadway	None	430
5. Ped Was Struck by Motorist While: Hitchhiking; Crossing Limited Access Expressway; Walking or Running Along a Road Without Sidewalks			
The ped was struck while hitchhiking.	Hitchhiking	None	510

GROUP/DESCRIPTION	TYPE	SUBTYPE	CODE
Ped was struck while attempting to cross a limited access expressway.	Expressway Crossing	None	520
Ped was walking or running along a road in the same direction as traffic.	Walking Along Road	With Traffic	531
Ped was walking or running along a road facing traffic (i.e., against traffic).		Against Traffic	532
Ped was walking or running along a road -- direction with respect to traffic not specified.		Can't Specify	539
6. Did Motorist Strike Ped: On/Near Curb or Roadway Edge? On Sidewalk or Other Non-Roadway Location?			
Ped was struck while WAITING to cross roadway, standing at or near curb.	Ped Waiting to Cross at/ Near Curb	None	610
Ped was struck when not in/near a roadway (e.g., in a parking lot, driveway, private road, gas station, alley, sidewalk, yard, garage, ball field).	Ped Not in Roadway	None	620
7. Accident Occurred At or Within 50 Feet of an Intersection			
Ped entered roadway in front of standing/ stopped traffic, and was struck by vehicle heading in same direction as stopped traffic.	Multiple Threat-at Intersection	None	710
Ped and vehicle collided while the vehicle was in the process of turning/merging, was preparing to turn/merge, or had just completed a turning/merging maneuver.	Vehicle/Turn Merge	None	720
The motorist's view of the ped was blocked until an instant before impact and/or the ped was running.	Intersection Dash	None	730

GROUP/DESCRIPTION	TYPE	SUBTYPE	CODE
At a signalized intersection, ped in process of crossing was struck when light changed and traffic started moving.	Trapped	None	740
Ped WALKED into (i.e., struck) the vehicle.	Ped Walks Into Vehicle -- At Intersection	None	750
Ped was struck by a driver who was proceeding straight ahead and the report indicated that the driver committed one or more of the following violations: careless driving, failed to yield right-of-way, signal/sign violation, speeding/ too fast for conditions, DWI/DUI.	Intersection -- Driver Violation	None	760
Accident occurred at an intersection but is not covered by any of the above or there is insufficient information to code in any of the above.	Intersection -- Other	None	790
8. Accident Occurred Midblock (More Than 50 Feet From an Intersection)			
Ped entered roadway in front of standing/ stopped traffic, and was struck by vehicle heading in same direction as standing traffic; driver's vision was blocked by standing traffic	Multiple Threat-Not at Intersection	None	810
Ped was struck before crossing half of the roadway (in first half of roadway) and the motorist's view of the ped was blocked until an instant before impact.	Dart-Out	First Half	821
Ped was struck after crossing over half of the roadway (in second half of roadway) and the motorist's view of the ped was blocked until an instant before impact.	Dart-Out	Second Half	822

GROUP/DESCRIPTION	TYPE	SUBTYPE	CODE
Ped was struck after entering roadway and motorist's view of the ped was blocked until an instant before impact (first or second half of roadway not specified).	Dart-Out	Can't Specify	829
Ped was running and the motorist's view of the ped was NOT obstructed.	Midblock Dash	None	830
Ped walked into (i.e., struck) the vehicle.	Ped Walks Into Vehicle--Midblock	None	840
Accident occurred midblock but is not covered by any of the above or insufficient information is given to code any of the above.	Midblock -- Other	None	890

9. Other Type or Inadequate Information

The accident situation is not covered by any of the types listed in categories 1-8.	Other -- Weird	None	910
Insufficient information was available to specify the accident type.	Inadequate Information	None	920

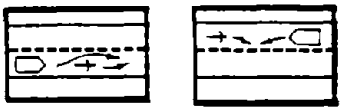
U.S. Department
of Transportation
**National Highway
Traffic Safety
Administration**

Manual Accident Typing for Bicyclist Accidents

Coder's Handbook

DEFINITION OF TERMS

COUNTERACTIVE EVASIVE ACTION - In attempting to avoid the accident, both operators turned in the same direction which led to the collision.



CYCLIST - The rider of a bicycle or an adult tricycle.

FAILED TO DETECT - The operator did not see the other vehicle until after a crash was imminent. Failure to detect may be the result of a physical obstruction to view such as vehicles, bushes, sunglare, or the result of operator inattention.

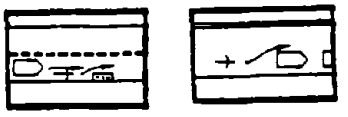
FAILURE TO YIELD - The operator did not stop and allow the vehicle with the right-of-way to proceed. For example, when entering the road from a driveway, an operator should stop and wait for approaching traffic to clear. Not doing so would constitute failing to yield. If an operator stops but fails to wait (e.g., because the operator did not detect the other vehicle), this is also "Failure to Yield."

INTENTIONALLY CAUSED ACCIDENT - When an operator purposely struck another vehicle in an attempt to cause injury or vehicle damage. Intentionally causing an accident should not be confused with improper driving or inattention, or cases in which the operator was reckless but did not intend to strike another vehicle.

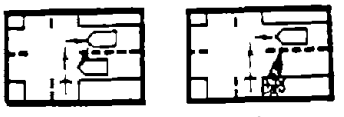
INTERSECTION - An accident is defined as occurring at an intersection when the point of impact was in the center of the intersection or within the crosswalks. All other locations are considered midblock.

MISJUDGED PASSING SPACE - A motorist did not allow enough lateral distance between the vehicle and the cyclist as the cyclist is being overtaken or passed, or the motorist pulled back into the lane before completely passing the cyclist.

OBSTRUCTION, PATH - The intended path (the cyclist's) was blocked by some physical obstruction, such as a car, a storm sewer grate, a pedestrian, or any object which would necessitate a change in course to proceed.

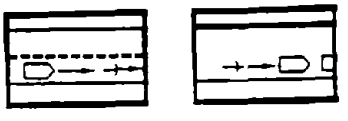


OBSTRUCTED VIEW - The operator's view was obscured. Obstructions could be moving or standing traffic, parked cars, bushes sunglare, etc.



OPERATOR - Either the motor vehicle driver or the cyclist when no distinction between them is required.

OVERTAKING - When both operators were on parallel paths, heading in the same direction, the vehicle that approached from behind and was going faster than the vehicle in front was the overtaking vehicle.



