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

NHTSA

DOT HS 812 745

August 2019

Statistics of Light-Vehicle Pre-Crash Scenarios Based on 2011-2015 National Crash Data

DISCLAIMER

Suggested APA format citation:

Swanson, E., Foderaro, F., Yanagisawa, M., Najm, W. G., & Azeredo, P. (2019, August). *Statistics of light-vehicle pre-crash scenarios based on 2011-2015 national crash data* (Report No. DOT HS 812 745). Washington, DC: National Highway Traffic Safety Administration.

Technical Report Documentation

1. Report No. DOT HS 812 745	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Statistics of Light-Vehicle Pre-Crash Scenarios Based on 2011-2015 National Crash Data		5. Report Date August 2019
		6. Performing Organization Code HS63A3 QLP67
7. Authors Elizabeth D. Swanson, Frank Foderaro, Mikio Yanagisawa, Wassim G. Najm, and Philip Azeredo		8. Performing Organization Report DOT-VNTSC-NHTSA-18-01
9. Performing Organization Name and Address John A. Volpe National Transportation Systems Center U.S. Department of Transportation 55 Broadway Cambridge, MA 02142		10. Work Unit No. (TRAIS)
		11. Contract or Grant No.
12. Sponsoring Agency Name And Address National Highway Traffic Safety Administration 1200 New Jersey Avenue SE Washington, DC 20590		13. Type of Report and Period Covered Final Report (2017-2018)
		14. Sponsoring Agency Code
15. Supplementary Notes		

16. Abstract

This report defines a new set of 36 distinct pre-crash scenarios that represent the crash population of light-vehicles (LVs) based on data from the 2011-2015 Fatality Analysis Reporting System (FARS) and National Automotive Sampling System General Estimates System (GES) crash databases. LVs include all passenger cars, vans, minivans, sport utility vehicles, and light pickup trucks with gross vehicle weight ratings less than or equal to 10,000 pounds. Pre-crash scenarios describe vehicle movements and the critical event that made the crash imminent (i.e., something occurred that made the collision possible). The 36 pre-crash scenarios are arranged into nine groups: control loss, road departure, animal, pedestrian, pedalcyclist, lane change, opposite direction, rear-end, and crossing paths. These nine groups account for 24,534 (94%) fatal crashes and an estimated 5,020,000 (89%) of all police-reported crashes based on the yearly average of the 2011-2015 FARS and GES crash databases, respectively. This report also provides crash characteristics for each pre-crash scenario and group in terms of environmental conditions, road geometry, crash location, vehicle/crash-related factors, driver characteristics, attempted avoidance maneuver, traffic violations, and crash contributing factors.

17. Key Words	18. Distribution Statement
pre-crash scenario, crash avoidance, light vehicles, police-reported crashes, Fatality Analysis Reporting System, FARS, General Estimates System, GES, crash characteristics	Document is available to the public from the National Technical Information Service, www.ntis.gov.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	136	

Form DOT F 1700.7 Reproduction of complete page authorized

Table of Contents

List of Figures

List of Tables

List of Acronyms

AIS	Abbreviated Injury Scale
CDS	Crashworthiness Data System
EL	Equivalent Lives
FARS	Fatality Analysis Reporting System
GES	General Estimates System
LTAP/LD	Left Turn Across Path/Lateral Direction
LTAP/OD	Left Turn Across Path/Opposite Direction
LTIP	Left Turn Into Path
LV	Light Vehicle
LVA	Lead Vehicle Accelerating
LVD	Lead Vehicle Decelerating
LVM	Lead Vehicle Moving
LVS	Lead Vehicle Stopped
MAIS	Maximum Abbreviated Injury Scale
NASS	National Automotive Sampling System
RTAP	Right Turn Across Path
RTIP	Right Turn Into Path
SCP	Straight Crossing Paths
VMT	Vehicle Miles Traveled

Executive Summary

This report describes a new pre-crash scenario typology that serves as a basis for the research and development of crash avoidance systems. The typology consists of 36 dynamically distinct pre-crash scenarios that represent the majority of police-reported crashes in the United States. Pre-crash scenarios depict specific vehicle movements and the critical event occurring immediately prior to the crash. Each crash involves at least one light-vehicle[1] (LV) in the critical event that made the crash possible. Other vehicles involved in the crash include all body types. This report updates the 2007 pre-crash scenario typology and its crash characteristics [5] using updated crash data, in order to address current and emerging crash avoidance and automated driving technologies.

The 36 pre-crash scenarios are arranged into the following nine groups representing crashes with similar vehicle movements and dynamics: (1) control loss, (2) road departure, (3) animal, (4) pedestrian, (5) pedalcyclist, (6) lane change, (7) opposite direction, (8) rear-end, and (9) crossing paths. This report presents statistical characteristics for each pre-crash scenario and group based on crash data from the 2011 to 2015 Fatality Analysis Reporting System (FARS) and National Automotive Sampling System (NASS) General Estimates System (GES) crash databases. It also ranks the scenarios and groups in terms of seven harm measures: (1) frequency of fatal crashes, (2) frequency of all police-reported crashes, (3) rate of fatal crashes per vehicle miles traveled (VMT), (4) rate of all police-reported crashes per VMT, (5) comprehensive costs,[2] (6) equivalent lives (EL) lost,[3] and (7) ratio of fatal crashes to all police-reported crashes. Table ES1 shows the statistics of these seven measures for the nine pre-crash scenario groups based on the yearly average of the 2011-2015 FARS and NASS GES crash data. The crossing-paths group accounts for the highest comprehensive costs and EL lost among the nine groups, while the pedestrian[4] group has the highest fatal-to-all crash ratio. The animal group is the lowest-ranked group in terms of crash comprehensive costs and other harm measures based on fatal crashes.

This report provides detailed crash statistics for each pre-crash scenario and group for the cases where the LV makes the critical action (losing control, departing road, changing lanes, striking, maneuvering, etc.). Statistical parameters include driver characteristics and conditions, traffic violations, crash contributing factors, and attempted avoidance maneuver. Key observations are:

- Driver Gender: Male drivers are involved in 70 percent of fatal crashes and 56 percent of all police-reported crashes.
- Driver Age: Middle-aged (25 to 64 years old) drivers are involved in 60 percent of fatal crashes and 61 percent of all police-reported crashes. Younger (≤ 24 years old) drivers are most involved in fatal crashes when examining the number of fatal crashes in a particular age group divided by the number of licensed drivers in that age group.

[1] LVs include all passenger cars, vans, minivans, sport utility vehicles, or light pickup trucks with gross vehicle weight ratings less than or equal to 10,000 pounds.

[2] Includes medical, emergency services, lost productivity, insurance, workplace loss, legal, travel delay, and property damage costs. It also includes intangible costs associated with lost quality of life or physical pain. The costs are based on values from reference [12]

[3] EL lost is a measure of total harm in terms of preventing fatalities. It is derived using the comprehensive costs. It equates the cost of nonfatal injuries and damage costs from "property-damage only" vehicles to the cost of preventing fatalities.

[4] Any non-motorist involved in the crash (i.e., people on foot, walking, running, jogging, hiking, standing still, sitting, lying down, pushing a vehicle, carried by another person), including pedestrians on personal conveyances (e.g., skaters, wheel chair occupants).

- Driver Impairment:[5] Impaired drivers are involved in 24 percent of fatal crashes and 6 percent of all police-reported crashes. This factor contributes to a relatively high percentage of crashes in the control loss, road departure, and opposite direction pre-crash scenario groups.
- Alcohol Involvement: Drunk drivers are responsible for 28 percent of fatal crashes and 4 percent of all police-reported crashes. This factor contributes to a relatively high percentage of crashes in the control loss and road departure pre-crash scenario groups.
- Driver Vision Obscured: This factor accounts for 3 percent of fatal crashes and 3 percent of all police-reported crashes. There are high percentages of vision-obscured crashes involving pedestrians and pedalcyclists.
- Driver Distraction: Distracted drivers are reported in 9 percent of fatal crashes and 15 percent of all police-reported crashes. In fatal rear-end crash scenarios, the driver is distracted in 23 percent of the crashes. Drivers are distracted in about 20 percent of all police-reported road-departure crash group and in about 24 percent of all police-reported rear-end crash group.
- Traffic Violations: Drivers are cited for traffic violations in 15 percent of fatal crashes and 32 percent of all police-reported crashes. Failure to yield violations are cited in 8 percent of fatal and 24 percent of all police-reported crossing-paths scenario group.
- Crash Contributing Factors: Failure to keep in lane contributes to about 50 percent of opposite-direction fatal crashes.
- Attempted Avoidance Maneuver: Drivers attempted an avoidance maneuver in 20 percent of fatal crashes and 14 percent of all police-reported crashes. Unknown maneuver is reported in 25 percent of fatal crashes and 62 percent of all police-reported crashes. Drivers attempted to steer in about 36 percent of fatal animal crashes and about 30 percent of fatal control loss crashes.

[5] Any physical impairment of the driver that may have contributed to the crash (e.g., alcohol, drugs, medication, drowsiness).

Table ES1. Yearly Average Statistics—Scenario Groups Based on 2011-2015 FARS and GES

#	Scenario Group	Crashes Involving a Light Vehicle in the Critical Event		Crashes Where the Light Vehicle is Making the Critical Action*						
				Total		No. of Crashes per Billion Light Vehicle Miles Traveled		Cost ($ Millions)	Equivalent Lives	No. of Fatal Crashes per Thousand Crashes
		Fatal	All	Fatal	All	Fatal	All			
1	Control Loss	4,529	473,392	4,456	470,733	1.6	174	$ 77,507	8,474	9.5
2	Road Departure	6,536	562,564	6,500	547,098	2.4	202	$ 97,737	10,686	11.9
3	Animal	103	298,106	102	297,968	0.0	110	$ 6,231	681	0.3
4	Pedestrian	3,732	70,525	3,731	70,461	1.4	26	$ 47,342	5,176	53.0
5	Pedalcyclist	518	47,927	518	47,927	0.2	18	$ 12,146	1,328	10.8
6	Lane Change	875	697,888	752	644,099	0.3	238	$ 32,935	3,601	1.2
7	Opposite Direction	3,288	100,993	3,258	100,786	1.2	37	$ 48,255	5,276	32.3
8	Rear-End	1,623	1,756,327	1,245	1,709,717	0.5	632	$ 106,515	11,646	0.7
9	Crossing Paths	4,086	1,152,112	3,972	1,131,273	1.5	418	$ 135,406	14,805	3.5
	Group Total	25,289	5,159,833	24,534	5,020,062	9.1	1,855	$ 564,073	61,674	4.9

*Refers to whether the vehicle is losing control, departing road, changing lanes, striking, maneuvering, etc.

1 Introduction

The Volpe National Transportation Systems Center (Volpe Center) supports NHTSA in crash avoidance research. One research effort is focused on pre-crash scenario typologies that provide a means to estimate potential safety benefits of crash countermeasure systems based on national crash databases. Pre-crash scenarios categorize crash data into a prioritized list of dynamically distinct scenarios based on vehicle movements and dynamics, as well as the critical events occurring immediately prior to the crash. Periodically, it is necessary to update and revise the typology structure to capture more recent trends in motor vehicle crashes and to better map emerging vehicle safety technologies to their target crashes. In addition, enhancements to the crash databases from year to year (changing variables, addition of data elements, etc.) make it necessary to re-evaluate the coding definitions for each scenario.

This study examines the current typology consisting of 37 distinct pre-crash scenarios [1] and modifies it by creating scenarios that are directly applicable to current and emerging crash avoidance systems. This study uses crash data from the Fatality Analysis Reporting System (FARS) and National Automotive Sampling System (NASS) General Estimates System (GES) 2011-2015 crash databases. The analysis examines all police-reported crashes involving a light-vehicle (LV) in the critical event of the crash that is the circumstance that made the crash possible. LVs include all passenger cars, vans, minivans, sport utility vehicles, or light pickup trucks with gross vehicle weight ratings less than or equal to 10,000 pounds. Statistical descriptions of each pre-crash scenario grouping (e.g., environmental conditions, driver characteristics, injuries, costs) are defined for each scenario. This provides the input necessary to aid in the research of the functionality, development, and benefits estimation of crash avoidance technologies.

1.1 Background

NHTSA's mission is to save lives, prevent injuries, and reduce economic costs due to roadway crashes. According to the FARS and NASS GES data for 2015, there were over 6 million estimated crashes nationwide and approximately 32,000 of those crashes resulted in fatalities. The detailed definition of crashes enables the identification of intervention opportunities that researchers and developers can use to develop appropriate crash avoidance technologies. Crash typologies categorize vehicle crashes into pre-crash scenarios that describe the events leading to the crashes. Knowledge of such pre-crash scenarios and their crash statistics guide researchers and developers to focus on specific crash countermeasures and to determine if they are effective at reducing their target crashes.

1.2 Previous Pre-Crash Scenarios Research

Two previous crash typologies were used for crash avoidance research in support of the Intelligent Vehicle Initiative in the Intelligent Transportation Systems program: the "44 Crashes" typology [2] [3] and a later pre-crash scenario typology presented in *Analysis of Light Vehicle Crashes and Pre-Crash Scenarios Based on the General Estimates System* [4].

In "44 Crashes," the crash scenarios represented all collisions in the United States. Each crash scenario was investigated using the 1991 GES crash database and samples of 1990-1991 police-reported crashes from Michigan and North Carolina. Shortcomings of this method for typology generation included the limited study of State crash data and the amount of effort necessary to replicate the results using recent crash data.

In the later typology, the results were based primarily on pre-crash variables in the NASS GES and Crashworthiness Data System (CDS) crash databases. Common crash types were analyzed to produce the list of representative pre-crash scenarios. Multi-vehicle (greater than 2 vehicles) crashes were not

included in the analysis. Some low-frequency crash types were also excluded (e.g., vehicle failure, non-collision incidents, and evasive action scenarios). As a result, this pre-crash scenario typology did not account for 100 percent of all police-reported crashes.

Based on combined crash information from both typologies previously mentioned, a third typology of pre-crash scenarios was developed for crash avoidance research called, *Pre-Crash Scenario Typology for Crash Avoidance Research* [5] (referenced in the report as the "37 pre-crash scenario typology"). This new typology consisted of 37 pre-crash scenarios that depicted vehicle movements and dynamics, and the critical pre-crash events. The goal of this typology was to establish a common vehicle safety research foundation for public and private organizations. This would allow researchers to prioritize traffic safety issues for further investigation and to develop related crash avoidance systems. A report was published [6] that provided pre-crash scenario statistics from the 2004-2008 GES based on this typology. All crashes included in the report involved an LV (similar to the analysis presented in this report). The new typology presented in this report is a revised version of the 37 pre-crash scenario typology.

1.3 Approach

This study provides updated pre-crash scenario definitions and related crash statistics. The analytical steps are:

1. Review the current 37 pre-crash scenario typology and available FARS and GES data variables.
2. Redefine a new typology structure.
3. Update and characterize the pre-scenarios with statistics from the FARS and GES databases.
4. Consolidate scenarios into relevant groups.
5. Provide rankings for the pre-crash scenario groups based on measures related to frequency of occurrence, comprehensive costs, fatalities, and vehicle-miles traveled (VMT).
6. Provide a comparison and analysis of relevant statistics for each scenario group.

In addition to this chapter, the approach taken is organized into the chapters described below:

- Chapter 2: describes the structure revision and reorganization of scenarios and the methods used to identify and prioritize the new pre-crash scenarios.
- Chapter 3: contains pre-crash scenarios, grouping statistics, and rankings.
- Chapter 4: presents key crash-characteristics information for each scenario group.
- Chapter 5: presents the conclusions.

The Appendix contains additional pre-crash scenario statistics and crash characteristics, in addition to other relevant information.

When references to data frequencies or percentages from the databases are made throughout the report, the terms "FARS" and "GES" are used synonymously for "fatal crashes" and "all crashes," respectively.

1.4 Data Sources and Limitations

The FARS and GES databases [7] [8] [9] are used in this analysis to examine vehicle crashes and statistically describe the pre-crash scenarios. FARS is a complete census of all fatal crashes on public roadways, where at least one fatality occurred within 30 days of the crash. GES is a nationally

representative sampling of police-reported crashes.[6] FARS is used to examine fatal crashes and GES is used to study all crashes.[7] Both databases are structurally similar and contain information on environmental conditions, physical settings, and other contributing factors and circumstances.

This report presents results from crashes representing a 5-year period from 2011 to 2015. These years were chosen because FARS and GES have the most consistent set of data elements starting in 2011.[8] Figure 1 shows the total number of fatal crashes contained in FARS and the national estimate of all crashes in GES for each year from 2011 to 2015. Since the GES data are estimated, error bars representing the generalized standard errors for the estimates of the crash totals are included.[9] The range represents a 95 percent confidence interval of the estimate. When averaged over the 5-year period, these values represent an annual total of 30,660 fatal crashes in FARS and approximately 5,791,000 crashes in GES. Each database is described in more detail in Sections and 1.4.1 and 1.4.2.

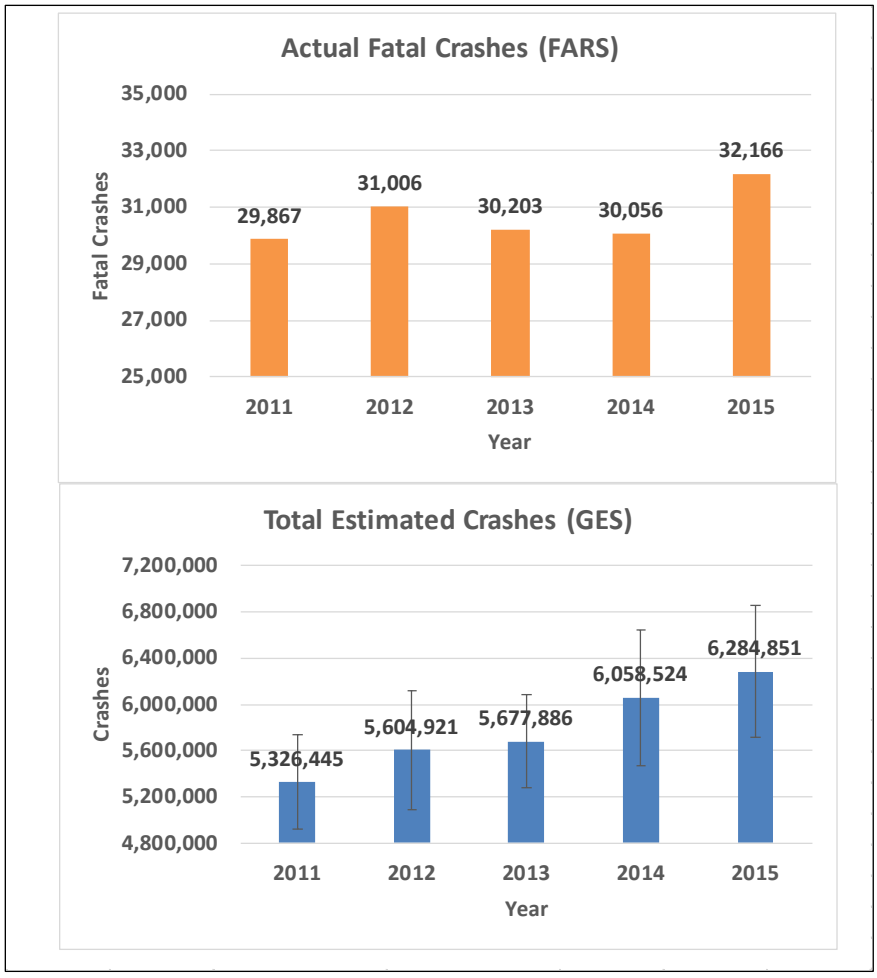


Figure 1. Yearly National Crash Totals

[6] Crashes involving minor property damage are typically unreported. Unreported crashes are less likely to utilize towing and occupants involved in these crashes are less likely to use hospitalization or emergency services [12].
[7] Although the GES database includes fatal crashes, it consistently underestimates these crashes.
[8] For more information on the FARS and GES Standardization refer to Appendix F in the National Automotive Sampling System General Estimates System Analytical User's Manual [8].
[9] Generalized standard error data for 2011 to 2014 is available at https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812320. Data for 2015 is available at https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812384.

1.4.1 Fatality Analysis Reporting System

FARS data is a complete, nationwide census of all crashes involving a motor vehicle on public roadways that each resulted in at least one fatal injury suffered by an occupant or a non-occupant. The fatalities reported in the FARS crashes most likely happened as a result of the crash and occurred within 30 days of the crash. A preliminary version of the FARS database is released when the data is available. Any additions and changes to the data, particularly regarding alcohol test results and fatalities are added and released in a final version. The data in this report represents the final FARS datasets for all years, except for 2015.

1.4.2 General Estimates System

The GES crash database estimates the national crash population each year based on a probability sample of about 50,000[10] police-reported crash cases that include all vehicle types and injury levels. These crash estimates do not account for non-reported crashes. The national estimates produced from the GES data may differ from the true population values because they are based on a probability sample of police-reported crashes rather than a census of all crashes. Also, the GES data contain information on fatalities, but since this information is collected from police reports and weighted based on a probability sample, the results may differ from those contained in FARS.

1.4.3 Data Limitations

The following assumptions apply to the data and/or analysis:

- The data include sampling errors since GES is a nationally representative data set estimated from samples of crashes.
- There exist gaps in the data where no information is available. These cases are coded as unknown or not on the police report.
- The data includes limitations of police-reported data.
    - Police reports may contain incomplete data.
    - Police reports may have under-reporting of important facts, and are subject to the interpretation of the law enforcement officer or coders.
    - Many non-severe crashes are not reported to the law enforcement agency.
- Both FARS and GES contain values for fatalities. FARS represents an actual count and GES is an estimated value. The actual fatality values from FARS are used to replace the estimated values in GES when determining costs, so that there is not double-counting of fatalities.

[10] In 2013 this number was reduced to approximately 35,000 due to NHTSA budget restrictions.

2 Revised Scenario Typology

The 37 pre-crash scenario typology was analyzed to determine changes necessary to improve the mapping of the typology scenarios to the current features of existing and emerging crash avoidance technologies. For uniformity, the revised list of scenarios is focused on the basic vehicle dynamics (e.g., straight crossing paths) and not on the individual characteristics of the crash (e.g., running red light.) The majority of scenarios remained the same, but a few changes were made to the typology (as described below.)

2.1 Structure Revision and Reorganization

The pre-crash scenario typology organizes the total crash population into a list of distinct pre-crash scenarios based on vehicle dynamics and movements. Each crash is only represented by one scenario from the list. For example, a crash belonging to a vehicle failure scenario is not counted again in another scenario such as the rear-end pre-crash scenario.

The scenarios are prioritized to identify crash avoidance technologies that have the potential to mitigate or eliminate the associated crashes. Specific crash avoidance technologies that address the higher-ordered scenarios might also address crashes in the lower-ordered scenarios. The order of the pre-crash scenarios does not necessarily mean that a scenario has more importance over another scenario or that it has a higher priority for crash avoidance technology. Pre-crash scenarios involving a vehicle experiencing control loss are at the top of the list since these situations could lead to various crashes such as road departure, rear-end, or opposite direction crash. Figure 2 lists pre-crash scenarios in order, and illustrates the scenario mapping from the 37 previous pre-crash scenario typology to the 36 revised pre-crash scenario typology.

Three scenarios in the 37 pre-crash scenario typology were removed in the revised set because these scenarios differ from the others as they are based on characteristics of the crash. These scenarios were no driver present (classified as a part of the category, other), running red light, and running stop sign. Although these three scenarios are not present in the new scenario list, crashes that previously fell into one of these categories are now categorized into one of the other scenarios.[11]

Another revision to the typology is that the new scenario typology does not distinguish between signal crashes (at signalized intersections with a traffic light present) and non-signal crashes (at stop-sign controlled and non-signalized intersections). Scenarios from the earlier typology with those distinctions are combined in the revised typology. These scenarios are present in the intersection and turning scenarios. The presence of a traffic control device is now specified as a characteristic variable of the scenario as explained in Section 4.3.2.

Finally, the turning scenarios were modified into scenarios that contain greater detail according to whether the vehicle was making a left or right turn and if it was turning into or across the path of the other vehicle. No changes were made to the remaining scenarios. The new typology contains a set of 36 scenarios as shown in Figure 2.

[11] Specific crashes were not removed from the analysis and the revised typology still represents 100 percent of the crashes. The individual scenarios for "running red light," "running stop sign," and "straight crossing paths" (SCP) were combined into one scenario, SCP, in the revised scenario typology. All related crashes, independent of a stop sign or a three-color signal, are categorized into this one scenario. If further detail is needed, the crashes in this scenario can be filtered based on the crash characteristics (i.e., whether there was a traffic control device present).

Old Scenario	37 Previous Scenarios		New Scenario	36 Revised Scenarios
Other	No driver present	Removed		
1	Vehicle failure	Same	1	Vehicle failure
2	Control loss/vehicle action		2	Control loss/vehicle action
3	Control loss/no vehicle action		3	Control loss/no vehicle action
4	Running red light	Removed		
5	Running stop sign	Removed		
6	Road edge departure/maneuver	Same	4	Road edge departure/maneuver
7	Road edge departure/no maneuver		5	Road edge departure/no maneuver
8	Road edge departure/backing		6	Road edge departure/backing
9	Animal/maneuver		7	Animal/maneuver
10	Animal/no maneuver		8	Animal/no maneuver
11	Pedestrian/maneuver		9	Pedestrian/maneuver
12	Pedestrian/no maneuver		10	Pedestrian/no maneuver
13	Pedalcyclist/maneuver		11	Pedalcyclist/maneuver
14	Pedalcyclist/no maneuver		12	Pedalcyclist/no maneuver
15	Backing into vehicle		13	Backing into vehicle
16	Turning/same direction		14	Turning/same direction
17	Parking/same direction		15	Parking/same direction
18	Changing lanes/same direction		16	Changing lanes/same direction
19	Drifting/same direction		17	Drifting/same direction
20	Opposite direction/maneuver		18	Opposite direction/maneuver
21	Opposite direction/no maneuver		19	Opposite direction/no maneuver
22	Rear-end/striking maneuver		20	Rear-end/striking maneuver
23	Rear-end/LVA		21	Rear-end/LVA
24	Rear-end/LVM		22	Rear-end/LVM
25	Rear-end/LVD		23	Rear-end/LVD
26	Rear-end/LVS		24	Rear-end/LVS
27	LTAP/OD at signal	Revised	25	RTIP - Right turn into path
28	Turn right at signal		26	RTAP - Right turn across path
29	LTAP/OD at non signal		27	SCP - Straight crossing paths
30	SCP at non signal		28	LTAP/LD - Left turn across path, lateral direction
31	Turn at non signal		29	LTIP - Left turn into path
			30	LTAP/OD - Left turn across path, opposite direction
32	Evasive maneuver/maneuver	Same	31	Evasive maneuver/maneuver
33	Evasive maneuver/no maneuver		32	Evasive maneuver/no maneuver
Other	Rollover (untripped)		Other	Rollover (untripped)
34	Noncollision - No Impact		33	Noncollision - No Impact
35	Object/maneuver		34	Object/maneuver
36	Object/no maneuver		35	Object/no maneuver
Other	Hit and run		Other	Hit and run
	Other Rear-End			Other Rear-End
	Other Sideswipe			Other Sideswipe
	Other Opposite Direction			Other Opposite Direction
	Other Turn Across Path			Other Turn Across Path
	Other Turn Into Path			Other Turn Into Path
	Other Straight Paths			Other Straight Paths
	Other			Other

Figure 2. Pre-Crash Scenario Revision

Following is a list of the 36 pre-crash scenarios and a description of each. Diagrams of the intersection crashes (scenarios 25–30) are shown in Figure 3 for better understanding of the vehicle positions and movements.

1. Vehicle Failure–A vehicle crashes due to a component/mechanical problem or failure (e.g., tire blowout, steering issue).
2. Control Loss/Vehicle Action–A vehicle loses control while performing a maneuver (e.g., passing, turning at an intersection).
3. Control Loss/No Vehicle Action–A vehicle loses control while driving straight or negotiating a curve.
4. Road Edge Departure/Maneuver–A vehicle departs the road while performing a maneuver (e.g., passing, turning, changing lanes).
5. Road Edge Departure/No Maneuver–A vehicle departs the road while driving straight or negotiating a curve.
6. Road Edge Departure/Backing–A vehicle departs the road while backing.
7. Animal/Maneuver–A vehicle strikes an animal while performing a maneuver (e.g., passing, turning).
8. Animal/No Maneuver–A vehicle strikes an animal while driving straight or negotiating a curve.
9. Pedestrian/Maneuver–A vehicle strikes a pedestrian while performing a maneuver (e.g., passing, turning).
10. Pedestrian/No Maneuver–A vehicle strikes a pedestrian while driving straight or negotiating a curve.
11. Pedalcyclist/Maneuver–A vehicle strikes a pedalcyclist while performing a maneuver (e.g., passing, turning).
12. Pedalcyclist/No Maneuver–A vehicle strikes a pedalcyclist while driving straight or negotiating a curve.
13. Backing into Vehicle–A vehicle collides with another vehicle while backing.
14. Turning/Same Direction–A vehicle turns and cuts across the path of another vehicle initially traveling in the same direction.
15. Parking/Same Direction–A vehicle is entering or leaving a parked position and collides with another vehicle.
16. Changing Lanes/Same Direction–A vehicle changes lanes and encroaches into another vehicle traveling in the same direction.
17. Drifting/Same Direction–A vehicle drifts into an adjacent vehicle traveling in the same direction.
18. Opposite Direction/Maneuver–A vehicle makes a maneuver (e.g., passing) and encroaches into another vehicle traveling in the opposite direction.
19. Opposite Direction/No Maneuver–A vehicle drifts and encroaches into another vehicle traveling in the opposite direction.
20. Rear-End/Striking Maneuver–A vehicle changes lanes or passes another vehicle, and closes in on a vehicle ahead in the same lane.
21. Rear-End/Lead Vehicle Accelerating (LVA)–A vehicle closes in on an accelerating lead vehicle ahead in the same lane.

22. Rear-End/Lead Vehicle Moving (LVM)–A vehicle closes in on a moving vehicle ahead in the same lane.
23. Rear-End/Lead Vehicle Decelerating (LVD)–A vehicle closes in on a decelerating lead vehicle ahead in the same lane.
24. Rear-End/Lead Vehicle Stopped (LVS)–A vehicle closes in on a stopped lead vehicle ahead in the same lane.
25. Right Turn Into Path (RTIP)–A vehicle is turning right at an intersection and turns into the same direction of another vehicle crossing from a lateral direction.
26. Right Turn Across Path (RTAP)–A vehicle is turning right at an intersection and turns into the opposite direction of another vehicle crossing from a lateral direction.
27. Straight Crossing Paths (SCP)–A vehicle is going straight and collides with another straight crossing vehicle from a lateral direction at an intersection.
28. Left Turn Across Path, Lateral Direction (LTAP/LD)–A vehicle turns left at an intersection and crosses the path of another vehicle traveling in the opposite direction from a lateral direction (left).
29. Left Turn Into Path (LTIP)–A vehicle turns left at an intersection and turns into the path of another vehicle traveling in the same direction from a lateral direction (right).
30. Left Turn Across Path/Opposite Direction (LTAP/OD)–A vehicle turns left at an intersection and crosses the path of another vehicle traveling in the opposite direction.
31. Avoidance/Maneuver–A vehicle attempts a maneuver to avoid something while turning, passing, etc.
32. Avoidance/No Maneuver–A vehicle attempts a maneuver to avoid something while driving straight or negotiating a curve.
33. Non-Collision/No Impact–A vehicle makes no contact with another vehicle but it experiences a damaging or injury-producing event (e.g., fire, an occupant fell/jumped from vehicle, etc.).
34. Object/Maneuver–A vehicle strikes an object while performing a maneuver (e.g., passing, turning).
35. Object/No Maneuver–A vehicle strikes an object while driving straight or negotiating a curve.
36. Other–Includes rollovers, hit-and-run, and other crashes where details are missing to accurately define the scenario.

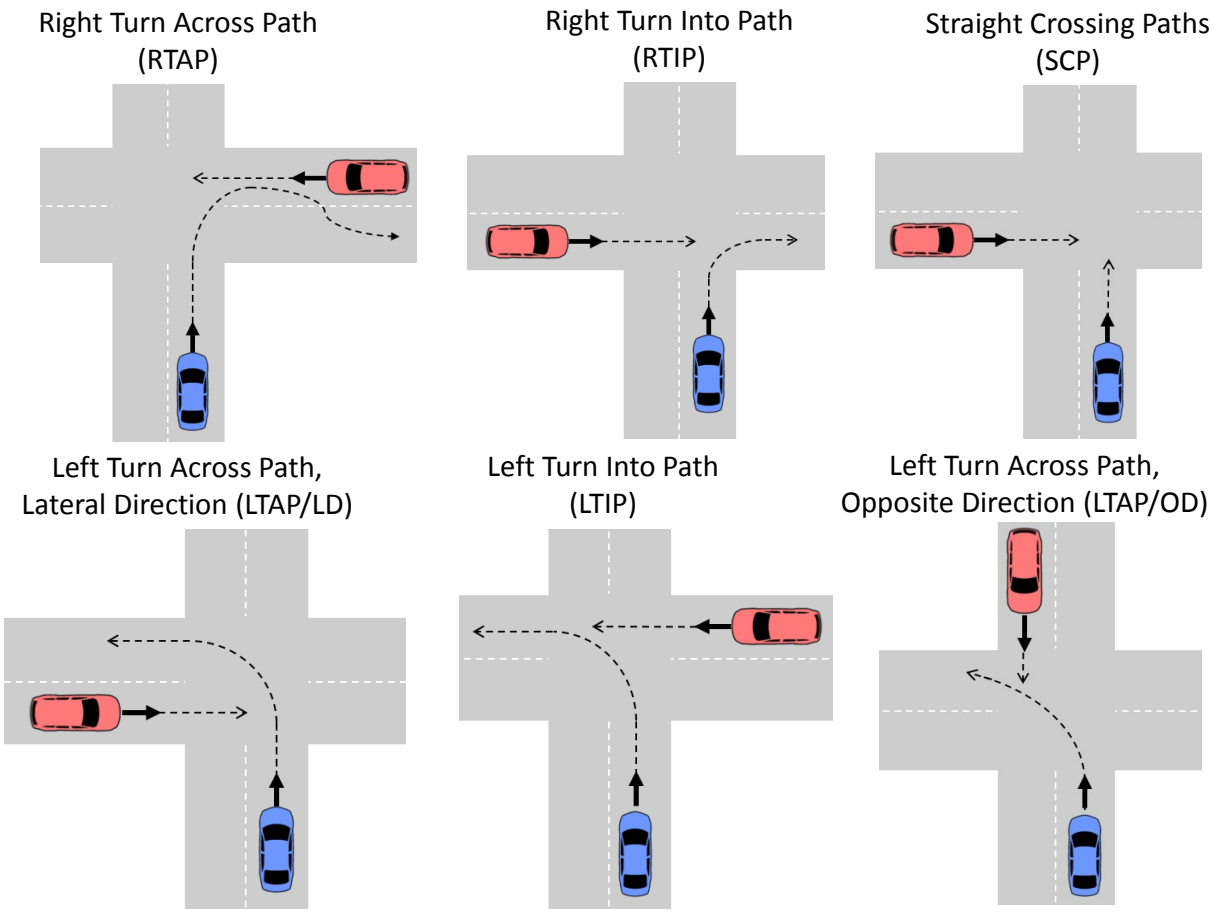


Figure 3. Intersection Crossing-Paths Crash Scenarios

2.2 Scenario Coding

The scenarios are defined based on variables that are available in the 2011-2015 FARS and GES databases. Each scenario is described in terms of the first harmful event and the pre-crash circumstances that made the crash possible. The three main variables that are primarily used are all related to the critical event that made the crash imminent. These variables are defined as:

1. Critical event–the event that occurred that made the crash imminent.
2. Pre-event movement–the vehicle's action prior to an impending critical event or prior to impact if the driver did not make any action.
3. Accident type[12]–the crash type based on the first harmful event and the pre-crash circumstances.

In addition to the three main variables above, the scenario definitions are enhanced based on a few other variables, such as the initial contact point on the vehicle, or whether the vehicle was involved in a rollover or a hit-and-run. The sequence of events of the crash and other information (i.e., whether a second vehicle is involved) is also helpful in some scenario definitions. Also, the body type variable is used to define an LV. Appendix A contains the coding schematic used to define the pre-crash scenarios.

[12] See Appendix A of the GES Analytical User's Manual [8] for the list of accident types.

2.3 Scenario Grouping and Vehicle Role Definition

The 36 scenarios were combined into similar groups by vehicle dynamics and crash type. These groups also relate to types of advanced vehicle technology that might potentially address the crash. The nine groups are control loss, road departure, animal, pedestrian,[13] pedalcyclist, lane change, opposite direction, rear-end, and crossing paths. Examples of related technologies to address associated crashes are shown in Table 1. Remaining scenarios not covered by these groups include those related to vehicle failure, road edge departure/backing,[14] backing into vehicle, avoidance maneuver, rollover, non-collision, object, hit-and-run, and other scenarios. These scenarios represent whether the crash frequencies are either very low, the vehicle is not moving forward, or the scenarios are not adequately defined because of missing information. Note that rear-visibility technology mandated by NHTSA[15] could help to mitigate or avoid the crashes involving backing.

Table 1. Pre-Crash Scenario Groups

Scenario Group	Related Advanced Technology Examples
Control Loss	Electronic Stability Control
Road Departure	Lane and Road Departure Warning Systems
Animal	Animal Detection Systems Automatic Emergency Braking
Pedestrian	Pedestrian Detection Systems Automatic Emergency Braking
Pedalcyclist	Cyclist Detection Systems Automatic Emergency Braking
Lane Change	Lane Change Warning Systems Blind Spot Detection
Opposite Direction	Lane-Keeping Support
Rear-End	Forward Collision Warning Automatic Emergency Braking
Crossing Paths	Intersection Movement Assist Left Turn Assist

Note: Backing into another vehicle or object is not included since crash frequencies are low and also NHTSA has mandated the use of rear-visibility technology on all vehicles under 10,000 pounds by 2018. Backing into a pedestrian/pedalcyclist is included in the pedestrian/pedalcyclist categories.

The analysis included in this report is based on the LV making a particular action tied to the critical event of the crash in each pre-crash scenario. Each action to define the role of the LV and its corresponding scenario is shown in Table 2. The individual pre-crash scenario mapping into the nine groups is also

[13] Includes pedestrians on personal conveyances (e.g., skaters, wheel chair occupants).
[14] Backover crashes that occur on off-road locations (i.e., driveways, parking lots) are not included.
[15] 49 CFR Part 571, Federal Motor Vehicle Safety Standards; Rear Visibility; Final Rule (2014, April 7), Vol. 79, No. 66, p. 19178-19250. Available at www.gpo.gov/fdsys/pkg/FR-2014-04-07/pdf/2014-07469.pdf

shown in Table 2. Appendix A contains the database variable attributes used for coding the LV making the critical action.

Table 2. Light-Vehicle Role and Scenario Grouping

Scen. No	Light-Vehicle Critical Action	Scenario Group	Pre-Crash Scenario
2	Lost control	Control Loss	Control loss/vehicle action
3			Control loss/no vehicle action
4	Departed road	Road Departure	Road edge departure/maneuver
5			Road edge departure/no maneuver
7	Struck animal	Animal	Animal/maneuver
8			Animal/no maneuver
9	Struck pedestrian	Pedestrian	Pedestrian/maneuver
10			Pedestrian/no maneuver
11	Struck pedalcyclist	Pedalcyclist	Pedalcyclist/maneuver
12			Pedalcyclist/no maneuver
14	Made lane change	Lane Change	Turning/same direction
15			Parking/same direction
16			Changing lanes/same direction
17			Drifting/same direction
18	Maneuvered into opposite direction*	Opposite Direction	Opposite direction/maneuver
19			Opposite direction/no maneuver
20	Striking vehicle/rear vehicle	Rear-End	Rear-end/striking maneuver
21			Rear-end/Lead Vehicle Accelerating (LVA)
22			Rear-end/Lead Vehicle Moving (LVM)
23			Rear-end/Lead Vehicle Decelerating (LVD)
24			Rear-end/Lead Vehicle Stopped (LVS)
25	Straight Crossing Paths: See note below* Turning scenarios: Turning vehicle	Crossing Paths	RTIP - Right turn into path
26			RTAP - Right turn across path
27			SCP - Straight crossing paths
28			LTAP/LD - Left turn across path, lateral direction
29			LTIP - Left turn into path
30			LTAP/OD - Left turn across path, opposite direction

* If the light-vehicle role cannot be matched directly to a specific vehicle in the pre-crash scenario (e.g., "Opposite Direction - No Manuever" and "Straight Crossing Path" scenarios), then the first light vehicle identified/coded in the database is assigned as the subject vehicle role.

Note: Scenario #'s 1, 6, 13, 31, 32, 33, 34, 35, 36, 37 and "other" not included in the "group" categories.

3 Light Vehicle Pre-Crash Scenario Statistics

The analysis presented is based on crashes where an LV is involved in the critical event of a crash. It includes those crashes contained in the FARS and GES databases from 2011 to 2015. LVs include passenger cars, vans, minivans, sport utility vehicles, or light pickup trucks with a gross vehicle weight rating of 10,000 pounds or less.

Figure 4 shows a 5-year average of 26,197 fatal crashes that involve an LV in the critical event. The LV is making the critical action in 97 percent of these crashes. Note that some of these crashes are single-vehicle crashes so there is only one LV in these cases. Depending on the scenario, the critical action refers to whether the vehicle is turning, changing lanes, striking, maneuvering, etc. (Refer to Table 2 for definition of vehicle action.) In some scenarios, it is unknown which vehicle is making the critical action and for these, the first LV coded in the databases is used. Of the crashes where the LV is making the critical action, 94 percent of fatal light-vehicle crashes belong to the nine scenario groups. These crashes represent 24,534 fatal crashes.