SPECIFIC CIRCUMSTANCES

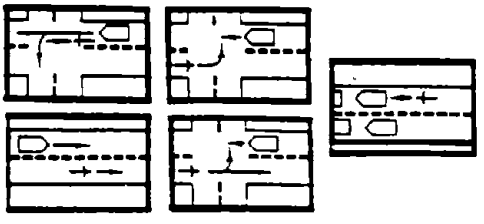
	ACCIDENT CODE	ACCIDENT TYPE
1. THE ACCIDENT WAS WEIRD BECAUSE * The motorist or cyclist intentionally caused the accident. * The officer indicated no accident actually occurred. * The accident did not involve a cyclist. * The cyclist was struck by falling cargo.	36	Weird
2. THE CYCLIST WAS RIDING * A child's vehicle, such as a "Big Wheel"-type tricycle, other tricycle, or a bicycle with training wheels. (But not an adult tricycle.)	40	Play Vehicle
3. THE ACCIDENT INVOLVED * A motor vehicle which was backing.	11	Backing
4. THE ACCIDENT OCCURRED * In a parking lot or open area. * Other non-roadway location, such as a gas station, alley, lot, etc.	29	Non-Roadway

INITIAL APPROACH PATHS

If none of the above types apply, were the initial approach paths (i.e., before any turns which caused the accident or turns to avoid it):

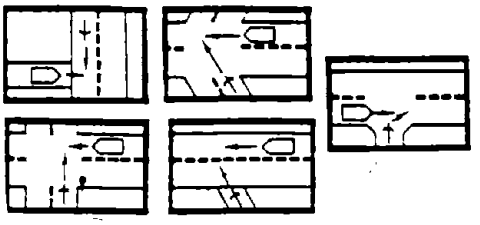
PARALLEL

The cycle and motor vehicle were approaching each other on parallel paths, either heading in the same or opposing direction.



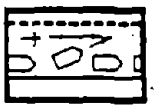
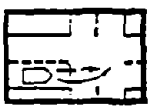
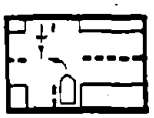
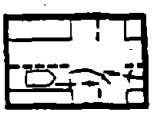
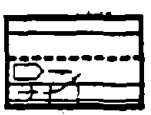
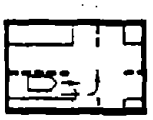
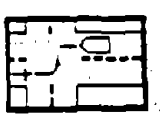
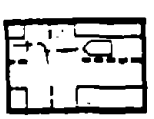
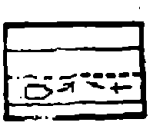
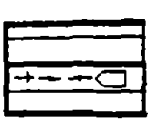
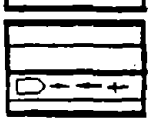
CROSSING

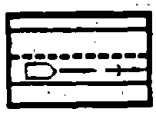
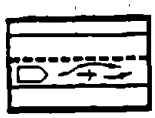
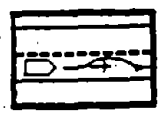
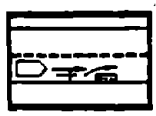
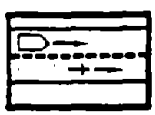
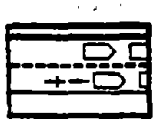
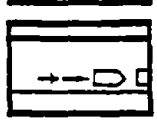
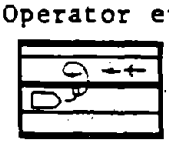
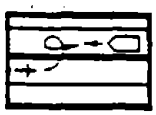
The cycle and motor vehicle were on intersecting paths.



UNKNOWN IF PARALELL OR CROSSING 0097

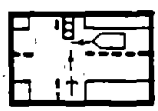
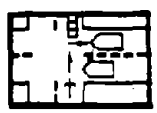
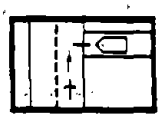
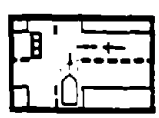
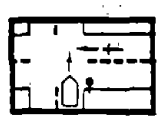
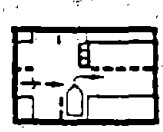
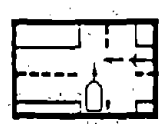
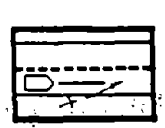
PARALLEL PATHS

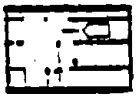
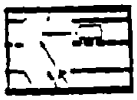
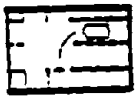
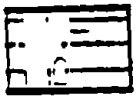
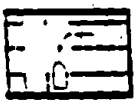
	ACCIDENT CODE	ACCIDENT TYPE
1. THE MOTORIST TURNED OR MERGED INTO THE PATH OF THE CYCLIST		
 The motorist was exiting or entering on-street parking.	35	Drive out - on-street parking
 Left, going in the same direction as cyclist.	22	Motorist left turn in front of cyclist
 Left, facing each other as approached.	23	Motorist left turn facing cyclist
 Right, either going in the same or opposing directions.	24	Motorist right turn
2. THE CYCLIST TURNED OR MERGED INTO THE PATH OF THE MOTORIST		
 Onto the street from a residential driveway or alley. Cyclist coming from side-walk.	3	Ride-out from sidewalk
 Left, going the same direction as the motorist.	18	Cyclist left turn, in front of traffic
 Left, facing each other as they approached.	19	Cyclist left turn, facing traffic
 Right, and the cyclist was riding on the wrong side of of the street	21	Cyclist right turn, from wrong side of street
3. THE OPERATOR WAS ON THE WRONG SIDE OF THE STREET		
 Either operator was going the wrong way, the approach was head on, the evasive actions were counteractive.	30	Head on, counter-active evasive actions
 The motorist was going the wrong way.	28	Wrong way motorist
 The cyclist was going the wrong way.	26	Wrong way cyclist

	ACCIDENT CODE	ACCIDENT TYPE
4. THE MOTORIST WAS OVERTAKING THE CYCLIST		
 The motorist failed to detect the cyclist.	13	Motorist overtakes undetected cyclist
 The evasive actions were counteractive.	15	Motorist overtaking, counteractive evasive actions
 The motorist misjudged the space, length or width, required to pass the cyclist.	16	Motorist overtaking, misjudges passing space
 The cyclist's path was obstructed. Cyclist struck obstruction or overtaking motorist.	17	Motorist overtaking cyclist, path obstructed
 Other situations involving a motorist overtaking a cyclist.	39	Motorist overtaking
5. THE CYCLIST WAS OVERTAKING A MOTOR VEHICLE		
 Cyclist struck a slow or stopped vehicle in a traffic lane.	27	Cyclist overtaking
 Cyclist struck a vehicle in parking lane.	41	Cyclist strikes parked vehicle
6. THE OPERATOR LOST CONTROL AND INADVERTENTLY SWERVED INTO THE PATH OF THE OTHER VEHICLE BECAUSE OF ANY OF THE FOLLOWING REASONS: * Mechanical failure, such as brakes, steering, tires, or other vehicle problems. * Road conditions, such as ice, potholes, mud, sand, or other surface conditions. * Prior collision with moving or stationary objects. * Operator impairment due to drugs or alcohol. * Operator error due to oversteering or improper braking.		
 Motorist loss of control	14	Motorist lost control
 Cyclist loss of control	20	Cyclist lost control
7. INSUFFICIENT INFORMATION	98	Parallel path - unknown