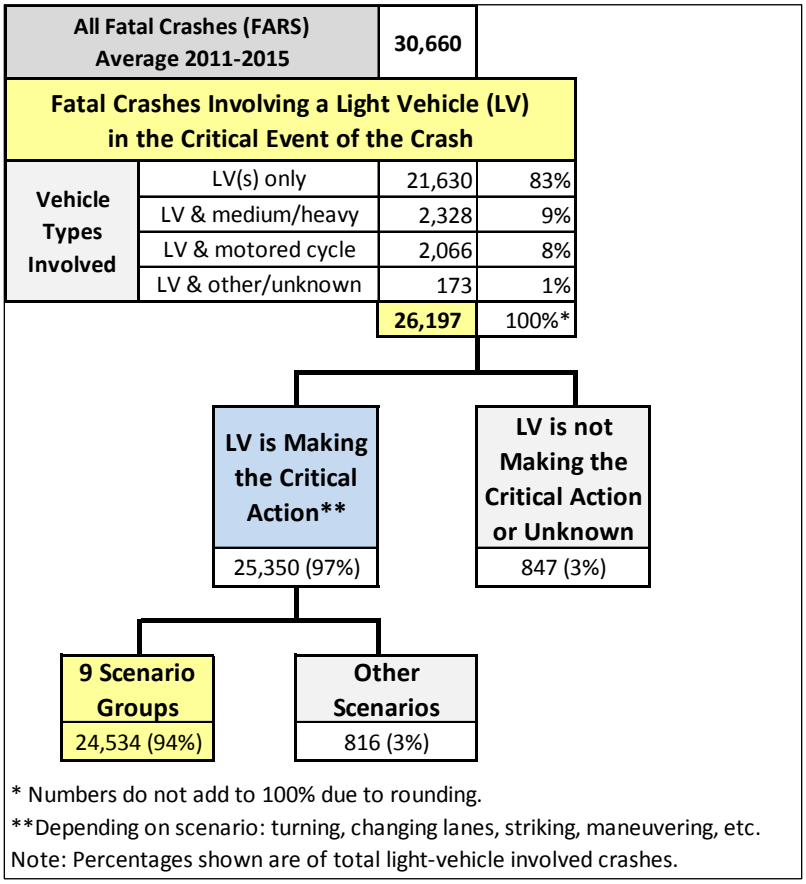


Figure 4. FARS Light-Vehicle Crash Overview

Similar information to what is presented in Figure 4 is shown in Figure 5 for the GES crashes. Figure 5 shows a 5-year average of over 5.6 million estimated crashes that involve an LV in the critical event. The nine scenario groups comprise just over an estimated five-million total crashes that translates to 89 percent of all light-vehicle crashes.

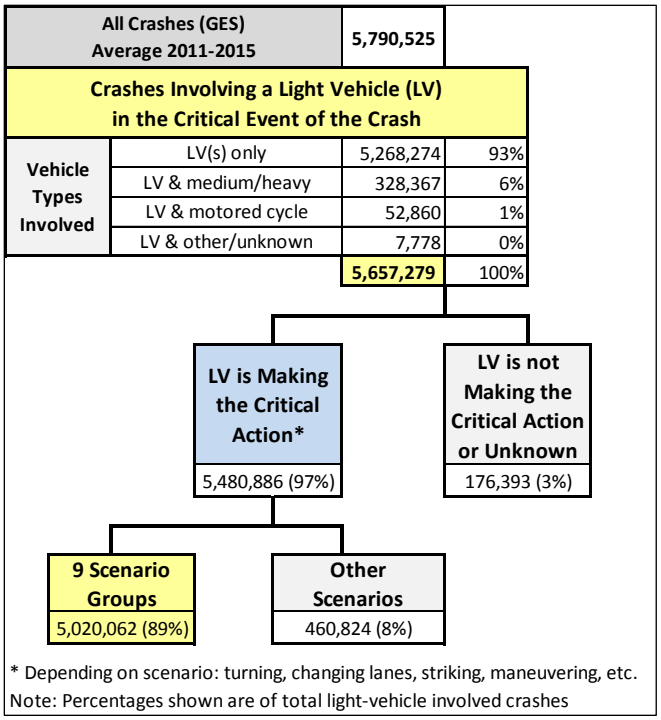


Figure 5. GES Light-Vehicle Crash Overview

3.1 All Light-Vehicle Crash Scenario Statistics

The FARS and GES crash frequencies for each of the 36 scenarios are shown in Appendix B (Table 10 and 11). The top three scenarios for fatal crashes are road edge departure/no maneuver, control loss/no vehicle action, and pedestrian/no maneuver. In total, these three scenarios comprise 54 percent of crashes that involve an LV making the critical action. The top three scenarios for GES are the rear-end/lead vehicle stopped, road edge departure/no maneuver, and the straight crossing paths scenarios. Together, these only account for 35 percent of the same crashes stated above. The data suggests that rear-end crashes tend to be less fatal but they are a more common occurrence.

Four additional measures are used to describe the individual pre-crash scenarios and the nine scenario groups. A description of each follows:

1. Crashes per VMT–This measure is used to provide a consistent comparison of the crash frequencies over each data year since the number of vehicle-miles traveled can vary from year to year. The Federal Highway Administration's data [10] [11] for the miles traveled by LVs per year is shown in Table 3. These values include NHTSA's revisions to the R.L. Polk National Vehicle Population Profile registration counts.

Table 3. Vehicle Miles Traveled by Light Vehicles (2011-2015)

Year	Light-Vehicle Travel in Millions of Vehicle Miles
2011	2,650,458
2012	2,664,060
2013	2,677,730
2014	2,710,556
2015	2,779,693

2. Comprehensive cost–These are the costs associated with the outcome of the crash based on the subsequent injury [12]. The costs are based on 2010 economics. They include costs associated with lost productivity, medical costs, legal and court costs, emergency service costs, insurance administration costs, travel delay, property damage, and workplace losses. Intangible consequences of the crash, such as pain and suffering or loss of life, are also included. Comprehensive costs also include the value of quality-adjusted life-years. The comprehensive costs are based on injuries using the Maximum Abbreviated Injury Scale (MAIS) while the FARS and GES databases report injuries using the KABCO[16] scale. The KABCO non-fatal injuries reported in the GES need to be translated into MAIS values. Appendix C contains details on how this conversion is done. To calculate a more precise cost of the crashes, the fatalities from FARS replace those in GES since fatalities in FARS are actual counts and those in GES represent a weighted sample.
3. Equivalent lives (EL)–The value of a life is assessed at $9,145,998 [12]. The cost of a fatality represents the highest amount as compared to the cost associated with other varying degrees of injuries. The measure equates the cost of nonfatal injuries and damage costs from "property-damage only" vehicles to the cost of preventing a fatality. The total comprehensive cost divided by the value of a life is equal to the EL. This measure is another form of total harm measurement.
4. Ratio of fatal crashes to all crashes–The number of fatal crashes divided by all crashes. This measure shows the probability of a fatal crash given that a crash would occur. Different crash types occur at a wide range of varying frequencies, resulting in varying amount of fatalities. This measure shows which scenarios have higher fatality rates and which may warrant further more understanding or research.

Appendix B (Table 12) contains a comprehensive list of each of the measures specified above for all 36 pre-crash scenarios.

3.2 Scenario Groups

The nine scenario groups defined in Section 2.3 are based on common vehicle dynamics, movements and location, and other characteristics of the crash. Statistics for these nine groups with the measures mentioned in Section 3.1 are shown in Table 4. The total number of crashes, the percent of total crashes, and the rankings associated with each individual scenario group across fatal crashes and all crashes are found in Table 5. This same information based on crashes per VMT is also shown in Table 5. When comparing crashes where an LV was involved to crashes where the LV was making the critical action, the

[16] The KABCO scale is used for classifying injuries. Refer to Appendix C for more information regarding the individual classifications.

rankings of the groups do not change (even though the crash percentages may vary slightly). Similarly, the rankings do not change when the crash frequency is calculated per VMT. Figures 6 and 7 show the graphical comparisons of fatal crashes and all crashes of the same data presented in Table 5.

Nearly 26 percent of the fatal crashes are categorized in the highest-ranked, road departure group. The control loss group (comprising 18% of the crashes) is the second most fatal category. Conversely, these two groups are ranked fourth and fifth when considering all crashes. The highest-ranked group for all crashes is the rear-end category that accounted for nearly one-third of the population of LV crashes. This is followed by the crossing paths at 21 percent and lane change at 12 percent. Statistics for the groups related to the costs, EL, and the number of fatal crashes per thousand crashes are also shown in Table 4. The order of the scenarios in Table 4 is based on pre-crash scenario numbering and is not representative of any numerical rankings. The associated group rankings are discussed next in Section 3.2.1.

Table 4. Scenario Group Statistics

Scenario Group	Crashes Involving a Light Vehicle in the Critical Event		Crashes Where the Light Vehicle is Making the Critical Action						
			Total		No. of Crashes per Billion Light Vehicle Miles Traveled		Cost ($ Millions)	Equivalent Lives	No. of Fatal Crashes per Thousand Crashes
	Fatal	All	Fatal	All	Fatal	All			
Control Loss	4,529	473,392	4,456	470,733	1.6	174	$ 77,507	8,474	9.5
Road Departure	6,536	562,564	6,500	547,098	2.4	202	$ 97,737	10,686	11.9
Animal	103	298,106	102	297,968	0.0	110	$ 6,231	681	0.3
Pedestrian	3,732	70,525	3,731	70,461	1.4	26	$ 47,342	5,176	53.0
Pedalcyclist	518	47,927	518	47,927	0.2	18	$ 12,146	1,328	10.8
Lane Change	875	697,888	752	644,099	0.3	238	$ 32,935	3,601	1.2
Opposite Direction	3,288	100,993	3,258	100,786	1.2	37	$ 48,255	5,276	32.3
Rear-End	1,623	1,756,327	1,245	1,709,717	0.5	632	$ 106,515	11,646	0.7
Crossing Paths	4,086	1,152,112	3,972	1,131,273	1.5	418	$ 135,406	14,805	3.5
Group Total	25,289	5,159,833	24,534	5,020,062	9.1	1,855	$ 564,073	61,674	4.9

Note: Values based on average of 2011-2015 FARS and GES data.

Table 5. Crash Rank for the Light Vehicle Making the Critical Action

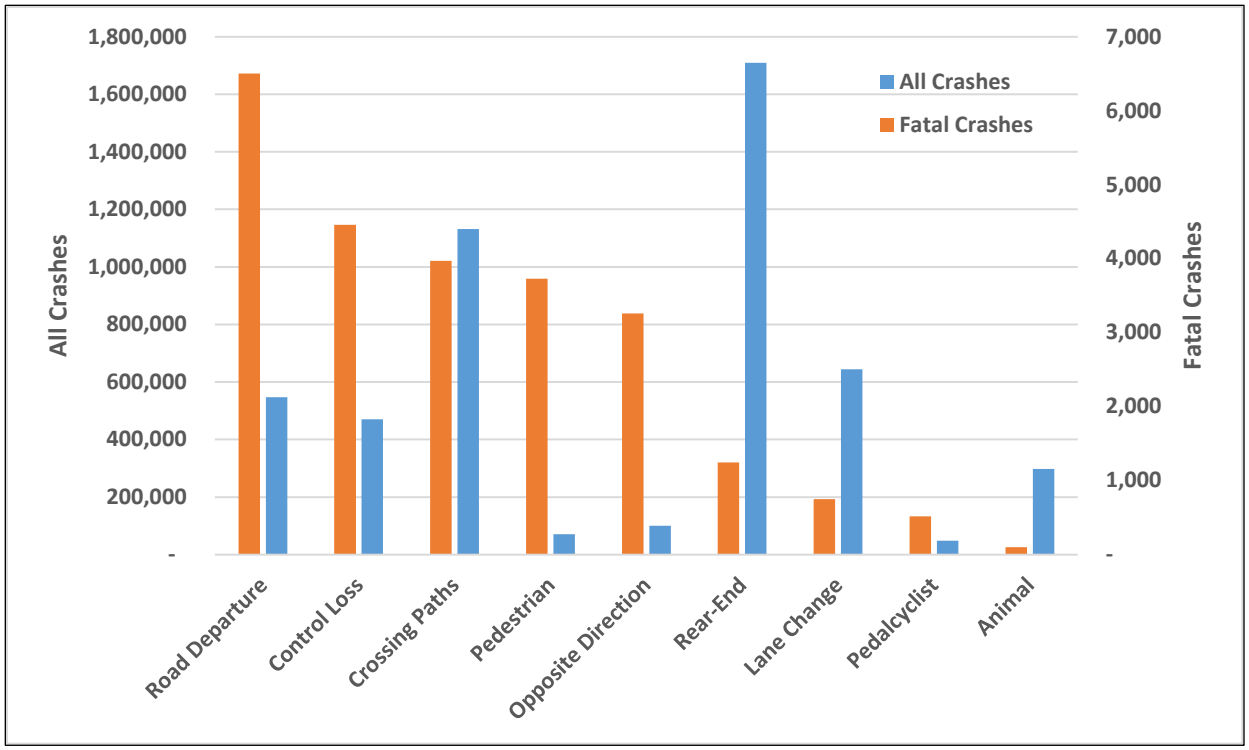
Fatal Crashes			
Rank	Scenario Group	Total	%
1	Road Departure	6,500	26%
2	Control Loss	4,456	18%
3	Crossing Paths	3,972	16%
4	Pedestrian	3,731	15%
5	Opposite Direction	3,258	13%
6	Rear-End	1,245	5%
7	Lane Change	752	3%
8	Pedalcyclist	518	2%
9	Animal	102	0%
	Remaining Scenarios	816	3%
	Total	**25,350**	**100%**

All Crashes			
Rank	Scenario Group	Total	%
1	Rear-End	1,709,717	31%
2	Crossing Paths	1,131,273	21%
3	Lane Change	644,099	12%
4	Road Departure	547,098	10%
5	Control Loss	470,733	9%
6	Animal	297,968	5%
7	Opposite Direction	100,786	2%
8	Pedestrian	70,461	1%
9	Pedalcyclist	47,927	1%
	Remaining Scenarios	460,824	8%
	Total	**5,480,886**	**100%**

Fatal Crashes per Billion Light-Vehicle Miles Traveled			
Rank	Scenario Group	Total	%
1	Road Departure	2.4	26%
2	Control Loss	1.6	18%
3	Crossing Paths	1.5	16%
4	Pedestrian	1.4	15%
5	Opposite Direction	1.2	13%
6	Rear-End	0.5	5%
7	Lane Change	0.3	3%
8	Pedalcyclist	0.2	2%
9	Animal	0.0	0%
	Remaining Scenarios	0.3	3%
	Total	**9.4**	**100%**

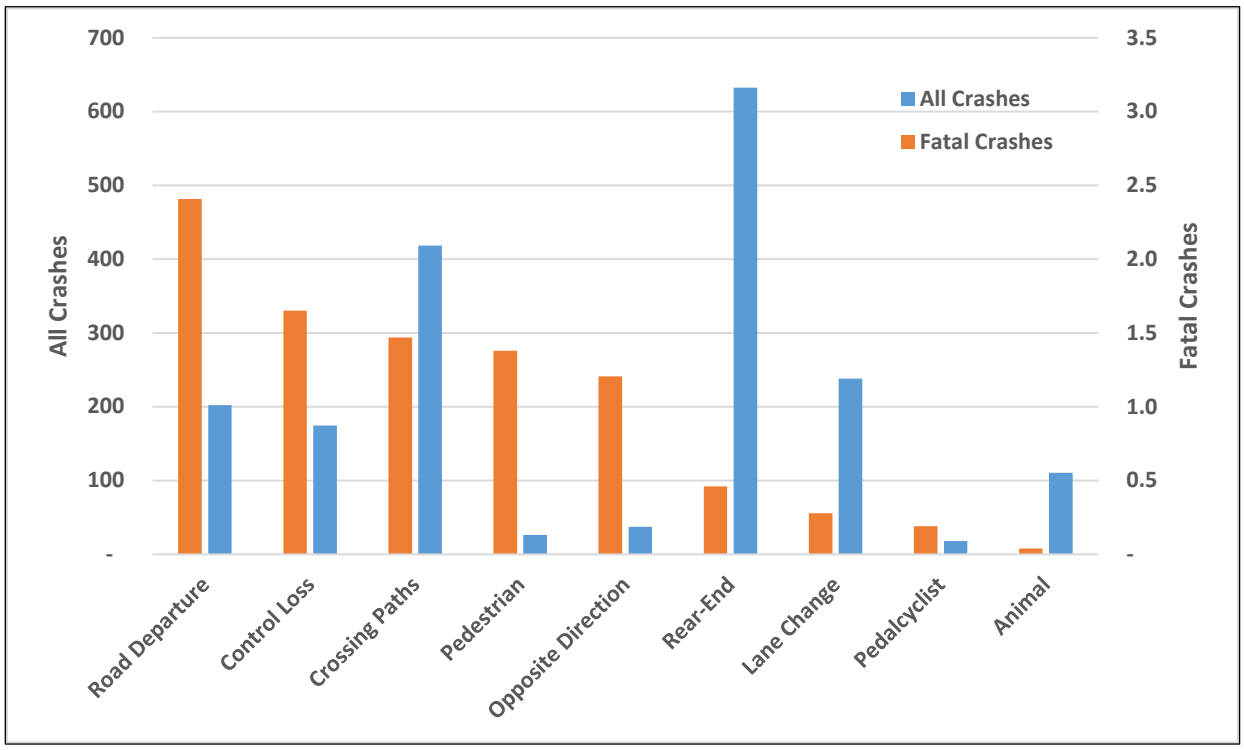
All Crashes per Billion Light-Vehicle Miles Traveled			
Rank	Scenario Group	Total	%
1	Rear-End	632	31%
2	Crossing Paths	418	21%
3	Lane Change	238	12%
4	Road Departure	202	10%
5	Control Loss	174	9%
6	Animal	110	5%
7	Opposite Direction	37	2%
8	Pedestrian	26	1%
9	Pedalcyclist	18	1%
	Remaining Scenarios	170	8%
	Total	**2,025**	**100%**

Note: Values based on average of 2011-2015 FARS and GES data.



Note: Values based on average of 2011-2015 FARS and GES data.

Figure 6. Crash Statistics of the Light-Vehicle Involvement in the Critical Event of the Crash



Note: Values based on average of 2011-2015 FARS and GES data for LV involved in the critical event.

Figure 7. Crashes per Billion Light-Vehicle Miles Traveled

3.2.1 Ranking by Cost, Crash Rate

The percentages (averaged from 2011 to 2015) for the comprehensive costs and EL of each scenario group are shown in Table 6. The fatal-to-all crash ratios are shown in Table 7. Figures 8 and 9 show the graphical comparisons of fatal crashes and all crashes for the same data. Crossing-paths crashes have the highest comprehensive costs and EL, but these crashes are associated with lower fatal crashes as they rank sixth in the fatal-to-all crashes ratio relative to the other scenario groups. These crashes also rank third among the groups when all crashes per VMT are compared. The pedestrian group has the highest fatal-to-all crash ratio at 53 fatal crashes per thousand crashes while this scenario ranks next to the bottom for number of crashes per VMT. The lowest-ranked group across all measures is the animal group. Table 13 of Appendix B contains the frequencies, percentages, and rankings for the comprehensive costs, EL, and "number of fatal crashes to all crashes" for all crashes by pre-crash scenarios. Table 14 of Appendix B presents the same information by scenario groups.

Table 6. Annual Comprehensive Cost and Equivalent Lives by Scenario Group

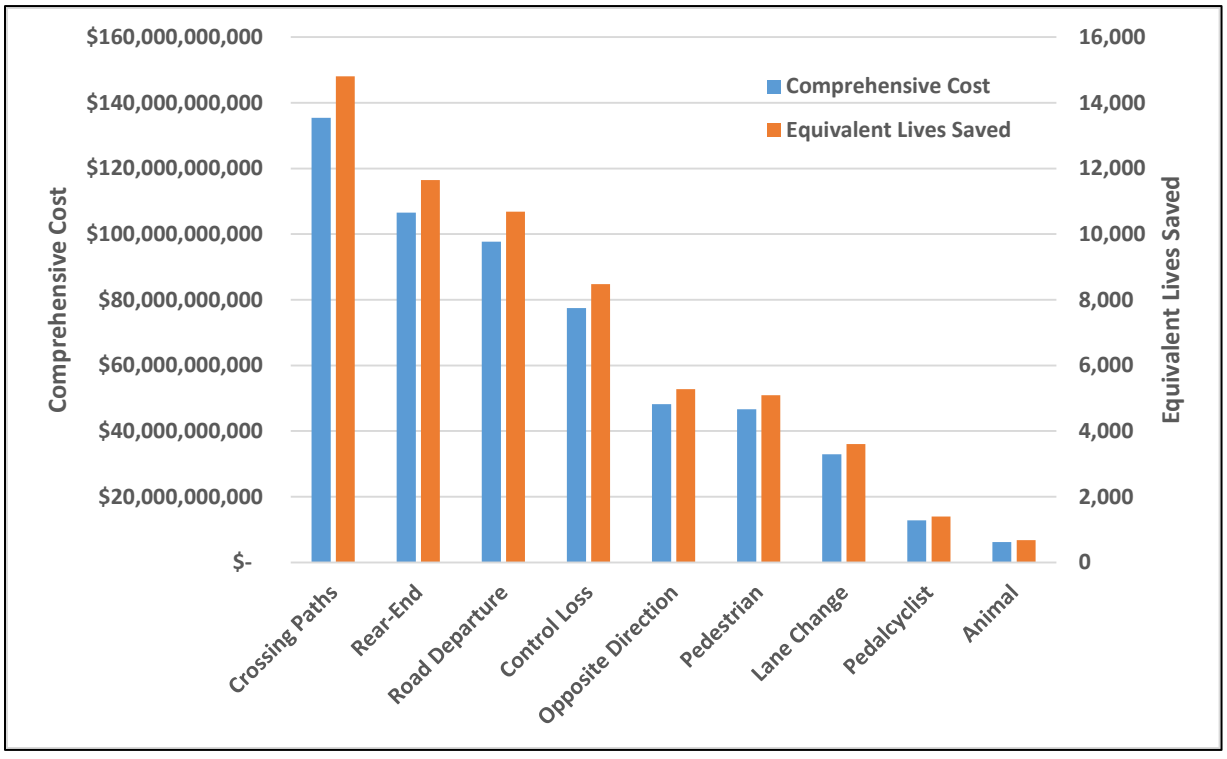
Rank	Scenario Group	Cost ($ Billions)	Equivalent Lives	%
1	Crossing Paths	$ 135,409	14,805	23%
2	Rear-End	$ 106,516	11,646	18%
3	Road Departure	$ 97,737	10,686	17%
4	Control Loss	$ 77,507	8,474	13%
5	Opposite Direction	$ 48,255	5,276	8%
6	Pedestrian	$ 46,611	5,096	8%
7	Lane Change	$ 32,935	3,601	6%
8	Pedalcyclist	$ 12,833	1,403	2%
9	Animal	$ 6,231	681	1%
N/A	Remaining Scenarios	$ 24,709	2,702	4%
	Total	**$ 588,743**	**$ 64,372**	**100%**

Note: Values based on average of 2011-2015 FARS and GES data.

Table 7. Fatal-to-All Crash Ratio

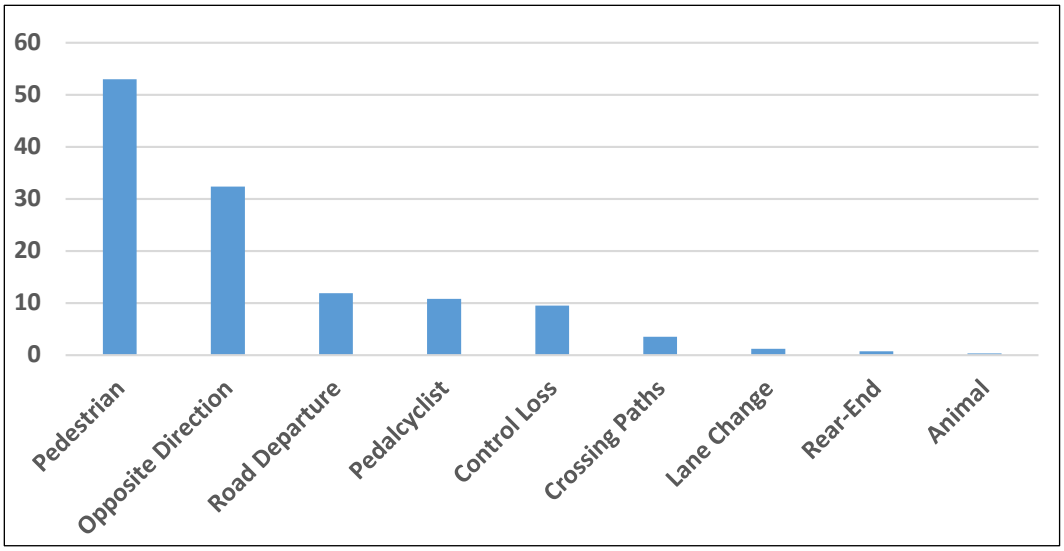
No. of Fatal Crashes per Thousand Crashes		
Rank	**Scenario Group**	**Total**
1	Pedestrian	53.0
2	Opposite Direction	32.3
3	Road Departure	11.9
4	Pedalcyclist	10.8
5	Control Loss	9.5
6	Crossing Paths	3.5
7	Lane Change	1.2
8	Rear-End	0.7
9	Animal	0.3

Note: Values based on average of 2011-2015 FARS data.



Note: Values based on average of 2011-2015 FARS and GES data.

Figure 8. Comprehensive Cost and EL by Scenario Group



Note: Values based on average of 2011-2015 FARS and GES data.

Figure 9. Fatal-to-All Crash Ratio by Scenario Group

3.3 Pre-Crash Scenario Changes/Variations by Year

Figures 10 and 11 illustrate the results of the 5-year data analysis respectively for fatal crashes and all crashes by VMT. This can serve as a foundation to project any future trends in the data if additional years are added. The control loss group shows a steady decline in fatal crashes each year. This equates to an overall change of 16 percent from 2011 to 2015. Total control loss crashes per billion VMT also showed a decline of 15 percent over the 5-year period. The availability of electronic stability control and other technologies to address control loss crashes has contributed to this decline. Conversely, although rear-end fatal crashes are not as frequent, these crash types show an increase over the 5-year period of 26 percent. The total rear-end crashes have also increased. Driver distraction due to the increased usage and availability of in-vehicle technology (e.g., cellular phones, navigation systems, driver-vehicle interfaces) could contribute to the increases seen in these crash groups. There is essentially no change (under 1%) seen in the road departure, animal, and lane change fatal pre-crash scenario groups over the 5 years.

The comprehensive costs for the scenario groups are compared by year in Figure 12. Most scenario groups showed an increase in costs, with the exceptions of the control loss and animal scenario groups. The increases from 2011 to 2015 for these seven groups were relatively the same and ranged from 11 to 17 percent.

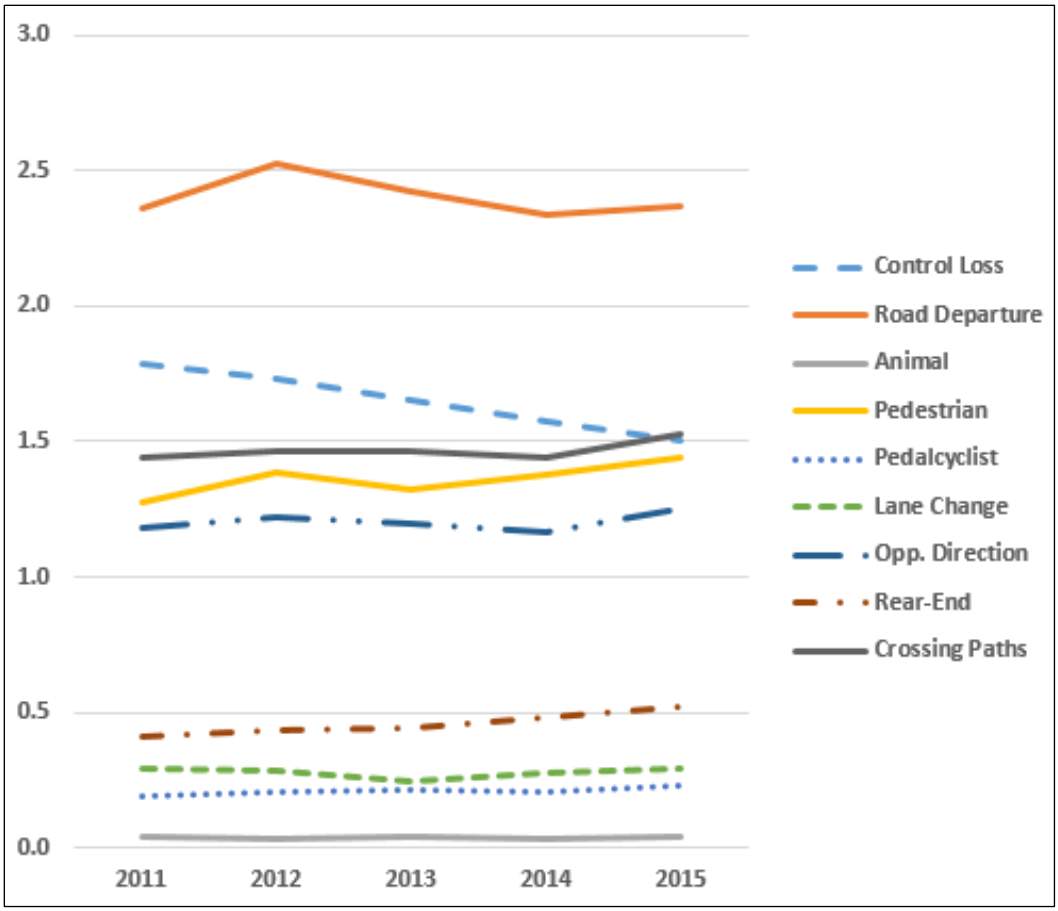


Figure 10. Fatal Crashes per Vehicle Miles Traveled by Scenario Group and Year

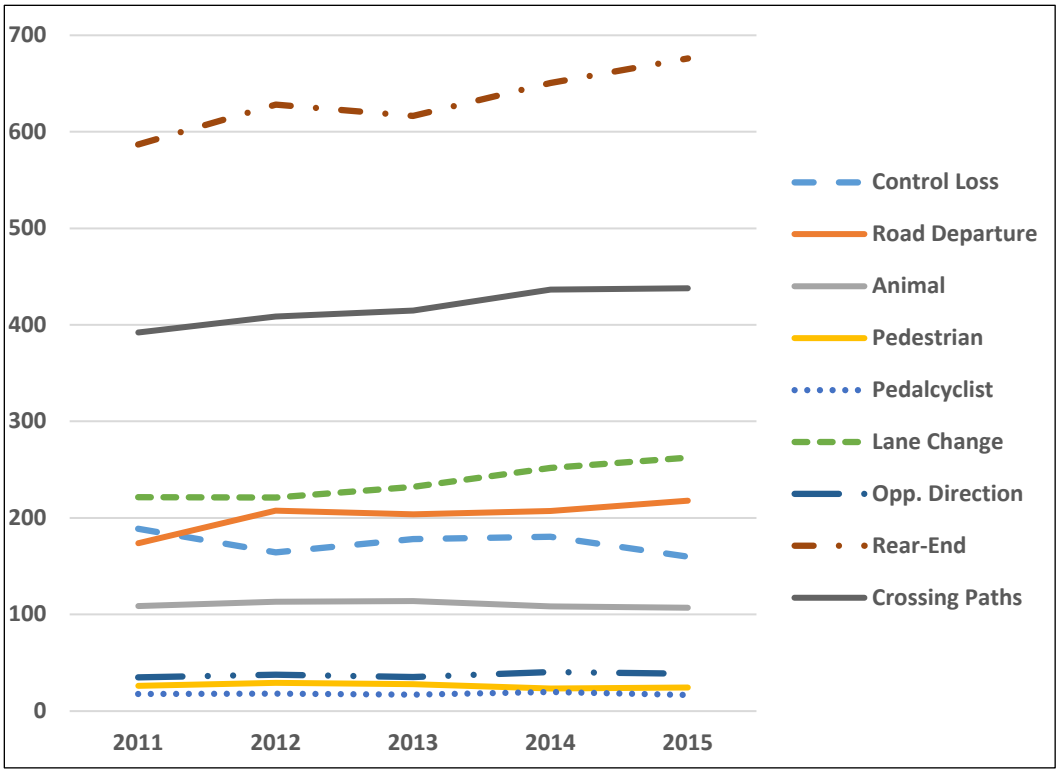


Figure 11. All Crashes per Vehicles Miles Traveled by Scenario Group and Year

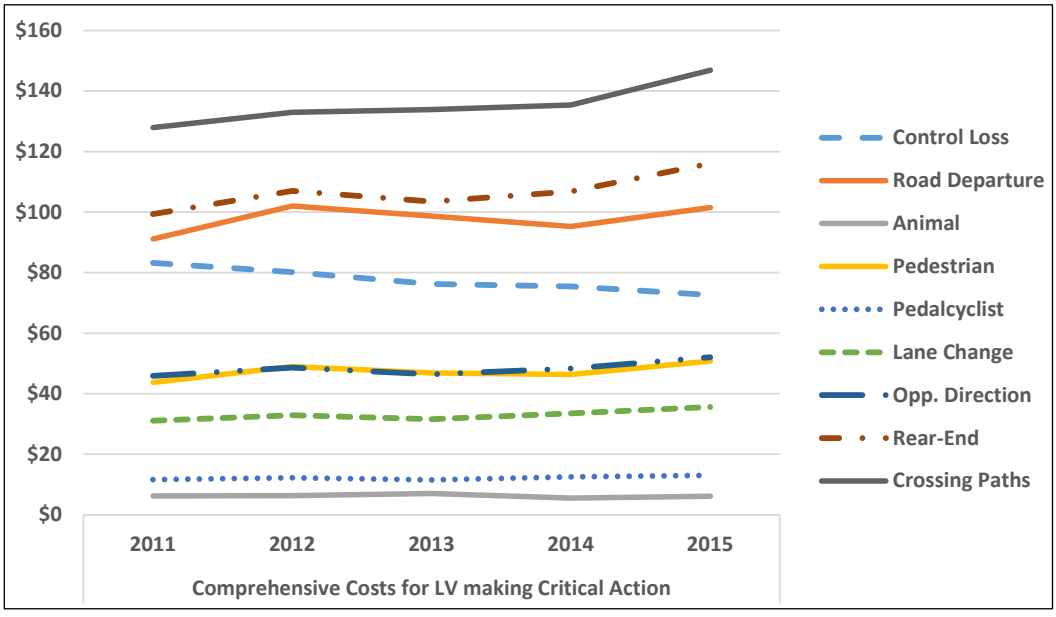


Figure 12. Comprehensive Costs by Scenario Group and Year

(Numerical data associated with Figures 10, 11, and 12 are located in the Appendix D, Tables 16 and 17.)

4 Pre-Crash Scenario Characteristics

Crash characteristics are determined for all crashes where an LV was making the critical action. The statistics presented are based on a single LV from each crash. This vehicle was making the critical action as defined in Table 2 according to the pre-crash scenario group. It is referred to as the subject vehicle in this section. The data represented are an average of the FARS and GES databases from 2011 through 2015. The nine scenario groups presented in Section 2.3 represent a total of 24,534 fatal crashes and about 5,020,000 overall crashes.

The characteristics that are used to quantify the pre-crash scenario groups are the environmental conditions, road geometry, crash location, vehicle/crash-related parameters, driver characteristics, attempted avoidance maneuver, traffic violations, and contributing factors. The characteristics associated with these categories are listed in Table 8. The order of scenarios depicted in each of the charts is based on the priority number of each of the scenarios and is consistent throughout this section. The order of scenarios is independent of any statistical representation of the data. A definition for each and a comparison of the associated statistics across the scenario groups is presented in Sections 4.1 through 4.8. These same statistics are also presented for each individual scenario group in Tables 18-26 of Appendix E. Note that the pre-crash scenario, "Left Turn Across Path/Opposite Direction" of the crossing paths group is also included in Appendix E (Table 27) since the crash-avoidance technology that might address these crashes differs from the technology that might address the crashes in the rest of the scenario group.

Section 4.9 contains combined statistics for six selected characteristics for each scenario group. These are weather, lighting, road surface conditions, road alignment, road grade, and highway occurrence.

Table 8. Pre-Crash Scenario Characteristics

Category	Characteristic
Driving Environment	Atmospheric Conditions
	Lighting
	Roadway Surface Conditions
Road Geometry	Roadway Alignment
	Roadway Grade
Crash Location	Relation to Junction
	Traffic Control Device
	Highway Occurrence
Vehicle/Crash Related	Speeding Related
	Posted Speed Limit
	Travel Speed
Driver Characteristics/Factors	Gender
	Age
	Impairment
	Alcohol Involvement
	Vision Obscured
	Driver Distraction
Other	Attempted Avoidance Maneuver
	Violations
	Contributing Factors

4.1 Driving Environment

There are three characteristics that are used to qualify the driving environment:

- Atmospheric conditions
- Lighting
- Roadway surface conditions

The order of scenarios depicted in the charts in this section is based on the priority number of each of the scenarios. The order of scenarios is independent of any statistical representation of the data.

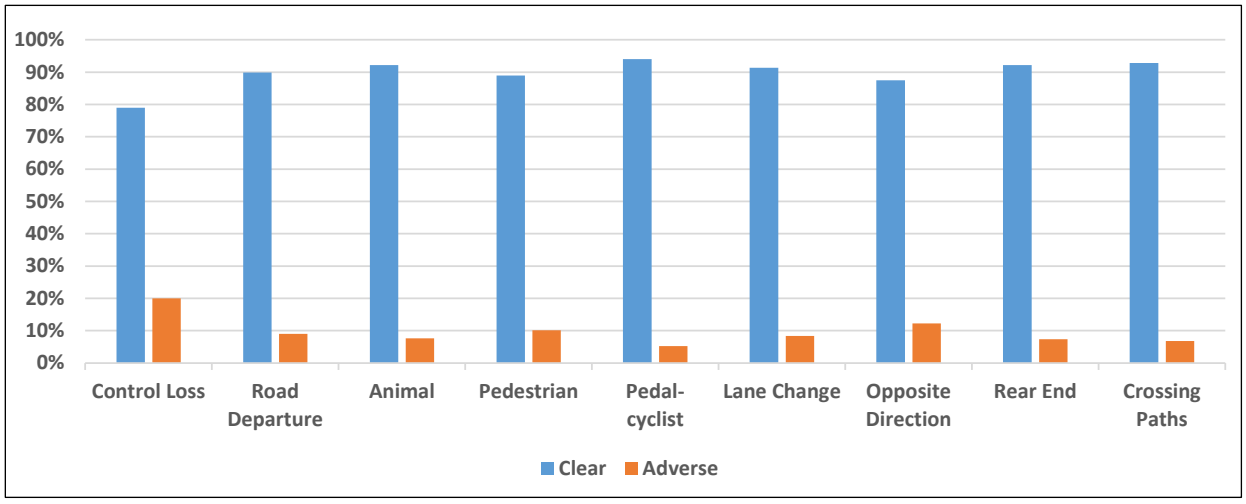
4.1.1 Atmospheric Conditions

Weather describes the atmospheric conditions at the time of the crash. The categories are below:

- Clear–includes cloudy
- Adverse–includes rain, sleet, snow, fog, severe crosswinds, blowing sand, etc.
- Other/Unknown/Not Reported

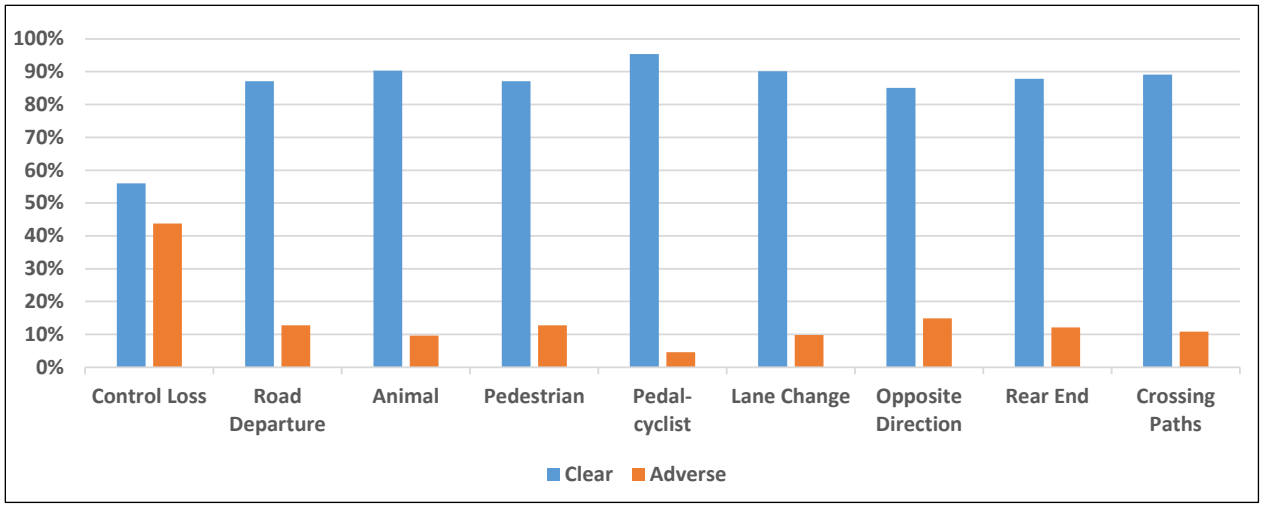
For all crashes that involve an LV making the critical action, 11 percent of fatal light-vehicle crashes and 14 percent of all light-vehicle crashes occur during adverse weather conditions (see Table 28 in Appendix E). These percentages are noticeably higher during adverse weather in the control loss group with 20 percent of fatal crashes and 44 percent of all crashes. Figures 13 and 14 compare the weather for the scenario groups for fatal crashes and all crashes.

Table 29 of Appendix F contains statistics detailing individual percentages for atmospheric conditions for each scenario group.



Note: Values based on average of 2011-2015 FARS data for crashes that involve an LV making the critical action.

Figure 13. Fatal Crashes by Atmospheric Conditions



Note: Values based on average of 2011-2015 GES data for an LV making the critical action.