PARALLEL PATHS

CROSSING PATHS

	ACCIDENT CODE	ACCIDENT TYPE
1. THE CYCLIST DID NOT CLEAR INTERSECTION BEFORE LIGHT TURNED GREEN FOR CROSS TRAFFIC		
 The motorist's view of the cyclist was not obstructed.	6	Trapped
 The motorist's view of the cyclist was obstructed by standing traffic.	7	Multiple Threat
2. THE MOTORIST FAILED TO YIELD TO THE CYCLIST		
 At a driveway or alley or other midblock location.	8	Drive out - driveway/ alley
 At a controlled intersection. Motorist ran a sign or signal.	12	Drive through
 At an intersection controlled by a stop sign or flashing red light, motorist obeyed the sign but failed to yield to cyclist.	9	Drive out - stop sign
 At an intersection controlled by a signal, motorist obeyed signal but failed to yield to cyclist.	10	Right on red
 At an intersection, situation not covered above.	48	Drive out - intersection
3. THE CYCLIST FAILED TO YIELD TO THE MOTORIST, MIDBLOCK		
 At a residential driveway or alley.	1	Ride out - residential driveway
 At a commercial driveway.	2	Ride out - commercial driveway
 At a shoulder or curb - midblock location. (Cyclist not using driveway.)	4	Ride out - midblock

	ACCIDENT CODE	ACCIDENT TYPE
4. THE CYCLIST FAILED TO YIELD TO THE MOTORIST AT AN INTERSECTION		
 At an intersection controlled by a stop sign or flashing red signal.	5	Ride-out - stop sign
 At an intersection, situation not covered above.	49	Ride out - intersection
5. THE MOTORIST WAS TURNING		
 Left, cut the corner.	33	Motorist cuts corner
 Right, swung out too wide.	34	Motorist swings wide
6. THE CYCLIST WAS TURNING		
 Left, cut the corner.	31	Cyclist cuts corner
 Right, swung out too wide.	32	Cyclist swings wide
7. THE ACCIDENT OCCURRED AT AN INTERSECTION		
 That was controlled by stop signs or signals.	55	Controlled intersection, other
 That had neither sign nor signal.	25	Uncontrolled intersection, other
8. INSUFFICIENT INFORMATION	99	Intersecting paths - unknown

APPENDIX B
PEDESTRIAN CODING VARIABLES LIST

Group 1- Accident Descriptors
1.1 Accident case number
1.2 NHTSA accident type

Group 2- Locational Characteristics
2.1 Freeway/Interstate location
1. Non-freeway/Interstate
2. F/I, mainline
3. F/I, interchange/ramp
4. F/I, service road
9. F/I, other
0. Unknown

2.2 Private property details
1. Not on private property
2. Commercial/retail related parking lot
3. Non-shopping related or other parking lot
4. Ped on sidewalk/path and hit by vehicle in driveway
5. Ped and vehicle both in driveway
6. Private road
7. Gas station
8. Alley
9. Yard
10. Garage
11. Open field (ball field, farm, etc.)
99. Other private property
0. Unknown/unable to determine

2.3 Official school zone
1. Yes
2. No/None indicated
0. Unknown/unclear

2.4 Special ped signal
1. Yes
2. No/None indicated (If no traffic signal present mark 2)
0. Unknown

2.5 Ped marked crosswalk
1. Yes
2. No/None indicated
9. N.A.
0. Unknown

2.6 Ped in marked crosswalk
1. Yes
2. No (Even if not crossing and 2.5=1)
9. N.A. (if 2.5=2 or 9)
0. Unknown

2.7 Sidewalk indicated
1. At intersection or not road-related
2. None
3. Ped side only
4. Non-ped side only
5. At least ped side
6. At least non-ped side
7. Both sides
0. Unknown

2.8 Motor vehicle lane width
1-20. 1-20 feet
21. >20 feet
99. N.A. (not road related)
0. Unknown

2.9 shoulder type indicated
1. At intersection or not road related
2. No shoulder indicated
3. Unpaved
4. Paved
5. Curb and gutter
6. Shoulder indicated, type unknown
9. N.A. (not road related)
0. Unknown

2.10 Ped-side shoulder width
1-12. 1-12 feet
13. >12
99. N.A. (not road related or 2.9=1,2,5, or 9)
0. Unknown

2.11 Median width
1-97. 1-97 feet
98. >97 feet
99. None/N.A.
0. Unknown

2.12 Total crossing width of lanes including median
1-998. 1-998 feet
999. N.A. (not road-related)
0. Unknown

2.13 Total crossing width before refuge/safety
1-997. 1-997 feet
99. No refuge/island/wide median indicated
999. N.A. (not road-related)
0. Unknown

2.14 Ped location when crash
1. In travel lane
2. At the edge of lane (uncertain if in lane)
3. On shoulder
4. On sidewalk/walkway
5. On path beside road
6. Out of lane/shoulder but not on path
7. Road-related, unsure of exact location
8. Alley, driveway, other entering roadway
9. Parking lot, parking space related (including access/egress)
10. Parking lot, travel lanes
11. Parking lot, unknown/unable to specify
12. In marked bicycle lane
13. In bicycle/multi-use path
14. In median
15. On ped island
16. On-street parking space/lane
99. Other
0. Unknown

Group 3- Pedestrian Characteristics

3.1 Special equipment used
1. None indicated
2. Manual wheelchair
3. Motorized wheelchair
4. Pushing a bicycle
5. Tricycle
6. Big wheel
7. Roller skates
8. Skateboard
9. In-line skates (roller blades)
10. Crutch/cane/walker
11. Pushing cart/baby stroller
12. scooter
13. Carrying a child
14. Wearing headphones
99. Other
0. Unknown

3.2 School trip related
1. No school trip indicated
2. Walking/riding to/from school
3. Struck getting on school bus by another vehicle
4. Struck leaving school bus by another vehicle
5. Struck by school bus
9. Other
0. Unknown

Group 4- Contributory Causes

4.1 Driver
1. None indicated
2. Hit and run
3. Illness
4. Driver drowsy/fell asleep
5. Inattention/distraction
6. vision impairment
7. Hearing impairment
8. Impaired by alcohol
9. Impaired by drug
10. Failure to signal
11. Exceeding speed limit
12. Speed too fast for conditions/Failed to reduce speed
13. Reckless driving
14. Failure to yield to ped
15. Ignored traffic control sign
16. Ignored traffic control signal
17. Improper passing
18. Improper turning
19. Traveling wrong direction
20. Failure to turn lights on at dawn/dusk
21. Left engine running
22. Inexperience
23. No license
24. Avoiding vehicle/ped/object
25. Assault with vehicle
26. failure to properly secure vehicle
27. Right turn on red
28. Improper backing
29. Restriction not complied with
99. Other
0. Unknown

4.2 Vehicle
1. None indicated
2. Defective lights
3. Defective brakes
4. Defective steering
5. Defective tires or tire blowout
6. Inoperable/defective turn signal
7. Unclear (dirty/foggy) windshield
8. Another vehicle shielded view
9. Inspection violation
11. Fictitious registration
12. Oversize
99. Other
0. Unknown