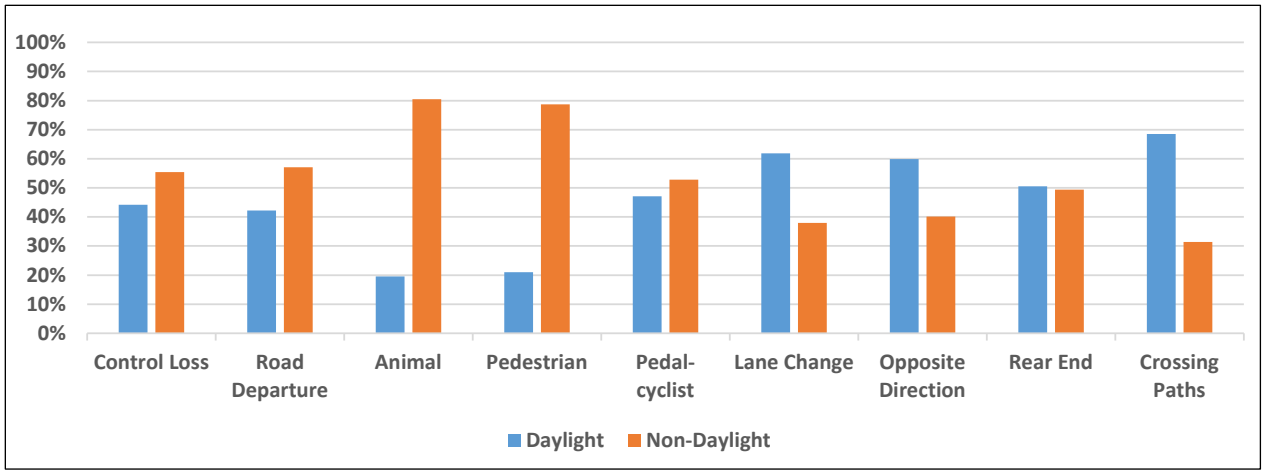
Figure 14. All Crashes by Atmospheric Conditions

4.1.2 Lighting

Lighting encompasses both the natural light from the sun and light from overhead lighting fixtures. The lighting categories are:

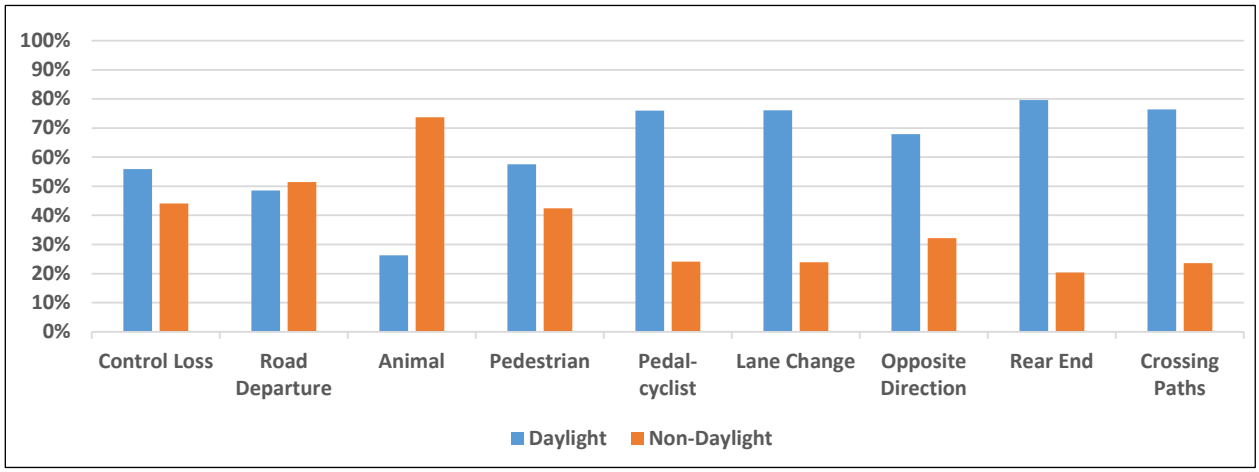
- Daylight
- Non-daylight
  - Dark–no street lighting or unknown if street lighting present
  - Dark–with overhead street lighting
  - Dawn/Dusk
- Other/Unknown/Not Reported

For all crashes that involve an LV making the critical action, 52 percent of fatal light-vehicle crashes and 31 percent of all light-vehicle crashes occur in non-daylight conditions (see Table 28 in Appendix E). The majority of animal (80%) and pedestrian (79%) light-vehicle fatal crashes occurred in non-daylight conditions. Also, in the animal scenario group, there is a high percentage (74%) of all light-vehicle crashes that occurred under non-daylight conditions. Figures 15 and 16 compare the lighting for the scenarios for fatal crashes and all crashes. Table 30 of Appendix F contains statistics detailing individual percentages for lighting conditions for each scenario group.



Note: Values based on average of 2011-2015 FARS data for crashes that involve an LV making the critical action.

Figure 15. Fatal Crashes by Lighting



Note: Values based on average of 2011-2015 GES data for crashes that involve an LV making the critical action.

Figure 16. All Crashes by Lighting

4.1.3 Roadway Surface Conditions

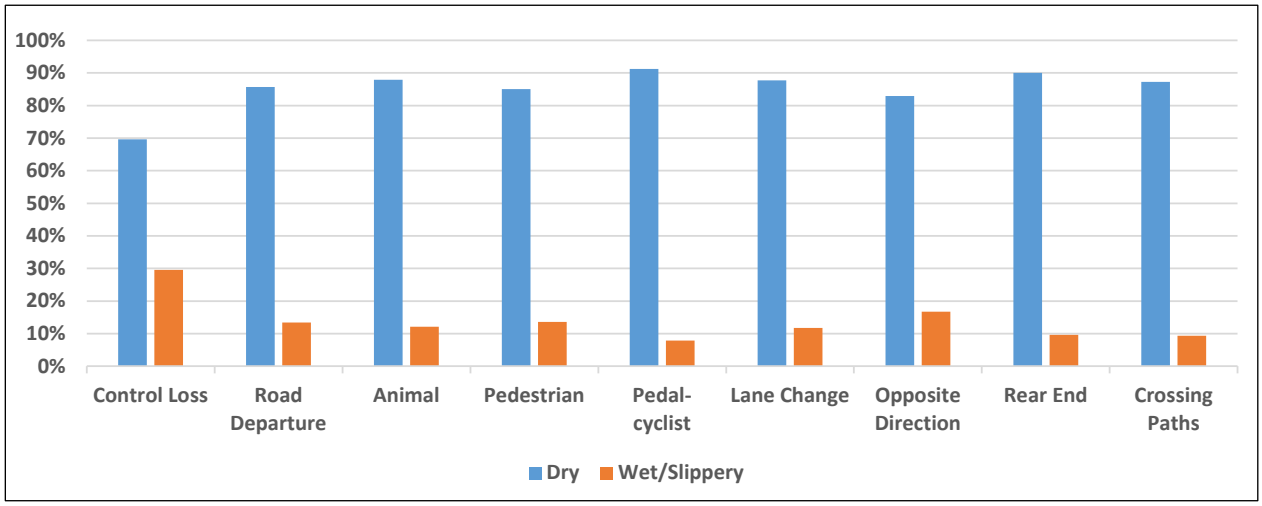
This variable describes the road surface condition that most affected the subject vehicle's traction at the time of the crash. The categories are:

- Dry
- Wet/Slippery–Wet, Snow, Ice, Water, Slush, Mud, Sand, etc.
- Other/Unknown/Not Reported
- Non-Traffic Way[17]

For all crashes that involve an LV making the critical action, 16 percent of fatal light-vehicle crashes and 20 percent of all light-vehicle crashes occurred on wet/slippery roads (see Table 28 in Appendix E).

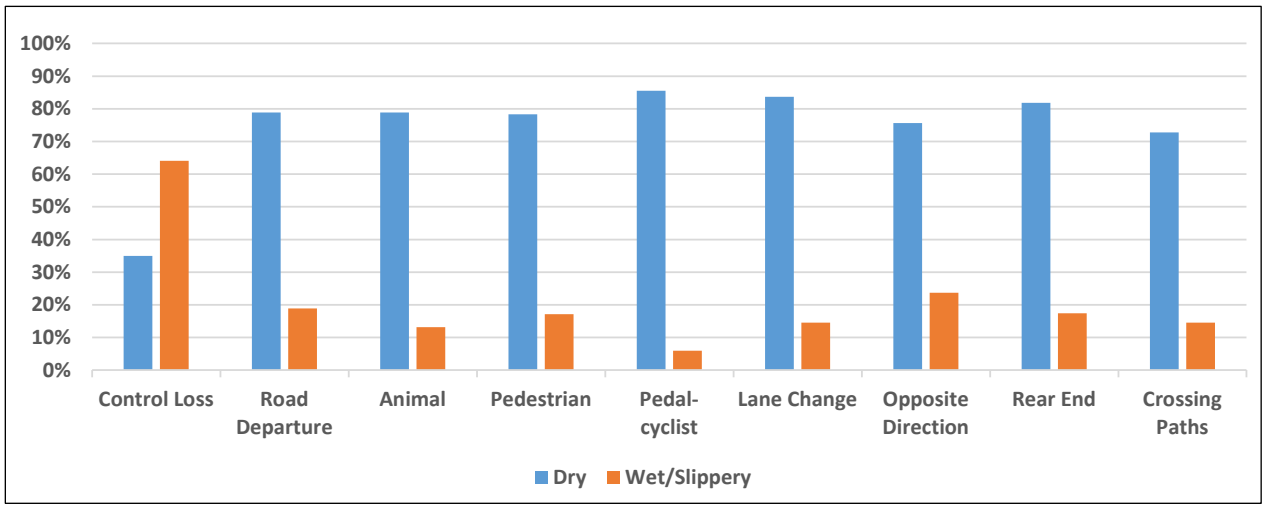
[17] Non-traffic way includes driveway access and refers to when the vehicle was not on a traffic way, but was entering one prior to its critical pre-crash event.

These percentages are noticeably higher in the control loss group with 30 percent of fatal crashes and 64 percent of all crashes happening with slippery roads conditions. Figures 17 and 18 compare the roadway surface conditions for the scenarios for fatal crashes and all crashes. Table 31 of Appendix F contains statistics detailing individual percentages for road surface conditions for each scenario group.



Note: Values based on average of 2011-2015 FARS data for an LV making the critical action.

Figure 17. Fatal Crashes by Roadway Surface Conditions



Note: Values based on average of 2011-2015 GES data for an LV making the critical action.

Figure 18. All Crashes by Roadway Surface Conditions

4.2 Road Geometry

There are two characteristics that are used to qualify the road geometry:

- Road Alignment
- Road Grade

The order of scenarios depicted in each of the charts in this section is based on the priority number of each of the scenarios. The order of scenarios is independent of any statistical representation of the data.

4.2.1 Roadway Alignment

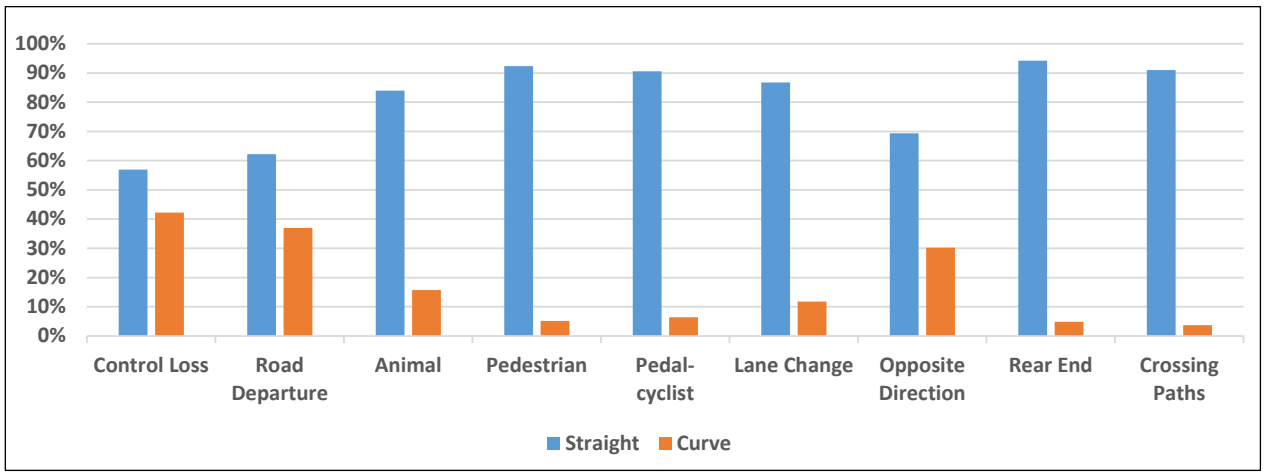
The roadway alignment variable describes whether the road that the host vehicle was traveling on prior to the crash was straight or curved. Non-traffic way includes driveway accesses and refers to when the vehicle was not on a traffic way. The categories are:

- Straight
- Curve (curved to the right or left, or curved in an unknown direction)
- Not Reported/Unknown
- Non-Traffic Way

For all crashes that involve an LV making the critical action, 23 percent of fatal light-vehicle crashes and 9 percent of all light-vehicle crashes occurred on a curve (see Appendix E, Table 28). Over 30 percent of control loss, road departure, and opposite direction fatal crashes occurred on a curve. Some other statistics to note for the following scenario groups are below.

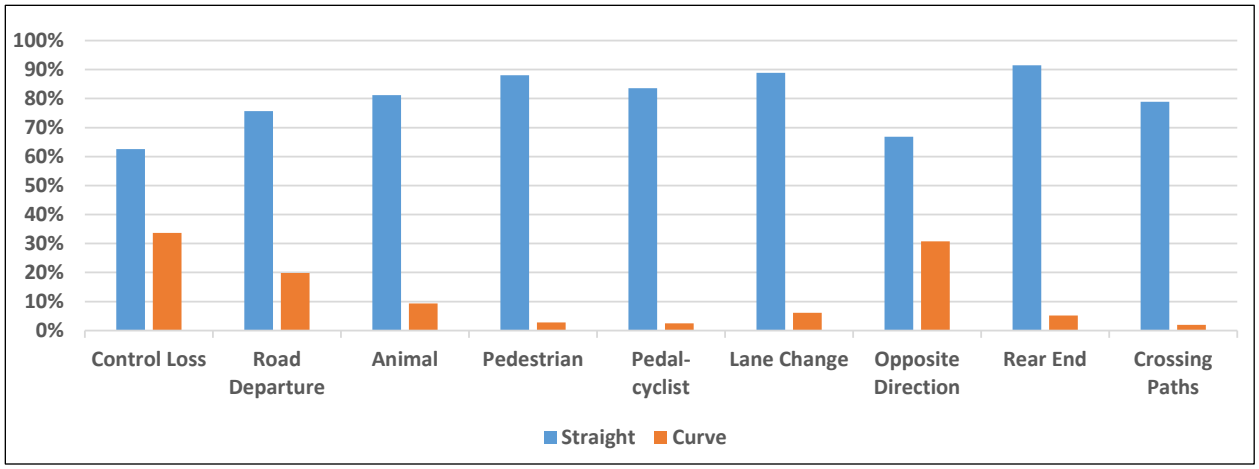
- Crossing Paths–12 percent of all crashes occurred in non-traffic ways.
- Animal–9 percent of all crashes occurred where road alignment was unknown or not reported.

Figures 19 and 20 compare the road alignment for the scenarios for fatal crashes and all crashes. Table 32 of Appendix F contains statistics detailing individual percentages for road alignment for each scenario group.



Note: Values based on average of 2011-2015 FARS data for an LV making the critical action.

Figure 19. Fatal Crashes by Roadway Alignment



Note: Values based on average of 2011-2015 GES data for an LV making the critical action.

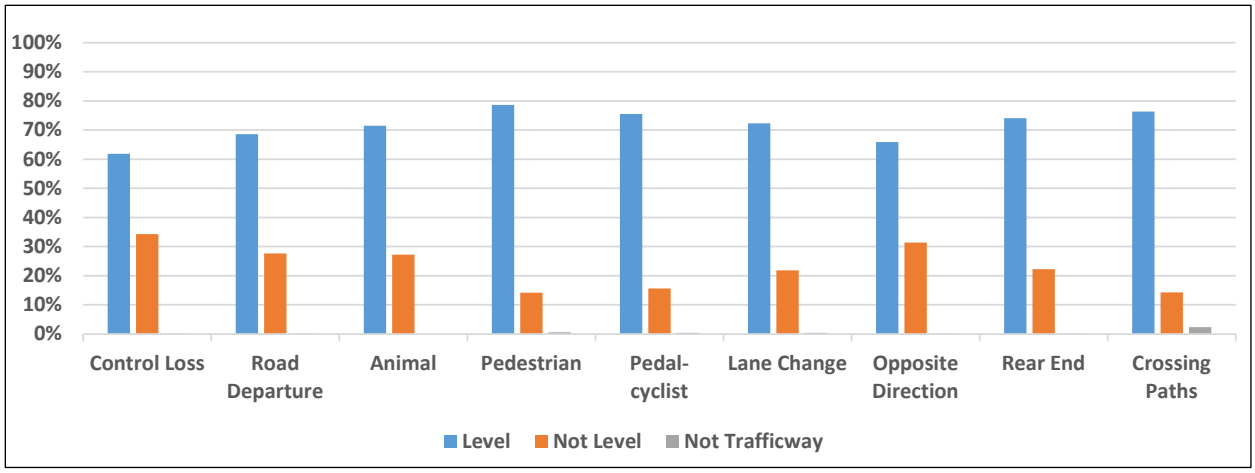
Figure 20. All Crashes by Roadway Alignment

4.2.2 Roadway Grade

Roadway grade defines the vertical alignment of the road the host vehicle was traveling on prior to the critical event of the crash. "Non-Traffic Way Area" is used when the host vehicle was not on a traffic way but was entering one prior to its critical pre-crash event. The categories are:

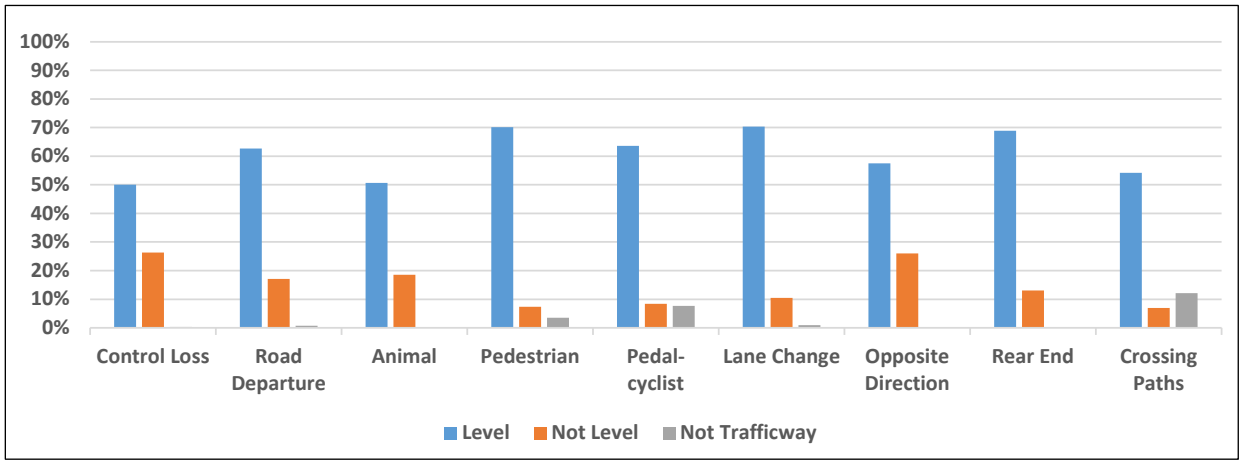
- Level
- Not Level
  - Grade, Unknown Slope
  - Hillcrest
  - Sag (Bottom)
  - Uphill
  - Downhill
- Non-Traffic Way Area (Entering a Traffic Way)
- Not Reported/Unknown

For all crashes that involve an LV making the critical action, 24 percent of fatal light-vehicle crashes and 13 percent of all light-vehicle crashes occurred on roadways that were not level (see Appendix E, Table 28). Note that also for all crashes, this variable had high amounts of unknowns in the GES, with 21 percent of all crashes coded as "unknown" or "not reported roadway grade." Over 30 percent of control loss and opposite direction fatal crashes occurred on roadways that were not level. There were 12 percent of LV crashes that occurred at non-traffic way areas for the crossing path scenario. Figures 21 and 22 compare the roadway grade for the scenarios for fatal crashes and all crashes. Table 33 of Appendix F contains statistics detailing individual percentages for roadway grade for each scenario group.



Note: Values based on average of 2011-2015 FARS data for crashes that involve an LV making the critical action.

Figure 21. Fatal Crashes by Roadway Grade



Note: Values based on average of 2011-2015 GES data for crashes that involve an LV making the critical action.

Figure 22. All Crashes by Roadway Grade

4.3 Crash Location

There are three characteristics used to qualify the crash location in terms of the type of road where the crash occurred and if there was presence of a traffic control device for the driver of the host vehicle. The crash location categories are:

- Relation to Junction
- Traffic Control Device Used
- Highway Occurrence

The order of scenarios depicted in each of the charts in this section is based on the priority number of each of the scenarios. The order of scenarios is independent of any statistical representation of the data.

4.3.1 Relation to Junction

The relation to junction describes whether the crash occurred at a junction or a non-junction for the host vehicle. The relation to junction categories are below.

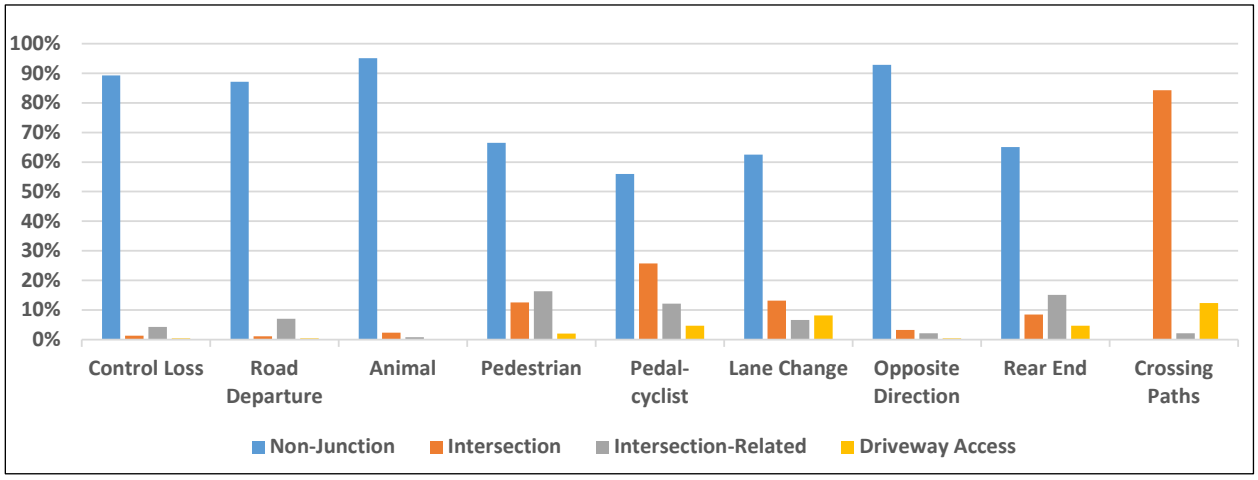
- Non-junction
- Intersection
- Intersection-related
- Driveway Access
- Other–entrance/exit ramp, railway grade crossing, crossover related, shared-use path crossing, etc.
- Not Reported/Unknown

For all crashes that involve an LV making the critical action, 18 percent of fatal light-vehicle crashes and 20 percent of all light-vehicle crashes occurred at intersections (see Appendix E, Table 28). There were 7 percent of fatal light-vehicle crashes and 23 percent of all light-vehicle crashes that occurred at intersection-related areas. These areas include the approaches or exit areas of intersections, and the crash in all likelihood resulted from an action, behavior, or control related to the intersection. Also, 3 percent of all fatal light-vehicle crashes and 8 percent of all light-vehicle crashes occurred at driveway access areas.

Some statistics to note for the scenario groups were:

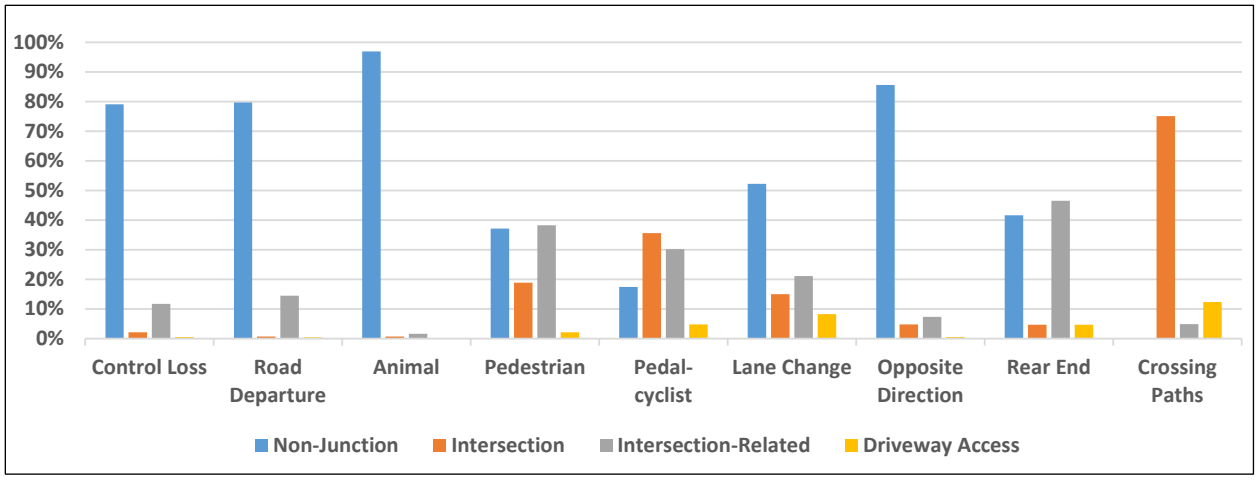
- Pedalcyclists–38 percent of all fatal crashes occurred at intersections and intersection-related areas.
- Pedestrians–29 percent of fatal crashes occurred at intersections and intersection-related areas.

Figures 23 and 24 compare relation to junction for the scenarios for fatal crashes and all crashes. Table 34 of Appendix F contains statistics detailing individual percentages for relation to junction for each scenario group.



Note: Values based on average of 2011-2015 FARS data for crashes that involve an LV making the critical action.

Figure 23. Fatal Crashes by Relation to Junction



Note: Values based on average of 2011-2015 GES data for crashes that involve an LV making the critical action.

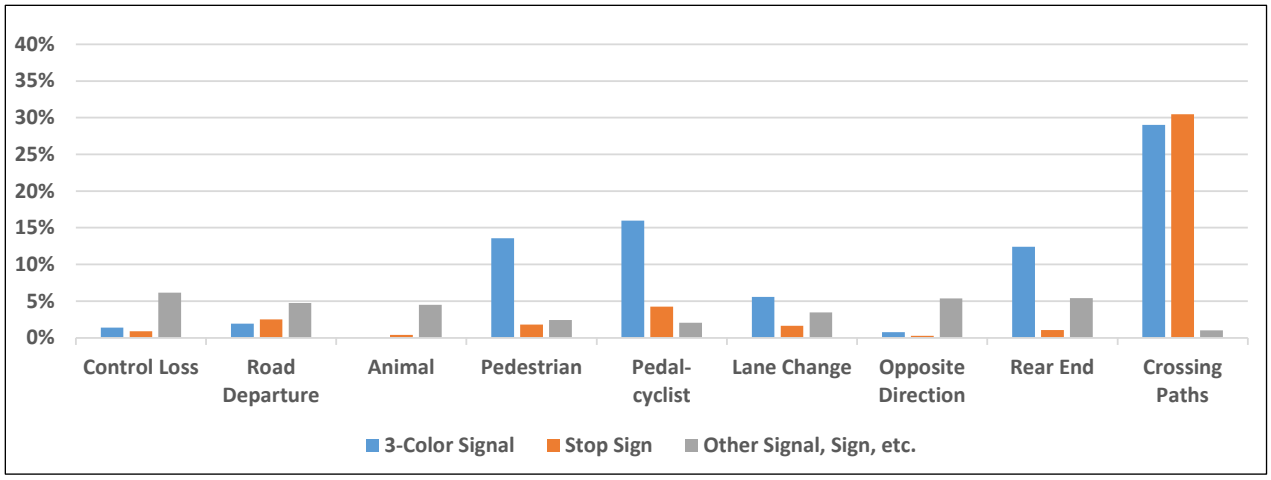
Figure 24. All Crashes by Relation to Junction

4.3.2 Traffic Control Device

This characteristic describes the type of traffic control device used at the location of the crash as seen by the host vehicle. The traffic control device categories are:

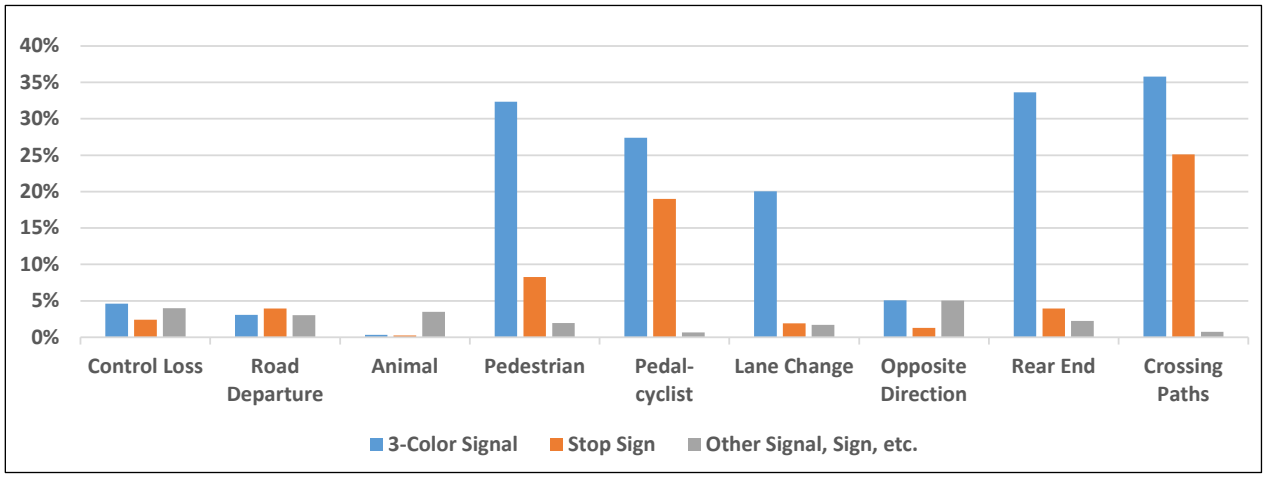
- No Traffic Controls
- 3-Color Signal
- Stop Sign
- Flashing Signal
- Yield Sign
- Other Signal, Sign, etc.
- Not Reported/Unknown

For all crashes that involve an LV making the critical action, 20 percent of fatal light-vehicle crashes and 35 percent of all light-vehicle crashes occurred in the presence of some type of traffic control signal/device/sign (see Appendix E, Table 28). Figures 25 and 26 compare type of traffic control devices for the scenarios for fatal crashes and all crashes. Table 35 of Appendix F contains statistics detailing individual percentages for traffic control device for each scenario group.



Note: Values based on average of 2011-2015 FARS data for crashes that involve an LV making the critical action.

Figure 25. Fatal Crashes by Type of Traffic Control Device



Note: Values based on average of 2011-2015 GES data for crashes that involve an LV making the critical action.

Figure 26. All Crashes by Type of Traffic Control Device

4.3.3 Highway Occurrence

This characteristic describes whether or not the crash occurred on a highway. FARS and GES do not specifically have a variable to determine the presence of a highway, but the combination of three variables were used. The crash was determined to occur on a highway if conditions were true for all three variables as follows:

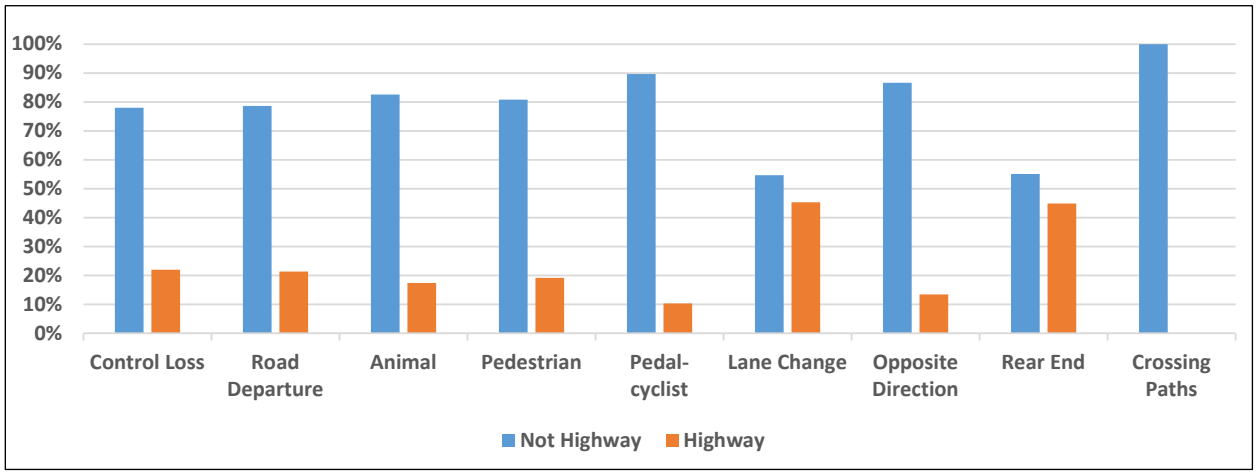
1. A posted speed limit was ≥ 45 mph.
2. The relation to junction was a non-junction, through roadway, or other location within an interchange area.
3. The trafficway description was a two-way, divided, unprotected (painted > 4 feet) median; two-way, divided, positive median barrier; or entrance/exit ramp.

The highway occurrence categories are:

- Non-highway
- Highway

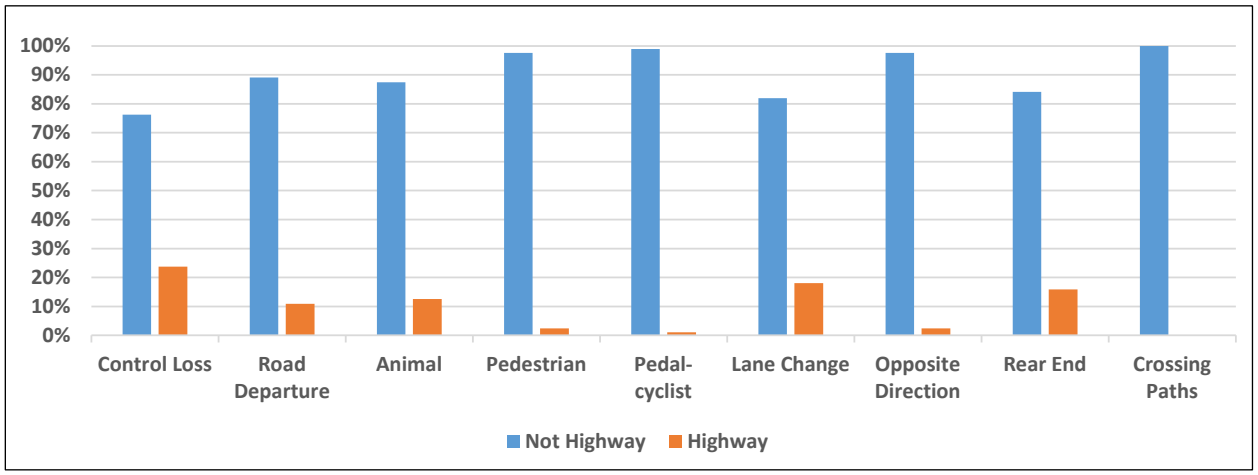
For all crashes that involve an LV making the critical action, 19 percent of fatal light-vehicle crashes and 12 percent of all light-vehicle crashes occurred on highways (see Appendix E, Table 28). Nearly half (45%) of the fatal lane-change and rear-end highway crashes occur on a highway. Figures 27 and 28 compare the highway crashes for the scenarios for fatal crashes and all crashes.

Table 36 of Appendix F contains statistics detailing individual percentages for highway occurrence for each scenario group.



Note: Values based on average of 2011-2015 FARS data for crashes that involve an LV making the critical action.

Figure 27. Breakdown of Fatal Crashes by Scenario Group and Roadway Type



Note: Values based on average of 2011-2015 GES data for crashes that involve an LV making the critical action.

Figure 28. All Highway Crashes

4.4 Other Vehicle/Crash Related Factors

Three other characteristics related to the crash that could contribute to the critical action or reason for the crash are:

- Speeding-Related
- Posted Speed Limit
- Travel Speed

The actual vehicle speed at the time of crash is not always accurately reflected in the data because either the driver was not able to provide precise information or it is unknown in the police report. About 62 percent of all the FARS and 65 percent of all the GES crashes record unknown or unreported travel speeds. The posted speed limit and "speeding-related," a variable to specify whether the driver's speed was related to the crash, are used to enhance the vehicle speed estimations. The crash is determined to be speed-related if the police report states that the vehicle was traveling too fast for conditions, the driver was issued a speeding citation, or the speed used was higher than a reasonable or prudent speed. If the driver was traveling too slowly, it would not be considered as speed-related. The majority of cases do not have speeding for the driver of the subject vehicle as a factor. An assumption is made in these cases that the vehicle is traveling close to the range of the posted speed limit.

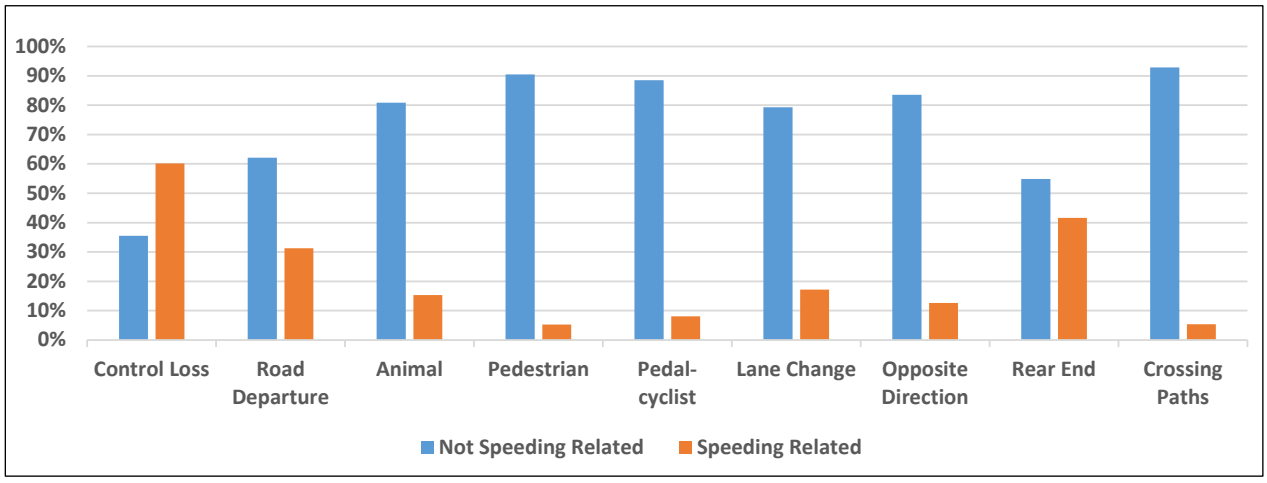
The order of scenarios depicted in each of the charts in this section is based on the priority number of each of the scenarios. The order of scenarios is independent of any statistical representation of the data.

4.4.1 Speeding Related

This variable describes whether the driver's speed of the subject vehicle was related to the crash as determined by the police report. The categories are:

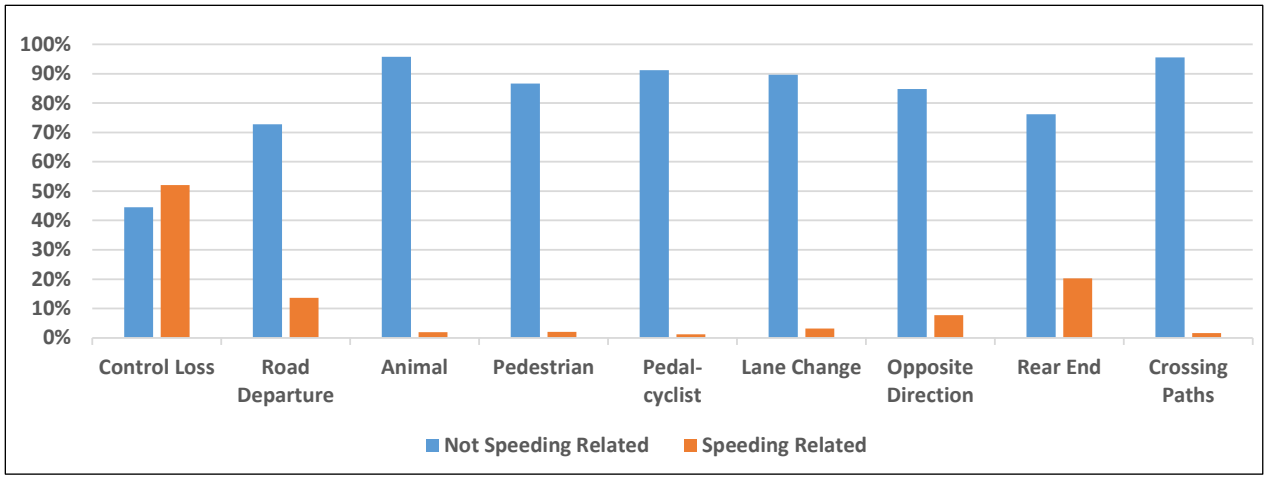
- Yes
- No
- No Driver/Unknown if Driver Present
- Unknown

For all crashes that involve an LV making the critical action, 25 percent of fatal light-vehicle crashes and 13 percent of all light-vehicle crashes were qualified as speeding-related (see Table 28 in Appendix E). High percentages of speeding-related crashes occurred in the control loss, road departure, and rear end scenario groups. Figures 29 and 30 compare the speeding-related characteristics of the scenarios for fatal crashes and all crashes. Table 37 of Appendix F contains statistics detailing individual percentages related to speed for each scenario group.



Note: Values based on average of 2011-2015 FARS data for crashes that involve an LV making the critical action.

Figure 29. Speeding-Related Statistics for Fatal Crashes



Note: Values based on average of 2011-2015 GES data for crashes that involve an LV making the critical action.

Figure 30. Speeding-Related Statistics for All Crashes

4.4.2 Posted Speed Limit

The posted speed limit variable represents the posted speed limit prior to the subject vehicle's critical pre-crash event and it is given in mph. Non-traffic way area includes driveway accesses and refers to when the vehicle was not on a traffic way. The categories are:

- ≤ 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, and ≥ 75 mph
- Not Reported/Unknown
- Non-Traffic Way Area

The crossing paths, pedalcyclist, and pedestrian scenario groups have higher frequencies of light-vehicle crashes that occurred at lower posted speed limits when compared to the other six scenarios. Figure 31 compares the posted speed limit distribution and Figure 32 compares the cumulative distribution of the scenarios for fatal crashes and all crashes. Table 38 of Appendix F contains statistics detailing individual percentages for posted speed limit for each scenario group.

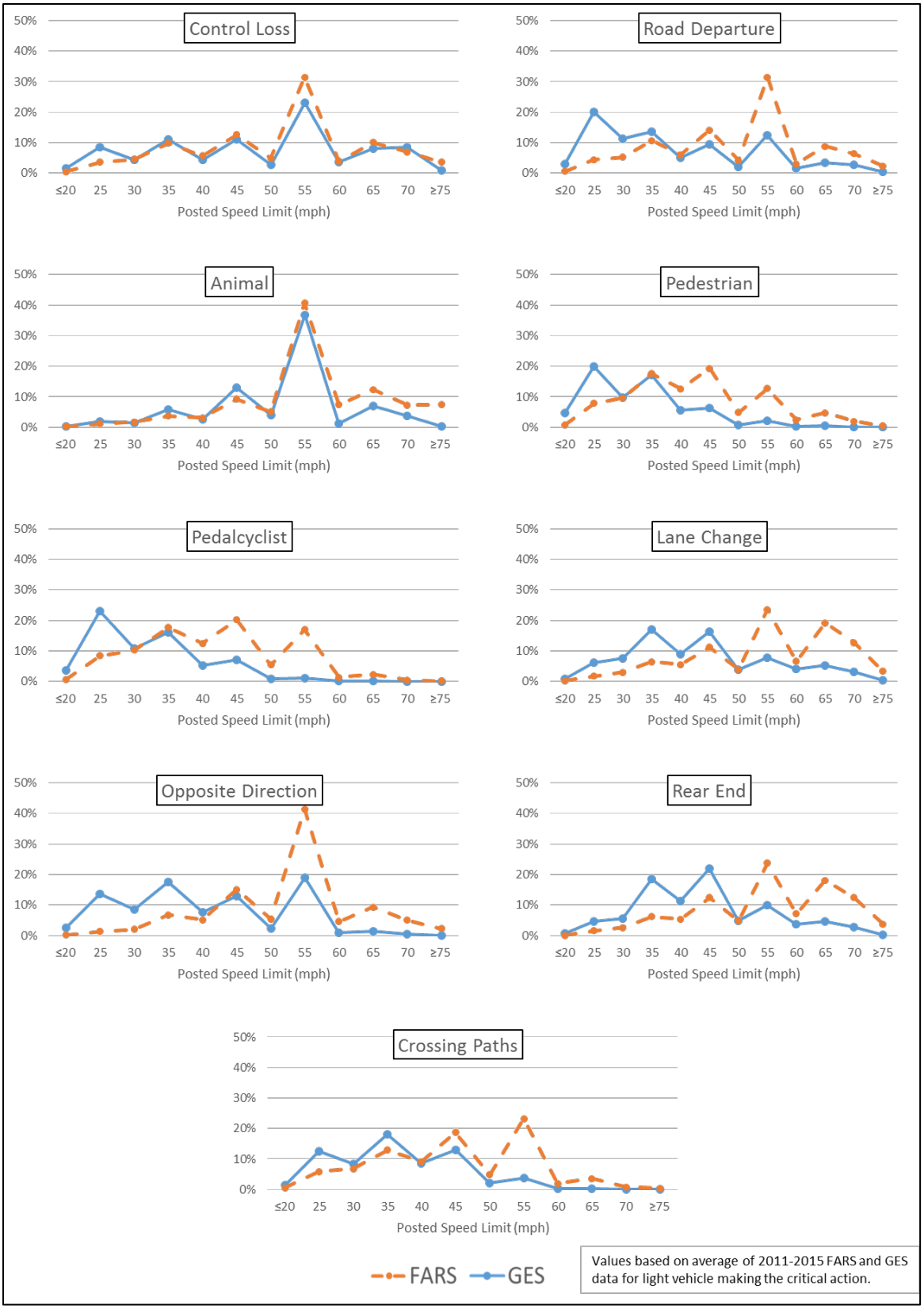


Figure 31. Distribution of Crashes by Scenario Group and Posted Speed Limit

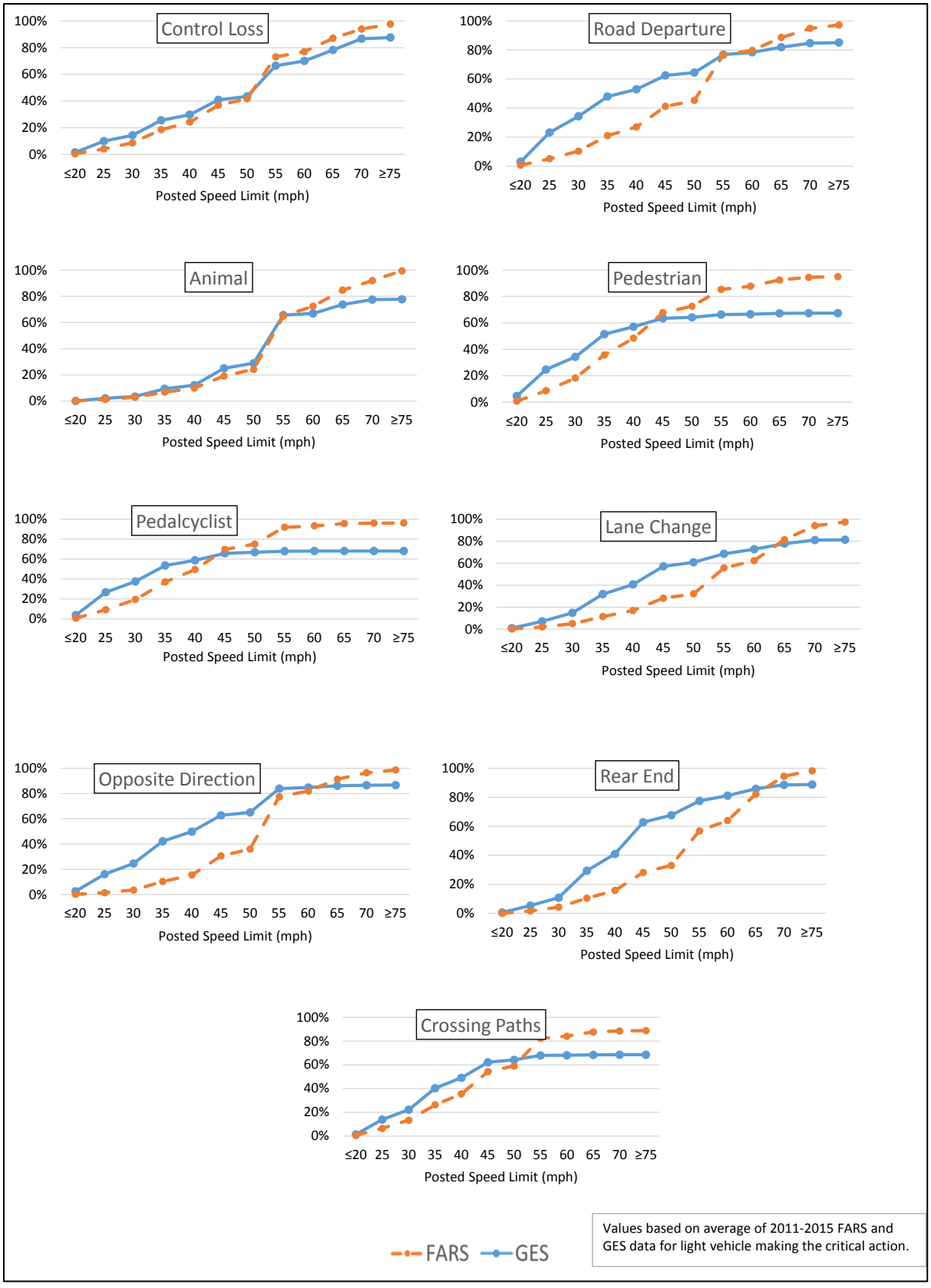


Figure 32. Cumulative Distribution of Crashes by Scenario Group and Posted Speed Limit

4.4.3 Travel Speed

The travel speed variable represents the subject vehicle's travel speed in mph prior to its critical pre-crash event. The data reported on travel speeds for the scenario groups contains a high number of unknowns (52%–72%) because the travel speed is not always included on the police report or it is not known.[18] The travel speed data represent only the data that is known. Refer to Table 39 of Appendix F for the percentage of unknowns associated with each scenario group. The travel speed categories are:

- ≤ 10, 11-15, 16-20, 21-25, 26-30, 31- 35, 36-40, 41-45, 46-50, 51-55, 56-60, 61-65, 66-70, and ≥ 71 mph
- Not Reported/Unknown
- Stopped Motor Vehicle in Transport

The crossing paths, pedalcyclist, and pedestrian scenario groups have higher frequencies of light-vehicle crashes that occurred at lower travel speeds when compared to the other six scenarios. Figure 33 compares the travel speed distribution and Figure 34 compares the cumulative distribution for the scenarios for fatal crashes and all crashes. Table 39 of Appendix F contains statistics detailing individual percentages for travel speed for each scenario group.

[18] Consider using the Travel Speed variable cautiously since it contains high numbers of unknowns. Also, it is not an estimate based on crash reconstruction since it comes from the police report. There may be major discrepancies when it is compared to the posted speed limit in some scenarios.

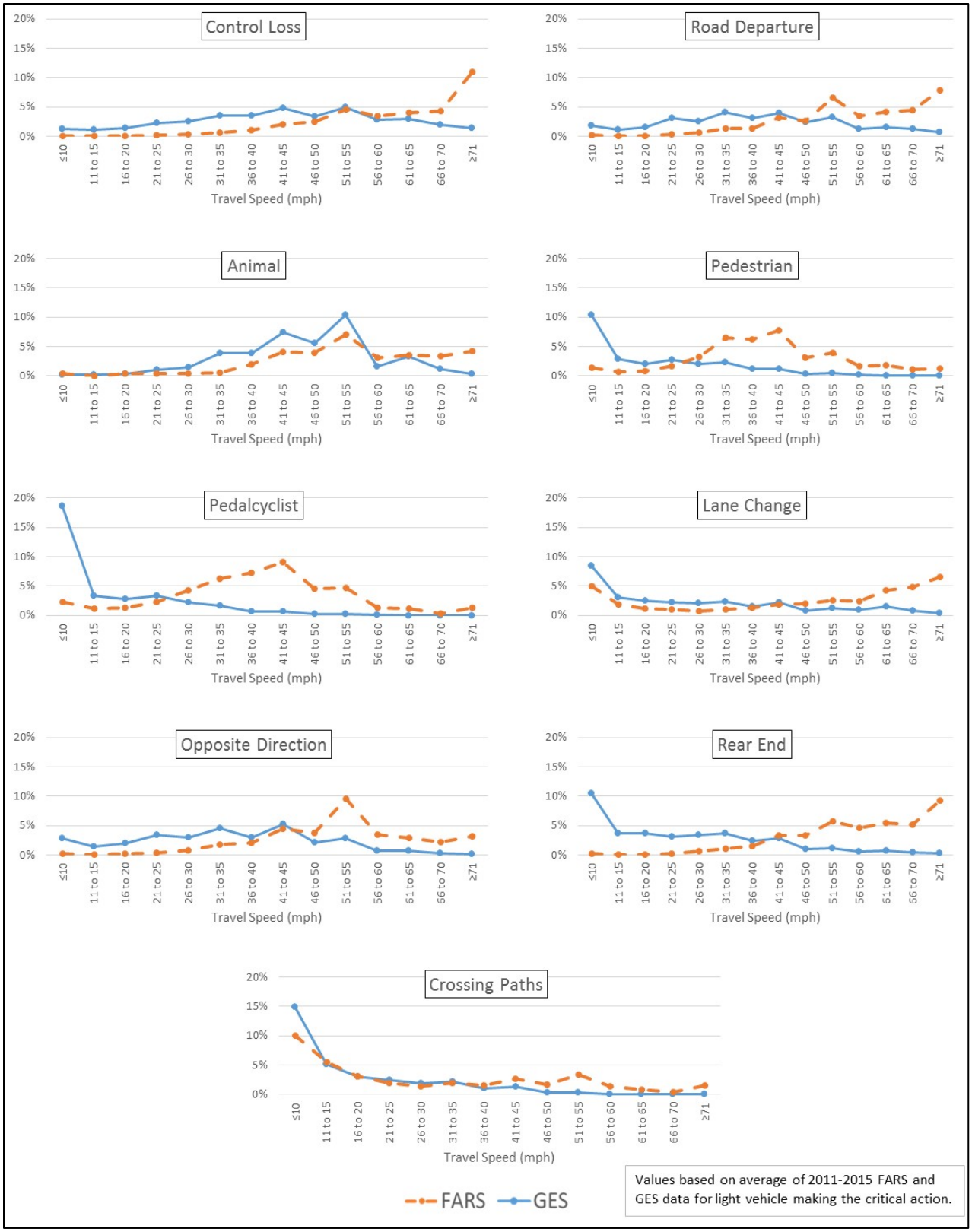


Figure 33. Distribution of Crashes With Known Travel Speed

Figure 34. Cumulative Distribution of Crashes With Known Travel Speed

4.5 Driver Characteristics/Contributing Factors

There are five characteristics used to qualify the driver of the subject vehicle:

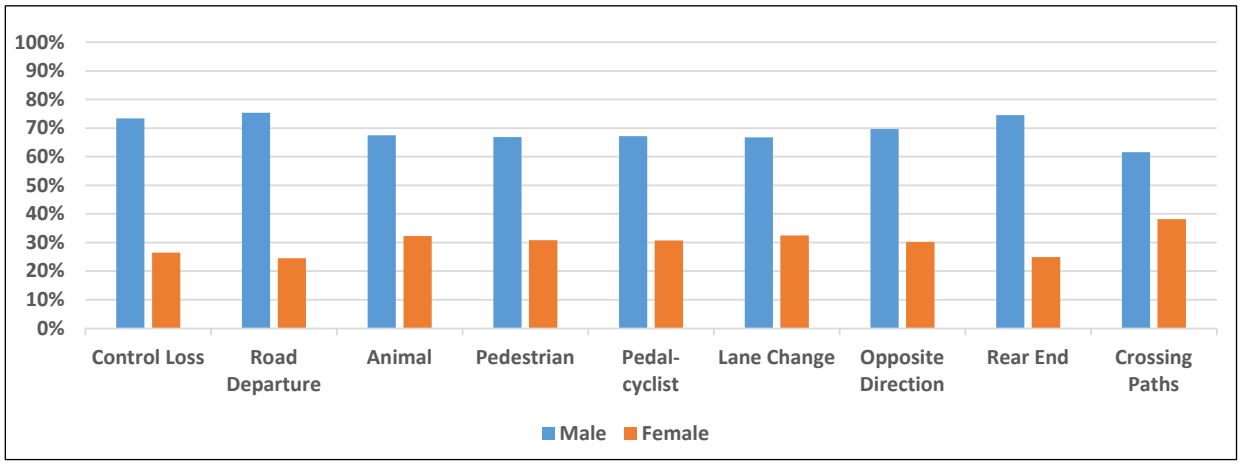
- Gender
- Age
- Impairment
- Alcohol Involvement
- Vision Obscured
- Driver Distraction

The order of scenarios depicted in each of the charts in this section is based on the priority number of each of the scenarios. The order of scenarios is independent of any statistical representation of the data.

4.5.1 Gender

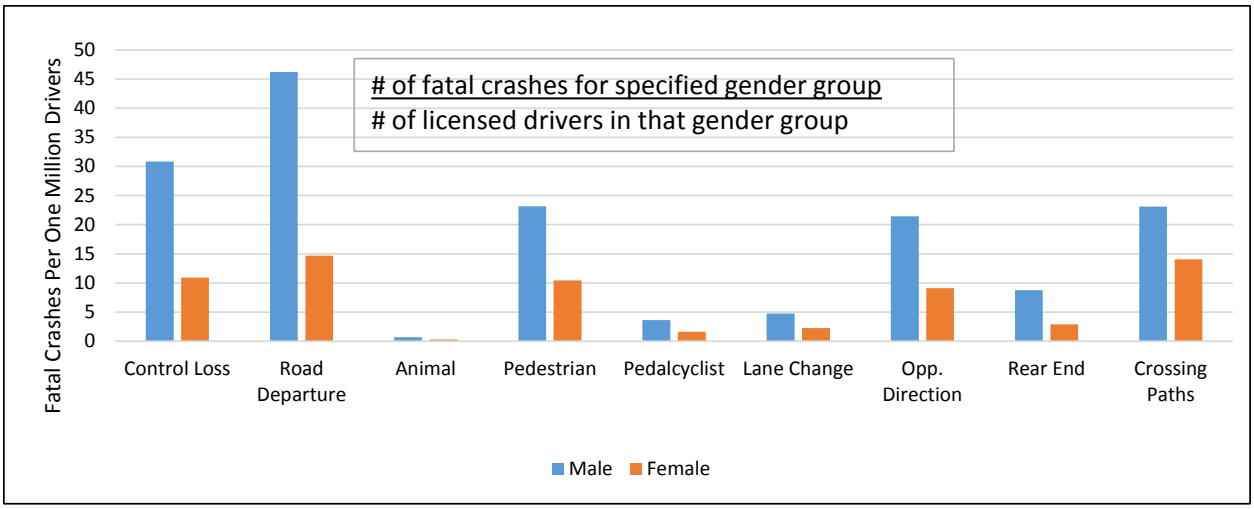
This characteristic describes whether the driver of the subject vehicle is a male or female. Data is also presented normalized by the number of licensed drivers in each gender group. Appendix H shows the number of licensed drivers by gender for each year from 2011 to 2015.

For all crashes that involve an LV making the critical action, 70 percent of fatal light-vehicle crashes and 56 percent of all light-vehicle crashes involved a male driver (see Appendix E, Table 28). There is a much higher percentage of fatal crashes that involve male drivers than female drivers for all crashes. Figures 35 and 36 compare crashes by gender and crashes normalized by licensed drivers per gender related to the scenarios for fatal crashes. Figures 37 and 38 compare the same data for all crashes. Table 40 of Appendix F contains statistics detailing individual percentages for the driver's gender for each scenario group.



Note: Values based on average of 2011-2015 FARS data for the driver of an LV making the critical action.

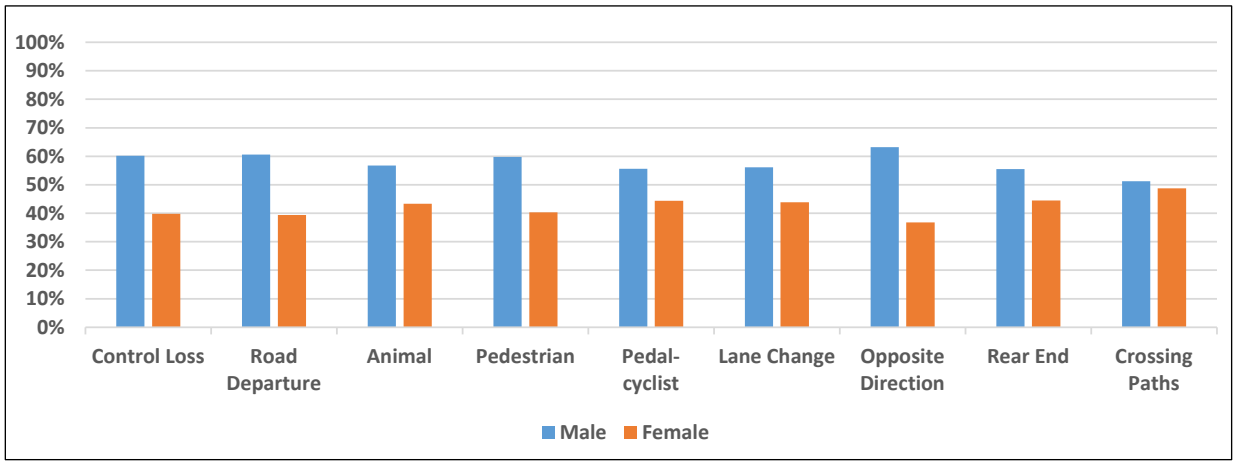
Figure 35. Fatal Crashes by Gender



Note: Values based on average of 2011-2015 FARS data for the driver of an LV making the critical action.

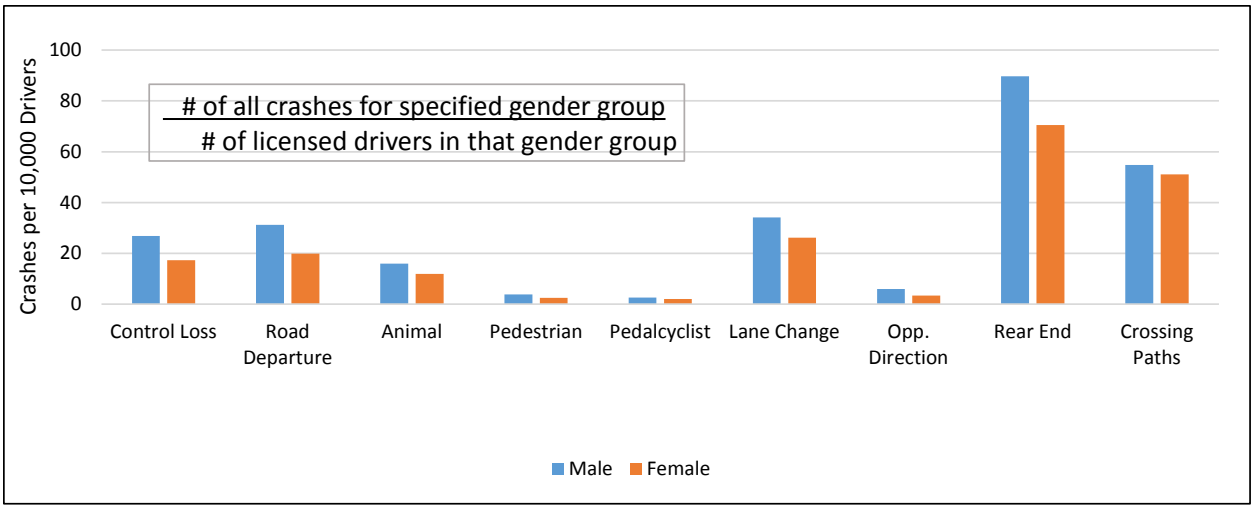
Figure 36. Fatal Crashes per One Million Licensed Drivers by Gender

+=



Note: Values based on average of 2011-2015 GES data for the driver of an LV making the critical action.

Figure 37. All Crashes by Gender



Note: Values based on average of 2011-2015 GES data for the driver of an LV making the critical action.

Figure 38. All Crashes per 10,000 Licensed Drivers by Gender

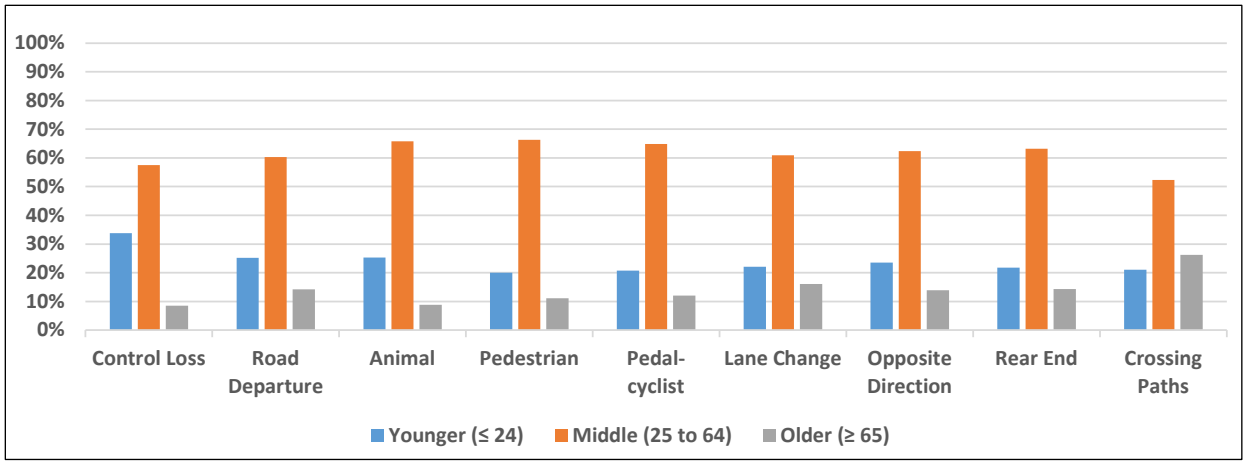
4.5.2 Age

This variable describes the age in years with respect to the last birthday of the driver of the subject vehicle. Age categories are:

- Younger (≤ 24 years)
- Middle (25 to 64 years)
- Older (≥ 65 years)

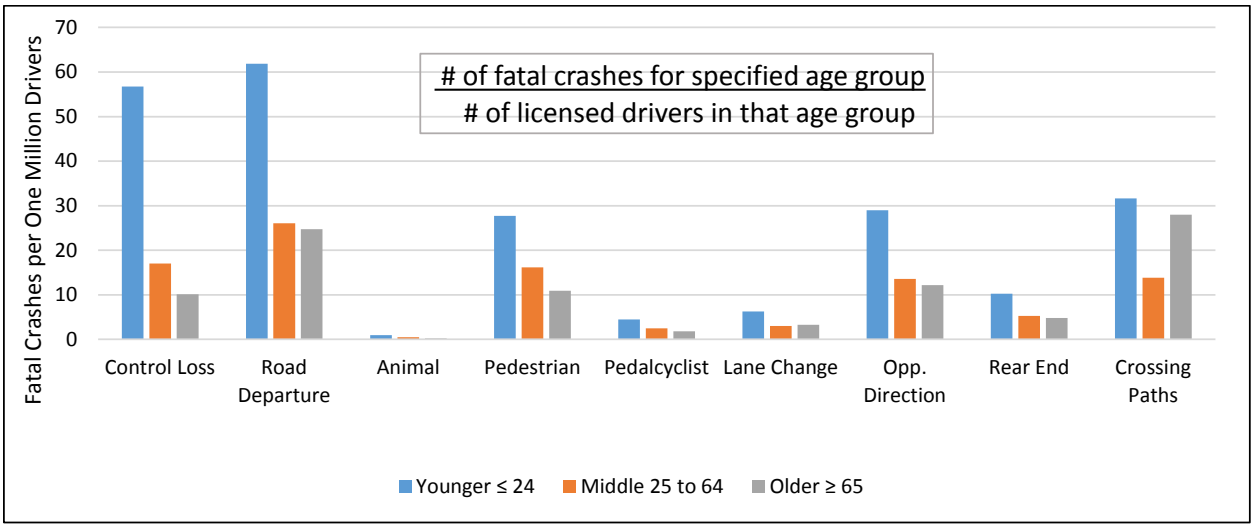
Data is also presented normalized by the number of licensed drivers in each age group. Appendix H shows the number of licensed drivers by age for each year from 2011 to 2015.

For all crashes that involve an LV making the critical action, 60 percent of fatal light-vehicle crashes and 61 percent of all light-vehicle crashes involved a middle-aged driver (see Appendix E, Table 28). Over one-third of control loss crashes involve younger drivers. When the data is compared by examining the number of fatal crashes in a particular age group divided by the number of licensed drivers in that age group, it shows that the younger drivers are involved in more fatal crashes for all scenario groups compared to the two older age groups. Figures 39 and 40 compare the age group and "normalized by licensed drivers" data related to the scenarios for fatal crashes. Figures 41 and 42 compare the same data for all crashes. Table 41 of Appendix F contains statistics detailing individual percentages for the driver's age for each scenario group.



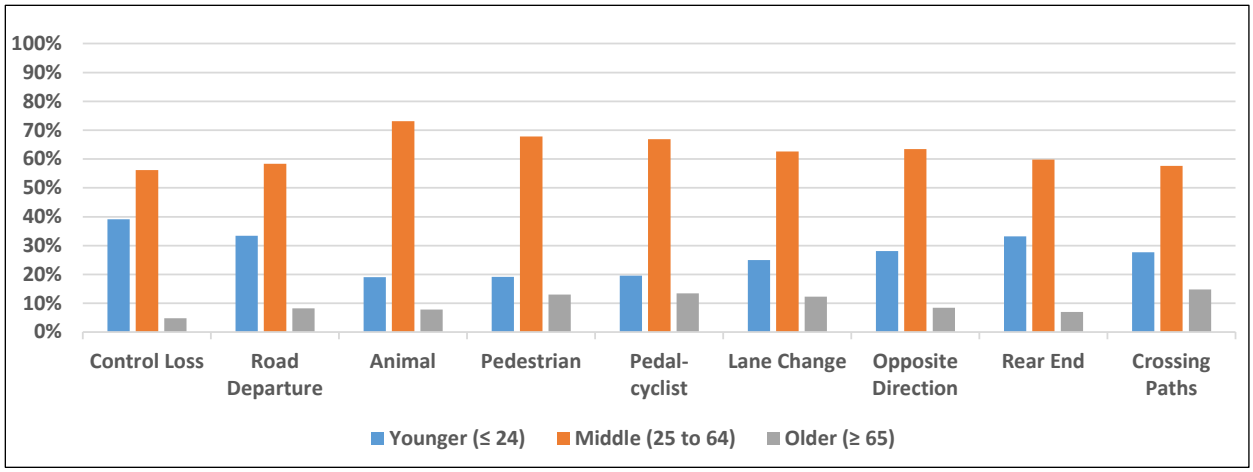
Note: Values based on average of 2011-2015 FARS data for the driver of an LV making the critical action.

Figure 39. Fatal Crashes by Age Group



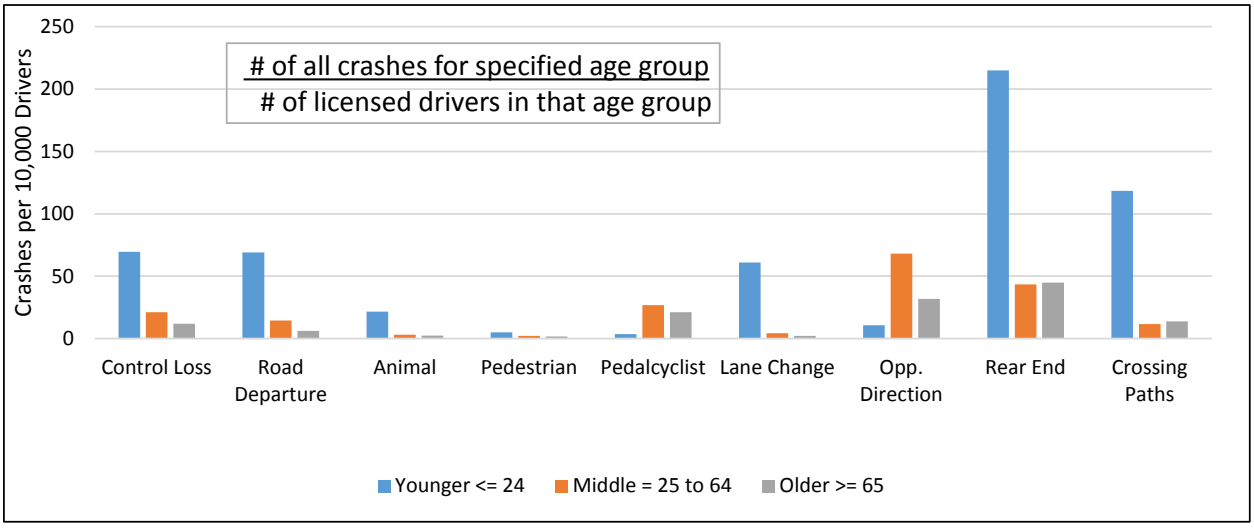
Note: Values based on average of 2011-2015 FARS data for the driver of an LV making the critical action.

Figure 40. Fatal Crashes per One Million Licensed Drivers by Age Group



Note: Values based on average of 2011-2015 GES data for the driver of an LV making the critical action.

Figure 41. All Crashes by Age Group



Note: Values based on average of 2011-2015 GES data for the driver of an LV making the critical action.

Figure 42. All Crashes per 10,000 Licensed Drivers by Age Group

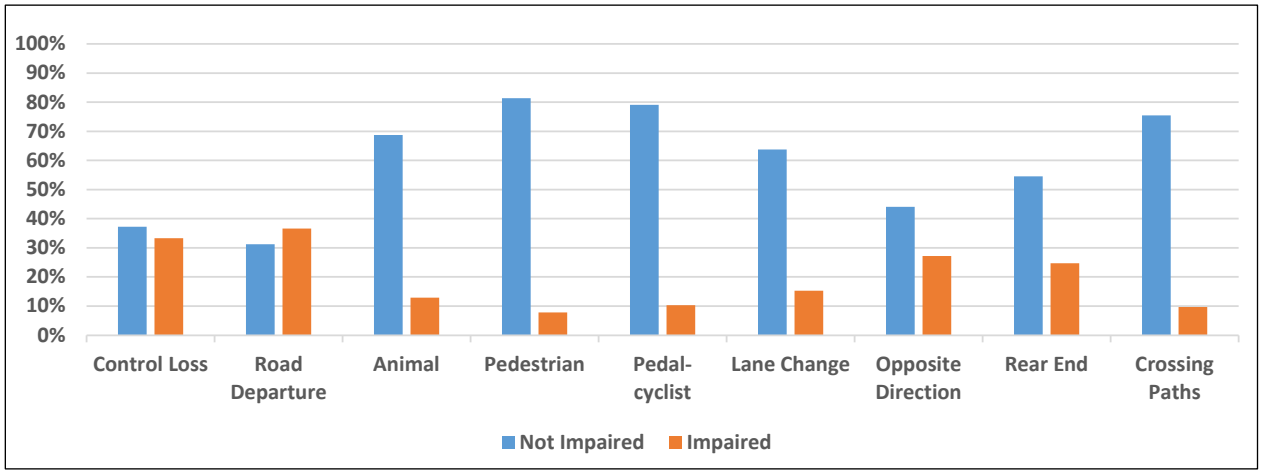
4.5.3 Impairment

This variable describes any physical impairment of the driver of the subject vehicle that may have contributed to the crash. The majority of the cases where the driver was impaired are related to alcohol, drugs, and/or medication. The police-reported alcohol involvement is presented individually in Section 4.5.4. Note that there can be more than one type of impairment defined for the subject driver, but each driver is only represented once as having an impairment. The categories are:

- Driver Impaired
    - Ill, Blackout
    - Drowsy–Asleep or Fatigued
    - Physical Impairment
    - Emotional (Depressed, Angry, Disturbed, etc.)

    - Under the Influence of Alcohol, Drugs, or Medication[19]
- No Impairment
- No Driver/Unknown if Driver Present
- Unknown/Not Reported

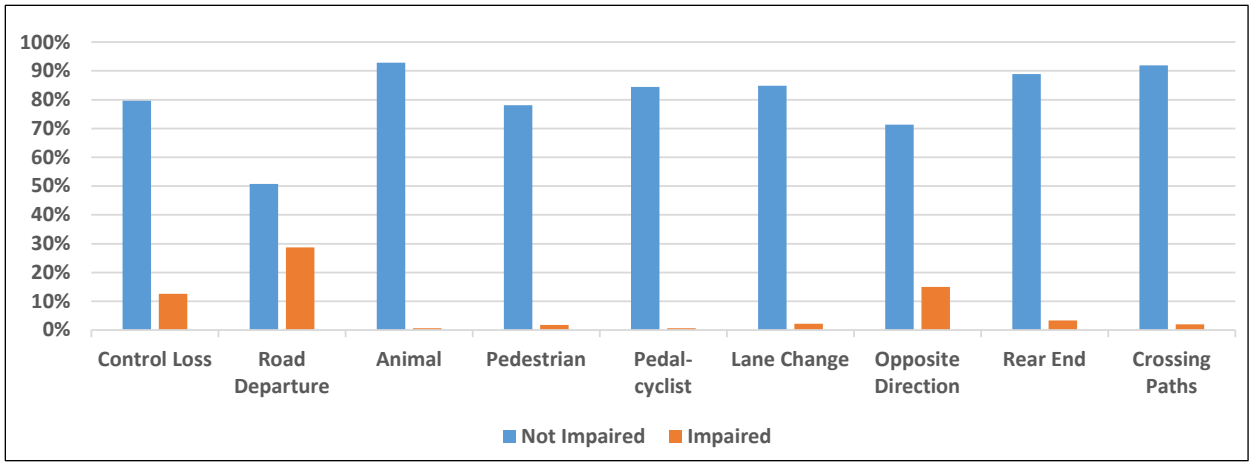
For all crashes that involve an LV making the critical action, 24 percent of fatal light-vehicle crashes and 6 percent of all light-vehicle crashes involved an impaired driver (see Appendix E, Table 28). A relatively high percentage of crashes that involve an impaired driver occurred in the control loss, road departure, and opposite direction scenario groups. Figures 43 and 44 compare driver impairment for each scenario for fatal crashes and all crashes. Table 42 of Appendix F contains statistics detailing individual percentages for driver impairment for each scenario group. Also, Table 43 contains the percentages for the individual impairments associated with the driver.



Note: Values based on average of 2011-2015 FARS data for the driver of an LV making the critical action.

Figure 43. Statistics of Impaired Driver Involvement in Fatal Crashes

[19] The investigating officer indicated on the police report that the person was under the influence of alcohol, drugs or medication. This attribute excludes interpretation of test results by the analyst/coder.



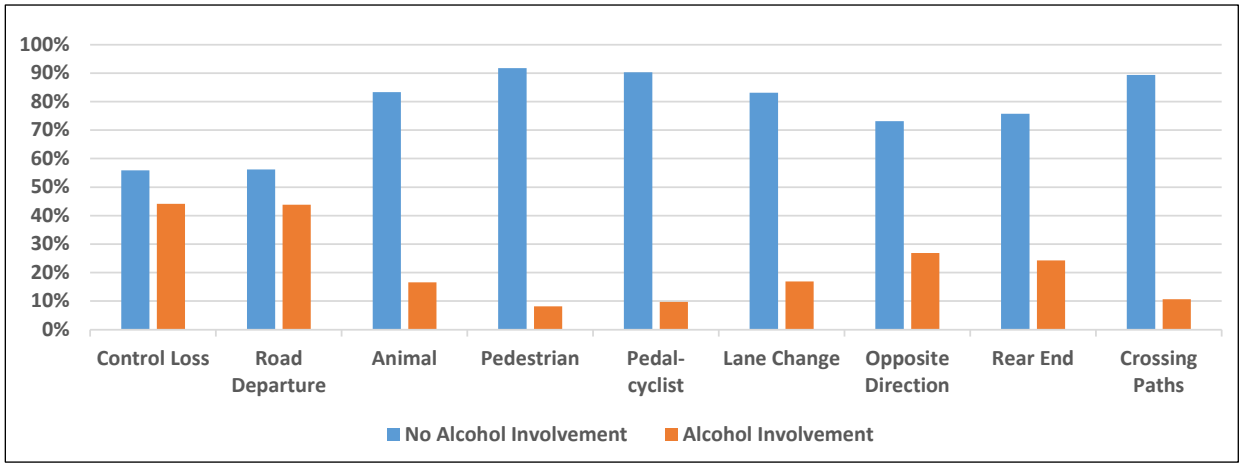
Note: Values based on average of 2011-2015 GES data for the driver of an LV making the critical action.

Figure 44. Statistics of Impaired Driver Involvement in All Crashes

4.5.4 Alcohol Involvement

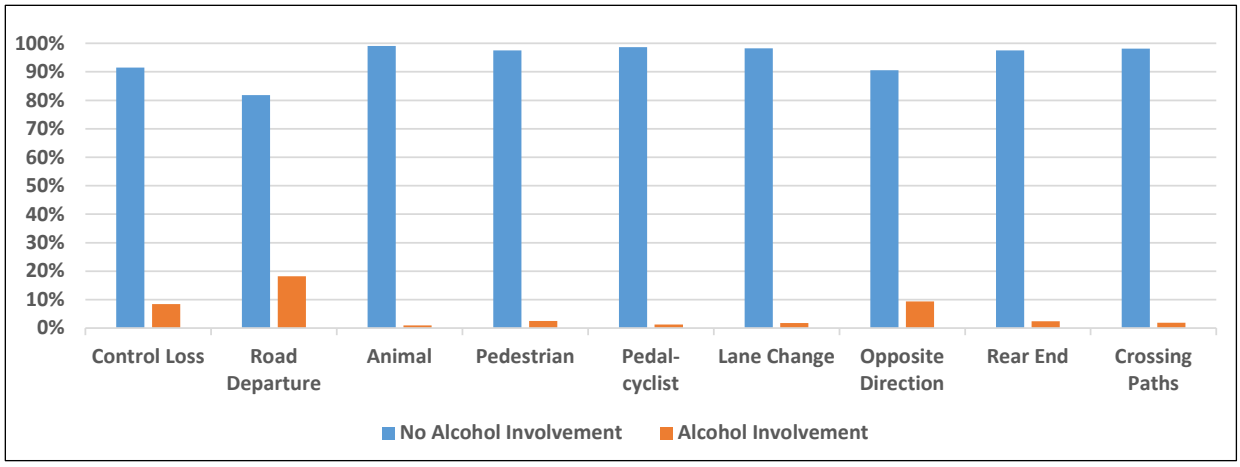
This variable describes whether there was alcohol involvement for the driver of the subject vehicle. It includes the judgement of law enforcement (i.e., if they believe and report that alcohol was present) and cases where alcohol test results are below the legal limit, but an alcohol presence was still reported for the driver.

For all crashes that involve an LV making the critical action, 28 percent of fatal light-vehicle crashes and 4 percent of all light-vehicle crashes involved alcohol for the driver (see Appendix E, Table 28). There are high percentages of alcohol-involved crashes involving the control loss and road departure scenario groups. Figures 45 and 46 compare driver alcohol involvement for each scenario for fatal crashes and all crashes. Table 44 in Appendix F contains statistics detailing individual percentages for driver alcohol involvement for each scenario group.



Note: Values based on average of 2011-2015 FARS data for the driver of an LV making the critical action.

Figure 45. Statistics of Driver Alcohol Involvement in Fatal Crashes



Note: Values based on average of 2011-2015 GES data for the driver of an LV making the critical action.