4.3 Pedestrian
(use only one from 2-7)
1. None indicated
2. Jaywalking
3. Ran into street
4. Stepped into street
5. Stepped/ran into street from between parked/stopped cars
6. Failed to yield r-o-w to motorist
7. Failed to obey traffic/ped signal
8. Lack of conspicuity
9. Unsafe skateboard maneuver
10. Unsafe roller blade maneuver
11. Playing in the street
12. Fell out of back of pickup truck
13. Alcohol impaired
14. Impaired by drugs
15. Vision impairment
16. Hearing impairment
17. Other physical disability
18. Other mental disability
19. Walk/run in wrong direction
20. Working on car in parking lot
21. Talking/standing in roadway
22. Leaning/clinging on vehicle
23. Lying in road
24. Jogging
25. Unsafe exiting/entering vehicle
99. Other
0. Unknown

4.4 Roadway/Environment
1. None indicated
2. Foggy
3. Rainy/wet roadway
4. Snowy/icy
5. Sleet/hail
6. Sun glare blinded motorist/ped
7. Other glare blinded motorist/ped
8. Dusk/Darkness
9. Glass/debris/other loose material on surface
10. Pothole/drainage grate/other surface irregularity
11. No suitable place to walk (only if in narrative)
12. Construction zone
13. Narrow roadway
14. Vision blocked
99. Other
0. Unknown

Group 5- Fault
1. Driver only
2. Driver; ped unknown
3. Ped only
4. Ped; driver unknown
5. Both
6. Neither
0. Both unknown/unable to determine

BICYCLE CODING VARIABLES LIST

Group 1- Accident Descriptors
1.1 Accident case number
1.2 NHTSA accident type

1.3 Motor vehicle pre-crash maneuver
1. Starting in roadway; pre-turn (e.g., from stoplight)
2. Proceeding straight; accelerating (already started)
3. Proceeding straight; constant speed or unknown
4. Slowing/Stopping
5. Stopped
6. Right turn; from stopped position (or unknown if stopped or moving)
7. Right turn; from moving
8. Left turn
9. U turn
10. Other unsafe turning
11. Backing
12. Passing/Overtaking
13. Changing lanes
14. Parked out of travel lanes
15. Parked in travel lanes
16. Entering roadway; parallel paths (e.g., from shoulder)
17. Leaving roadway; parallel paths (purposeful intent)
18. Entering roadway; perpendicular paths; pre-turn (e.g., from driveway)
19. Entering parking
20. Leaving parking
21. Merging
22. Crowded off roadway (e.g., number of lanes decreases)
23. Ran off road (single vehicle event)
24. Crossed into opposing lane (instantaneous)
25. Traveling wrong way (long term)
26. Avoiding object
27. Avoiding vehicle (front/back)
28. Avoiding vehicle (angle)
29. Avoiding previous accident
30. Avoiding ped
31. Avoiding animal
    Note: Avoiding takes precedence over all except merging and crowded off roadway.
32. Crossing midblock (of roadway, driveway, or alley)
33. Driverless moving
34. Lost load from vehicle
35. Skidding before braking/Lost control
36. Skidding after braking
37. "Playing" in road
38. Assault with vehicle
0. Unknown/N.A.

1.4 Bicycle pre-crash maneuver

1. Starting in roadway; pre-turn (e.g., from stoplight)
2. Proceeding straight; accelerating (already started)
3. Proceeding straight; constant speed or unknown
4. Slowing/Stopping
5. Stopped
6. Right turn from stopped position (or unknown if stopped or moving)
7. Right turn from moving
8. Left turn
9. U turn
10. Other unsafe turning (e.g., crossing intersection diagonally)
11. Backing
12. Passing
13. Changing lanes
14. Parked out of travel lanes
15. Parked in travel lanes
16. Entering roadway; parallel paths (e.g., from shoulder. Use when intent is to merge, not when swerved from shoulder)
17. Leaving roadway; parallel paths (purposeful intent)
18. Entering roadway; pre-turn; perpendicular paths (e.g., from driveway)
19. Entering parking
20. Leaving parking
21. Merging
22. Crowded off roadway
23. Ran off road (single vehicle event)
24. Crossed into opposing lane (instantaneous)
25. Traveling wrong way (long term)
26. Avoiding object
27. Avoiding vehicle (front/back)
28. Avoiding vehicle (angle)
29. Avoiding previous accident
30. Avoiding ped
31. Avoiding animal

    Note: Avoiding takes precedence over all except merging and crowded off roadway.

32. Crossing midblock
33. Lost control
34. Swerve left
35. Swerve right
36. Playing in road
0. Unknown

Group 2- Locational Characteristics

2.1 Freeway/Interstate location

1. Non-freeway/Interstate
2. F/I, mainline
3. F/I, interchange/ramp
4. F/I, service road
9. F/I, other
0. Unknown

2.2 Private property/Non-roadway details

1. Not on private property
2. Commercial/retail related parking lot
3. Housing related parking lot
4. Public parking lot
5. Other/Unknown parking lot
6. Bicyclist and vehicle both in driveway/alley/private road
7. Yard
8. Open field (e.g., ball field, farm, etc.)
9. Other private/public property
0. Unknown/unable to determine

2.3 Road Feature

1. No special feature/Not road related (e.g., if both in driveway)
2. Bridge
3. Underpass
4. Driveway, public or unknown
5. Driveway, private residence
6. Alley intersection

   Note: Use 4 , 5 , or 6 if road or sidewalk junction related.
7. Intersection of roadways (must be within crosswalks)
8. Non-intersection median crossing
9. End or beginning of divided highway
10. Interchange ramp
11. Interchange service road
12. Railroad crossing
13. Tunnel
14. Other
15. Intersection of roadways related
16. Bicycle/Multi-use path intersection with road
17. Parking lot abuts road
0. Unknown

2.4 Road Character

1. N.A.
2. Straight, level
3. Straight, hillcrest
4. Straight, grade
5. Straight, bottom
6. Curve, level
7. Curve, hillcrest
8. Curve, grade
9. Curve, bottom
0. Unknown

2.5 Detailed bicyclist location at impact

1. In thru travel lane (superseded by 16 or 17)
2. At edge of thru travel lane (not sure if lane or shoulder)
3. Roadside out of thru travel lane (not sure if official shoulder)
4. On shoulder
5. On sidewalk
6. On path beside road
7. Right turn lane
8. Left turn lane
9. Merge lane
10. TWLTL
11. Bike lane
12. On-street parking space/lane
14. Median/median turn way
15. Ped island
16. Ped crosswalk; marked
17. Ped crosswalk area; implied or unknown

    Note: Use 16 or 17 when bicyclist came off sidewalk at intersection or driveway/alley

18. Road-related; unsure of exact location
19. On bicycle/multi-use path
20. In alley, driveway, other entering roadway
21. Parking lot; parking space related (including access/egress area)
22. Parking lot; travel lane
23. Parking lot; other; unknown/unable to specify
24. Other non-roadway
99. Other
0. Unknown