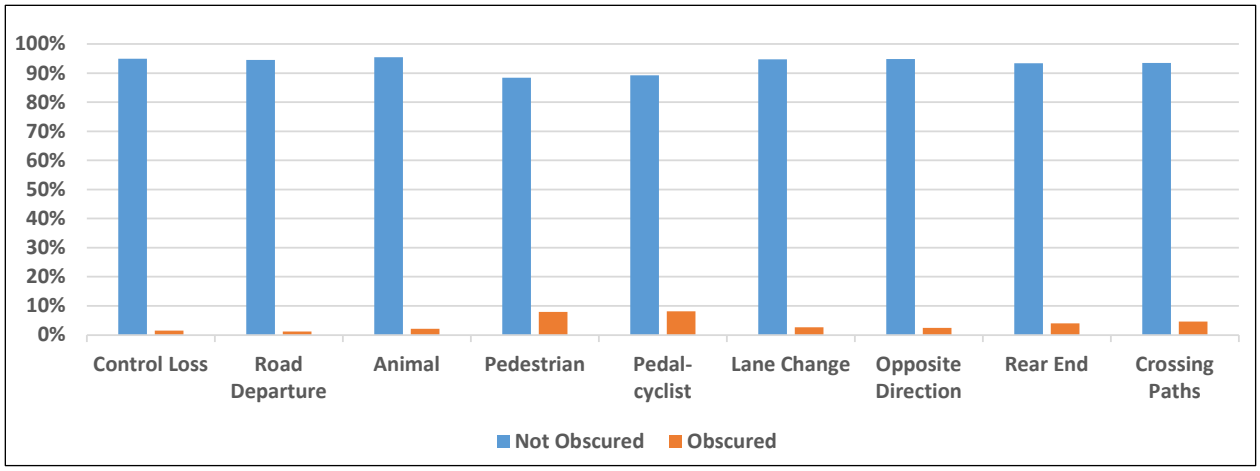
Figure 46. Statistics of Driver Alcohol Involvement in All Crashes

4.5.5 Vision Obscured

The vision obscured variable describes obstructions to the subject-vehicle driver's field of vision. These obstructions can include external objects (vehicles, buildings, signs, etc.) or internal objects (blind spots, stickers, etc.). They can also be due to the weather (glare, snow, rain, etc.) or the environment (curves, hills, etc.). Note that there can be more than one type of obstruction defined for the driver. Each crash is only represented once as having an obstruction. The categories are:

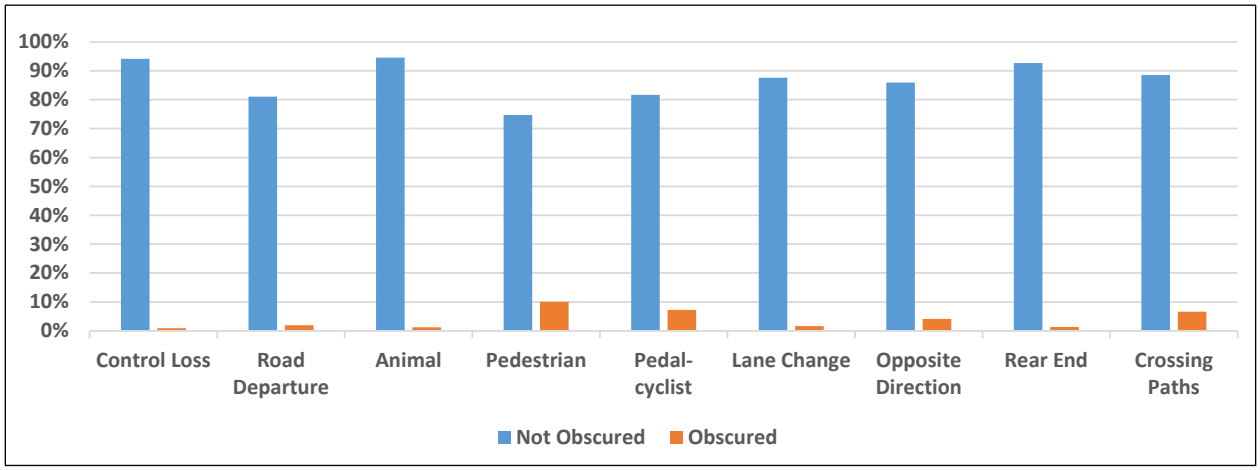
- **Obstructions:**
  - Rain, Snow, Fog, Smoke, Sand, Dust
  - Reflected Glare, Bright Sunlight, Headlights
  - Curve, Hill, or Other Roadway Design Feature
  - Building, Billboard, or Other Structure
  - Trees, Crops, Vegetation
  - In-Transport Motor Vehicle (Including Load)
  - Not-in-Transport Motor Vehicle (Parked, Working)
  - Splash or Spray of Passing Vehicle
  - Inadequate Defrost of Defog System
  - Inadequate Vehicle Lighting System
  - Obstruction Interior to Vehicle
  - External Mirrors
  - Broken or Improperly Cleaned Windshield
  - Obstructing Angle on Vehicle
  - Vision Obscured-No Details
  - Other Visual Obstruction
- **No Obstruction**
- **No Driver/Unknown if Driver Present**
- **Unknown/Not Reported**

For all crashes that involve an LV making the critical action, 3 percent of fatal light-vehicle crashes and 3 percent of all light-vehicle crashes involved a visual obstruction (see Table 28 in Appendix E). There are high percentages of vision-obscured crashes involving pedestrians and pedalcyclists. Pedestrians and pedalcyclists may be more easily obscured by an obstruction since they are smaller than vehicles. Figures 47 and 48 compare the presence of a driver vision obstruction for each scenario for fatal crashes and all crashes. Table 45 in Appendix F contains statistics detailing individual percentages for driver vision obstructions for each scenario group.



Note: Values based on average of 2011-2015 FARS data for the driver of an LV making the critical action.

Figure 47. Statistics of Vision Obstruction in Fatal Crashes



Note: Values based on average of 2011-2015 GES data for the driver of an LV making the critical action.

Figure 48. Statistics of Vision Obstruction in All Crashes

4.5.6 Driver Distraction

The driver distraction characteristic describes situations that may cause the driver of the subject vehicle to lose attention to the driving task prior to the crash. The number of distractions in the database may be underestimated because the police reports may inaccurately reflect the driver's status or identify known distractions. Driving while daydreaming or lost in thought is considered as distracted driving but impairments are not included as distracted driving [9]. Note that there can be more than one type of distraction defined in a crash but each crash is only represented once as having a distraction.

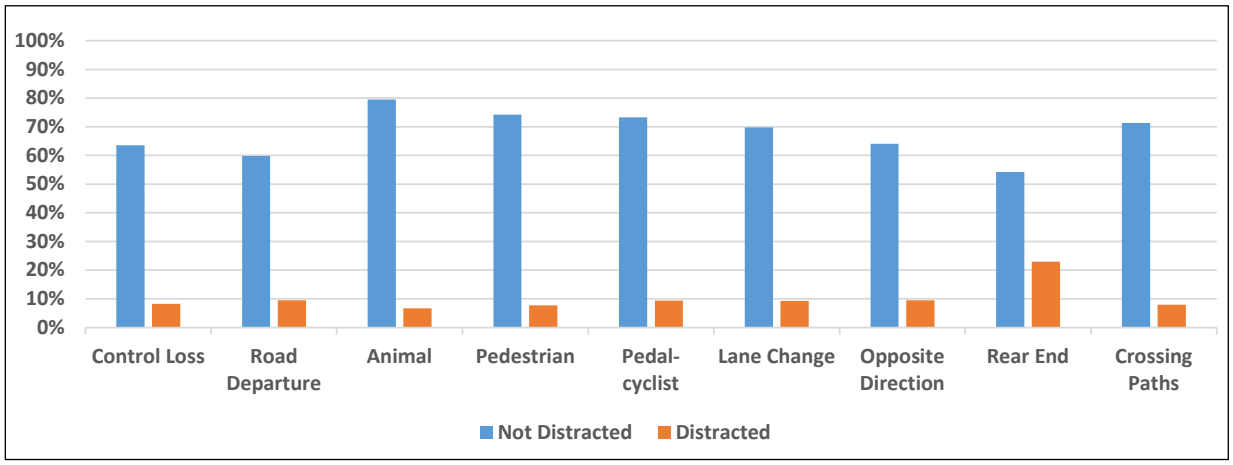
Distraction categories are:

- **Distracted**:
  - By Other Occupants
  - By Moving Object in Vehicle
  - While Talking or Listening to Cellular Phone
  - While Manipulating Cellular Phone
  - While Adjusting Audio or Climate Controls
  - While Using Other Component/Controls Integral to Vehicle
  - While/Reaching for Device/Object Brought in Vehicle
  - Distracted By Outside Person, Object or Event
  - Eating or Drinking
  - Smoking Related
  - Other Cellular Phone Related
  - Other Distraction

  Applies only to the 2011 data year:
  - Distraction/Inattention, Details Unknown
  - Inattentive or Lost in Thought

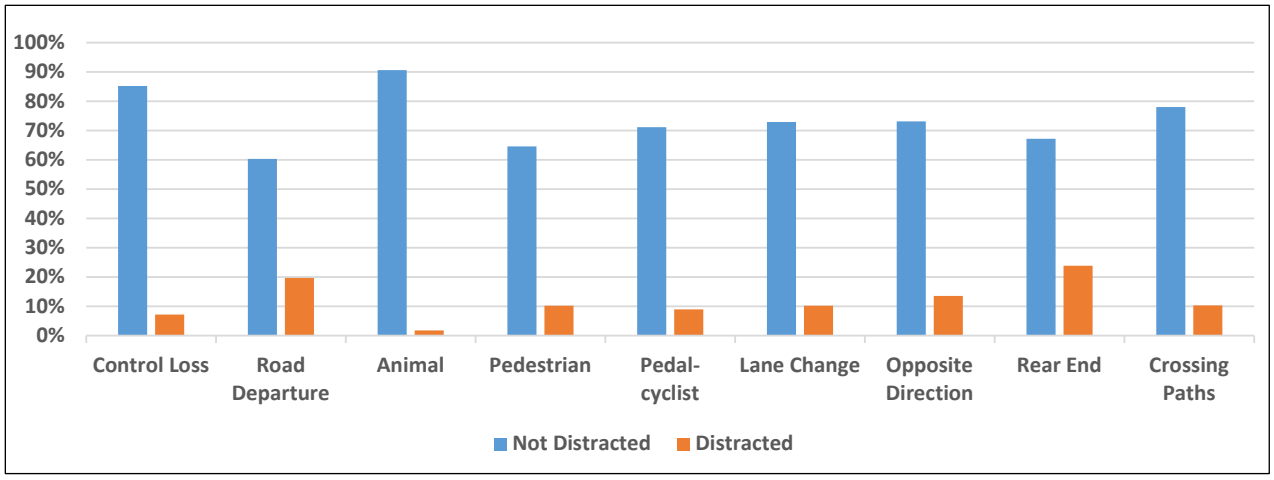
  Applies only to 2012-2015 data years:
  - Distraction/Inattention
  - Distraction/Careless
  - Careless/Inattentive
  - Distraction (Distracted), Details Unknown
  - Inattention (Inattentive), Details Unknown
  - Lost in Thought/Day Dreaming
- **Not Distracted**
- **Looked but Did Not See**
- **No Driver/Unknown if Driver Present**
- **Unknown/Not Reported**

For all crashes that involve an LV making the critical action, 9 percent of fatal light-vehicle crashes and 15 percent of all light-vehicle crashes involved a distracted driver (see Table 28 in Appendix E). In rear-end fatal crash scenarios, the driver is distracted in 23 percent of the crashes. A driver is distracted in about 20 percent of the road-departure crash group and in about 24 percent of the rear-end crash group for all crashes. Figures 49 and 50 compare driver distraction for each scenario group for fatal crashes and all crashes. Table 46 in Appendix F contains statistics detailing individual percentages for driver distractions for each scenario group.



Note: Values based on average of 2011-2015 FARS data for the driver of an LV making the critical action.

Figure 49. Statistics of Driver Distraction in Fatal Crashes



Note: Values based on average of 2011-2015 GES data for the driver of an LV making the critical action.

Figure 50. Statistics of Driver Distraction in All Crashes

4.6 Attempted Avoidance Maneuver

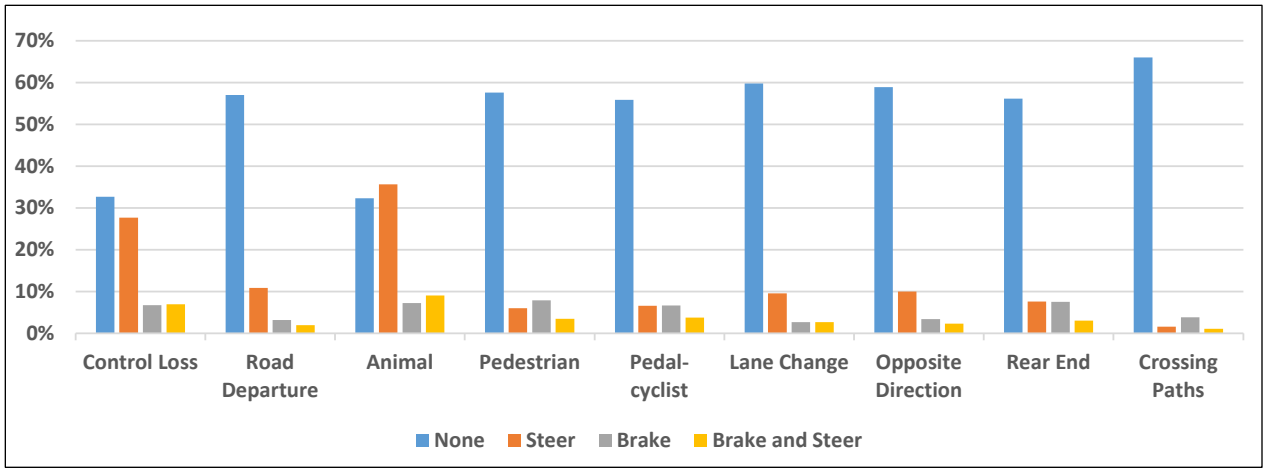
The attempted avoidance maneuver describes any attempt or lack of attempt by the driver of the subject vehicle to prevent or mitigate a crash. The categories are:

- Steer
- Brake
- Brake and Steer
- Accelerate
- Accelerate and Steer
- Other Maneuver/Unspecified
- No Maneuver and Unknown[20]
- No Driver/Unknown if Driver Present

For all crashes that involve an LV making the critical action, the driver attempted an avoidance maneuver in 20 percent of fatal light-vehicle crashes and 14 percent of all light-vehicle crashes (see Table 28 in Appendix E). Also, 25 percent of fatal light-vehicle crashes and 62 percent of all light-vehicle crashes qualified as the unknown category. See Appendix G for more information on coding of the "no maneuver" and "unknown" categories. Drivers attempted to steer in fatal crashes in the animal group with percentages close to 36 percent and in the control loss group close to 30 percent. In the animal scenario group, the driver attempted to brake and steer simultaneously a large percentage of times when compared to other scenarios (9%). This same fact was true in the control loss scenario group (7%). Figures 51 and 52 compare the attempted avoidance maneuver of each scenario for fatal crashes and all crashes. Table 47 in Appendix F contains statistics detailing individual percentages for attempted avoidance maneuvers for each scenario group.

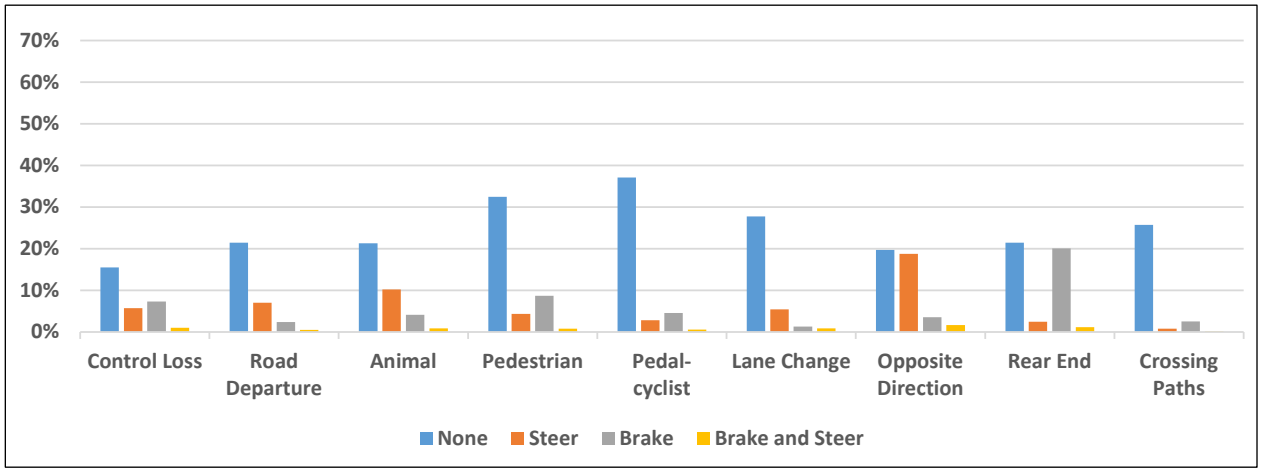
The order of scenarios depicted in each of the charts in this section is based on the priority number of each of the scenarios. The order of scenarios is independent of any statistical representation of the data.

[20] See Appendix G for actual data on all vehicle body types.



Note: Values based on average of 2011-2015 FARS data for the driver of an LV making the critical action.

Figure 51. Statistics of Drivers Attempting Avoidance Maneuvers in Fatal Crashes



Note: Values based on average of 2011-2015 GES data for the driver of an LV making the critical action.

Figure 52. Statistics of Drivers Attempting Avoidance Maneuvers in All Crashes

4.7 Violations

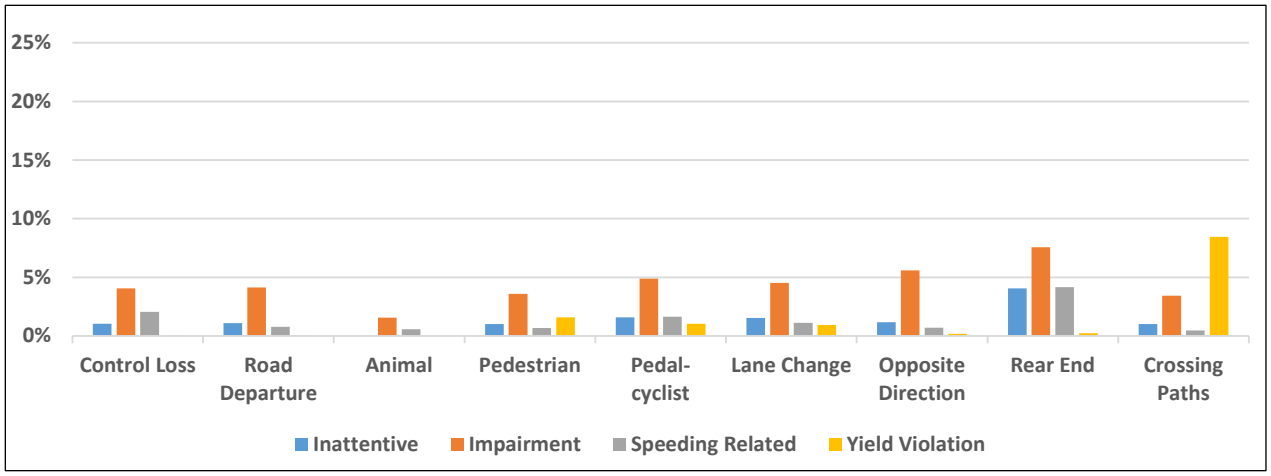
This variable describes any moving violation committed by the driver of the subject vehicle leading to the crash. The violations are not mutually exclusive (i.e., a driver can be classified as having more than one violation). The main categories are:

- Inattentive - careless, improper driving
- Impairment–driving while intoxicated, impaired, or under the influence of a substance; drinking while operating; driving with detectable alcohol; or other general alcohol, drug or impairment violations
- Speeding Related–racing, speeding, and other general speed-related violations
- Yield Violation–failure to yield to another vehicle

- Reckless–driving to endanger, negligent driving, unsafe reckless, fleeing or eluding law enforcement, fail to obey authorized person directing traffic, serious violation resulting in one or more fatalities
- Hit-and-Run
- Driving Too Slow
- Fail to Stop for Red Light or Flashing Red Light
- Violation of Turn on Red
- Miscellaneous Sign/Signal–fail to obey flashing signal, general signal, yield sign, or traffic control device; violate railroad grade crossing device/regulations
- Fail to Obey Stop Sign
- Turn Violation–disobey signs, turn arrow, or pavement markings; improper method and position of turn; fail to signal for turn or stop
- Intersection Violation–enter intersection when space insufficient
- Miscellaneous Rules of the Road–general turn, yield, signaling violations; general wrong side, passing, following violations; improper use of lane; right lane restriction; general lane violations
- Wrong-Way Driving–driving wrong way, driving on left, wrong side of road
- Passing Violation–improper, unsafe passing; pass on right; pass stopped school bus, fail to give way when overtaken
- Following Too Closely
- Lane Change–unsafe or prohibited lane change
- Lamp/Brake Violations

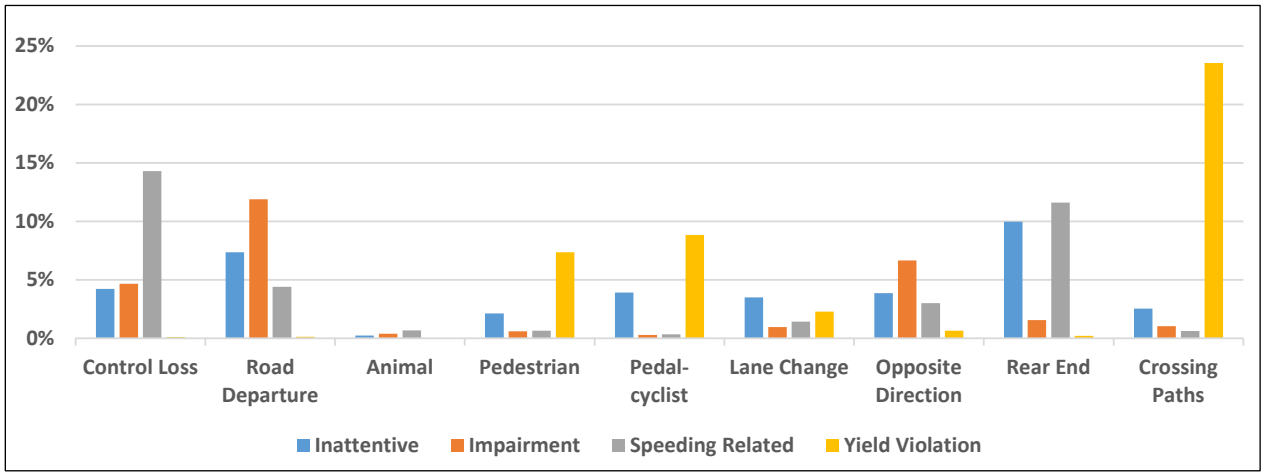
For all crashes that involve an LV making the critical action, 15 percent of fatal light-vehicle crashes and 32 percent of all light-vehicle crashes involved a traffic violation committed by the driver of the subject vehicle (see Table 28 in Appendix E). In the crossing-paths scenario group, 8 percent of fatal light-vehicle crashes and 24 percent of all LV crashes involved a yield violation. Figures 53 and 54 compare the most common violations charged for each scenario for fatal crashes and all crashes. Table 48 in Appendix F contains statistics detailing individual percentages for violations for each scenario group and some additional violation statistics.

The order of scenarios depicted in each of the charts in this section is based on the priority number of each of the scenarios. The order of scenarios is independent of any statistical representation of the data.



Note: Values based on average of 2011-2015 FARS data for the driver of an LV making the critical action.

Figure 53. Statistics of Violation Types in Fatal Crashes



Note: Values based on average of 2011-2015 GES data for the driver of an LV making the critical action.

Figure 54. Statistics of Violation Types in All Crashes

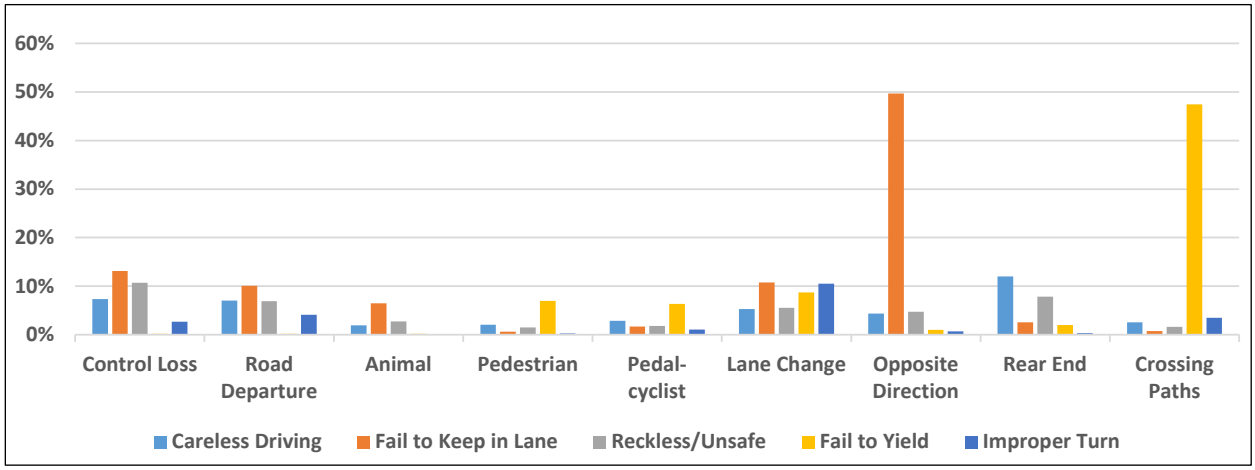
4.8 Contributing Factors

This variable describes any factors related to the driver of the subject vehicle that may have contributed to the crash expressed by the investigating officer. The contributing factors are not mutually exclusive (i.e., a crash can be classified as having more than factor.) The categories are:

- Careless Driving (physical/mental condition)
- Failure to Keep in Proper Lane (changed to improper lane usage in 2015)
- Erratic/Reckless/Negligent Driving/Unsafe—operating the vehicle in an erratic, reckless or negligent manner; operating at erratic or suddenly changing speeds
- Fail to Yield Right-of-Way
- Improper Turn
- Following Improperly - following too closely
- Improper or Erratic Lane Change

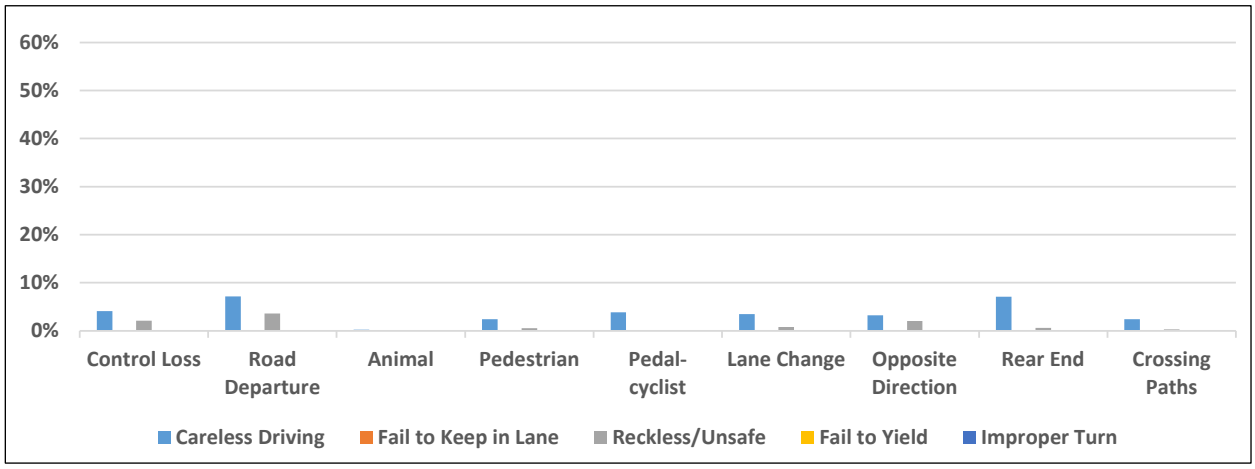
In the crossing-paths scenario group, 47 percent of fatal light-vehicle crashes had failure to yield as a contributing factor. This statistic was 70 percent of the LTAP/OD fatal crashes (see Appendix E, Table 27). There were 50 percent of opposite-direction fatal crashes that had a "failure to keep in lane" contributing factor. Figures 55 and 56 compare contributing factors for each scenario for fatal crashes and all crashes. The contributing factors and the maximum percent range are the same on each table for comparison. Table 49 in Appendix F contains statistics detailing individual percentages for contributing factors for each scenario group.

The order of scenarios depicted in each of the charts in this section is based on the priority number of each of the scenarios. The order of scenarios is independent of any statistical representation of the data.



Note: Values based on average of 2011-2015 FARS data for the driver of an LV making the critical action.

Figure 55. Statistics of Contributing Factors in Fatal Crashes



Note: Values based on average of 2011-2015 GES data for the driver of an LV making the critical action.

Figure 56. Statistics of Contributing Factors in All Crashes

4.9 Multi-Variable Crash Characteristics

To assist in determining conditions for testing crash avoidance technology geared for specific scenarios and to assess the population of crashes they address, results from a six-variable combination of crash-contributing factors are presented in Table 9 using FARS data. Appendix I presents similar results using GES statistics. The six-variable combination includes weather, lighting, road surface conditions, road alignment, road grade, and road type (whether highway or not). The highest-ranked combination for each of the ten scenario groups consisted of a "clear, dry, straight, level, and not on a highway" crash and only differed by the lighting factor. The animal and pedestrian scenario combinations occurred in the dark and dark with overhead light, respectively, while the other scenarios occurred in the day. The table shows the rank and percentage of each six-variable combination by scenario group. It's interesting to note that the highest frequency for the control loss group was only 8 percent, which indicates that there are many combinations of these six variables in which control loss crashes occur. Conversely, the highest group of the LTAP/OD scenario includes over half the crashes in this one combination of crashes. Appendix I contains the percentages associated with the six-variable combinations for the scenario groups for fatal crashes in Table 50 and for all crashes in Table 51.

Table 9. Rank of Scenarios Based on Six-Variable Combination of Crash-Contributing Factors

Pre-Crash Scenario Variable						Top 10 Rank of each Scenario Group (FARS 2011-2015)								
Weather	Lighting	Road Surface Conditions	Road Alignment	Road Grade	Highway	Control Loss	Road Departure	Animal	Pedestrian	Pedalcyclist	Lane Change	Opposite Direction	Rear End	Crossing Paths
Clear	Daylight	Dry	Straight	Level	No	1	1	4	3	1	1	1	1	1
Clear	Daylight	Dry	Straight	Level	Yes	7	4	.	.	7	2	8	2	.
Clear	Daylight	Dry	Straight	Not Level	No	8	9	6	10	4	4	4	6	3
Clear	Daylight	Dry	Straight	Not Level	Yes	.	.	.	.	.	8	.	8	.
Clear	Daylight	Dry	Straight	Ukn/Not Rep.	No	.	.	.	.	6	.	.	.	7
Clear	Daylight	Dry	Curve	Level	No	5	5	.	.	.	9	3	.	.
Clear	Daylight	Dry	Curve	Not Level	No	6	8	.	.	.	10	5	.	.
Clear	Daylight	Wet/Slippery	Straight	Level	No	.	.	.	.	.	.	.	.	9
Clear	Daylight	Not Trafficway	Not Trafficway	Not Trafficway	No	.	.	.	.	.	.	.	.	8
Clear	Dark	Dry	Straight	Level	No	2	2	1	2	3	6	2	4	4
Clear	Dark	Dry	Straight	Level	Yes	.	10	3	4	8	3	6	3	.
Clear	Dark	Dry	Straight	Not Level	No	10	.	2	7	9	.	7	10	.
Clear	Dark	Dry	Straight	Not Level	Yes	.	.	10	.	.	.	.	9	.
Clear	Dark	Dry	Curve	Level	No	3	3	5	.	.	.	10	.	.
Clear	Dark	Dry	Curve	Not Level	No	4	7	8	.	.	.	.	.	.
Clear	Dark/Overhead Light	Dry	Straight	Level	No	9	6	7	1	2	5	.	5	2
Clear	Dark/Overhead Light	Dry	Straight	Level	Yes	.	.	.	5	10	7	.	7	.
Clear	Dark/Overhead Light	Dry	Straight	Not Level	No	.	.	.	8	.	.	.	.	10
Clear	Dawn/Dusk	Dry	Straight	Level	No	.	.	9	.	5	.	.	.	5
Adverse	Daylight	Wet/Slippery	Straight	Level	No	.	.	.	.	.	.	9	.	6
Adverse	Dark	Wet/Slippery	Straight	Level	No	.	.	.	9	.	.	.	.	.
Adverse	Dark/Overhead Light	Wet/Slippery	Straight	Level	No	.	.	.	6	.	.	.	.	.

Contains at least one top-ranked combination of the scenarios
5 Highest-ranked percentages of each scenario

Note: Values based on average of 2011-2015 FARS data for crashes that involve an LV making the critical action.

The order of scenarios depicted in Table 9 is based on the priority number of each of the scenarios. The order of scenarios is independent of any statistical representation of the data.

5 Conclusions

This report presented an updated typology of 36 independent pre-crash scenarios that represent a prioritized list of all light-vehicle, police-reported crashes. The pre-crash scenarios were organized into nine groups to represent the most common pre-crash scenarios and denote the scenarios that might be addressed by advanced vehicle safety technologies. The nine groups distinctly represent 24,534 (94%) fatal crashes and an estimated 5,020,062 (89%) crashes of all severities from an average of the 2011-2015 FARS and GES crash databases, respectively.

5.1 Pre-Crash Scenarios Findings

In terms of individual pre-crash scenarios, the three most fatal pre-crash scenarios are the road edge departure/no maneuver, control loss/no vehicle action, and pedestrian/no maneuver scenarios. These three scenarios account for 54 percent of all light-vehicle fatal crashes where the LV is making the critical action. The three most frequent scenarios are the rear-end/lead vehicle stopped, road edge departure/no maneuver, and the straight crossing-paths scenarios. These three scenarios account for 35 percent of all light-vehicle crashes.

5.2 Scenarios Group Findings

In terms of the scenario groups, the crossing-paths crashes have the highest comprehensive costs and EL lost, but these crashes are associated with fewer fatal crashes as they rank sixth in the fatal-to-all crashes ratio relative to the other scenario groups. These crashes also rank third among the groups when fatal crashes per VMT is compared. The pedestrian group has the highest fatal-to-all crash ratio at 53 fatal crashes per thousand crashes while this scenario ranks next-to-lowest for the number of crashes per VMT. The lowest-ranked group overall and across all measures is the animal group.

The characteristics of the light-vehicle crashes are analyzed for the cases where the LV makes the critical action. Specific key findings for each of the scenario groups based on the 2011-2015 police-reported data[21] are discussed below.

5.2.1 Control Loss

- 20 percent of fatal control loss crashes and 44 percent of all control loss crashes happened during adverse weather.
- Almost one-third of fatal control loss crashes and two-thirds of all control loss crashes happened on wet/slippery road conditions.
- Over 30 percent of fatal control loss crashes occurred on a curve.
- Over 30 percent fatal control loss crashes occurred on roadways that were not level.
- High percentages of speeding-related control loss crashes occurred; (60%) fatal crashes, and (52%) all crashes.
- Over one-third of all control loss crashes involved younger (≤ 24 years) drivers.
- A high percentage (33%) of fatal control loss crashes involved an impaired driver.
- The driver attempted to steer in nearly 30 percent of fatal control loss crashes. The driver attempted to brake and steer simultaneously in 7 percent of fatal crashes.

[21] The data is subject to the limitations in Section 1.4.3 (e.g., sampling errors, misinterpretation of facts, missing or unknown information, coding discrepancies.)

5.2.2 Road Departure

- Over 30 percent of fatal road departure crashes occurred on a curve road.
- 31 percent of fatal road departure crashes were speed-related.
- A high percentage of road departure fatal crashes (37%) involved an impaired driver.
- A driver was distracted in close to 20 percent of the road departure crashes.

5.2.3 Animal

- 80 percent of fatal animal crashes and 74 percent of all animal crashes occurred in non-daylight conditions.
- The driver attempted to steer in 36 percent of fatal animal crashes. The driver attempted to brake and steer simultaneously in 9 percent of fatal animal crashes.

5.2.4 Pedestrian

- 79 percent of fatal pedestrian crashes occurred in non-daylight conditions.
- 66 percent of fatal pedestrian crashes occurred at non-junctions, while only 29 percent of fatal pedestrian crashes occurred at intersections and intersection-related areas.
- 69 percent of fatal pedestrian crashes and 67 percent of all pedestrian crashes occurred on roads with posted speed limits of 45 mph or less.

5.2.5 Pedalcyclist

- 56 percent of fatal pedalcyclist crashes occurred at non-junctions, while only 38 percent of fatal pedalcyclist crashes occurred at intersections and intersection-related areas.
- 69 percent of fatal pedalcyclist crashes and 73 percent of all pedalcyclist crashes occurred on roads with posted speed limits of 45 mph or less.

5.2.6 Lane Change

- Nearly half of lane-change crashes on highways were fatal.

5.2.7 Opposite Direction

- Over 30 percent of fatal opposite-direction crashes occurred on a curve.
- Over 30 percent of fatal opposite-direction crashes occurred on roadways that were not level.
- 27 percent of fatal opposite-direction crashes involved an impaired driver.

5.2.8 Rear End

- Nearly half of rear-end crashes on highways were fatal.
- 42 percent of fatal rear-end crashes and 20 percent of all rear-end crashes were speeding-related.
- The driver was distracted in 23 percent of fatal rear-end crashes and 24 percent of all rear-end crashes.

5.2.9 Crossing Paths

- 57 percent of fatal crossing-paths crashes and 74 percent of all crossing-paths crashes occurred on roads with posted speed limits of 45 mph or less.
- Failure to yield was a contributing factor in 47 percent of fatal crossing-paths crashes. This factor accounted for 70 percent of the fatal LTAP/OD crashes.

6 References

[1] Najm, W. G., Smith, J., & Yanagisawa, M. (2007, April). Pre-crash scenario typology for crash avoidance research (Report No. DOT HS 810 767). Washington, DC: National Highway Traffic Safety Administration. Available at www.nhtsa.gov/sites/nhtsa.dot.gov/files/pre-crash_scenario_typology-final_pdf_version_5-2-07.pdf

[2] General Motors. (1997). 44 Crashes, v.3.0. Warren, MI: NAO Engineering, Safety & Restraints Center, Crash Avoidance Department.

[3] Crash Avoidance Metrics Partnership. (2004, November). *Enhanced digital mapping project - final report*. (Report No. FHWA-JPO-05-073; DTFH61-01-X-00014). Washington, DC: National Highway Traffic Safety Administration. Available at https://ntlrepository.blob.core.windows.net/lib/jpodocs/repts_te/14161_files/14161.pdf

[4] W. G. Najm, Sen, B., Smith, J. D., & Campbell, B. N. (2003, February). *Analysis of light vehicle crashes and pre-crash scenarios based on the 2000 general estimates system*. (Report No. DOT HS 809 573). Washington, DC: National Highway Traffic Safety Administration. Retrieved from www.nhtsa.gov/DOT/NHTSA/NRD/Multimedia/PDFs/Crash%20Avoidance/2002/DOTHS809573.pdf

[5] W. G. Najm, Smith, J., & Yanagisawa, M. (2007, April). *Pre-crash scenario typology for crash avoidance research*. (Report No. DOT HS 810 767). Washington, DC: National Highway Traffic Safety Administration. Available at www.nhtsa.gov/sites/nhtsa.dot.gov/files/pre-crash_scenario_typology-final_pdf_version_5-2-07.pdf

[6] Najm, W. G., Ranganathan, R., Srinivasan, G., Smith, J. D., Toma, S., Swanson, E., & Burgett, A. (2013, May). *Description of light-vehicle pre-crash scenarios for safety applications based on vehicle-to-vehicle communications* (Report No. DOT HS 811 731). Washington, DC: National Highway Traffic Safety Administration. Available at https://www.nhtsa.gov/-sites/nhtsa.dot.gov/files/811731.pdf

[7] National Center for Statistics and Analysis (2016, August). *Fatality Analysis Reporting System (FARS) analytical user's manual 1975-2015* (Report No. DOT HS 812 315).Washington, DC: National Highway Traffic Safety Administration. Retrieved from https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812315.

[8] National Center for Statistics and Analysis. (2016, August) *National Automotive Sampling System (NASS) General Estimates System (GES) analytical user's manual 1988-20015* (Report No. DOT HS 812 320).Washington, DC: National Highway Traffic Safety Administration. Available at https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812320.