2.6 Official school zone

1. No/None indicated
2. Yes
0. Unknown

2.7 School trip related

1. No school trip indicated
2. Yes, riding to/from school
3. Other (e.g., in school parking lot during school hrs)
0. Unknown if school trip

2.8 Traffic Control

1. No control present/N.A.
2. Stop sign
3. Yield sign
4. Stop and go signal
5. Flashing signal with stop sign
6. Flashing signal without stop sign
7. RR gate and flasher
8. RR flasher
9. RR crossbucks only
10. Human control
11. Other
12. Flashing; unspecified
13. RR; unspecified
0. Unknown

2.9 Bikelane

1. No/N.A.
2. Bicyclist side only
3. Non-bicyclist side only
4. At least bicyclist side
5. At least non-bicyclist side
6. Both sides
0. Unknown

2.10 Bicyclist in bikelane
1. No/N.A. (2.9 = 1,3,5,0)
2. Yes
3. Exited bicycle lane
0. Unknown

2.11 Bikelane width
1. N.A.
2-7. 2-7 feet
8. 8 or more
0. Unknown

2.12 Other bikeway designation
1. No/N.A.
2. Signed bike route
3. Share the Road sign
4. Other
0. Unknown

2.13 Sidewalk
1. No/N.A.
2. Bicyclist side only
3. Non-bicyclist side only
4. At least bicyclist side
5. At least non-bicyclist side
6. Both sides
0. Unknown

2.14 Bicyclist using sidewalk
1. No/N.A. (2.13 = 1,3,5,0)
2. Yes (even if exited sidewalk and struck in street)
0. Unknown

2.15 Shoulder type
1. No/None indicated/N.A.
2. Unpaved
3. Paved (includes shoulder bike lane)
4. Curb/gutter
5. Shoulder indicated, type unknown
6. Urban "shoulder" with curb and gutter
0. Unknown

2.16 Bicyclist-side shoulder width
1-98. 1-98 feet
99. N.A. (2.15 =1,4,0)
0. Unknown

2.17 Bicyclist side on-street parking
1. No/None indicated/N.A.
2. Parallel parking, or type unknown
3. Diagonal parking
0. Unknown if parking or not

2.18 Number of thru lanes
1-7. 1-7 thru lanes
8. More than 7 lanes
9. N.A.
0. Unknown

2.19 Lane width
(most relevant at intersection— on or crossing)
1. N.A.
2-98. 2-98 feet
0. Unknown

2.20 Differentially stripped multi-lane road (outside lane is wider than inside lane)
1. No/N.A.
2. Yes
0. Unknown

2.21 Outside lane width
1. N.A.
2-98. 2-98 feet
0. Unknown

2.22 Total number of lanes including turn lanes (at intersection code relevant leg with most lanes)
1-7. 1-7
8. More than 7 lanes
9. N.A.
0. Unknown

2.23 Median width
1. No median/N.A.
2-97. 2-97 feet
98. >97 feet
0. Unknown

2.24 Crossing width to median/refuge
1. No median/N.A.
2-998. 2-998 feet
0. Unknown

2.25 Total crossing width of all lanes, including median
1. N.A.
2-998. 2-998 feet
0. Unknown

Group 3- Bicyclist Characteristics

3.1 Helmet use

1. No/Not indicated
2. Yes
0. Unknown

3.2 Other safety equipment used (maximum 4)

1. None indicated
2. Head light
3. Tail light
4. Flashing LED
5. Bicycle reflectors
6. Retroreflective clothing/vest/bands
7. Retroreflective wheels/tires/spokes
8. Bright colored clothing
9. Bright colored bicycle
10. Flag
11. Glasses/goggles
99. Other
0. Unknown

3.3 Special equipment used (maximum 3)

1. None indicated
3. Racks/Panniers
4. Child seat
5. Bicycle trailer
9. Other
0. Unknown

3.4 Bicycle type

1. No special type indicated
2. Adult tricycle
3. Recumbent
4. Tandem
9. Other
0. Unknown

3.5 Predominant direction of travel (including if on sidewalk/in crosswalk)

1. N.A.
2. With traffic
3. Against traffic
4. Crossing/entering traffic midblock; crossed intersection diagonally
0. Unknown

Group 4- Junction Maneuver Details
(Includes intersections and driveway/alley junctions)

4.1 Bicyclist intended junction maneuver
1. N.A.
2. Straight thru
3. Left
4. Right
0. Unknown

4.2 Motorist intended junction maneuver
1. N.A.
2. Straight thru
3. Left
4. Right
0. Unknown

4.3 Bicyclist entering condition (1st half)
1. N.A. (including if crossing traffic from driveway)
2. With traffic/In street
3. With traffic/Off street
4. Against traffic/In street
5. Against traffic/Off street
0. Unknown

4.4 Bicyclist exiting condition (2nd half)
(actual or intended)
1. N.A.
2. With traffic/In street
3. With traffic/Off street
4. Against traffic/In street
5. Against traffic/Off street
0. Unknown

4.5 Crossing Approach
1. N.A.
2. Bicyclist from motorist left
3. Bicyclist from motorist right
0. Unknown

Group 5- Violation(s)/Contributory Causes

5.1 Driver

1. None
2. Alcohol use
3. Drug use
4. Yield violation
5. Stop sign violation
6. Traffic signal violation
7. Exceeding speed limit
8. Exceeding safe speed
9. Minimum speed law
10. Passed stopped school bus
11. Passing on hill
12. Passing on curve
13. Other improper passing
14. Improper lane change
15. Use of improper lane
16. Improper turn
17. Improper or no signal
18. Improper vehicle equipment
19. Safe movement violation
20. Following too closely
21. Improper backing
22. Improper parking
23. Left of center/Driving wrong side/way
24. Right turn on red
26. Hit and run
27. Inattention/distraction
28. Reckless driving
29. Failure to turn lights on at dawn/dusk/dark
30. Left engine running when parked
31. Failure to properly secure vehicle
32. Failure to properly secure cargo
33. Inexperience
34. No operators license
35. Restriction not complied with
36. Avoiding other vehicle/ped/object
37. Assault with vehicle
38. Possible assault with vehicle
39. Crossed parking space lines
40. ill
41. Fatigued
42. Asleep
43. Other physical impairment
44. Impairment due to medicine
45. Other mental impairment
46. Fleeing pursuit
47. Failed to look both ways
48. Didn't see bicyclist (no vision obstruction)
49. Didn't see bicyclist (own vehicle acted as v.o.)
50. Didn't see bicyclist (other v.o.)

Note: 48-50 are driver claim or police conclusion

51. Unsafe exiting/entering vehicle
52. Couldn't avoid crash (driver claim)
53. Misjudged gap
54. Misinterpreted other party's intent
55. Failed to maintain straight line
56. Driving on shoulder
57. Evasive action was counteractive
58. Crossed stop sign limit line (marked or implied) before stopping
59. Blew horn prior to crash
99. Other
0. Unknown

5.2 Bicyclist

1. None
2. Alcohol use
3. Drug use
4. Failed to yield
5. Stop sign violation
6. Traffic signal violation
7. Exceeding speed limit
8. Exceeding safe speed
9. Minimum speed law
10. Passed stopped school bus
11. Passing on hill
12. Passing on curve
13. Other improper passing (not <29> or <30>)
14. Improper lane change
15. Use of improper lane (not when against traffic <21>)
16. Improper turn (not right turn on red <23>)
17. Improper or no hand signal
18. Lack of conspicuity
19. Safe movement violation
20. Following too closely
21. Riding against traffic (use only when in street)
22. Left of center (not long term against traffic <21>)
23. Improper right turn on red
24. Inattention/distraction
25. Reckless riding (purposeful disregard of proper riding)
26. No hands riding
27. Other stunt riding
28. Racing
29. Passing motor vehicle on right
30. Riding between stopped vehicles in traffic (parallel or perpendicular)
31. Improper road/lane position (not for when turning- use 16)
    (e.g., in gutter; moved to right though intersection; etc)
32. Failure to ride as far to the right as practicable (only when cited)
33. Failed to maintain straight line (e.g., weaving)
34. Swerved left while being overtaken
35. Came off sidewalk at intersection; bicyclist has ROW
36. Came off sidewalk at driveway/alley
37. Avoiding other vehicle/ped/object
38. Crossed parking space lines
39. Clothing got caught in bicycle
40. Improper passenger(s)
41. Carrying object(s) in arm
42. Carrying improperly secured object(s) on bicycle
43. Wearing headphones
44. Following the leader
45. Riding two or more abreast
46. Fleeing pursuit
47. Misjudged gap
48. Misinterpreted other party's intent
49. Didn't see motor vehicle (bicyclist claim; no vision obstruction)
50. Didn't see motor vehicle (bicyclist claim; vision obstruction)
51. Couldn't avoid crash (bicyclist claim)
52. Hurrying to clear intersection
53. Lost control
54. Evasive action was counteractive
55. Hit and run
56. Physical/hearing impairment
99. Other
0. Unknown

5.3 Motor Vehicle

1. None indicated
2. Defective brakes
3. Defective headlights
4. Defective rear lights
5. Defective steering
6. Defective tires/wheels
7. Defective turn signal
8. Defective transmission/drivetrain
9. Unclear (dirty/foggy) windshield
10. Oversize
11. Oversize load
12. Protruding mirror
99. Other
0. Unknown

5.4 Bicycle

1. No defects indicated
2. No/defective/ineffective brakes
3. No relevant lights
4. No/Defective reflectors
5. Defective steering
6. Defective tires/wheels
7. Defective drivetrain/chain
8. Defective frame
9. No/defective saddle
10. Too big/small for operator
99. Other
0. Unknown

5.5 Roadway/Environment

1. None indicated
2. Weather condition
3. Sun glare blinded
4. Other glare blinded (e.g., headlights)
5. Parked vehicle vision obstruction
6. Moving or stopped vehicle vision obstruction
7. Road geometrics vision obstruction (e.g., hillcrest; curve)
8. Other vision obstruction
9. Lane narrowed
10. Bikelane/shoulder ended
11. Road geometrics; other
12. Road condition (e.g., wet; polished: muddy; snowy; etc.)
13. Loose material on surface
14. Road surface or shoulder defect (e.g., cracks; potholes; etc.)
15. Road feature (e.g., raised dots; reflectors; slick pavement markings; drainage grate; etc.)
16. Obstruction in roadway (e.g., vehicle extended door; illegally parked vehicle; etc.)
17. Construction zone
18. Railroad tracks
19. Animal chased/scared/collided with bicyclist
20. Person chased/scared bicyclist
21. Prior collision
22. Heavy traffic
23. Bike Path ends
99. Other
0. Unknown

Group 6- Fault

1. Driver only
2. Driver; Bicyclist unknown
3. Bicyclist only
4. Bicyclist; driver unknown
5. Both
6. Neither
0. Both unknown/unable to determine

APPENDIX C
DESCRIPTIONS OF BICYCLIST CASES CLASSIFIED AS "WEIRD"

MOTORIST INTENTIONALLY CAUSED ACCIDENT

- DRIVER DELIBERATELY ATTEMPTED TO HIT BIKE; MADE EYE CONTACT.
- ACCORDING TO BIKER, VEHICLE DELIBERATELY SWERVED INTO BIKE. HIT AND RUN DRIVER CROSSED CENTERLINE TO INSIDE OF CURVE.
- MOTOR VEHICLE DROVE INTO BIKE LANE.
- WHILE OVERTAKING, MOTOR VEHICLE PURPOSELY STRUCK BICYCLIST.
- MOTORIST CROSSED CENTERLINE TO STRIKE BICYCLIST.
- HIT AND RUN MOTORIST STRUCK BIKE FROM BEHIND.
- MOTORIST OVERTAKING, ASSAULT WITH VEHICLE.
- MOTORIST OVERTAKING, POSSIBLE ASSAULT

NO CONTACT BUT CYCLIST CRASHED

- NO CONTACT BUT MOTOR VEHICLE FORCED BIKE INTO CURB CAUSING CYCLIST TO FALL OFF OF BIKE.
- BICYCLIST APPARENTLY GOT SPOOKED AND LOST CONTROL.
- RIDING IN GUTTER, LOST CONTROL WHEN FRONT WHEEL HIT PAVEMENT EDGE.
- BICYCLIST COLLIDED WITH DOG.

OFFICER INDICATED NO ACCIDENT ACTUALLY OCCURRED; ACCIDENT DID NOT INVOLVE A CYCLIST; OTHER WEIRD

- DRIVERLESS VEHICLE ROLLED OUT OF DRIVEWAY HITTING CYCLIST.
- CYCLIST WAS BEING CHASED BY POLICE AND RAN INTO STREET.
- DRIVER FLEEING SCENE OF PRIOR ACCIDENT HIT CYCLIST.
- COLLISION WITH POLICE PURSUIT WHO WAS STOPPED.
- CYCLIST RODE INTO ROADWAY TO AVOID DOG ATTACK.
- CYCLIST 1 HIT CYCLIST 2 CAUSING CYCLIST 1 TO FALL IN STREET AND GET HIT BY VEHICLE.
- A TIRE CAME OFF VEHICLE AND STRUCK PARKED CAR AND CHILD ON BIKE IN DRIVEWAY.

CYCLIST WAS STRUCK BY FALLING CARGO/EXTENDED CARGO/CONSTRUCTION EQUIPMENT, ETC.

- LADDER EXTENDING OUT SIDE OF VEHICLE STRUCK BICYCLIST.
- AWNING HAD COME OFF OF TRAILER AND HIT BIKER RIDING ON SHOULDER.
- LADDER ON TRUCK STRUCK CYCLIST RIDING WRONG WAY ON SHOULDER.