[9] National Center for Statistics and Analysis. (2016, July). *2015 FARS/NASS GES coding and validation manual* (Report No. DOT HS 812 296). Washington, DC: National Highway Traffic Safety Administration. Available at https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812296

[10] National Center for Statistics and Analysis. (2014). *Traffic Safety Facts 2014* (Report No. DOT HS 812 261).Washington, DC: National Highway Traffic Safety Administration. Available at www-nrd.nhtsa.dot.gov/Pubs/812261.pdf

[11] Office of Highway Policy Information. (n.a.). Highway Statistics 2015: User's Guide (Web page). Washington DC: Federal Highway Administration. Retrieved from www.fhwa.dot.gov/policyinformation/statistics/2015

[12] Blincoe, L. J., Miller, T. R., Zaloshnja, E., & Lawrence, B. A. (2015, May). *The economic and societal impact of motor vehicle crashes, 2010 (Revised)* (Report No. DOT HS 812 013). Washington, DC: National Highway Traffic Safety Administration. Retrieved from https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812013

Appendix A: Pre-Crash Scenario Code and Host Criterion

Pre-Crash Scenario Code

Scenario	Sub-group	FARS and GES Variable Codes (The suffixes _1 and _2 represent the respective vehicles involved in the critical event.)
Vehicle failure	1a	p_crash2_1 = 1- 4 or p_crash2_2 = 1- 4
	1b	acc_type_1 = 98 and p_crash2_1 = 10-14, 98 and (first event) SOE = 61,62 and vnum2 in (5555,9999)
	1c	acc_type_1 = 4,5,9,10,15,16,98,99 and p_crash2_1= 15-19,98,99 and (first event) SOE = 61,62 and ve_total = 1
Control loss/vehicle action	2a	(p_crash2_1 = 5 - 9 AND p_crash1_1 = 2 - 4, 6, 8 - 13, 15 - 99) or (p_crash2_2 = 5 - 9 AND p_crash1_2 = 2 - 4, 6, 8 - 13, 15 - 99)
	2b	(acc_type_1 = 34, 36, 54, 56 AND p_crash1_1 = 2 - 4, 6, 8 - 13, 15 - 99) or (acc_type_2 = 34, 36, 54, 56 AND p_crash1_2 = 2 - 4, 6, 8 - 13, 15 - 99)
	2c	(acc_type_1 = 2, 7 AND p_crash1_1 = 2 - 4, 6, 8 - 13, 15 - 99) or (acc_type = 2_2, 7 AND p_crash1_2 = 2 - 4, 6, 8 - 13, 15 - 99)
	2d	((first event) SOE = 51 AND p_crash1_1 = 2 - 4, 6, 8 - 13, 15 - 99) or ((first event) SOE = 51 AND p_crash1_2 = 2 - 4, 6, 8 - 13, 15 - 99)
Control loss/no vehicle action	3a	(p_crash2_1 = 5 - 9 AND p_crash1_1 = 1, 14) or (p_crash2_2 = 5 - 9 AND p_crash1_2 = 1, 14)
	3b	(acc_type_1 = 34, 36, 54, 56 AND p_crash1_1 = 1, 14) or (acc_type_2 = 34, 36, 54, 56 AND p_crash1_2 = 1, 14)
	3c	(acc_type_1 = 2, 7 AND p_crash1_1 = 1, 14) or (acc_type_2 = 2, 7 AND p_crash1_2 = 1, 14)
	3d	((first event) SOE = 51 AND AND p_crash1_1 = 1, 14) or ((first event) SOE = 51 AND AND p_crash1_2 = 1, 14)
	3e	(p_crash1_1_1 = 0 and p_crash2_1_1 = 5-9)
Road edge departure/maneuver	4a	(acc_type_1 = 1, 6, 14 AND p_crash1_1 = 6, 8 - 12, 15 - 99) or (acc_type_2 = 1, 6, 14 AND p_crash1_2 = 6, 8 - 12, 15 - 99)
	4b	(ve_forms = 1 and p_crash2_1 = 10-14 and p_crash1_1 = 6, 8 - 12, 15 - 99) or (ve_forms = 1 and p_crash2_2 = 10-14 and p_crash1_2 = 6, 8 - 12, 15 - 99)
	4c	acc_type_1 = 4,5, 9,10,12,13,15,16,98,99 and p_crash2_1 =10-14 and (first event) SOE = 63,64,65,79 and p_crash1 = 6, 8 - 12, 15 - 99 and vnum2 = 5555,9999
	4d	acc_type_1 = 4,5, 9,10,12,13,15,16,98,99 and p_crash2_1 = 15-19,98,99 and (first event) SOE = 63,64,65,79 and p_crash1 = 6, 8 - 12, 15 - 99
Road edge departure/no maneuver	5a	(acc_type_1 = 1, 6, 14 AND p_crash1_1 = 1 - 5, 7, 14) or (acc_type_2 = 1, 6, 14 AND p_crash1_2 = 1 - 5, 7, 14)
	5b	(ve_forms=1 and p_crash2_1 = 10-14 and p_crash1_1 = 1 - 5, 7, 14) or (ve_forms=1 and p_crash2_2 = 10-14 and p_crash1_2 = 1 - 5, 7, 14)
	5c	p_crash1_1 = 0 and p_crash2_1 =10-14
	5d	acc_type_1 = 4,5,9,10,12,13,15,16,98,99 and p_crash2_1 =10-14 and (first event) SOE = 63,64,65,79 and p_crash1 = 1 - 5, 7, 14 and vnum2 = 5555,9999
	5e	acc_type_1 = 4,5, 9,10,12,13,15,16,98,99 and p_crash2_1 = 15-19,98,99 and (first event) SOE = 63,64,65,79 and p_crash1 = 1 - 5, 7, 14
Road edge departure/backing	6a	(acc_type_1 = 1, 6, 14 AND p_crash1_1 = 13) or (acc_type_2 = 1, 6, 14 AND p_crash1_2 = 13)
	6b	(ve_forms=1 and p_crash2_1 = 10-14 and p_crash1_1 = 13) or (ve_forms=1 and p_crash2_2 = 10-14 and p_crash1_2 = 13)
	6c	vnum2 = 5555,9999 and (first event) SOE = 63,64,65,71,79 and h_pcrash1_1=13 and p_crash2_1 = 98
	6d	ve_forms=1 and acc_type_1=92 and p_crash1_1 = 13
Animal/maneuver	7a	(p_crash2_1 = 87 - 89 AND p_crash1_1 = 6, 8 - 13, 15 - 99) or (p_crash2_2 = 87 - 89 AND p_crash1_2 = 6, 8 - 13, 15 - 99)
	7b	vnum2 = 5555,9999 AND (first event) SOE=11 AND p_crash1_1 = 6, 8 - 13, 15 -99
	7c	If ve_forms = 1 and ve_total = 1 and (first event) SOE = 11 AND p_crash1_1 = 6, 8 - 13, 15 - 99
Animal/no maneuver	8a	(p_crash2_1 = 87 - 89 AND p_crash1_1 = 1 - 5, 7, 14) or (p_crash2_2 = 87 - 89 AND p_crash1_2 = 1 - 5, 7, 14)
	8b	vnum2 = 5555,9999 AND (first event) SOE=11 AND p_crash1_1 = 1 - 5, 7, 14
	8c	If ve_forms = 1 and ve_total = 1 and (first event) SOE = 11 AND p_crash1_1 = 1 - 5, 7, 14
	8d	p_crash1_1 = 0 and p_crash2_1 =87-89, 98 and (first event) SOE = 11
Pedestrian/maneuver	9a	(p_crash2_1 = 80 - 82 AND p_crash1_1 = 6, 8 - 13, 15 - 99) or (p_crash2_2 = 80 - 82 AND p_crash1_2 = 6, 8 - 13, 15 - 99)
	9b	vnum2 = 5555,9999 AND (first event) SOE=8,15 AND p_crash1_1 = 6, 8 - 13, 15 - 99
	9c	If ve_forms = 1 and ve_total = 1 and (first event) SOE = 8,15 AND p_crash1_1 = 6, 8 - 13, 15 - 99
Pedestrian/no maneuver	10a	(p_crash2_1 = 80 - 82 AND p_crash1_1 = 1 - 5, 7, 14) or (p_crash2_2 = 80 - 82 AND p_crash1_2 = 1 - 5, 7, 14)
	10b	vnum2 = 5555,9999 AND (first event) SOE=8,15 AND p_crash1_1 = 1 - 5, 7, 14
	10c	If ve_forms = 1 and ve_total = 1 and (first event) SOE = 8,15 AND p_crash1_1 = 1 - 5, 7, 14
	10d	(p_crash1_1 = 0 and p_crash2_1 =19,80-82,98 and (first event) SOE = 8,15) or (p_crash1_2 = 0 and p_crash2_2 =19,80-82,98 and (first event) SOE = 8,15)
	10e	vnum2 = 5555,9999 AND (first event) SOE=8,15 and pcrash1_1 = 0

Scenario	Sub-group	FARS and GES Variable Codes (The suffixes _1 and _2 represent the respective vehicles involved in the critical event.)
Cyclist/maneuver	11a	(p_crash2_1 = 83 - 85 AND p_crash1_1 = 6, 8 - 13, 15 - 99) or (p_crash2_2 = 83 - 85 AND p_crash1_2 = 6, 8 - 13, 15 - 99)
	11b	vnum2 = 5555,9999 AND (first event) SOE= 9 AND p_crash1_1 = 6, 8 - 13, 15 - 99
	11c	If ve_forms = 1 and ve_total = 1 and (first event) SOE = 9 AND p_crash1_1 = 6, 8 - 13, 15 - 99
Cyclist/no maneuver	12a	(p_crash2_1 = 83 - 85 AND p_crash1_1 = 1 - 5, 7, 14) or (p_crash2_2 = 83 - 85 AND p_crash1_2 = 1 - 5, 7, 14)
	12b	vnum2 = 5555,9999 AND (first event) SOE=9 AND p_crash1_1 = 1 - 5, 7, 14
	12c	If ve_forms = 1 and ve_total = 1 and (first event) SOE = 9 AND p_crash1_1 = 1 - 5, 7, 14
	12d	(p_crash1_1 = 0 and p_crash2_1 =83 - 85, 98 and (first event) SOE = 9) or p_crash1_2 = 0 and p_crash2_2 =83 - 85, 98 and (first event) SOE = 9
Backing into vehicle	13a	(acc_type_1 = 92, 93 AND h_event1 = 12,55) or (acc_type_2 = 92, 93 AND h_event1 = 12,55)
	13b	(ve_forms = 1 and p_crash2_1 = 56) or (ve_forms = 1 and p_crash2_2 = 56)
Turning/same direction	14a	(acc_type_1 = 44 - 49, 70 - 73 AND p_crash1_1 = 10 - 12) or (acc_type_2 = 44 - 49, 70 - 73 AND p_crash1_2 = 10 - 12)
	14b	(acc_type_1 = 20 - 43 AND p_crash1_1 = 10,11,12 AND h_impct1_1 = 5,6,7,63,83) or (acc_type_2 = 20 - 43 AND p_crash1_2 = 10,11,12 AND h_impct1_2 = 5,6,7,63,83)
	14c	(p_crash1_1 = 10-12 or p_crash1_2 = 10-12) AND (p_crash2_1 = 60, 61or p_crash2_2 = 60, 61)
Parking/same direction	15a	(acc_type_1 = 44 - 49, 70 - 73 AND p_crash1_1 = 8, 9) or (acc_type_2 = 44 - 49, 70 - 73 AND p_crash1_2 = 8, 9)
	15b	(acc_type_1 = 20 - 43 AND p_crash1_1 = 8, 9 AND h_impct1_1= 5,6,7,63,83) or (acc_type_2 = 20 - 43 AND p_crash1_2 = 8, 9 AND h_impct1_2 = 5,6,7,63,83)
	15c	(p_crash1_1 = 8, 9 AND p_crash2_1 = 60, 61) or (p_crash1_2 = 8, 9 AND p_crash2_2 = 60, 61)
	15d	p_crash2_1 = 64 or p_crash2_2 = 64
Changing lanes/same direction	16a	(acc_type_1 = 44 - 49, 70 - 73 AND p_crash_1 = 6, 15, 16) or (acc_type_2 = 44 - 49, 70 - 73 AND p_crash_2 = 6, 15, 16)
	16b	(acc_type_1 = 20 - 43 AND p_crash1_1 = 6, 15, 16 and h_impct1_1 = 5,6,7,63,83) or (acc_type_2 = 20 - 43 AND p_crash1_2 = 6, 15, 16 and h_impct1_2 = 5,6,7,63,83)
	16c	(p_crash1_1 = 6, 15, 16 or p_crash1_2 = 6, 15, 16) AND (p_crash2_1= 60, 61 or p_crash2_2= 60, 61)
Drifting/same direction	17a	(acc_type_1 = 44 - 49, 70 - 73 AND p_crash1_1 = 1 - 5, 7, 14) or (acc_type_2 = 44 - 49, 70 - 73 AND p_crash1_2 = 1 - 5, 7, 14)
	17b	(acc_type_1 = 20 - 43 AND p_crash2_1 = 10, 11 AND h_impct1_1 = 5,6,7,63,83) or (acc_type_2 = 20 - 43 AND p_crash2_2 = 10, 11 AND h_impct1_2 = 5,6,7,63,83)
	17c	(h_pcrsh1_1 = 0 and acc_typ_1 = 98,99 and p_crash2_1 =10 and p_crash2_2 =61) or (h_pcrsh1_1=0 and acc_typ_1 = 98,99 and p_crash2_1 = 11 and p_crash2_2 = 60)
	17d	(h_pcrsh1_2 = 0 and acc_typ_2 = 98,99 and p_crash2_1 = 10 and p_crash2_2 = 61) or (h_pcrsh1_2 = 0 and acc_typ_2 = 98,99 and p_crash2_1 = 11 and p_crash2_2 = 60)
Opposite direction/maneuver	18a	(acc_typ_1 = 50-67 and h_pcrsh1_1 = 6, 8-13, 15-99) or (acc_typ_2 = 50-67 and h_pcrsh1_2 = 6, 8-13, 15-99)
	18b	(p_crash2_1 = 54, 62, 63 AND p_crash1_1 = 6, 8 - 13, 15 - 99 and ve_forms=1) or (p_crash2_2 = 54, 62, 63 AND p_crash1_2 = 6, 8 - 13, 15 - 99 and ve_forms=1)
Opposite direction/no maneuver	19a	(acc_type_1 = 50 - 67 AND p_crash1_1 = 0 - 5, 7, 14) or (acc_type_2 = 50 - 67 AND p_crash1_2 = 0 - 5, 7, 14)
	19b	(p_crash2_1 = 54, 62, 63 AND p_crash1_1 = 0 - 5, 7, 14 and ve_forms = 1) or (p_crash2_2 = 54, 62, 63 AND p_crash1_2 = 0 - 5, 7, 14 and ve_forms = 1)
Rear-end/striking maneuver	20a	(acc_type_1 = 20 - 43 AND p_crash1_1 = 6, 8 - 12, 15 - 99 AND h_impct1_1 = 1-3,9-12,62,82) or (acc_type_2 = 20 - 43 AND p_crash1_2 = 6, 8 - 12, 15 - 99 AND h_impct1_2 = 1-3,9-12,62,82)
	20b	(acc_type_1 = 20 - 43 AND p_crash1_1 = 13 AND h_impct1_1 = 3-9,63,83) or (acc_type_2 = 20 - 43 AND p_crash1_2 = 13 AND h_impct1_2 = 3-9,63,83)
	20c	(acc_type_1 = 20 - 43 AND p_crash1_1 = 6, 8 - 12, 15 - 99 AND h_impct1_1 = 1-3,9-12,62,82 AND p_crash2_1 = 50, 51, 52) or (acc_type_2 = 20 - 43 AND p_crash1_2 = 6, 8 - 12, 15 - 99 AND h_impct1_2 = 1-3,9-12,62,82 AND p_crash2_2 = 50, 51, 52)
	20d	(acc_type_1 = 20 - 43 AND p_crash1_1 = 13 AND p_crash2_1 = 50, 51, 52 AND h_impct1_1 = 3-9,63,83) or (acc_type_2 = 20 - 43 AND p_crash1_2 = 13 AND p_crash2_2 = 50, 51, 52 AND h_impct1_2 = 3-9,63,83)
Rear-end/LVA	21a	(acc_type_1 = 20 - 43 AND p_crash1_1 = 3, 4 AND h_impct1_1 in (5,6,7,63,83) or (acc_type_2 = 20 - 43 AND p_crash1_2 = 3, 4 AND h_impct1_2 in (5,6,7,63,83)
	21b	(acc_type_1 = 20 - 43 AND p_crash1_1 = 3, 4 AND p_crash2_1 = 53) or (acc_type_2 = 20 - 43 AND p_crash1_2 = 3, 4 AND p_crash2_2 = 53)
Rear-end/LVM	22a	acc_type_1 = 25 - 27 or acc_type_2 = 25 - 27
	22b	(acc_type_1 = 20 - 43 AND p_crash1_1 = 1, 14 AND h_impct1_1= 5,6,7,63,83) or (acc_type_2 = 20 - 43 AND p_crash1_2 = 1, 14 AND h_impct1_2= 5,6,7,63,83)
	22c	(acc_type_1 = 20 - 43 AND p_crash2= 51_1 and h_impct_1 = 1,11,12,62,82) or (acc_type_2 = 20 - 43 AND p_crash2= 51_2 and h_impct_2 = 1,11,12,62,82)
	22d	p_crash2_1 = 51 or p_crash2_2 = 51
	22e	(p_crash1_1 = 1, 14 AND p_crash2_1 = 53) or (p_crash1_2 = 1, 14 AND p_crash2_2 = 53)

Scenario	Sub-group	FARS and GES Variable Codes (The suffixes _1 and _2 represent the respective vehicles involved in the critical event.)
Rear-end/LVD	23a	acc_type_1 = 29 - 31 or acc_type_2 = 29 - 31
	23b	(acc_type_1 = 20 - 43 AND p_crash1_1 = 2 AND h_impct1_1 = 5,6,7,63,83) or (acc_type_2 = 20 - 43 AND p_crash1_2 = 2 AND h_impct1_2 = 5,6,7,63,83)
	23c	(acc_type_1 = 20 - 43 AND p_crash2_1 = 52 AND h_impct1_1 = 1,11,12,62,82) or (acc_type_2 = 20 - 43 AND p_crash2_2 = 52 AND h_impct1_2 = 1,11,12,62,82)
	23d	p_crash2_1 = 52 or p_crash2_2 = 52
	23e	(p_crash1_1 = 2 AND p_crash2_1 = 53) or (p_crash1_2 = 2 AND p_crash2_2 = 53)
Rear-end/LVS	24a	acc_type_1 = 21 - 23 or acc_type_2 = 21 - 23
	24b	(acc_type_1 = 20 - 43 AND p_crash1_1 = 5, 7 AND h_impct1_1 = 5,6,7,63,83) or (acc_type_2 = 20 - 43 AND p_crash1_2 = 5, 7 AND h_impct1_2 = 5,6,7,63,83)
	24c	(acc_type_1 = 20 - 43 AND p_crash2_1 = 50 AND h_impct1_1 = 1,11,12,62,82) or (acc_type_2 = 20 - 43 AND p_crash2_2 = 50 AND h_impct1_2 = 1,11,12,62,82)
	24d	p_crash2_1 = 50 or p_crash2_2 = 50
	24e	(p_crash1_1 = 5, 7 AND p_crash2_1 = 53) or (p_crash1_2 = 5, 7 AND p_crash2_2 = 53)
	24f	(acc_type_1 = 20 - 43 AND (p_crash1_1 = 1 AND p_crash1_2 = 0) or (acc_type_2 = 20 - 43 AND (p_crash1_2 = 1 AND p_crash1_1 = 0)
Right turn into path (RTIP)	25a	acc_type_1 = 78 , 79 or acc_type_2 = 78 , 79
	25b	(p_crash1_1 = 10 AND p_crash2_1 = 65, 70) or (p_crash1_2 = 10 AND p_crash2_2 = 65, 70)
	25c	(p_crash2_1 = 16 AND p_crash2_2 = 65, 70) or (p_crash2_2 = 16 AND p_crash2_1 = 65, 70)
Right turn across path (RTAP)	26a	acc_type_1 = 80 , 81 or acc_type_2 = 80 , 81
	26b	(p_crash1= 10_1 AND p_crash2_1 = 67, 72) or (p_crash1_2 = 10 AND p_crash2_2 = 67, 72)
	26c	(p_crash2_1 = 16 AND p_crash2_2 = 67, 72) or (p_crash2_2 = 16 AND p_crash2_1 = 67, 72)
Straight crossing paths (SCP)	27a	acc_type_1 = 86 - 91or acc_type_2 = 86 - 91
	27b	(p_crash1_1 not =10 -12 AND p_crash2_1 = 66, 71) or (p_crash1_2 not =10 -12 AND p_crash2_2 = 66, 71)
	27c	(p_crash2_1 not = 15, 16 AND p_crash2_2 = 66, 71) or (p_crash2_2 not = 15, 16 AND p_crash2_1 = 66, 71)
Left turn across path, lateral direction (LTAP/LD)	28a	acc_type_1 = 82 , 83 or acc_type_2 = 82 , 83
Left turn into path (LTIP)	29a	acc_type_1 = 76 , 77 or acc_type_2 = 76 , 77
Left turn across path, opposite direction (LTAP/OD)	30a	acc_type_1 = 68, 69 or acc_type_2 = 68, 69
	30b	(p_crash1_1 =11 AND p_crash2_1= 54, 62, 63) or (p_crash1_2 =11 AND p_crash2_2= 54, 62, 63)
	30c	(p_crash2_1 = 15 AND p_crash2_2 = 54, 62, 63) or (p_crash2_2 = 15 AND p_crash2_1 = 54, 62, 63)
Avoidance/maneuver	31a	(acc_type_1 = 3, 8 AND p_crash1_1 = 6, 8 - 13, 15 - 99) or (acc_type_2 = 3, 8 AND p_crash1_2 = 6, 8 - 13, 15 - 99)
	31b	(p_crash2_1 = 50 - 78 AND p_crash1_1 = 6, 8 - 13, 15 - 99) or (p_crash2_2 = 50 - 78 AND p_crash1_2 = 6, 8 - 13, 15 - 99)
Avoidance/no maneuver	32a	(acc_type_1 = 3, 8 AND p_crash1_1 = 1 - 5, 7, 14) or (acc_type_2 = 3, 8 AND p_crash1_2 = 1 - 5, 7, 14)
	32b	(p_crash2_1 = 50 - 78 AND p_crash1_1 = 1 - 5, 7, 14) or (p_crash2_2 = 50 - 78 AND p_crash1_2 = 1 - 5, 7, 14)
Rollover	33a	rollover_1 = 2 or rollover_2 = 2
	33b	vnum2 in (5555,9999) AND (first event) SOE=1
Noncollision - No Impact	34a	vnum2 in (5555,9999) AND (first event) SOE=2-7, 16, 44, 51, 72
	34b	acc_type_1 = 0 or acc_type_2 = 0
Object/maneuver	35a	(p_crash2_1 = 90, 91, 92 AND p_crash1_1 = 6, 8 - 13, 15 - 99) or (p_crash2_2 = 90, 91, 92 AND p_crash1_2 = 6, 8 - 13, 15 - 99)
	35b	(acc_type_1 = 11,12 AND p_crash1_1 = 6, 8 - 13, 15 - 99) or (acc_type_1 = 11,12 AND p_crash1_1 = 6, 8 - 13, 15 - 99)
	35c	(vnum2 =5555,9999 AND (first event) SOE =10,14,17-21,23-26,30-35 38-43 45-46,48-50 52,53,57-59,73 AND p_crash1_1 = 6, 8-13,15-99) or (vnum2 =5555,9999 AND (first event) SOE =10,14,17-21,23-26,30-35 38-43 45-46,48-50 52,53,57-59,73 AND p_crash1_2 = 6, 8-13,15-99)
	35d	(acc_type_1 = 15,16 and p_crash1_1 = 6, 8 - 13, 15 - 99 and (first event) SOE = 10, 14, 17 - 21, 23 - 26, 30 - 35, 38 - 43, 45 - 46, 48 - 50, 52,53, 57-59,73) or (acc_type_1 = 15,16 and p_crash1_1 = 6, 8 - 13, 15 - 99 and (first event) SOE = 10, 14, 17 - 21, 23 - 26, 30 - 35, 38 - 43, 45 - 46, 48 - 50, 52,53, 57-59,73)

Scenario	Sub-group	FARS and GES Variable Codes (The suffixes _1 and _2 represent the respective vehicles involved in the critical event.)
Object/no maneuver	36a	(p_crash2_1 = 90, 91, 92 AND p_crash1_1 = 1 - 5, 7, 14) or (p_crash2_2 = 90, 91, 92 AND p_crash1_2 = 1 - 5, 7, 14)
	36b	(acc_type_1 = 11,12 AND p_crash1_1 = 1 - 5, 7, 14) or (acc_type_2 = 11,12 AND p_crash1_2 = 1 - 5, 7, 14)
	36c	(vnum2 = 5555,9999 AND (first event) SOE =10,14,17-21,23-26,30-35,38-43,45-46,48-50,52,53,57-59,73 AND p_crash1_1 = 1 -5,7,14) or (vnum2 = 5555,9999 AND (first event) SOE =10,14,17-21,23-26,30-35,38-43,45-46,48-50,52,53,57-59,73 AND p_crash1_2 = 1 -5,7,14)
	36d	(p_crash1_1 = 0 and p_crash2_1 = 90, 91, 92) or (p_crash1_2 = 0 and p_crash2_2 = 90, 91, 92)
	36e	(acc_type_1 = 15,16 and p_crash1_1 = 1 - 5, 7, 14 and (first event) SOE = 10,14,17-21 23-26,30-35,38-43,45-46,48-50 52,53, 57-59,73) or (acc_type_1 = 15,16 and p_crash1_1 = 1 - 5, 7, 14 and (first event) SOE = 10,14,17-21 23-26,30-35,38-43,45-46,48-50 52,53, 57-59,73)
Hit and run	37a	hitrun_1 = 1 or hitrun_2 = 1
Other - Rear-End	38a	acc_type_1 = 20 - 43 or acc_type_2 = 20 - 43
Other - Sideswipe	39a	acc_type_1 = 44 - 49 or acc_type_2 = 44 - 49
Other - Opposite Direction	40a	acc_type_1 = 50 - 67 or acc_type_2 = 50 - 67
Other - Turn Across Path	41a	acc_type_1 = 68 - 75 or acc_type_2 = 68 - 75
	42b	(p_crash2_1 = 15,16 AND p_crash2_2 = 66) or (p_crash2_2 = 15,16 AND p_crash2_1 = 66)
Other - Turn Into Path	42a	acc_type_1 = 76 - 85 or acc_type_2 = 76 - 85
	42b	(p_crash2_1 = 15,16 AND p_crash2_2 = 71) or (p_crash2_2 = 15,16 AND p_crash2_1 = 71)
Other - Straight Paths	43a	acc_type_1 = 86 - 91 or acc_type_2 = 86 - 91

Coding Attributes for LV Making the Critical Action

Scenario No.	Pre-Crash Scenario	Light-Vehicle Critical Action Criterion (Host Vehicle) Database Variable Attribute				
		ACC_TYPE	P_CRASH1	P_CRASH2	AOI	SOE
1	Vehicle failure			1,2,3,4		61,62
2	Control loss/vehicle action	2,7,34,36,54,56	2,3,4,6,8,9,10,11,12,13,15,16,17,98,	5,6,8,9		51
3	Control loss/no vehicle action	2,7,34,36,54,56	0,1,14	5,6,8,9		51
4	Road edge departure/maneuver	1,4,5,6,9,10,14	6, 8,9,10,11,12,15,16,17,98,99	10,11,12,13,14		63,64,65,79
5	Road edge departure/no maneuver	1,4,5,6,9,10,14	0,1 - 5, 7, 14	10,11,12,13,14		63,64,65,79
6	Road edge departure/backing	1,6,14,92	13	10,11,12,13,14		63,64,65,79
7	Animal/maneuver	13	6, 8 - 13, 15 - 99	87,88,89		11
8	Animal/no maneuver	13	0,1 - 5, 7, 14	87,88,89		11
9	Pedestrian/maneuver	13	6, 8 - 13, 15 - 99	80,81,82		8,15
10	Pedestrian/no maneuver	13	0,1 - 5, 7, 14	80,81,82		8,15
11	Cyclist/maneuver		6, 8 - 13, 15 - 99	83,84,85		9
12	Cyclist/no maneuver		0,1 - 5, 7, 14	83,84,85		9
13	Backing into vehicle	92	13			
14	Turning/same direction	46,47,70,72	10,11,12,15,16			
15	Parking/same direction	11	8,9			
16	Changing lanes/same direction	46,47,70,72	6,15,16	10,11,12,13,14, 15,16,17,50		
17	Drifting/same direction	46,47,70,72	6,15,16	10,11,12,13,14, 15,16,17,50		
18	Opposite direction/maneuver	50,54,56,58,60,64,52,53,62,63,66,67	6, 8 - 13, 15 - 99			
19	Opposite direction/no maneuver	50,54,56,58,60,64,52,53,62,63,66,67	0,1 - 5, 7, 14			
20	Rear-end/striking maneuver	20,24,28,34,36,38,40	6, 8 - 13, 15 - 99			
21	Rear-end/LVA	20,24,28,34,36,38,40	3,4			
22	Rear-end/LVM	20,24,28,34,36,38,40		51	1,11,12,62,82	
23	Rear-end/LVD	20,24,28,34,36,38,40		52	1,11,12,62,82	
24	Rear-end/LVS	20,24,28,34,36,38,40		50	1,11,12,62,82	
25	RTIP - Right turn into path	78	10	16		
26	RTAP - Right turn across path	80	10	16		
27	SCP					
28	LTAP/LD	82	11	15		
29	LTIP - Left turn into path	76	11	15		
30	LTAP/OD	68	11	15		
31	Evasive maneuver/maneuver	3,8,34,36,38,40,54,56,58,60	6, 8 - 13, 15 - 99	50-78		
32	Evasive maneuver/no maneuver	3,8,34,36,38,40,54,56,58,60	0,1 - 5, 7, 14,17	50-78		
33	Rollover					1
34	Noncollision - No Impact	0				
35	Object/maneuver	11,12,15,16	6, 8 - 13, 15 - 99	90,91,92		
36	Object/no maneuver	11,12,15,16	1 - 5, 7, 14	90,91,92		
37	Hit and run					
38	Other - Rear-End					
39	Other - Sideswipe		10,11,12,15,16	10,11,12,13,14, 15,16,17,50		
40	Other - Opposite Direction					
41	Other - Turn Across Path		10,11,12	15,16		
42	Other - Turn Into Path		10,11,12	15,16		
43	Other - Straight Paths					
99	Other					

* with single vehicle and vnum2=5555,9999

Note: Depending on the scenario, the critical action refers to whether the vehicle is turning, changing lanes, striking, maneuvering, etc. (refer to Table 2 for definition of vehicle action). In some cases, it is unknown which vehicle is making the critical action and for these, the first light vehicle coded in the databases is used.

Appendix B: Pre-Crash Scenario Statistics

Table 10. Fatal Crashes by Pre-Crash Scenario

Scenario	Crashes Involving a Light Vehicle in the Critical Event			Crashes Where the Light Vehicle is Making the Critical Action		
	Fatal Crashes	%	Cumulative %	Fatal Crashes	%	Cumulative %
Road Edge Departure/No Maneuver	6,284	24.0%	24.0%	6,252	24.7%	24.7%
Control Loss/No Vehicle Action	4,124	15.7%	39.7%	4,065	16.0%	40.7%
Pedestrian/No Maneuver	3,409	13.0%	52.7%	3,408	13.4%	54.1%
Opposite Direction/No Maneuver	2,983	11.4%	64.1%	2,983	11.8%	65.9%
Straight Crossing Paths (SCP)	2,206	8.4%	72.6%	2,206	8.7%	74.6%
Left Turn Across Path, Opp. Dir. (LTAP/OD)	1,192	4.6%	77.1%	1,131	4.5%	79.1%
Rear-End/LVS	667	2.5%	79.7%	519	2.0%	81.1%
Rear-End/Lead Vehicle Moving (LVM)	647	2.5%	82.1%	503	2.0%	83.1%
Left Turn Across Path, Lat. Dir. (LTAP/LD)	555	2.1%	84.2%	521	2.1%	85.2%
Pedal Cyclist/No Maneuver	456	1.7%	86.0%	456	1.8%	87.0%
Control Loss/Vehicle Action	405	1.5%	87.5%	391	1.5%	88.5%
Changing Lanes/Same Direction	360	1.4%	88.9%	285	1.1%	89.6%
Pedestrian/Maneuver	323	1.2%	90.1%	323	1.3%	90.9%
Opposite Direction/Maneuver	305	1.2%	91.3%	275	1.1%	92.0%
Road Edge Departure/Maneuver	252	1.0%	92.3%	249	1.0%	93.0%
Turning/Same Direction	222	0.8%	93.1%	188	0.7%	93.7%
Vehicle Failure	216	0.8%	93.9%	206	0.8%	94.5%
Drifting/Same Direction	196	0.7%	94.7%	196	0.8%	95.3%
Rear-End/LVD	196	0.7%	95.4%	140	0.6%	95.9%
Noncollision - No Impact	173	0.7%	96.1%	173	0.7%	96.5%
Object/No Maneuver	151	0.6%	96.7%	148	0.6%	97.1%
Avoidance/No Maneuver	133	0.5%	97.2%	93	0.4%	97.5%
Parking/Same Direction	97	0.4%	97.5%	83	0.3%	97.8%
Animal/No Maneuver	96	0.4%	97.9%	96	0.4%	98.2%
Rear-End/Striking Maneuver	88	0.3%	98.2%	63	0.2%	98.4%
Other	73	0.3%	98.5%	56	0.2%	98.7%
Pedal Cyclist/Maneuver	62	0.2%	98.8%	62	0.2%	98.9%
Right Turn Into Path (RTIP)	59	0.2%	99.0%	51	0.2%	99.1%
Left Turn Into Path (LTIP)	55	0.2%	99.2%	49	0.2%	99.3%
Road Edge Departure/Backing	43	0.2%	99.4%	43	0.2%	99.5%
Avoidance/Maneuver	31	0.1%	99.5%	26	0.1%	99.6%
Backing into Vehicle	30	0.1%	99.6%	18	0.1%	99.6%
Rear-End/Lead Vehicle Accelerating (LVA)	25	0.1%	99.7%	19	0.1%	99.7%
Rollover	24	0.1%	99.8%	24	0.1%	99.8%
Right Turn Across Path (RTAP)	18	0.1%	99.8%	13	0.1%	99.9%
Object/Maneuver	15	0.1%	99.9%	14	0.1%	99.9%
Other - Turn Into Path	7	0.0%	99.9%	6	0.0%	99.9%
Animal/Maneuver	7	0.0%	100.0%	6	0.0%	100.0%
Hit and Run	6	0.0%	100.0%	3	0.0%	100.0%
Other - Turn Across Path	5	0.0%	100.0%	4	0.0%	100.0%
Other - Rear-End	1	0.0%	100.0%	1	0.0%	100.0%
Other - Sideswipe	0	0.0%	100.0%	0	0.0%	100.0%
Total	26,197	100%		25,350	100%	

Note: Values based on average of 2011-2015 FARS data.

Table 11. All Crashes by Pre-Crash Scenario

Scenario	Crashes Involving a Light Vehicle in the Critical Event			Crashes Where the Light Vehicle is Making the Critical Action		
	All Crashes	%	Cumulative %	All Crashes	%	Cumulative %
Rear-End/LVS	1,050,558	18.6%	18.6%	1,026,054	18.7%	18.7%
Road edge departure/No Maneuver	472,182	8.3%	26.9%	464,367	8.5%	27.2%
Straight Crossing Paths (SCP)	434,374	7.7%	34.6%	434,374	7.9%	35.1%
Rear-End/LVD	412,536	7.3%	41.9%	400,005	7.3%	42.4%
Control Loss/No Vehicle Action	399,439	7.1%	48.9%	397,530	7.3%	49.7%
Changing Lanes/Same Direction	348,464	6.2%	55.1%	320,052	5.8%	55.5%
Left Turn Across Path, Opp. Dir. (LTAP/OD)	329,410	5.8%	60.9%	321,965	5.9%	61.4%
Animal/No Maneuver	295,273	5.2%	66.1%	295,139	5.4%	66.8%
Rear-End/Lead Vehicle Moving (LVM)	214,001	3.8%	69.9%	206,589	3.8%	70.5%
Turning/Same Direction	194,303	3.4%	73.4%	170,549	3.1%	73.6%
Left Turn Across Path, Lat. Dir. (LTAP/LD)	193,102	3.4%	76.8%	186,582	3.4%	77.1%
Drifting/Same Direction	120,223	2.1%	78.9%	120,223	2.2%	79.2%
Backing into Vehicle	113,685	2.0%	80.9%	100,624	1.8%	81.1%
Opposite Direction/No Maneuver	96,095	1.7%	82.6%	96,095	1.8%	82.8%
Right Turn Into Path (RTIP)	91,191	1.6%	84.2%	87,991	1.6%	84.4%
Road Edge Departure/Maneuver	90,382	1.6%	85.8%	82,731	1.5%	86.0%
Left Turn Into Path (LTIP)	80,585	1.4%	87.2%	78,108	1.4%	87.4%
Object/No Maneuver	80,088	1.4%	88.7%	76,533	1.4%	88.8%
Avoidance/No Maneuver	79,713	1.4%	90.1%	77,377	1.4%	90.2%
Control Loss/Vehicle Action	73,952	1.3%	91.4%	73,203	1.3%	91.5%
Road Edge Departure/Backing	70,025	1.2%	92.6%	65,926	1.2%	92.7%
Rear-End/Striking Maneuver	57,224	1.0%	93.6%	55,494	1.0%	93.7%
Pedestrian/No Maneuver	41,094	0.7%	94.4%	41,071	0.7%	94.5%
Vehicle Failure	39,359	0.7%	95.1%	38,576	0.7%	95.2%
Parking/Same Direction	34,898	0.6%	95.7%	33,276	0.6%	95.8%
Pedestrian/Maneuver	28,018	0.5%	96.2%	27,977	0.5%	96.3%
Other	27,061	0.5%	96.6%	21,641	0.4%	96.7%
Pedal Cyclist/No Maneuver	26,149	0.5%	97.1%	26,149	0.5%	97.2%
Right Turn Across Path (RTAP)	23,451	0.4%	97.5%	22,254	0.4%	97.6%
Pedal Cyclist/Maneuver	23,019	0.4%	97.9%	23,019	0.4%	98.0%
Rear-End/Lead Vehicle Accelerating (LVA)	22,008	0.4%	98.3%	21,574	0.4%	98.4%
Avoidance/Maneuver	21,152	0.4%	98.7%	20,004	0.4%	98.8%
Hit and Run	19,604	0.3%	99.0%	17,364	0.3%	99.1%
Object/Maneuver	16,417	0.3%	99.3%	14,356	0.3%	99.3%
Other - Turn Across Path	13,127	0.2%	99.6%	11,535	0.2%	99.6%
Noncollision - No Impact	10,496	0.2%	99.7%	10,496	0.2%	99.7%
Other - Turn Into Path	5,581	0.1%	99.8%	5,301	0.1%	99.8%
Opposite Direction/Maneuver	4,897	0.1%	99.9%	4,691	0.1%	99.9%
Animal/Maneuver	2,833	0.1%	100.0%	2,829	0.1%	100.0%
Rollover	1,069	0.0%	100.0%	1,069	0.0%	100.0%
Other - Sideswipe	141	0.0%	100.0%	94	0.0%	100.0%
Other - Rear-End	102	0.0%	100.0%	102	0.0%	100.0%
Total	5,657,279	100.0%		5,480,886	100%	

Note: Values based on average of 2011-2015 GES data.

Table 12. LV Pre-Crash Scenario Crash Measures

#	Scenario	Crashes Involving a Light Vehicle in the Critical Event		Crashes Where the Light Vehicle is Making the Critical Action						
				Total		No. of Crashes per Billion Light Vehicle Miles Traveled		Cost ($ Millions)	Equivalent Lives	No. of Fatal Crashes per Thousand Crashes
		Fatal	All	Fatal	All	Fatal	All			
1	Vehicle Failure	216	39,359	206	38,576	0.08	14	$ 5,029	550	5.3
2	Control Loss/Vehicle Action	405	73,952	391	73,203	0.14	27	$ 7,758	848	5.3
3	Control Loss/No Vehicle Action	4,124	399,439	4,065	397,530	1.50	147	$ 69,749	7,626	10.2
4	Road Edge Departure/Maneuver	252	90,382	249	82,731	0.09	31	$ 6,029	659	3.0
5	Road edge departure/No Maneuver	6,284	472,182	6,252	464,367	2.31	171	$ 91,707	10,027	13.5
6	Road Edge Departure/Backing	43	70,025	43	65,926	0.02	24	$ 1,827	200	0.7
7	Animal/Maneuver	7	2,833	6	2,829	0.00	1	$ 171	19	2.3
8	Animal/No Maneuver	96	295,273	96	295,139	0.04	109	$ 6,060	663	0.3
9	Pedestrian/Maneuver	323	28,018	323	27,977	0.12	10	$ 7,417	811	11.5
10	Pedestrian/No Maneuver	3,409	42,507	3,408	42,484	1.26	16	$ 39,926	4,365	80.2
11	Pedal Cyclist/Maneuver	62	23,019	62	23,019	0.02	9	$ 3,923	429	2.7
12	Pedal Cyclist/No Maneuver	456	24,908	456	24,908	0.17	9	$ 8,223	899	18.3
13	Backing into Vehicle	30	113,685	18	100,624	0.01	37	$ 2,407	263	0.2
14	Turning/Same Direction	222	194,303	188	170,549	0.07	63	$ 9,181	1,004	1.1
15	Parking/Same Direction	97	34,898	83	33,276	0.03	12	$ 2,409	263	2.5
16	Changing Lanes/Same Direction	360	348,464	285	320,052	0.11	118	$ 14,473	1,582	0.9
17	Drifting/Same Direction	196	120,223	196	120,223	0.07	44	$ 6,872	751	1.6
18	Opposite Direction/Maneuver	305	4,897	275	4,691	0.10	2	$ 3,969	434	58.6
19	Opposite Direction/No Maneuver	2,983	96,095	2,983	96,095	1.10	36	$ 44,285	4,842	31.0
20	Rear-End/Striking Maneuver	88	57,224	63	55,494	0.02	20	$ 3,272	358	1.1
21	Rear-End/Lead Vehicle Accelerating (LVA)	25	22,008	19	21,574	0.01	8	$ 1,274	139	0.9
22	Rear-End/Lead Vehicle Moving (LVM)	647	214,001	503	206,589	0.19	76	$ 17,863	1,953	2.4
23	Rear-End/LVD	196	412,536	140	400,005	0.05	148	$ 23,464	2,566	0.4
24	Rear-End/LVS	667	1,050,558	519	1,026,054	0.19	379	$ 60,641	6,630	0.5
25	Right Turn Into Path (RTIP)	59	91,191	51	87,991	0.02	32	$ 4,308	471	0.6
26	Right Turn Across Path (RTAP)	18	23,451	13	22,254	0.00	8	$ 1,114	122	0.6
27	Straight Crossing Paths (SCP)	2,206	434,374	2,206	434,374	0.82	161	$ 63,557	6,949	5.1
28	Left Turn Across Path, Lat. Dir. (LTAP/LD)	555	193,102	521	186,582	0.19	69	$ 19,911	2,177	2.8
29	Left Turn Into Path (LTIP)	55	80,585	49	78,108	0.02	29	$ 3,905	427	0.6
30	Left Turn Across Path, Opp. Dir. (LTAP/OD)	1,192	329,410	1,131	321,965	0.42	119	$ 42,610	4,659	3.5
31	Avoidance/Maneuver	31	21,152	26	20,004	0.01	7	$ 983	108	1.3
32	Avoidance/No Maneuver	133	79,713	93	77,377	0.03	29	$ 5,236	573	1.2
Other	Rollover	24	1,069	24	1,069	0.01	0	$ 360	39	22.3
33	Noncollision - No Impact	173	10,496	173	10,496	0.06	4	$ 2,293	251	16.5
34	Object/Maneuver	15	16,417	14	14,356	0.01	5	$ 515	56	1.0
35	Object/No Maneuver	151	80,088	148	76,533	0.05	28	$ 3,688	403	1.9
Other	Hit and Run	6	19,540	3	17,300	0.00	6	$ 532	58	0.2
	Other - Rear-End	1	102	1	102	0.00	0	$ 12	1	7.9
	Other - Sideswipe	0	141	0	94	0.00	0	$ 5	1	2.1
	Other - Turn Across Path	5	13,127	4	11,535	0.00	4	$ 341	37	0.4
	Other - Turn Into Path	7	5,581	6	5,301	0.00	2	$ 234	26	1.2
	Other	73	26,953	56	21,533	0.02	8	$ 1,208	132	2.6
	Total	26,197	5,657,279	25,350	5,480,886	9.37	2,025	$ 588,743	64,372	4.6

Notes:

1. Values based on average of 2011-2015 FARS and GES data.
2. Pre-crash scenarios are shown in the prioritized order mentioned in Section 2.1.
3. Individual rankings of statistics for crashes where the LV is making the critical action are shown in Table 13.