DESCRIPTIONS OF PEDESTRIAN CASES CLASSIFIED AS "WEIRD"

LYING IN LANE

- PED WAS SLEEPING UNDER A STACK OF BOXES IN THE ROAD WHEN HE WAS HIT BY THE VEHICLE.
- PED WAS LYING IN THE LANE AFTER A MOTORCYCLE ACCIDENT. DRIVER DID NOT SEE HIM UNTIL TOO LATE AND COULD NOT GO AROUND BECAUSE OF VEHICLES IN THE OTHER LANES.
- PED WAS LYING IN THE ROADWAY AFTER JUST BEING INVOLVED IN A MOTORCYCLE ACCIDENT WHEN HE WAS STRUCK BY THE VEHICLE. HE WAS INTOXICATED AT THE TIME.
- PED WAS LYING UNDER A VEHICLE TO BE REPAIRED WHEN IT MOVED.
- AN UNCONSCIOUS DRUNK PED WAS LYING IN THE ROAD WHEN FATALLY STRUCK BY THE VEHICLE.
- PED WAS LYING DOWN IN PARKING LOT WHEN VEHICLE BACKED OVER HIM.
- PED WAS LYING IN THE LANE AFTER A PREVIOUS ACCIDENT.

SUICIDE ATTEMPT

- PED DELIBERATELY JUMPED INTO THE PATH OF THE VEHICLE.
- PED DELIBERATELY RAN INTO THE PATH OF THE VEHICLE ATTEMPTING SUICIDE.
- PED ATTEMPTED SUICIDE.
- PED WAS LYING IN THE LANE ATTEMPTING TO COMMIT SUICIDE.

PURPOSEFUL ASSAULT WITH VEHICLE

- ASSAULT ON PURSUING POLICEMAN.
- DISPUTE RELATED ASSAULT.
- DRIVER BEING TICKETED FLED, STRIKING OFFICER.
- DRIVER STRUCK OFFICER DIRECTING TRAFFIC.
- PED WAS PARKING CARS IN FRONT OF STORE; DRIVER GOT IMPATIENT AND HIT PED, PINNING HIM BETWEEN 2 VEHICLES.
- AFTER A FIGHT IN THE PARKING LOT, ONE PARTICIPANT GOT IN HIS CAR AND PURPOSEFULLY RAN OVER ANOTHER PARTICIPANT AND LEFT THE SCENE.
- SECURITY GUARD TRIED TO STOP A LARCENY SUSPECT (DRIVER OF VEHICLE) WHEN SUSPECT STRUCK THE SECURITY GUARD.
- ASSAULT WITH VEHICLE OCCURRED FOLLOWING DOMESTIC VIOLENCE
- DRIVER DELIBERATELY HIT PED WALKING ON SHOULDER AND ROBBED HIM.

- DRIVER MOVED TO SHOULDER ON OPPOSITE SIDE OF ROADWAY TO HIT PED.

DOMESTIC RELATED OR DISPUTE RELATED

- PED WAS BEING CHASED BY A GROUP OF MALES WHEN SHE RAN INTO THE STREET IN FRONT OF THE VEHICLE.
- PED WAS LEANING ON VEHICLE ARGUING WITH THE DRIVER WHO PULLED AWAY INJURING THE PED.
- PED 1 AND 2 WERE ARGUING WHEN PED 2 THREW PED 1 INTO STREET WHERE HE WAS HIT BY VEHICLE.
- PED (GIRLFRIEND OF DRIVER) WAS ON HOOD OF VEHICLE KICKING AND BANGING THE VEHICLE. WHEN VEHICLE STOPPED, PED JUMPED OFF AND FELL TO THE GROUND.
- PED & DRIVER WERE INVOLVED IN A DISPUTE EARLIER. PED WAS HOLDING THE STEERING WHEEL AND TALKING TO DRIVER WHEN DRIVER PULLED OFF, RUNNING OVER PED.
- DRIVER DELIBERATELY SWERVED TO OTHER SIDE OF STREET AND HIT PED STANDING OFF ROAD. AFTER THE ACCIDENT, VEHICLE FLED & PED RAN. WAS REPORTED BY WITNESS WHO IS A FRIEND OF THE PED.
- PED FELL WHILE TRYING TO GET OUT OF VEHICLE BEFORE IT HAD COME TO A STOP, FOLLOWING ALTERCATION WITH DRIVER.
- PED HELD ONTO VEHICLE AND WAS DRAGGED AS THE VEHICLE ATTEMPTED TO LEAVE THE SCENE OF A DOMESTIC DISPUTE.
- PED KICKED THE VEHICLE AS IT BACKED FROM A PARKING SPACE. THE PED APPROACHED VEHICLE IN A THREATENING MANNER AND WAS STRUCK AS THE VEHICLE ATTEMPTED TO FLEE.
- DRIVER GRABBED PED'S ARM AND DROVE OFF, DRAGGING HER ALONG.

SITTING ON, LEANING ON, OR CLINGING TO VEHICLE (NOT DISPUTE RELATED)

- PED & TWO OTHERS WERE RIDING ON BUMPER OF THE VEHICLE WHEN THE PED FELL OFF & WAS HIT BY VEHICLE.
- PASSENGER IN VEHICLE WOULD NOT LET PED IN SO PED JUMPED ON HOOD. PED FELL OFF AS VEHICLE WENT AROUND CIRCLE.
- PARADE PARTICIPANT TRIED TO JUMP ON VEHICLE AND WAS HIT.
- PED ON SKATES HANGING ON TO VEHICLE FELL.
- YOUTH ATTEMPTING TO STEAL APPLE FROM FARM TRAILER WAS STRUCK.
- PED WAS 4 YR OLD CHILD WHO GRABBED THE BUMPER OF VEHICLE & FELL WHEN HE LOST HIS BALANCE AS VEHICLE BEGAN TO MOVE.
- PED WAS RIDING ON HOOD OF VEHICLE AND FELL OFF WHEN VEHICLE TURNED CORNER.

- FOR UNKNOWN REASONS, PED WAS CLINGING TO DOOR OF VEHICLE & DRAGGED 300 FEET.
- PED HAD JUST COME OUT OF A BAR AND GRABBED ONTO THE DOOR OF THE VEHICLE AS IT PULLED OFF, KNOCKING PED TO THE GROUND.
- PED WAS SITTING ON HOOD OF BACKING VEHICLE AND FELL OFF WHEN VEHICLE RAN UP ON CURB. BOTH PED & DRIVER HAD BEEN DRINKING.