Table 13. Light-Vehicle Scenario Groups and Associated Crash Measures

Scenario Group	Scenario	Crashes Involving a Light Vehicle in the Critical Event		Crashes Where the Light Vehicle is Making the Critical Action													
				Total Crashes				No. of Crashes per Billion Light Vehicle Miles Traveled				Cost ($ Millions)	Rank	Equivalent Lives	Rank	No. of Fatal Crashes per Thousand Crashes	Rank
		Fatal	All	Fatal	Rank	All	Rank	Fatal	Rank	All	Rank						
Control Loss	Control Loss/Vehicle Action	405	73,952	391	11	73,203	20	0.14	11	27	20	$ 7,758	14	848	14	5.34	11
	Control Loss/No Vehicle Action	4,124	399,439	4,065	2	397,530	5	1.50	2	147	5	$ 69,749	2	7,626	2	10.23	9
	Total	**4,529**	**473,392**	**4,456**		**470,733**		**1.65**		**174**		**$ 77,507**		**8,474**		**9.47**	
Road Departure	Road Edge Departure/Maneuver	252	90,382	249	15	82,731	16	0.09	15	31	16	$ 6,029	18	659	18	3.00	15
	Road edge departure/No Maneuver	6,284	472,182	6,252	1	464,367	2	2.32	1	172	2	$ 91,707	1	10,027	1	13.46	7
	Total	**6,536**	**562,564**	**6,500**		**547,098**		**2.41**		**202**		**$ 97,737**		**10,686**		**11.88**	
Animal	Animal/Maneuver	7	2833	6	37	2,829	39	0.00	37	1	39	$ 171	40	19	40	2.26	21
	Animal/No Maneuver	96	295273	96	22	295,139	8	0.04	22	109	8	$ 6,060	17	663	17	0.32	40
	Total	**103**	**298,106**	**102**		**297,968**		**0.04**		**110**		**$ 6,231**		**681**		**0.34**	
Pedestrian	Pedestrian/Maneuver	323	28018	323	12	27,977	26	0.12	12	10	26	$ 7,417	15	811	15	11.55	8
	Pedestrian/No Maneuver	3409	42507	3408	3	42,484	23	1.26	3	16	23	$ 39,926	7	4,365	7	80.22	1
	Total	**3,732**	**70,525**	**3,731**		**70,461**		**1.38**		**26**		**$ 47,342**		**5,176**		**52.95**	
Pedal Cyclist	Pedal Cyclist/Maneuver	62	23,019	62	26	23,019	28	0.02	26	9	28	$ 3,923	23	429	23	2.68	17
	Pedal Cyclist/No Maneuver	456	24,908	456	10	24,908	27	0.17	10	9	27	$ 8,223	13	899	13	18.32	5
	Total	**518**	**47,927**	**518**		**47,927**		**0.19**		**18**		**$ 12,146**		**1,328**		**10.81**	
Lane Change	Turning/Same Direction	222	194303	188	18	170,549	11	0.07	18	63	11	$ 9,181	12	1,004	12	1.10	29
	Parking/Same Direction	97	34898	83	24	33,276	25	0.03	24	12	25	$ 2,409	27	263	27	2.48	19
	Changing Lanes/Same Direction	360	348464	285	13	320,052	7	0.11	13	118	7	$ 14,473	11	1,582	11	0.89	31
	Drifting/Same Direction	196	120223	196	17	120,223	12	0.07	17	44	12	$ 6,872	16	751	16	1.63	24
	Total	**875**	**697,888**	**752**		**644,099**		**0.28**		**238**		**$ 32,935**		**3,601**		**1.17**	
Opposite Direction	Opposite Direction/Maneuver	305	4897	275	14	4,691	38	0.10	14	2	38	$ 3,969	22	434	22	58.63	2
	Opposite Direction/No Maneuver	2983	96095	2983	4	96,095	14	1.10	4	36	14	$ 44,285	5	4,842	5	31.04	3
	Total	**3,288**	**100,993**	**3,258**		**100,786**		**1.20**		**37**		**$ 48,255**		**5,276**		**32.33**	
Rear-End	Rear-End/Striking Maneuver	88	57,224	63	25	55,494	22	0.02	25	20	22	$ 3,272	26	358	26	1.13	28
	Rear-End/Lead Vehicle Accelerating (LVA)	25	22008	19	33	21,574	30	0.01	33	8	30	$ 1,274	31	139	31	0.89	32
	Rear-End/Lead Vehicle Moving (LVM)	647	214001	503	9	206,589	9	0.19	9	76	9	$ 17,863	10	1,953	10	2.43	20
	Rear-End/LVD	196	412,536	140	21	400,005	4	0.05	21	148	4	$ 23,464	8	2,566	8	0.35	39
	Rear-End/LVS	667	1,050,558	519	8	1,026,054	1	0.19	8	379	1	$ 60,641	4	6,630	4	0.51	37
	Total	**1,623**	**1,756,327**	**1,245**		**1,709,717**		**0.46**		**632**		**$ 106,515**		**11,646**		**0.73**	

Table 13. Light-Vehicle Scenario Groups and Associated Crash Measures (cont.)

Scenario Group	Scenario	Crashes Involving a Light Vehicle in the Critical Event		Crashes Where the Light Vehicle is Making the Critical Action													
				Total Crashes				No. of Crashes per Billion Light Vehicle Miles Traveled				Cost ($ Millions)	Rank	Equivalent Lives	Rank	No. of Fatal Crashes per Thousand Crashes	Rank
		Fatal	All	Fatal	Rank	All	Rank	Fatal	Rank	All	Rank						
Lateral Crossing Paths	Right Turn Into Path (RTIP)	59	91,191	51	28	87,991	15	0.02	28	32	15	$ 4,308	21	471	21	0.582	36
	Right Turn Across Path (RTAP)	18	23,451	13	36	22,254	29	0.00	36	8	29	$ 1,114	33	122	33	0.584	35
	Straight Crossing Paths (SCP)	2,206	434,374	2,206	5	434,374	3	0.82	5	161	3	$ 63,557	3	6,949	3	5.079	13
	Left Turn Across Path, Lat. Dir. (LTAP/LD)	555	193,102	521	7	186,582	10	0.19	7	69	10	$ 19,911	9	2,177	9	2.793	16
	Left Turn Into Path (LTIP)	55	80,585	49	29	78,108	17	0.02	29	29	17	$ 3,905	24	427	24	0.627	34
	Total	**2,894**	**822,702**	**2,841**		**809,308**		**1.05**		**299**		**$ 92,795**		**10,146**		**3.510**	
LTAP/OD	Left Turn Across Path, Opp. Dir. (LTAP/OD)	1,192	329,410	1,131	6	321,965	6	0.42	6	119	6	$ 42,610	6	4,659	6	3.513	14
	Total	**1,192**	**329,410**	**1,131**		**321,965**		**0.42**		**119**		**$ 42,610**		**4,659**		**3.513**	
Other	Vehicle Failure	216	39,359	206	16	38,576	24	0.08	16	14	24	$ 5,029	20	550	20	5.335	12
	Road Edge Departure/Backing	43	70,025	43	30	65,926	21	0.02	30	24	21	$ 1,827	30	200	30	0.652	33
	Backing into Vehicle	30	113,685	18	34	100,624	13	0.01	34	37	13	$ 2,407	28	263	28	0.177	42
	Avoidance/Maneuver	31	21,152	26	31	20,004	32	0.01	31	7	32	$ 983	34	108	34	1.280	25
	Avoidance/No Maneuver	133	79,713	93	23	77,377	18	0.03	23	29	18	$ 5,236	19	573	19	1.197	27
	Rollover	24	1,069	24	32	1,069	40	0.01	32	0	40	$ 360	37	39	37	22.268	4
	Noncollision - No Impact	173	10,496	173	19	10,496	36	0.06	19	4	36	$ 2,293	29	251	29	16.521	6
	Object/Maneuver	15	16,417	14	35	14,356	34	0.01	35	5	34	$ 515	36	56	36	1.003	30
	Object/No Maneuver	151	80,088	148	20	76,533	19	0.05	20	28	19	$ 3,688	25	403	25	1.936	23
	Hit and Run	6	19,540	3	40	17,300	33	0.00	40	6	33	$ 532	35	58	35	0.197	41
	Other - Rear-End	1	102	1	41	102	41	0.00	41	0	41	$ 12	41	1	41	7.879	10
	Other - Sideswipe	0	141	0	42	94	42	0.00	42	0	42	$ 5	42	1	42	2.135	22
	Other - Turn Across Path	5	13,127	4	39	11,535	35	0.00	39	4	35	$ 341	38	37	38	0.364	38
	Other - Turn Into Path	7	5,581	6	37	5,301	37	0.00	38	2	37	$ 234	39	26	39	1.207	26
	Other	73	26,953	56	27	21,533	31	0.02	27	8	31	$ 1,208	32	132	32	2.610	18
	Total	**908**	**497,446**	**816**		**460,824**		**0**		**170**		**24,670**		**2,697**		**1.8**	
	Groups	**25,289**	**5,159,833**	**24,534**		**5,020,062**		**9.1**		**1,855**		**564,073**		**61,674**		**4.9**	
	Other	**908**	**497,446**	**816**		**460,824**		**0.3**		**170**		**$ 24,670**		**2,697**		**1.8**	
	Total	**26,197**	**5,657,279**	**25,350**		**5,480,886**		**9.4**		**2,025**		**$ 588,743**		**64,372**		**4.6**	

Notes:

1. Values based on average of 2011-2015 FARS and GES data.
2. There are 42 rankings shown since the individual categories of "other" are also ranked.

Table 14. All Crashes Where the LV Is Making the Critical Action

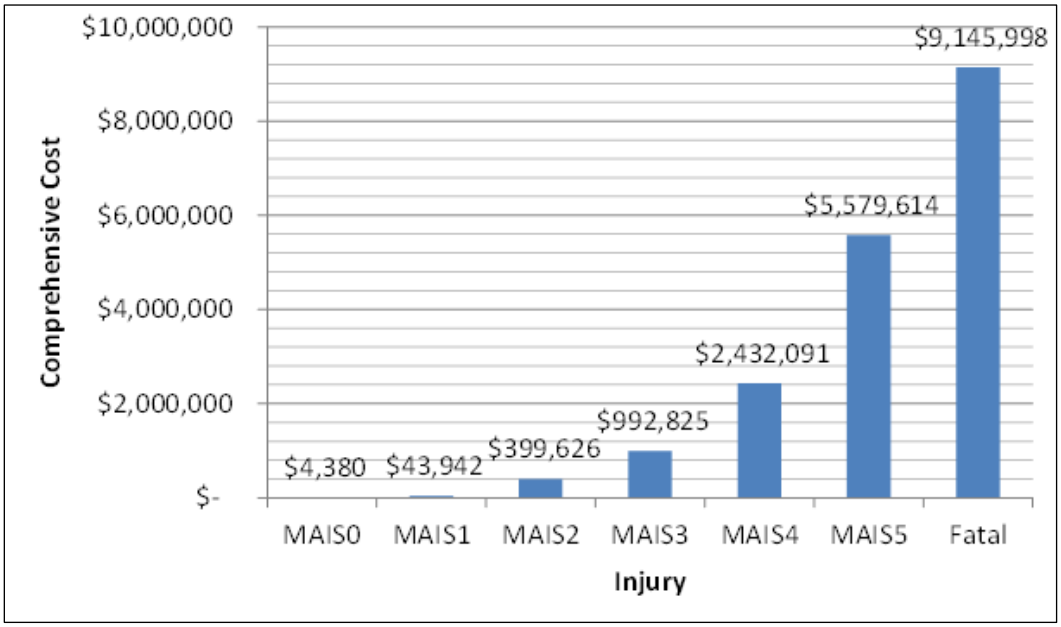
Scenario Group	Fatal Crashes			All Crashes			No. of Crashes per Billion Light Vehicle Miles Traveled						Cost ($ Billions)			Equivalent Lives			No. of Fatal Crashes per Thousand Crashes	
							Fatal Crashes			All Crashes										
	Total	%	Rank	Total	%	Rank	Total	%	Rank	Total	%	Rank	Total	%	Rank	Total	%	Rank	Total	Rank
Control Loss	4,456	18%	2	470,733	9%	5	1.6	18%	2	174	9%	5	$ 77,507	13%	4	8,474	13%	4	9.5	5
Road Departure	6,500	26%	1	547,098	10%	4	2.4	26%	1	202	10%	4	$ 97,737	17%	3	10,686	17%	3	11.9	3
Animal	102	0%	9	297,968	5%	6	0.0	0%	9	110	5%	6	$ 6,231	1%	9	681	1%	9	0.3	9
Pedestrian	3,679	15%	4	69,048	1%	8	1.4	15%	4	26	1%	8	$ 46,611	8%	6	5,096	8%	6	53.3	1
Pedalcyclist	568	2%	8	49,168	1%	9	0.2	2%	8	18	1%	9	$ 12,833	2%	8	1,403	2%	8	11.5	4
Lane Change	752	3%	7	644,099	12%	3	0.3	3%	7	238	12%	3	$ 32,935	6%	7	3,601	6%	7	1.2	7
Opposite Direction	3,258	13%	5	100,786	2%	7	1.2	13%	5	37	2%	7	$ 48,255	8%	5	5,276	8%	5	32.3	2
Rear-End	1,245	5%	6	1,709,717	31%	1	0.5	5%	6	632	31%	1	$ 106,516	18%	2	11,646	18%	2	0.7	8
Crossing Paths	3,972	16%	3	1,131,273	21%	2	1.5	16%	3	418	21%	2	$ 135,409	23%	1	14,805	23%	1	3.5	6
Total Groups	**24,532**	**97%**		**5,019,890**	**92%**		**9.07**	**97%**		**1,855**	**92%**		**$564,034**	**96%**		**61,670**	**96%**		**4.9**	
Remaining scenarios	818	3%		460,996	8%		0.30	3%		170	8%		$ 24,709	4%		2,702	4%		1.8	
Total All	**25,350**	**100%**		**5,480,886**	**100%**		**9.37**	**100%**		**2,025**	**100%**		**588,743**	**100%**		**64,372**	**100%**		**4.6**	

Notes:

1. Values based on average of 2011-2015 FARS and GES data.
2. Ranks shown are based on the nine pre-crash scenario groups.

Appendix C: Injury Severity Scale Conversion

The comprehensive cost is computed from the maximum injury of all the injured people involved in a specific crash using the Abbreviated Injury Scale (AIS). The AIS is a classification system for assessing impact injury severity developed by the Association for the Advancement of Automotive Medicine. It provides the basis for stratifying the economic costs of crashes by injury severity. The Maximum AIS (MAIS) is a function of AIS on a single injured person, which measures overall maximum injury severity. Figure 57 illustrates the values of comprehensive cost associated with each MAIS level [12].



Note: Costs are per-person for all injury levels.

Figure 57. Comprehensive Cost by MAIS Level

Since detailed information regarding injury severity in FARS and GES is retrieved from police reports, the KABCO scale is used to classify injuries versus the AIS scale. The KABCO scale classifies crash victim injuries as: K–killed, A–incapacitating injury, B–non-incapacitating injury, C–possible injury, O–no apparent injury, or ISU–injury severity unknown. The KABCO coding scheme allows non-medically trained people to make on-scene injury assessments without a hands-on examination, but the possibility exists that the KABCO ratings are imprecise and inconsistently coded between States and over different years. To estimate injuries based on the MAIS coding structure, a translator derived from the 1984–1986 NASS and 2008–2010 CDS data was applied to the GES police-reported injury profile as shown in Table 15 [12].

Table 15. Injury Severity Scale Conversion Matrix

KABCO-to-MAIS Conversion Table							
MAIS	Police-Reported Injury Severity System						
	O	C	B	A	K	U	
	No Injury	Possible Injury	Non Incapacitating	Incapacitating	Fatality	Injured, Severity Unknown	Unknown
0	0.92535	0.23431	0.08336	0.03421	0.00000	0.21528	0.42930
1	0.07257	0.68929	0.76745	0.55195	0.00000	0.62699	0.41027
2	0.00198	0.06389	0.10884	0.20812	0.00000	0.10395	0.08721
3	0.00008	0.01071	0.03187	0.14371	0.00000	0.03856	0.04735
4	0.00000	0.00142	0.00619	0.03968	0.00000	0.00442	0.00606
5	0.00003	0.00013	0.00101	0.01775	0.00000	0.01034	0.00274
Fatal	0.00000	0.00025	0.00128	0.00458	1.00000	0.00046	0.01707
Total	1.00001	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

Appendix D: Comprehensive Costs and Crashes per Vehicle Miles Traveled, by Year

Table 16. Crashes per Vehicle Miles Traveled by Year

Scenario Group	Crashes per Light-Vehicle (LV) Miles Traveled (Billions) for LV making Critical Action											
	Fatal Crashes						All Crashes					
	2011	2012	2013	2014	2015	Change	2011	2012	2013	2014	2015	Change
Control Loss	1.8	1.7	1.7	1.6	1.5		189	164	178	181	160	
Road Departure	2.4	2.5	2.4	2.3	2.4		174	208	204	207	218	
Animal	0.0	0.0	0.0	0.0	0.0		109	113	114	108	107	
Pedestrian	1.3	1.4	1.3	1.4	1.5		26	29	28	23	24	
Pedalcyclist	0.2	0.2	0.2	0.2	0.2		17	18	17	20	16	
Lane Change	0.3	0.3	0.2	0.3	0.3		221	221	232	252	262	
Opposite Direction	1.2	1.2	1.2	1.2	1.3		35	37	35	40	38	
Rear-End	0.4	0.4	0.4	0.5	0.5		587	628	617	651	676	
Crossing Paths	1.4	1.5	1.5	1.4	1.5		392	409	415	436	438	
Other	0.3	0.3	0.3	0.3	0.3		166	167	171	183	165	
Total	9.3	9.6	9.3	9.2	9.5		1,915	1,995	2,010	2,101	2,105	

Table 17. Comprehensive Costs by Year

Scenario Group	Comprehensive Costs for LV making Critical Action					
	2011	2012	2013	2014	2015	Change
Control Loss	$ 83,177,719,728	$ 80,122,316,079	$ 76,230,018,160	$ 75,439,113,810	$ 72,565,649,991	
Road Departure	$ 91,159,622,868	$ 102,050,098,735	$ 98,699,038,241	$ 95,243,887,997	$ 101,530,242,252	
Animal	$ 6,233,182,565	$ 6,346,758,004	$ 6,972,507,925	$ 5,536,249,716	$ 6,066,272,077	
Pedestrian	$ 43,761,695,071	$ 48,911,419,886	$ 46,877,928,685	$ 46,367,458,564	$ 50,793,915,579	
Pedalcyclist	$ 11,568,176,531	$ 12,176,596,921	$ 11,458,032,577	$ 12,475,547,444	$ 13,049,470,513	
Lane Change	$ 31,089,546,316	$ 32,924,902,856	$ 31,604,164,515	$ 33,484,005,672	$ 35,574,712,453	
Opp. Direction	$ 45,919,735,440	$ 48,630,204,243	$ 46,392,232,052	$ 48,292,748,188	$ 52,038,407,681	
Rear-End	$ 99,321,188,216	$ 106,948,822,309	$ 103,445,632,135	$ 106,829,168,496	$ 116,027,834,844	
Crossing Paths	$ 127,912,750,874	$ 132,998,974,325	$ 133,835,004,427	$ 135,396,594,647	$ 146,885,209,519	
Other	$ 24,398,861,229	$ 24,836,723,630	$ 23,732,798,385	$ 25,517,278,826	$ 24,863,525,263	
Total	$ 564,542,478,838	$ 595,946,816,987	$ 579,247,357,104	$ 584,582,053,360	$ 619,395,240,171	

Note: The graphed lines are meant to illustrate trends; however, the scales differ for each scenario group.

Appendix E: Comprehensive Statistics

All statistics are for the LV making the critical action.

Table 18. Control Loss Pre-Crash Scenario Group

Control Loss Average 5-year Crash Totals Fatal - 4,456 | All - 470,733							
Characteristic	Variable	Avg. 2011 - 2015 Percent		Characteristic	Variable	Avg. 2011 - 2015 Percent	
		FARS	GES			FARS	GES
Weather	Clear	79%	56%	Posted Speed Limit (MPH)	Not Trafficway	0%	0%
	Adverse	20%	44%		5	0%	0%
	Other	0%	0%		10	0%	0%
	Uknown/Not Reported	1%	.		15	0%	0%
Lighting	Daylight	44%	56%		20	0%	1%
	Dark	37%	22%		25	4%	8%
	Dark with Overhead Light	15%	17%		30	5%	4%
	Dawn/Dusk	4%	5%		35	10%	11%
	Other	0%	0%		40	6%	4%
	Uknown/Not Reported	0%	.		45	13%	11%
Roadway Surface Condition	Dry	70%	35%		50	5%	3%
	Wet/Slippery	30%	64%		55	31%	23%
	Not Trafficway	0%	0%		60	4%	4%
	Other	0%	0%		65	10%	8%
	Uknown/Not Reported	1%	1%		70	7%	8%
Roadway Alignment	Straight	57%	63%		75	3%	1%
	Curve	42%	34%		80	0%	.
	Not Trafficway	0%	0%		Uknown/Not Reported	2%	12%
	Uknown/Not Reported	1%	3%	Travel Speed (MPH)	Stopped Vehicle in Transport	0%	0%
Roadway Grade	Level	62%	50%		1 to 5	0%	0%
	Not Level	34%	26%		6 to 10	0%	1%
	Not Trafficway	0%	0%		11 to 15	0%	1%
	Uknown/Not Reported	4%	23%		16 to 20	0%	1%
Relation to Junction	Non-Junction	89%	79%		21 to 25	0%	2%
	Intersection	1%	2%		26 to 30	0%	3%
	Intersection-Related	4%	12%		31 to 35	1%	4%
	Driveway Access	0%	1%		36 to 40	1%	4%
	Other	5%	6%		41 to 45	2%	5%
	Uknown/Not Reported	0%	.		46 to 50	2%	3%
Highway	Not Highway	78%	76%		51 to 55	5%	5%
	Highway	22%	24%		56 to 60	4%	3%
Traffic Control Device	No Traffic Controls	91%	86%		61 to 65	4%	3%
	3-Color Signal	1%	5%		66 to 70	4%	2%
	Stop Sign	1%	2%		71 to 75	3%	1%
	Other Signal, Sign, etc.	6%	4%		76 to 80	3%	0%
	Flashing Signal	0%	0%		Over 80	5%	0%
	Yield Sign	0%	0%		Uknown/Not Reported	65%	61%
	Uknown/Not Reported	0%	3%				

Control Loss							
Average 5-year Crash Totals Fatal - 4,456 | All - 470,733							
Characteristic	Variable	Avg. 2011 - 2015 Percent		Characteristic	Variable	Avg. 2011 - 2015 Percent	
		FARS	GES			FARS	GES
Speeding Related	Not Speeding Related	36%	45%	Violations	None	88%	60%
	Speeding Related	60%	52%		Reckless	2%	2%
	No/Uknown if Driver	0%	0%		Inattentive	1%	4%
	Uknown	4%	3%		Hit and Run	0%	1%
Day	Weekday	62%	70%		Impairment	4%	5%
	Weekend	38%	30%		Speeding Related	2%	14%
Gender	Male	73%	60%		Driving Too Slow	.	0%
	Female	26%	40%		Fail to Stop for Red Light or Flashing Red Light	0%	0%
	Uknown/Not Reported	0%	.		Fail to Stop Turn Red	.	.
Age (Years)	Younger <= 24	34%	39%		Misc. Sign/Signal	0%	0%
	Middle = 25 to 64	58%	56%		Fail to Obey Stop Sign	0%	0%
	Older >= 65	8%	5%		Turn Violation	0%	0%
	Uknown/Not Reported	0%	.		Yield Violation	0%	0%
Driver Impairment	Not Impaired	37%	80%		Intersection Violation	.	.
	Impaired	33%	13%		Misc. Rules of the Road	1%	4%
	No/Uknown if Driver	0%	0%		Wrong-Way Driving	0%	0%
	Uknown/Not Reported	29%	8%		Passing Violation	0%	0%
Specific Driver Impairment	Ill / Blackout	2%	3%		Following Too Closely	0%	0%
	Drowsy	2%	2%		Lane Change Violation	0%	0%
	Physical Impairment	1%	0%		Lamp/Brake Violation	0%	0%
	Emotional	1%	0%		No/Uknown if Driver	0%	0%
	Alcohol/Drugs/Medication	28%	8%		Uknown/Not Reported	2%	4%
Police-Reported Alcohol Involvement	Yes	44%	8%	Driver Avoidance Maneuver	None	33%	15%
Vision Obscured	No Obstruction	95%	94%		Steer Left	16%	3%
	Obstruction	1%	1%		Steer Right	12%	3%
	No/Uknown if Driver	0%	0%		Brake	7%	7%
	Unknown	3%	5%		Brake and Steer Right	3%	0%
Driver Distracted	Not Distracted	64%	85%		Brake and Steer Left	4%	0%
	Distracted	8%	7%		Accelerate	0%	0%
	Looked-Didn't See	0%	0%		Accelerate & Steer Left	0%	0%
	No/Uknown if Driver	0%	0%		Accelerate & Steer Right	0%	0%
	Uknown/Not Reported	28%	7%		Uknown	24%	69%
					Other	2%	2%
					No/Uknown if Driver	0%	0%
				Contributing Factors	Careless Driving	7%	4%
					Aggressive	2%	0%
					Too Close	0%	.
					Erratic Lane Change	2%	.
					Fail to Keep in Lane	13%	.
					Prohibited Passing	0%	.
					Wrongside Passing	0%	.
					Passing Error	1%	.
					Reckless/Unsafe	11%	2%
					Fail to Yield	0%	.
					Too Slow	.	.
					Improper Turn	3%	.

Table 19. Road Departure Pre-Crash Scenario Group

Road Departure Average 5-year Crash Totals Fatal - 6,500 | All - 547,098							
Characteristic	**Variable**	**Avg. 2011 - 2015 Percent**		**Characteristic**	**Variable**	**Avg. 2011 - 2015 Percent**	
		FARS	**GES**			**FARS**	**GES**
Weather	Clear	90%	87%	Posted Speed Limit (MPH)	Not Trafficway	0%	1%
	Adverse	9%	13%		5	0%	0%
	Other	0%	0%		10	0%	0%
	Uknown/Not Reported	1%	.		15	0%	1%
Lighting	Daylight	42%	49%		20	0%	2%
	Dark	37%	20%		25	4%	20%
	Dark with Overhead Light	16%	27%		30	5%	11%
	Dawn/Dusk	4%	4%		35	11%	14%
	Other	0%	0%		40	6%	5%
	Uknown/Not Reported	1%	.		45	14%	10%
Roadway Surface Condition	Dry	86%	79%		50	4%	2%
	Wet/Slippery	13%	19%		55	31%	12%
	Not Trafficway	0%	1%		60	3%	2%
	Other	0%	0%		65	9%	3%
	Uknown/Not Reported	1%	1%		70	6%	3%
Roadway Alignment	Straight	62%	76%		75	2%	0%
	Curve	37%	20%		80	0%	.
	Not Trafficway	0%	1%		Uknown/Not Reported	3%	14%
	Uknown/Not Reported	1%	4%	Travel Speed (MPH)	Stopped Vehicle in Transport	0%	0%
Roadway Grade	Level	69%	63%		1 to 5	0%	1%
	Not Level	28%	17%		6 to 10	0%	1%
	Not Trafficway	0%	1%		11 to 15	0%	1%
	Uknown/Not Reported	4%	19%		16 to 20	0%	2%
Relation to Junction	Non-Junction	87%	80%		21 to 25	0%	3%
	Intersection	1%	1%		26 to 30	1%	3%
	Intersection-Related	7%	14%		31 to 35	1%	4%
	Driveway Access	0%	2%		36 to 40	1%	3%
	Other	4%	3%		41 to 45	3%	4%
	Uknown/Not Reported	0%	.		46 to 50	3%	2%
Highway	Not Highway	79%	89%		51 to 55	7%	3%
	Highway	21%	11%		56 to 60	3%	1%
Traffic Control Device	No Traffic Controls	90%	86%		61 to 65	4%	2%
	3-Color Signal	2%	3%		66 to 70	4%	1%
	Stop Sign	3%	4%		71 to 75	2%	0%
	Other Signal, Sign, etc.	5%	3%		76 to 80	2%	0%
	Flashing Signal	0%	0%		Over 80	4%	0%
	Yield Sign	0%	0%		Uknown/Not Reported	63%	68%
	Uknown/Not Reported	0%	3%				

Road Departure							
Average 5-year Crash Totals Fatal - 6,500 | All - 547,098							
Characteristic	Variable	Avg. 2011 - 2015 Percent		Characteristic	Variable	Avg. 2011 - 2015 Percent	
		FARS	GES			FARS	GES
Speeding Related	Not Speeding Related	62%	73%	Violations	None	90%	58%
	Speeding Related	31%	14%		Reckless	2%	3%
	No/Uknown if Driver	0%	0%		Inattentive	1%	7%
	Uknown	7%	13%		Hit and Run	1%	3%
Day	Weekday	62%	66%		Impairment	4%	12%
	Weekend	38%	34%		Speeding Related	1%	4%
Gender	Male	75%	61%		Driving Too Slow	.	.
	Female	24%	39%		Fail to Stop for Red Light or Flashing Red Light	0%	0%
	Uknown/Not Reported	0%	.		Fail to Stop Turn Red	.	.
Age (Years)	Younger <= 24	25%	33%		Misc. Sign/Signal	0%	0%
	Middle = 25 to 64	60%	58%		Fail to Obey Stop Sign	0%	0%
	Older >= 65	14%	8%		Turn Violation	0%	0%
	Uknown/Not Reported	0%	.		Yield Violation	0%	0%
Driver Impairment	Not Impaired	31%	51%		Intersection Violation	0%	0%
	Impaired	37%	29%		Misc. Rules of the Road	1%	6%
	No/Uknown if Driver	0%	0%		Wrong-Way Driving	0%	0%
	Uknown/Not Reported	32%	20%		Passing Violation	0%	0%
Specific Driver Impairment	Ill / Blackout	4%	2%		Following Too Closely	0%	0%
	Drowsy	5%	8%		Lane Change Violation	0%	0%
	Physical Impairment	1%	0%		Lamp/Brake Violation	0%	0%
	Emotional	0%	1%		No/Uknown if Driver	0%	0%
	Alcohol/Drugs/Medication	26%	18%		Uknown/Not Reported	1%	4%
Police-Reported Alcohol Involvement	Yes	44%	18%	Driver Avoidance Maneuver	None	57%	21%
Vision Obscured	No Obstruction	94%	81%		Steer Left	6%	3%
	Obstruction	1%	2%		Steer Right	5%	4%
	No/Uknown if Driver	0%	0%		Brake	3%	2%
	Unknown	4%	17%		Brake and Steer Right	1%	0%
Driver Distracted	Not Distracted	60%	60%		Brake and Steer Left	1%	0%
	Distracted	9%	20%		Accelerate	0%	0%
	Looked-Didn't See	0%	0%		Accelerate & Steer Left	0%	0%
	No/Uknown if Driver	0%	0%		Accelerate & Steer Right	0%	0%
	Uknown/Not Reported	31%	20%		Uknown	26%	68%
					Other	0%	1%
					No/Uknown if Driver	0%	0%
				Contributing Factors	Careless Driving	7%	7%
					Aggressive	1%	0%
					Too Close	0%	.
					Erratic Lane Change	1%	.
					Fail to Keep in Lane	10%	.
					Prohibited Passing	0%	.
					Wrongside Passing	0%	.
					Passing Error	0%	.
					Reckless/Unsafe	7%	4%
					Fail to Yield	0%	.
					Too Slow	0%	.
					Improper Turn	4%	.

Table 20. Animal Pre-Crash Scenario Group

Animal							
Average 5-year Crash Totals Fatal - 102 | All - 297,968							
Characteristic	Variable	Avg. 2011 - 2015 Percent		Characteristic	Variable	Avg. 2011 - 2015 Percent	
		FARS	GES			FARS	GES
Weather	Weather	92%	90%	Posted Speed Limit (MPH)	Not Trafficway	0%	0%
	Adverse	8%	10%		5	.	0%
	Other	.	0%		10	.	0%
	Uknown/Not Reported	0%	.		15	.	0%
Lighting	Daylight	20%	26%		20	0%	0%
	Dark	66%	54%		25	1%	2%
	Dark with Overhead Light	7%	12%		30	2%	1%
	Dawn/Dusk	7%	8%		35	4%	6%
	Other	.	0%		40	3%	3%
	Uknown/Not Reported	.	.		45	9%	13%
Roadway Surface Condition	Dry	88%	79%		50	5%	4%
	Wet/Slippery	12%	13%		55	41%	37%
	Not Trafficway	.	0%		60	7%	1%
	Other	.	0%		65	12%	7%
	Uknown/Not Reported	.	8%		70	7%	4%
Roadway Alignment	Straight	84%	81%		75	6%	0%
	Curve	16%	9%		80	1%	.
	Not Trafficway	.	0%		Uknown/Not Reported	0%	22%
	Uknown/Not Reported	0%	9%	Travel Speed (MPH)	Stopped Vehicle in Transport	1%	0%
Roadway Grade	Level	71%	51%		1 to 5	0%	0%
	Not Level	27%	19%		6 to 10	0%	0%
	Not Trafficway	.	0%		11 to 15	.	0%
	Uknown/Not Reported	1%	31%		16 to 20	0%	0%
Relation to Junction	Non-Junction	95%	97%		21 to 25	0%	1%
	Intersection	2%	1%		26 to 30	0%	1%
	Intersection-Related	1%	2%		31 to 35	1%	4%
	Driveway Access	0%	0%		36 to 40	2%	4%
	Other	2%	1%		41 to 45	4%	7%
	Uknown/Not Reported	.	.		46 to 50	4%	6%
Highway	Not Highway	83%	87%		51 to 55	7%	10%
	Highway	17%	13%		56 to 60	3%	2%
Traffic Control Device	No Traffic Controls	95%	89%		61 to 65	4%	3%
	3-Color Signal	.	0%		66 to 70	3%	1%
	Stop Sign	0%	0%		71 to 75	1%	0%
	Other Signal, Sign, etc.	5%	4%		76 to 80	1%	0%
	Flashing Signal	0%	0%		Over 80	2%	0%
	Yield Sign	.	0%		Uknown/Not Reported	65%	59%
	Uknown/Not Reported	.	7%				

Animal							
Average 5-year Crash Totals Fatal - 102 | All - 297,968							
Characteristic	Variable	Avg. 2011 - 2015 Percent		Characteristic	Variable	Avg. 2011 - 2015 Percent	
		FARS	GES			FARS	GES
Speeding Related	Not Speeding Related	81%	96%	Violations	None	93%	96%
	Speeding Related	15%	2%		Reckless	1%	0%
	No/Uknown if Driver	.	.		Inattentive	.	0%
	Uknown	4%	2%		Hit and Run	.	0%
Day	Weekday	68%	72%		Impairment	2%	0%
	Weekend	32%	28%		Speeding Related	1%	1%
Gender	Male	68%	57%		Driving Too Slow	.	.
	Female	32%	43%		Fail to Stop for Red Light or Flashing Red Light	.	.
	Uknown/Not Reported	0%	.		Fail to Stop Turn Red	.	.
Age (Years)	Younger <= 24	25%	19%		Misc. Sign/Signal	.	0%
	Middle = 25 to 64	66%	73%		Fail to Obey Stop Sign	.	.
	Older >= 65	9%	8%		Turn Violation	.	.
	Uknown/Not Reported	0%	.		Yield Violation	.	.
Driver Impairment	Not Impaired	69%	93%		Intersection Violation	.	.
	Impaired	13%	1%		Misc. Rules of the Road	1%	0%
	No/Uknown if Driver	.	.		Wrong-Way Driving	.	0%
	Uknown/Not Reported	18%	7%		Passing Violation	.	.
Specific Driver Impairment	Ill / Blackout	.	0%		Following Too Closely	.	0%
	Drowsy	0%	0%		Lane Change Violation	0%	0%
	Physical Impairment	1%	0%		Lamp/Brake Violation	.	.
	Emotional	0%	0%		No/Uknown if Driver	.	.
	Alcohol/Drugs/Medication	12%	1%		Uknown/Not Reported	1%	1%
Police-Reported Alcohol Involvement	Yes	17%	1%	Driver Avoidance Maneuver	None	32%	21%
Vision Obscured	No Obstruction	95%	95%		Steer Left	19%	4%
	Obstruction	2%	1%		Steer Right	16%	6%
	No/Uknown if Driver	.	.		Brake	7%	4%
	Unknown	2%	4%		Brake and Steer Right	4%	0%
Driver Distracted	Not Distracted	79%	91%		Brake and Steer Left	5%	0%
	Distracted	7%	2%		Accelerate	0%	.
	Looked-Didn't See	.	0%		Accelerate & Steer Left	.	0%
	No/Uknown if Driver	.	.		Accelerate & Steer Right	.	.
	Uknown/Not Reported	14%	7%		Uknown	15%	61%
					Other	1%	3%
					No/Uknown if Driver	.	.
				Contributing Factors	Careless Driving	2%	0%
					Aggressive	0%	0%
					Too Close	.	.
					Erratic Lane Change	1%	.
					Fail to Keep in Lane	6%	.
					Prohibited Passing	.	.
					Wrongside Passing	.	.
					Passing Error	0%	.
					Reckless/Unsafe	3%	0%
					Fail to Yield	0%	.
					Too Slow	.	.
					Improper Turn	.	.

Table 21. Pedestrian Pre-Crash Scenario Group

Pedestrian							
Average 5-year Crash Totals Fatal - 3,679| All - 69,048							
Characteristic	Variable	Avg. 2011 - 2015 Percent		Characteristic	Variable	Avg. 2011 - 2015 Percent	
		FARS	GES			FARS	GES
Weather	Clear	89%	87%	Posted Speed Limit (MPH)	Not Trafficway	1%	4%
	Adverse	10%	13%		5	0%	0%
	Other	0%	0%		10	0%	0%
	Uknown/Not Reported	1%	.		15	0%	2%
Lighting	Daylight	21%	58%		20	0%	2%
	Dark	36%	9%		25	8%	20%
	Dark with Overhead Light	39%	29%		30	10%	10%
	Dawn/Dusk	4%	4%		35	18%	17%
	Other	0%	0%		40	13%	6%
	Uknown/Not Reported	0%	.		45	19%	6%
Roadway Surface Condition	Dry	85%	78%		50	5%	1%
	Wet/Slippery	14%	17%		55	13%	2%
	Not Trafficway	1%	3%		60	2%	0%
	Other	0%	0%		65	5%	1%
	Uknown/Not Reported	1%	1%		70	2%	0%
Roadway Alignment	Straight	92%	88%		75	0%	0%
	Curve	5%	3%		80	0%	.
	Not Trafficway	1%	3%		Uknown/Not Reported	4%	29%
	Uknown/Not Reported	2%	6%	Travel Speed (MPH)	Stopped Vehicle in Transport	0%	2%
Roadway Grade	Level	79%	70%		1 to 5	1%	7%
	Not Level	14%	7%		6 to 10	1%	4%
	Not Trafficway	1%	3%		11 to 15	1%	3%
	Uknown/Not Reported	7%	19%		16 to 20	1%	2%
Relation to Junction	Non-Junction	66%	37%		21 to 25	2%	3%
	Intersection	13%	19%		26 to 30	3%	2%
	Intersection-Related	16%	38%		31 to 35	6%	2%
	Driveway Access	2%	5%		36 to 40	6%	1%
	Other	2%	0%		41 to 45	8%	1%
	Uknown/Not Reported	0%	.		46 to 50	3%	0%
Highway	Not Highway	81%	98%		51 to 55	4%	0%
	Highway	19%	2%		56 to 60	2%	0%
Traffic Control Device	No Traffic Controls	81%	54%		61 to 65	2%	0%
	3-Color Signal	14%	32%		66 to 70	1%	0%
	Stop Sign	2%	8%		71 to 75	0%	0%
	Other Signal, Sign, etc.	2%	2%		76 to 80	0%	0%
	Flashing Signal	0%	0%		Over 80	1%	0%
	Yield Sign	0%	0%		Uknown/Not Reported	59%	72%
	Uknown/Not Reported	0%	3%				

Pedestrian							
Average 5-year Crash Totals Fatal - 3,679| All - 69,048							
Characteristic	Variable	Avg. 2011 - 2015 Percent		Characteristic	Variable	Avg. 2011 - 2015 Percent	
		FARS	GES			FARS	GES
Speeding Related	Not Speeding Related	90%	87%	Violations	None	83%	81%
	Speeding Related	5%	2%		Reckless	2%	1%
	No/Uknown if Driver	1%	1%		Inattentive	1%	2%
	Uknown	4%	11%		Hit and Run	4%	1%
Day	Weekday	69%	78%		Impairment	4%	1%
	Weekend	31%	22%		Speeding Related	1%	1%
Gender	Male	67%	60%		Driving Too Slow	.	.
	Female	31%	40%		Fail to Stop for Red Light or Flashing Red Light	0%	0%
	Uknown/Not Reported	2%	.		Fail to Stop Turn Red	0%	0%
Age (Years)	Younger <= 24	20%	19%		Misc. Sign/Signal	0%	0%
	Middle = 25 to 64	66%	68%		Fail to Obey Stop Sign	0%	0%
	Older >= 65	11%	13%		Turn Violation	0%	0%
	Uknown/Not Reported	3%	.		Yield Violation	2%	7%
Driver Impairment	Not Impaired	81%	78%		Intersection Violation	.	0%
	Impaired	8%	2%		Misc. Rules of the Road	0%	0%
	No/Uknown if Driver	1%	1%		Wrong-Way Driving	0%	0%
	Uknown/Not Reported	10%	19%		Passing Violation	0%	0%
Specific Driver Impairment	Ill / Blackout	0%	0%		Following Too Closely	0%	0%
	Drowsy	0%	0%		Lane Change Violation	0%	0%
	Physical Impairment	0%	0%		Lamp/Brake Violation	0%	0%
	Emotional	0%	0%		No/Uknown if Driver	1%	1%
	Alcohol/Drugs/Medication	7%	1%		Uknown/Not Reported	2%	3%
Police-Reported Alcohol Involvement	Yes	8%	2%	Driver Avoidance Maneuver	None	58%	32%
Vision Obscured	No	88%	75%		Steer Left	4%	2%
	Yes	8%	10%		Steer Right	2%	2%
	No/Ukn if Driver	1%	1%		Brake	8%	9%
	Unknown	3%	15%		Brake and Steer Right	1%	0%
Driver Distracted	Not Distracted	74%	65%		Brake and Steer Left	2%	0%
	Distracted	8%	10%		Accelerate	0%	0%
	Looked-Didn't See	3%	6%		Accelerate & Steer Left	0%	0%
	No/Uknown if Driver	1%	1%		Accelerate & Steer Right	.	.
	Uknown/Not Reported	14%	18%		Uknown	24%	52%
					Other	1%	1%
					No/Uknown if Driver	1%	1%
				Contributing Factors	Careless Driving	2%	2%
					Aggressive	0%	0%
					Too Close	0%	.
					Erratic Lane Change	0%	.
					Fail to Keep in Lane	1%	.
					Prohibited Passing	0%	.
					Wrongside Passing	0%	.
					Passing Error	0%	.
					Reckless/Unsafe	2%	1%
					Fail to Yield	7%	.
					Too Slow	.	.
					Improper Turn	0%	.