RESULT OF AUTO-AUTO CRASH

- VEHICLE #1 ATTEMPTED TO PASS VEHICLE #2 AND COLLIDED WITH THE FRONT END OF VEHICLE #2, CAUSING IT TO RUN OFF THE ROAD AND HIT A PARKED CAR, THE PED, AND A LIGHT POLE.
- VEHICLE #1, WHICH HAD STOPPED TO ALLOW THE PED TO CROSS THE ROAD, WAS REAR-ENDED BY A SECOND VEHICLE, CAUSING VEHICLE #1 TO HIT THE PED.
- DRIVER OF VEHICLE #1 LOST CONTROL OF VEHICLE AND RAN OFF THE ROAD INTO A DRIVEWAY STRIKING VEHICLE #2 WHICH STRUCK THE PED, A CHILD PLAYING IN THE YARD. DRIVER WAS INTOXICATED AT THE TIME.
- SCHOOL BUS STRUCK OPEN CAR DOOR WHICH STRUCK THE PED.
- VEHICLE 3 MADE IMPROPER LANE CHANGE, SIDESWIPING VEHICLE 2 WHICH STRUCK PED AT BUS STOP.
- VEHICLE 1, WHICH WAS SPEEDING, CROSSED INTO OPPOSING LANE AROUND CURVE AND HIT VEHICLE 2. VEHICLE 2 WAS KNOCKED OFF THE ROADWAY WHERE IT STRUCK PED.
- VEHICLE 1 RAN A RED LIGHT AND HIT VEHICLE 2, WHICH HIT THE PED IN THE X-WALK.
- DRIVER LOST CONTROL OF VEHICLE ON ICY ROAD AND STRUCK PARKED VEHICLE WHICH THEN STRUCK PED. PED STANDING OUT OF TRAVEL LANE BETWEEN 2 PARKED VEHICLES.
- VEHICLE 1 WAS STOPPED ON THE EDGE OF ROAD WITH THE DRIVER TALKING TO THE PED, WHEN VEHICLE 2 STRUCK VEHICLE 1 CAUSING IT TO HIT THE PED.
- PED WAS STANDING IN ROADWAY AFTER AN ACCIDENT WHEN DRIVER HIT PED' S VEHICLE, CAUSING IT TO HIT THE PED.

RESULT OF AUTO-OBJECT CRASH

- DRIVER OF VEHICLE 1 FAILED TO YIELD TO AN EMERGENCY VEHICLE AND WAS HIT BY THIS VEHICLE. VEHICLE 1 SPUN OUT OF CONTROL INTO A STORE CAUSING INJURY TO A STORE CLERK.
- VEHICLE 1 HIT A SECOND VEHICLE FROM THE REAR. IT THEN SPUN OUT OF CONTROL AND HIT A BUILDING AND THEN THE PED.

- DRIVER LOST CONTROL OF THE VEHICLE WHILE MAKING A TURN AND RAN UP ON THE SIDEWALK HITTING A BENCH UPON WHICH THE PED WAS SITTING.
- AT HOUSE FIRE SCENE, FIRE HOSE GOT ENTANGLED IN PASSING VEHICLE CAUSING INJURY TO FIREMAN.
- DOWNED POWER LINE CAUGHT UNDER VEHICLE INJURED THE PED.
- VEHICLE HIT LADDER ON WHICH PED WAS STANDING.
- VEHICLE RAN INTO A HOUSE AT THE END OF A DEAD END STREET, RESULTING IN AN INJURY AND A FATALITY TO THE OCCUPANTS.
- VEHICLE HIT A HAMBURGER STAND, INJURING THE OCCUPANTS.
- IN A CONSTRUCTION ZONE, A TRUCK HIT A CABLE WHICH HIT THE PED.
- ACCELERATOR ON VEHICLE STUCK CAUSING IT TO RUN INTO A STORE AND HIT THE PED.

ENTERING/EXITING MOVING VEHICLE

- AS PED ENTERED VEHICLE, VEHICLE ROLLED FORWARD CAUSING PED TO FALL.
- PED ATTEMPTED TO GET INTO PASSENGER SIDE OF TRACTOR WHILE VEHICLE WAS MOVING. HE SLIPPED AND WAS RUN OVER BY THE TRAILER.
- PED EXITING BUS INJURED BY DEPARTING BUS.
- PASSENGER IN MOVING VEHICLE JUMPED OUT AND WAS HIT BY VEHICLE.
- DRIVER'S FOOT SLIPPED OFF BRAKE WHILE PASSENGER WAS DISEMBARKING. THE BACKWARDS ROLLING VEHICLE HIT THE PASSENGER.
- PED EXITED VEHICLE BEFORE IT HAD STOPPED.
- CROWD OF MIDDLE SCHOOL STUDENTS PUSHING TO GET ON BUS PUSHED STUDENT UNDER FRONT WHEEL.
- 9 YR OLD AND FRIEND WERE RACING TO GET INTO CAR WHILE IT WAS STILL MOVING.
- PED SLIPPED ENTERING PICK-UP VEHICLE.
- DRIVER DEPARTED BEFORE PASSENGER FULLY IN VEHICLE.

OTHER WEIRD

- PARTICIPANT OF A SCHOOL PARADE WAS STRUCK BY A PARADE VEHICLE.
- WHEEL CAME OFF TOWED TRAILER AND STRUCK PED IN BUILDING.
- PED SLIPPED FROM MEDIAN AND FELL INTO ROADWAY.
- PED WAS IN VEHICLE 2 STOPPED AT LIGHT BEHIND VEHICLE 1. PED GOT OUT TO TELL DRIVER HIS TAIL GATE WAS DOWN AND WAS HIT BY GATE AS VEHICLE 1 MOVED FORWARD.

- PASSENGER (PED) IN VEHICLE WAS HAVING A SEIZURE AND ATTEMPTED TO EXIT VEHICLE. DRIVER TRIED TO HELP HIM & DID NOT PUT VEHICLE IN PARK. VEHICLE RAN OVER PED.
- ACCIDENT INVOLVED HIGH SCHOOL STUDENTS PLAYING "CHICKEN".
- SON WALKING NEXT TO FATHER'S TRACTOR GOT HIT BY TOWED TRAILER.
- VEHICLE WAS DOING BACKWARDS DONUTS IN THE PARKING LOT WHEN IT HIT THE PED.
- A TRAILER BEING TOWED DETACHED FROM VEHICLE AND HIT A PED IN A YARD.
- VEHICLE ON FERRY HIT PED PARKING ATTENDANT.

INSUFFICIENT INFORMATION

- OFFICER AND DOCTOR BELIEVE NO ACCIDENT TOOK PLACE.
- WITNESSES CLAIMED NO ACCIDENT OCCURRED.
- CONFLICTING INFORMATION. QUESTIONABLE LEGITIMACY OF THE ACTUAL CRASH.
- CONFLICTING TESTIMONY. NO ON-SITE INVESTIGATION.
- REPORTED DAYS LATER. CONFLICTING TESTIMONY.
- VIRTUALLY NO INFORMATION GIVEN.
- NO PHYSICAL EVIDENCE TO SUPPORT THE PED'S CLAIM.
- UNRELIABLE INFORMATION GIVEN.
- INTOXICATED PED INVOLVED IN A HIT AND RUN. INSUFFICIENT INFORMATION.

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