Table 22. Pedalcyclist Pre-Crash Scenario Group

Pedalcyclist							
Average 5-year Crash Totals Fatal - 568 | All - 49,168							
Characteristic	Variable	Avg. 2011 - 2015 Percent		Characteristic	Variable	Avg. 2011 - 2015 Percent	
		FARS	GES			FARS	GES
Weather	Clear	94%	95%	Posted Speed Limit (MPH)	Not Trafficway	1%	8%
	Adverse	5%	5%		5	0%	0%
	Other	0%	0%		10	0%	1%
	Uknown/Not Reported	1%	.		15	0%	2%
Lighting	Daylight	48%	76%		20	0%	1%
	Dark	23%	4%		25	8%	23%
	Dark with Overhead Light	24%	15%		30	10%	11%
	Dawn/Dusk	6%	5%		35	17%	16%
	Other	.	0%		40	12%	5%
	Uknown/Not Reported	0%	.		45	20%	7%
Roadway Surface Condition	Dry	91%	86%		50	6%	1%
	Wet/Slippery	8%	6%		55	18%	1%
	Not Trafficway	1%	8%		60	1%	0%
	Other	.	0%		65	3%	0%
	Uknown/Not Reported	1%	1%		70	1%	0%
Roadway Alignment	Straight	90%	84%		75	0%	.
	Curve	6%	2%		80	.	.
	Not Trafficway	1%	8%		Uknown/Not Reported	4%	24%
	Uknown/Not Reported	3%	6%	Travel Speed (MPH)	Stopped Vehicle in Transport	0%	2%
Roadway Grade	Level	76%	63%		1 to 5	1%	13%
	Not Level	15%	8%		6 to 10	1%	6%
	Not Trafficway	1%	8%		11 to 15	1%	3%
	Uknown/Not Reported	8%	20%		16 to 20	1%	3%
Relation to Junction	Non-Junction	56%	17%		21 to 25	2%	3%
	Intersection	26%	36%		26 to 30	4%	2%
	Intersection-Related	12%	30%		31 to 35	6%	2%
	Driveway Access	5%	16%		36 to 40	7%	1%
	Other	1%	0%		41 to 45	9%	1%
	Uknown/Not Reported	0%	.		46 to 50	5%	0%
Highway	Not Highway	89%	99%		51 to 55	5%	0%
	Highway	11%	1%		56 to 60	1%	0%
Traffic Control Device	No Traffic Controls	77%	48%		61 to 65	1%	.
	3-Color Signal	16%	28%		66 to 70	0%	0%
	Stop Sign	4%	19%		71 to 75	0%	0%
	Other Signal, Sign, etc.	2%	1%		76 to 80	0%	.
	Flashing Signal	0%	0%		Over 80	1%	0%
	Yield Sign	0%	1%		Uknown/Not Reported	52%	64%
	Uknown/Not Reported	0%	4%				

Pedalcyclist							
Average 5-year Crash Totals Fatal - 568 | All - 49,168							
Characteristic	Variable	Avg. 2011 - 2015 Percent		Characteristic	Variable	Avg. 2011 - 2015 Percent	
		FARS	GES			FARS	GES
Speeding Related	Not Speeding Related	88%	91%	Violations	None	79%	77%
	Speeding Related	8%	1%		Reckless	2%	0%
	No/Uknown if Driver	0%	0%		Inattentive	2%	4%
	Uknown	3%	8%		Hit and Run	5%	1%
Day	Weekday	70%	77%		Impairment	5%	0%
	Weekend	30%	23%		Speeding Related	2%	0%
Gender	Male	67%	56%		Driving Too Slow	.	.
	Female	31%	44%		Fail to Stop for Red Light or Flashing Red Light	0%	0%
	Uknown/Not Reported	2%	.		Fail to Stop Turn Red	0%	0%
Age (Years)	Younger <= 24	21%	20%		Misc. Sign/Signal	0%	0%
	Middle = 25 to 64	65%	67%		Fail to Obey Stop Sign	0%	1%
	Older >= 65	12%	14%		Turn Violation	0%	0%
	Uknown/Not Reported	2%	.		Yield Violation	1%	9%
Driver Impairment	Not Impaired	79%	84%		Intersection Violation	.	0%
	Impaired	11%	1%		Misc. Rules of the Road	1%	1%
	No/Uknown if Driver	0%	0%		Wrong-Way Driving	0%	0%
	Uknown/Not Reported	11%	15%		Passing Violation	1%	0%
Specific Driver Impairment	Ill / Blackout	0%	0%		Following Too Closely	0%	0%
	Drowsy	1%	0%		Lane Change Violation	0%	0%
	Physical Impairment	0%	0%		Lamp/Brake Violation	0%	.
	Emotional	0%	0%		No/Uknown if Driver	0%	0%
	Alcohol/Drugs/Medication	9%	0%		Uknown/Not Reported	3%	2%
Police-Reported Alcohol Involvement	Yes	10%	1%	Driver Avoidance Maneuver	None	56%	37%
Vision Obscured	No	90%	82%		Steer Left	5%	2%
	Yes	8%	7%		Steer Right	2%	1%
	No/Ukn if Driver	0%	0%		Brake	6%	4%
	Unknown	3%	11%		Brake and Steer Right	1%	0%
Driver Distracted	Not Distracted	73%	71%		Brake and Steer Left	3%	0%
	Distracted	10%	9%		Accelerate	0%	0%
	Looked-Didn't See	3%	7%		Accelerate & Steer Left	.	0%
	No/Uknown if Driver	0%	0%		Accelerate & Steer Right	.	.
	Uknown/Not Reported	14%	13%		Uknown	26%	54%
					Other	1%	1%
					No/Uknown if Driver	0%	0%
				Contributing Factors	Careless Driving	3%	4%
					Aggressive	0%	0%
					Too Close	2%	.
					Erratic Lane Change	1%	.
					Fail to Keep in Lane	2%	.
					Prohibited Passing	0%	.
					Wrongside Passing	0%	.
					Passing Error	2%	.
					Reckless/Unsafe	2%	0%
					Fail to Yield	6%	.
					Too Slow	.	.
					Improper Turn	1%	.

Table 23. Lane Change Pre-Crash Scenario Group

Lane Change							
Average 5-year Crash Totals Fatal - 752 | All - 644,099							
Characteristic	Variable	Avg. 2011 - 2015 Percent		Characteristic	Variable	Avg. 2011 - 2015 Percent	
		FARS	GES			FARS	GES
Weather	Clear	91%	90%	Posted Speed Limit (MPH)	Not Trafficway	0%	1%
	Adverse	8%	10%		5	0%	0%
	Other	0%	0%		10	0%	0%
	Uknown/Not Reported	0%	.		15	0%	0%
Lighting	Daylight	62%	76%		20	0%	1%
	Dark	19%	5%		25	2%	6%
	Dark with Overhead Light	15%	16%		30	3%	8%
	Dawn/Dusk	4%	3%		35	6%	17%
	Other	0%	0%		40	6%	9%
	Uknown/Not Reported	0%	.		45	11%	16%
Roadway Surface Condition	Dry	88%	84%		50	4%	4%
	Wet/Slippery	12%	15%		55	24%	8%
	Not Trafficway	0%	1%		60	7%	4%
	Other	.	0%		65	19%	5%
	Uknown/Not Reported	0%	1%		70	13%	3%
Roadway Alignment	Straight	87%	89%		75	3%	0%
	Curve	12%	6%		80	0%	.
	Not Trafficway	0%	1%		Uknown/Not Reported	2%	18%
	Uknown/Not Reported	1%	4%	Travel Speed (MPH)	Stopped Vehicle in Transport	4%	1%
Roadway Grade	Level	72%	70%		1 to 5	2%	5%
	Not Level	22%	10%		6 to 10	3%	4%
	Not Trafficway	0%	1%		11 to 15	2%	3%
	Uknown/Not Reported	5%	18%		16 to 20	1%	3%
Relation to Junction	Non-Junction	62%	52%		21 to 25	1%	2%
	Intersection	13%	15%		26 to 30	1%	2%
	Intersection-Related	7%	21%		31 to 35	1%	2%
	Driveway Access	8%	7%		36 to 40	1%	1%
	Other	9%	5%		41 to 45	2%	2%
	Uknown/Not Reported	0%	.		46 to 50	2%	1%
Highway	Not Highway	55%	82%		51 to 55	3%	1%
	Highway	45%	18%		56 to 60	2%	1%
Traffic Control Device	No Traffic Controls	89%	72%		61 to 65	4%	2%
	3-Color Signal	6%	20%		66 to 70	5%	1%
	Stop Sign	2%	2%		71 to 75	2%	0%
	Other Signal, Sign, etc.	3%	2%		76 to 80	2%	0%
	Flashing Signal	0%	0%		Over 80	3%	0%
	Yield Sign	0%	2%		Uknown/Not Reported	60%	68%
	Uknown/Not Reported	0%	3%				

Lane Change							
Average 5-year Crash Totals Fatal - 752 | All - 644,099							
Characteristic	Variable	Avg. 2011 - 2015 Percent		Characteristic	Variable	Avg. 2011 - 2015 Percent	
		FARS	GES			FARS	GES
Speeding Related	Not Speeding Related	79%	90%	Violations	None	80%	66%
	Speeding Related	17%	3%		Reckless	3%	1%
	No/Uknown if Driver	1%	0%		Inattentive	2%	3%
	Uknown	3%	7%		Hit and Run	1%	1%
Day	Weekday	67%	78%		Impairment	5%	1%
	Weekend	33%	22%		Speeding Related	1%	1%
Gender	Male	67%	56%		Driving Too Slow	.	0%
	Female	33%	44%		Fail to Stop for Red Light or Flashing Red Light	0%	0%
	Uknown/Not Reported	1%	.		Fail to Stop Turn Red	.	0%
Age (Years)	Younger <= 24	22%	25%		Misc. Sign/Signal	0%	0%
	Middle = 25 to 64	61%	63%		Fail to Obey Stop Sign	0%	0%
	Older >= 65	16%	12%		Turn Violation	1%	2%
	Uknown/Not Reported	1%	.		Yield Violation	1%	2%
Driver Impairment	Not Impaired	64%	85%		Intersection Violation	.	0%
	Impaired	15%	2%		Misc. Rules of the Road	3%	6%
	No/Uknown if Driver	1%	0%		Wrong-Way Driving	0%	0%
	Uknown/Not Reported	20%	13%		Passing Violation	1%	1%
Specific Driver Impairment	Ill / Blackout	1%	0%		Following Too Closely	0%	1%
	Drowsy	1%	0%		Lane Change Violation	2%	8%
	Physical Impairment	1%	0%		Lamp/Brake Violation	0%	0%
	Emotional	0%	0%		No/Uknown if Driver	1%	0%
	Alcohol/Drugs/Medication	12%	1%		Uknown/Not Reported	3%	4%
Police-Reported Alcohol Involvement	Yes	17%	2%	Driver Avoidance Maneuver	None	60%	28%
Vision Obscured	No	95%	88%		Steer Left	5%	3%
	Yes	3%	2%		Steer Right	5%	3%
	No/Ukn if Driver	1%	0%		Brake	3%	1%
	Unknown	2%	11%		Brake and Steer Right	1%	0%
Driver Distracted	Not Distracted	70%	73%		Brake and Steer Left	1%	0%
	Distracted	9%	10%		Accelerate	0%	0%
	Looked-Didn't See	1%	4%		Accelerate & Steer Left	0%	0%
	No/Uknown if Driver	1%	0%		Accelerate & Steer Right	0%	0%
	Uknown/Not Reported	19%	12%		Uknown	24%	64%
					Other	0%	0%
					No/Uknown if Driver	1%	0%
				Contributing Factors	Careless Driving	5%	3%
					Aggressive	2%	0%
					Too Close	2%	.
					Erratic Lane Change	16%	.
					Fail to Keep in Lane	11%	.
					Prohibited Passing	1%	.
					Wrongside Passing	1%	.
					Passing Error	3%	.
					Reckless/Unsafe	6%	1%
					Fail to Yield	9%	.
					Too Slow	0%	.
					Improper Turn	11%	.

Table 24. Opposite Direction Pre-Crash Scenario Group

Opposite Direction Average 5-year Crash Totals Fatal - 3,258 | All - 100,786							
Characteristic	**Variable**	**Avg. 2011 - 2015 Percent**		**Characteristic**	**Variable**	**Avg. 2011 - 2015 Percent**	
		FARS	**GES**			**FARS**	**GES**
Weather	Clear	87%	85%	Posted Speed Limit (MPH)	Not Trafficway	0%	0%
	Adverse	12%	15%		5	.	0%
	Other	0%	0%		10	0%	0%
	Uknown/Not Reported	0%	.		15	0%	1%
Lighting	Daylight	60%	68%		20	0%	1%
	Dark	27%	14%		25	1%	14%
	Dark with Overhead Light	8%	14%		30	2%	8%
	Dawn/Dusk	5%	4%		35	7%	18%
	Other	0%	0%		40	5%	8%
	Uknown/Not Reported	0%	.		45	15%	13%
Roadway Surface Condition	Dry	83%	76%		50	5%	2%
	Wet/Slippery	17%	24%		55	41%	19%
	Not Trafficway	0%	0%		60	5%	1%
	Other	0%	0%		65	9%	1%
	Uknown/Not Reported	0%	0%		70	5%	0%
Roadway Alignment	Straight	69%	67%		75	2%	0%
	Curve	30%	31%		80	0%	.
	Not Trafficway	0%	0%		Uknown/Not Reported	1%	13%
	Uknown/Not Reported	1%	2%	Travel Speed (MPH)	Stopped Vehicle in Transport	0%	1%
Roadway Grade	Level	66%	57%		1 to 5	0%	1%
	Not Level	31%	26%		6 to 10	0%	1%
	Not Trafficway	0%	0%		11 to 15	0%	1%
	Uknown/Not Reported	3%	16%		16 to 20	0%	2%
Relation to Junction	Non-Junction	93%	86%		21 to 25	0%	3%
	Intersection	3%	5%		26 to 30	1%	3%
	Intersection-Related	2%	7%		31 to 35	2%	5%
	Driveway Access	0%	2%		36 to 40	2%	3%
	Other	1%	1%		41 to 45	4%	5%
	Uknown/Not Reported	0%	.		46 to 50	4%	2%
Highway	Not Highway	87%	98%		51 to 55	10%	3%
	Highway	13%	2%		56 to 60	3%	1%
Traffic Control Device	No Traffic Controls	93%	87%		61 to 65	3%	1%
	3-Color Signal	1%	5%		66 to 70	2%	0%
	Stop Sign	0%	1%		71 to 75	1%	0%
	Other Signal, Sign, etc.	5%	5%		76 to 80	1%	0%
	Flashing Signal	0%	0%		Over 80	2%	0%
	Yield Sign	0%	0%		Uknown/Not Reported	65%	67%
	Uknown/Not Reported	0%	2%				

Opposite Direction							
Average 5-year Crash Totals Fatal - 3,258 | All - 100,786							
Characteristic	Variable	Avg. 2011 - 2015 Percent		Characteristic	Variable	Avg. 2011 - 2015 Percent	
		FARS	GES			FARS	GES
Speeding Related	Not Speeding Related	84%	85%	Violations	None	83%	64%
	Speeding Related	13%	8%		Reckless	3%	2%
	No/Uknown if Driver	0%	0%		Inattentive	1%	4%
	Uknown	4%	7%		Hit and Run	0%	1%
Day	Weekday	70%	75%		Impairment	6%	7%
	Weekend	30%	25%		Speeding Related	1%	3%
Gender	Male	70%	63%		Driving Too Slow	.	.
	Female	30%	37%		Fail to Stop for Red Light or Flashing Red Light	0%	0%
	Uknown/Not Reported	0%	.		Fail to Stop Turn Red	.	.
Age (Years)	Younger <= 24	24%	28%		Misc. Sign/Signal	0%	0%
	Middle = 25 to 64	62%	63%		Fail to Obey Stop Sign	0%	0%
	Older >= 65	14%	8%		Turn Violation	0%	0%
	Uknown/Not Reported	0%	.		Yield Violation	0%	1%
Driver Impairment	Not Impaired	44%	71%		Intersection Violation	.	0%
	Impaired	27%	15%		Misc. Rules of the Road	3%	9%
	No/Uknown if Driver	0%	0%		Wrong-Way Driving	2%	4%
	Uknown/Not Reported	29%	13%		Passing Violation	1%	1%
Specific Driver Impairment	Ill / Blackout	2%	1%		Following Too Closely	0%	0%
	Drowsy	4%	3%		Lane Change Violation	0%	0%
	Physical Impairment	1%	0%		Lamp/Brake Violation	0%	0%
	Emotional	0%	0%		No/Uknown if Driver	0%	0%
	Alcohol/Drugs/Medication	20%	10%		Uknown/Not Reported	2%	4%
Police-Reported Alcohol Involvement	Yes	27%	9%	Driver Avoidance Maneuver	None	59%	20%
Vision Obscured	No	95%	86%		Steer Left	5%	5%
	Yes	2%	4%		Steer Right	5%	13%
	No/Ukn if Driver	0%	0%		Brake	3%	4%
	Unknown	3%	10%		Brake and Steer Right	1%	1%
Driver Distracted	Not Distracted	64%	73%		Brake and Steer Left	1%	1%
	Distracted	9%	13%		Accelerate	0%	0%
	Looked-Didn't See	0%	0%		Accelerate & Steer Left	0%	0%
	No/Uknown if Driver	0%	0%		Accelerate & Steer Right	0%	0%
	Uknown/Not Reported	26%	13%		Uknown	25%	55%
					Other	0%	1%
					No/Uknown if Driver	0%	0%
				Contributing Factors	Careless Driving	4%	3%
					Aggressive	1%	0%
					Too Close	0%	.
					Erratic Lane Change	1%	.
					Fail to Keep in Lane	50%	.
					Prohibited Passing	2%	.
					Wrongside Passing	0%	.
					Passing Error	3%	.
					Reckless/Unsafe	5%	2%
					Fail to Yield	1%	.
					Too Slow	0%	.
					Improper Turn	1%	.

Table 25. Rear-End Pre-Crash Scenario Group

Rear End							
Average 5-year Crash Totals Fatal - 1,245 | All - 1,709,717							
Characteristic	Variable	Avg. 2011 - 2015 Percent		Characteristic	Variable	Avg. 2011 - 2015 Percent	
		FARS	GES			FARS	GES
Weather	Clear	92%	88%	Posted Speed Limit (MPH)	Not Trafficway	0%	0%
	Adverse	7%	12%		5	.	0%
	Other	0%	0%		10	0%	0%
	Uknown/Not Reported	0%	.		15	0%	0%
Lighting	Daylight	51%	80%		20	0%	0%
	Dark	26%	4%		25	2%	5%
	Dark with Overhead Light	19%	13%		30	3%	5%
	Dawn/Dusk	4%	3%		35	6%	19%
	Other	0%	0%		40	5%	11%
	Uknown/Not Reported	0%	.		45	12%	22%
Roadway Surface Condition	Dry	90%	82%		50	5%	5%
	Wet/Slippery	10%	17%		55	24%	10%
	Not Trafficway	0%	0%		60	7%	4%
	Other	0%	0%		65	18%	5%
	Uknown/Not Reported	0%	1%		70	12%	3%
Roadway Alignment	Straight	94%	92%		75	4%	0%
	Curve	5%	5%		80	0%	0%
	Not Trafficway	0%	0%		Uknown/Not Reported	2%	11%
	Uknown/Not Reported	1%	3%	Travel Speed (MPH)	Stopped Vehicle in Transport	0%	0%
Roadway Grade	Level	74%	69%		1 to 5	0%	6%
	Not Level	22%	13%		6 to 10	0%	5%
	Not Trafficway	0%	0%		11 to 15	0%	4%
	Uknown/Not Reported	4%	18%		16 to 20	0%	4%
Relation to Junction	Non-Junction	65%	42%		21 to 25	0%	3%
	Intersection	8%	5%		26 to 30	1%	3%
	Intersection-Related	15%	47%		31 to 35	1%	4%
	Driveway Access	5%	4%		36 to 40	2%	2%
	Other	7%	4%		41 to 45	3%	3%
	Uknown/Not Reported	0%	.		46 to 50	3%	1%
Highway	Not Highway	55%	84%		51 to 55	6%	1%
	Highway	45%	16%		56 to 60	5%	1%
Traffic Control Device	No Traffic Controls	81%	53%		61 to 65	5%	1%
	3-Color Signal	12%	34%		66 to 70	5%	0%
	Stop Sign	1%	4%		71 to 75	3%	0%
	Other Signal, Sign, etc.	5%	2%		76 to 80	2%	0%
	Flashing Signal	0%	0%		Over 80	5%	0%
	Yield Sign	0%	4%		Uknown/Not Reported	58%	63%
	Uknown/Not Reported	0%	3%				

Rear End							
Average 5-year Crash Totals Fatal - 1,245 | All - 1,709,717							
Characteristic	Variable	Avg. 2011 - 2015 Percent		Characteristic	Variable	Avg. 2011 - 2015 Percent	
		FARS	GES			FARS	GES
Speeding Related	Not Speeding Related	55%	76%	Violations	None	73%	51%
	Speeding Related	42%	20%		Reckless	5%	1%
	No/Uknown if Driver	0%	0%		Inattentive	4%	10%
	Uknown	3%	4%		Hit and Run	2%	1%
Day	Weekday	71%	82%		Impairment	8%	2%
	Weekend	29%	18%		Speeding Related	4%	12%
Gender	Male	74%	56%		Driving Too Slow	.	0%
	Female	25%	44%		Fail to Stop for Red Light or Flashing Red Light	0%	0%
	Uknown/Not Reported	1%	.		Fail to Stop Turn Red	.	0%
Age (Years)	Younger <= 24	22%	33%		Misc. Sign/Signal	0%	0%
	Middle = 25 to 64	63%	60%		Fail to Obey Stop Sign	0%	0%
	Older >= 65	14%	7%		Turn Violation	0%	0%
	Uknown/Not Reported	1%	.		Yield Violation	0%	0%
Driver Impairment	Not Impaired	55%	89%		Intersection Violation	.	0%
	Impaired	25%	3%		Misc. Rules of the Road	1%	0%
	No/Uknown if Driver	0%	0%		Wrong-Way Driving	0%	0%
	Uknown/Not Reported	21%	8%		Passing Violation	0%	0%
Specific Driver Impairment	Ill / Blackout	2%	0%		Following Too Closely	2%	13%
	Drowsy	2%	1%		Lane Change Violation	0%	0%
	Physical Impairment	1%	0%		Lamp/Brake Violation	0%	0%
	Emotional	0%	0%		No/Uknown if Driver	0%	0%
	Alcohol/Drugs/Medication	20%	2%		Uknown/Not Reported	3%	5%
Police-Reported Alcohol Involvement	Yes	24%	2%	Driver Avoidance Maneuver	None	56%	21%
Vision Obscured	No	93%	93%		Steer Left	5%	1%
	Yes	4%	1%		Steer Right	3%	1%
	No/Ukn if Driver	0%	0%		Brake	8%	20%
	Unknown	3%	6%		Brake and Steer Right	2%	1%
Driver Distracted	Not Distracted	54%	67%		Brake and Steer Left	1%	0%
	Distracted	23%	24%		Accelerate	0%	0%
	Looked-Didn't See	1%	1%		Accelerate & Steer Left	0%	0%
	No/Uknown if Driver	0%	0%		Accelerate & Steer Right	0%	0%
	Uknown/Not Reported	22%	8%		Uknown	25%	54%
					Other	0%	0%
					No/Uknown if Driver	0%	0%
				Contributing Factors	Careless Driving	12%	7%
					Aggressive	2%	0%
					Too Close	19%	.
					Erratic Lane Change	2%	.
					Fail to Keep in Lane	3%	.
					Prohibited Passing	0%	.
					Wrongside Passing	0%	.
					Passing Error	1%	.
					Reckless/Unsafe	8%	1%
					Fail to Yield	2%	.
					Too Slow	.	.
					Improper Turn	0%	.

Table 26. Crossing Paths Pre-Crash Scenario Group

Crossing Paths							
Average 5-year Crash Totals Fatal - 3,972 | All - 1,131,273							
Characteristic	Variable	Avg. 2011 - 2015 Percent		Characteristic	Variable	Avg. 2011 - 2015 Percent	
		FARS	GES			FARS	GES
Weather	Clear	93%	89%	Posted Speed Limit (MPH)	Not Trafficway	2%	12%
	Adverse	7%	11%		5	0%	0%
	Other	0%	0%		10	0%	0%
	Uknown/Not Reported	0%	.		15	0%	1%
Lighting	Daylight	68%	76%		20	0%	1%
	Dark	10%	4%		25	6%	13%
	Dark with Overhead Light	17%	16%		30	7%	8%
	Dawn/Dusk	4%	3%		35	13%	18%
	Other	0%	0%		40	9%	9%
	Uknown/Not Reported	0%	.		45	19%	13%
Roadway Surface Condition	Dry	87%	73%		50	5%	2%
	Wet/Slippery	9%	15%		55	23%	4%
	Not Trafficway	2%	12%		60	2%	0%
	Other	0%	0%		65	4%	0%
	Uknown/Not Reported	1%	0%		70	1%	0%
Roadway Alignment	Straight	91%	79%		75	0%	0%
	Curve	4%	2%		80	.	.
	Not Trafficway	2%	12%		Uknown/Not Reported	9%	19%
	Uknown/Not Reported	3%	7%	Travel Speed (MPH)	Stopped Vehicle in Transport	0%	0%
Roadway Grade	Level	76%	54%		1 to 5	4%	7%
	Not Level	14%	7%		6 to 10	6%	8%
	Not Trafficway	2%	12%		11 to 15	6%	5%
	Uknown/Not Reported	7%	27%		16 to 20	3%	3%
Relation to Junction	Non-Junction	0%	0%		21 to 25	2%	2%
	Intersection	84%	75%		26 to 30	1%	2%
	Intersection-Related	2%	5%		31 to 35	2%	2%
	Driveway Access	12%	19%		36 to 40	1%	1%
	Other	1%	0%		41 to 45	3%	1%
	Uknown/Not Reported	0%	.		46 to 50	2%	0%
Highway	Not Highway	100%	100%		51 to 55	3%	0%
	Highway	0%	0%		56 to 60	1%	0%
Traffic Control Device	No Traffic Controls	37%	34%		61 to 65	1%	0%
	3-Color Signal	29%	36%		66 to 70	0%	0%
	Stop Sign	30%	25%		71 to 75	0%	0%
	Other Signal, Sign, etc.	1%	1%		76 to 80	0%	0%
	Flashing Signal	1%	1%		Over 80	1%	0%
	Yield Sign	1%	1%		Uknown/Not Reported	62%	67%
	Uknown/Not Reported	0%	2%				

Crossing Paths							
Average 5-year Crash Totals Fatal - 3,972 | All - 1,131,273							
Characteristic	Variable	Avg. 2011 - 2015 Percent		Characteristic	Variable	Avg. 2011 - 2015 Percent	
		FARS	GES			FARS	GES
Speeding Related	Not Speeding Related	93%	96%	Violations	None	76%	54%
	Speeding Related	5%	2%		Reckless	2%	1%
	No/Uknown if Driver	.	0%		Inattentive	1%	3%
	Uknown	2%	3%		Hit and Run	1%	1%
Day	Weekday	71%	79%		Impairment	3%	1%
	Weekend	29%	21%		Speeding Related	0%	1%
Gender	Male	62%	51%		Driving Too Slow	0%	0%
	Female	38%	49%		Fail to Stop for Red Light or Flashing Red Light	1%	4%
	Uknown/Not Reported	0%	.		Fail to Stop Turn Red	0%	0%
Age (Years)	Younger <= 24	21%	28%		Misc. Sign/Signal	1%	1%
	Middle = 25 to 64	52%	58%		Fail to Obey Stop Sign	2%	3%
	Older >= 65	26%	15%		Turn Violation	0%	1%
	Uknown/Not Reported	0%	.		Yield Violation	8%	24%
Driver Impairment	Not Impaired	75%	92%		Intersection Violation	0%	0%
	Impaired	10%	2%		Misc. Rules of the Road	1%	2%
	No/Uknown if Driver	.	0%		Wrong-Way Driving	0%	0%
	Uknown/Not Reported	15%	6%		Passing Violation	0%	0%
Specific Driver Impairment	Ill / Blackout	1%	0%		Following Too Closely	0%	0%
	Drowsy	0%	0%		Lane Change Violation	0%	0%
	Physical Impairment	1%	0%		Lamp/Brake Violation	0%	0%
	Emotional	0%	0%		No/Uknown if Driver	.	0%
	Alcohol/Drugs/Medication	8%	2%		Uknown/Not Reported	2%	4%
Police-Reported Alcohol Involvement	Yes	11%	2%	Driver Avoidance Maneuver	None	66%	26%
Vision Obscured	No	93%	89%		Steer Left	1%	0%
	Yes	5%	7%		Steer Right	0%	0%
	No/Ukn if Driver	.	0%		Brake	4%	2%
	Unknown	2%	5%		Brake and Steer Right	0%	0%
Driver Distracted	Not Distracted	71%	78%		Brake and Steer Left	1%	0%
	Distracted	8%	10%		Accelerate	0%	0%
	Looked-Didn't See	3%	5%		Accelerate & Steer Left	0%	0%
	No/Uknown if Driver	.	0%		Accelerate & Steer Right	0%	0%
	Uknown/Not Reported	18%	7%		Uknown	27%	70%
					Other	0%	0%
					No/Uknown if Driver	0%	0%
				Contributing Factors	Careless Driving	3%	2%
					Aggressive	0%	0%
					Too Close	0%	.
					Erratic Lane Change	0%	.
					Fail to Keep in Lane	1%	.
					Prohibited Passing	0%	.
					Wrongside Passing	0%	.
					Passing Error	0%	.
					Reckless/Unsafe	2%	0%
					Fail to Yield	47%	.
					Too Slow	0%	.
					Improper Turn	4%	.

Table 27. Left Turn Across Path/Opposite Direction Pre-Crash Scenario

Left Turn Across Path/ Opposite Direction (LTAP/OD)							
Average 5-year Crash Totals Fatal - 1,131 | All - 321,965							
Characteristic	Variable	Avg. 2011 - 2015 Percent		Characteristic	Variable	Avg. 2011 - 2015 Percent	
		FARS	GES			FARS	GES
Weather	Clear	94%	90%	Posted Speed Limit (MPH)	Not Trafficway	1%	0%
	Adverse	5%	10%		5	0%	0%
	Other	0%	0%		10	0%	0%
	Uknown/Not Reported	0%	.		15	0%	0%
Lighting	Daylight	65%	70%		20	0%	0%
	Dark	9%	4%		25	3%	7%
	Dark with Overhead Light	20%	22%		30	6%	8%
	Dawn/Dusk	5%	4%		35	16%	27%
	Other	0%	.		40	14%	16%
	Uknown/Not Reported	0%	.		45	26%	22%
Roadway Surface Condition	Dry	92%	84%		50	6%	4%
	Wet/Slippery	7%	15%		55	19%	4%
	Not Trafficway	1%	0%		60	2%	0%
	Other	0%	0%		65	3%	0%
	Uknown/Not Reported	0%	0%		70	1%	0%
Roadway Alignment	Straight	94%	93%		75	0%	.
	Curve	5%	2%		80	.	.
	Not Trafficway	1%	0%		Uknown/Not Reported	3%	11%
	Uknown/Not Reported	1%	4%	Travel Speed (MPH)	Stopped Vehicle in Transport	0%	0%
Roadway Grade	Level	79%	74%		1 to 5	4%	7%
	Not Level	17%	9%		6 to 10	9%	10%
	Not Trafficway	1%	0%		11 to 15	9%	7%
	Uknown/Not Reported	4%	17%		16 to 20	5%	4%
Relation to Junction	Non-Junction	0%	0%		21 to 25	3%	2%
	Intersection	76%	80%		26 to 30	2%	1%
	Intersection-Related	3%	2%		31 to 35	1%	1%
	Driveway Access	20%	18%		36 to 40	1%	1%
	Other	1%	0%		41 to 45	1%	1%
	Uknown/Not Reported	0%	.		46 to 50	0%	0%
Highway	Not Highway	100%	100%		51 to 55	1%	0%
	Highway	0%	.		56 to 60	0%	0%
Traffic Control Device	No Traffic Controls	51%	35%		61 to 65	0%	.
	3-Color Signal	39%	57%		66 to 70	.	.
	Stop Sign	5%	4%		71 to 75	0%	.
	Other Signal, Sign, etc.	2%	1%		76 to 80	0%	.
	Flashing Signal	1%	1%		Over 80	0%	0%
	Yield Sign	1%	0%		Uknown/Not Reported	63%	64%
	Uknown/Not Reported	0%	2%				

Left Turn Across Path/ Opposite Direction (LTAP/OD)							
Average 5-year Crash Totals Fatal - 1,131 | All - 321,965							
Characteristic	**Variable**	**Avg. 2011 - 2015 Percent**		**Characteristic**	**Variable**	**Avg. 2011 - 2015 Percent**	
		FARS	**GES**			**FARS**	**GES**
Speeding Related	Not Speeding Related	98%	97%	Violations	None	69%	49%
	Speeding Related	1%	1%		Reckless	3%	1%
	No/Uknown if Driver	.	.		Inattentive	2%	3%
	Uknown	1%	2%		Hit and Run	1%	0%
Day	Weekday	71%	80%		Impairment	3%	1%
	Weekend	29%	20%		Speeding Related	0%	0%
Gender	Male	60%	52%		Driving Too Slow	0%	.
	Female	40%	48%		Fail to Stop for Red Light or Flashing Red Light	0%	1%
	Uknown/Not Reported	0%	.		Fail to Stop Turn Red	.	0%
Age (Years)	Younger <= 24	18%	29%		Misc. Sign/Signal	1%	0%
	Middle = 25 to 64	50%	55%		Fail to Obey Stop Sign	0%	0%
	Older >= 65	31%	16%		Turn Violation	1%	1%
	Uknown/Not Reported	0%	.		Yield Violation	17%	35%
Driver Impairment	Not Impaired	80%	93%		Intersection Violation	0%	0%
	Impaired	8%	2%		Misc. Rules of the Road	3%	3%
	No/Uknown if Driver	.	.		Wrong-Way Driving	0%	0%
	Uknown/Not Reported	12%	5%		Passing Violation	.	0%
Specific Driver Impairment	Ill / Blackout	0%	0%		Following Too Closely	0%	0%
	Drowsy	0%	0%		Lane Change Violation	0%	0%
	Physical Impairment	0%	0%		Lamp/Brake Violation	0%	.
	Emotional	0%	0%		No/Uknown if Driver	.	.
	Alcohol/Drugs/Medication	7%	2%		Uknown/Not Reported	3%	4%
Police-Reported Alcohol Involvement	Yes	9%	2%	Driver Avoidance Maneuver	None	70%	25%
Vision Obscured	No Obstruction	93%	89%		Steer Left	0%	0%
	Obstruction	5%	7%		Steer Right	0%	0%
	No/Uknown if Driver	.	.		Brake	1%	1%
	Unknown	2%	4%		Brake and Steer Right	0%	0%
Driver Distracted	Not Distracted	72%	80%		Brake and Steer Left	0%	.
	Distracted	8%	10%		Accelerate	1%	0%
	Looked-Didn't See	4%	4%		Accelerate & Steer Left	0%	0%
	No/Uknown if Driver	.	.		Accelerate & Steer Right	.	.
	Uknown/Not Reported	16%	6%		Uknown	27%	73%
					Other	0%	0%
					No/Uknown if Driver	.	.
				Contributing Factors	Careless Driving	3%	3%
					Aggressive	0%	0%
					Too Close	0%	.
					Erratic Lane Change	0%	.
					Fail to Keep in Lane	1%	.
					Prohibited Passing	0%	.
					Wrongside Passing	0%	.
					Passing Error	0%	.
					Reckless/Unsafe	1%	0%
					Fail to Yield	70%	.
					Too Slow	0%	.
					Improper Turn	9%	.

Table 28. All Scenarios

All Data							
Average 5-year Crash Totals Fatal - 25,350 | All - 5,480,886							
Characteristic	Variable	Avg. 2011 - 2015 Percent		Characteristic	Variable	Avg. 2011 - 2015 Percent	
		FARS	GES			FARS	GES
Weather	Clear	88%	86%	Posted Speed Limit (MPH)	Not Trafficway	1%	4%
	Adverse	11%	14%		5	0%	0%
	Other	0%	0%		10	0%	0%
	Uknown/Not Reported	1%	.		15	0%	1%
Lighting	Daylight	47%	69%		20	0%	1%
	Dark	30%	11%		25	5%	10%
	Dark with Overhead Light	18%	16%		30	6%	7%
	Dawn/Dusk	4%	4%		35	11%	16%
	Other	0%	0%		40	7%	8%
	Uknown/Not Reported	0%	.		45	15%	15%
Roadway Surface Condition	Dry	83%	74%		50	5%	3%
	Wet/Slippery	16%	20%		55	27%	11%
	Not Trafficway	1%	4%		60	3%	2%
	Other	0%	0%		65	8%	4%
	Uknown/Not Reported	1%	1%		70	5%	3%
Roadway Alignment	Straight	75%	82%		75	2%	0%
	Curve	23%	9%		80	0%	0%
	Not Trafficway	1%	4%		Uknown/Not Reported	4%	16%
	Uknown/Not Reported	1%	5%	Travel Speed (MPH)	Stopped Vehicle in Transport	0%	0%
Roadway Grade	Level	70%	61%		1 to 5	1%	5%
	Not Level	24%	13%		6 to 10	1%	4%
	Not Trafficway	1%	4%		11 to 15	1%	3%
	Uknown/Not Reported	5%	21%		16 to 20	1%	3%
Relation to Junction	Non-Junction	68%	46%		21 to 25	1%	3%
	Intersection	18%	20%		26 to 30	1%	2%
	Intersection-Related	7%	23%		31 to 35	2%	3%
	Driveway Access	3%	8%		36 to 40	2%	2%
	Other	4%	3%		41 to 45	4%	3%
	Uknown/Not Reported	0%	.		46 to 50	3%	1%
Highway	Not Highway	81%	88%		51 to 55	5%	2%
	Highway	19%	12%		56 to 60	3%	1%
Traffic Control Device	No Traffic Controls	80%	62%		61 to 65	3%	1%
	3-Color Signal	9%	22%		66 to 70	3%	1%
	Stop Sign	6%	8%		71 to 75	2%	0%
	Other Signal, Sign, etc.	4%	2%		76 to 80	1%	0%
	Flashing Signal	0%	0%		Over 80	3%	0%
	Yield Sign	0%	2%		Uknown/Not Reported	62%	65%
	Uknown/Not Reported	0%	3%				

All Data							
Average 5-year Crash Totals Fatal - 25,350 | All - 5,480,886							
Characteristic	Variable	Avg. 2011 - 2015 Percent		Characteristic	Variable	Avg. 2011 - 2015 Percent	
		FARS	GES			FARS	GES
Speeding Related	Not Speeding Related	71%	81%	Violations	None	84%	61%
	Speeding Related	25%	13%		Reckless	2%	1%
	No/Uknown if Driver	0%	0%		Inattentive	1%	5%
	Uknown	4%	6%		Hit and Run	1%	1%
Day	Weekday	66%	77%		Impairment	4%	3%
	Weekend	34%	23%		Speeding Related	1%	6%
Gender	Male	70%	56%		Driving Too Slow	0%	0%
	Female	29%	44%		Fail to Stop for Red Light or Flashing Red Light	0%	1%
	Uknown/Not Reported	1%	.		Fail to Stop Turn Red	0%	0%
Age (Years)	Younger <= 24	25%	30%		Misc. Sign/Signal	0%	0%
	Middle = 25 to 64	60%	61%		Fail to Obey Stop Sign	0%	1%
	Older >= 65	15%	10%		Turn Violation	0%	0%
	Uknown/Not Reported	1%	.		Yield Violation	2%	5%
Driver Impairment	Not Impaired	52%	83%		Intersection Violation	0%	0%
	Impaired	24%	6%		Misc. Rules of the Road	1%	2%
	No/Uknown if Driver	0%	0%		Wrong-Way Driving	0%	0%
	Uknown/Not Reported	24%	10%		Passing Violation	0%	0%
Specific Driver Impairment	Ill / Blackout	2%	1%		Following Too Closely	0%	4%
	Drowsy	3%	1%		Lane Change Violation	0%	1%
	Physical Impairment	1%	0%		Lamp/Brake Violation	0%	0%
	Emotional	0%	0%		No/Uknown if Driver	0%	0%
	Alcohol/Drugs/Medication	18%	4%		Uknown/Not Reported	2%	4%
Police-Reported Alcohol Involvement	Yes	28%	4%	Driver Avoidance Maneuver	None	54%	23%
Vision Obscured	No Obstruction	93%	89%		Steer Left	6%	2%
	Obstruction	3%	3%		Steer Right	5%	2%
	No/Uknown if Driver	0%	0%		Brake	5%	8%
	Unknown	3%	8%		Brake and Steer Right	1%	0%
Driver Distracted	Not Distracted	66%	73%		Brake and Steer Left	2%	0%
	Distracted	9%	15%		Accelerate	0%	0%
	Looked-Didn't See	1%	2%		Accelerate & Steer Left	0%	0%
	No/Uknown if Driver	0%	0%		Accelerate & Steer Right	0%	0%
	Uknown/Not Reported	24%	10%		Uknown	25%	62%
					Other	1%	1%
					No/Uknown if Driver	0%	0%
				Contributing Factors	Careless Driving	5%	4%
					Aggressive	1%	0%
					Too Close	1%	.
					Erratic Lane Change	1%	.
					Fail to Keep in Lane	12%	.
					Prohibited Passing	0%	.
					Wrongside Passing	0%	.
					Passing Error	1%	.
					Reckless/Unsafe	5%	1%
					Fail to Yield	9%	.
					Too Slow	0%	.
					Improper Turn	3%	.

Appendix F: Crash Characteristics

Tables 29 to 49 provide percentages of each characteristic by pre-crash scenario group. The data is based on the 5-year average of all crashes from 2011 to 2015. The crashes include those where an LV is involved in the critical action of the crash. The critical action refers to whether the vehicle is turning, changing lanes, striking, maneuvering, etc. (refer to Table 2 for definition of vehicle action by scenario group). Data for fatal crashes and police-reported crashes are shown as FARS and GES, respectively. Note that due to rounding, the values in each row may not always sum to 100 percent. Also due to rounding, values under 0.5 percent are shown as 0 percent. A "." [period] means that the data does not exist.

Table 29. Percentage Distribution by Weather Conditions

Pre-Crash Scenario Group	Database	Weather			
		Clear	Adverse	Other	Unknown / Not Reported
Control Loss	FARS	79%	20%	0%	1%
	GES	56%	44%	0%	.
Road Departure	FARS	90%	9%	0%	1%
	GES	87%	13%	0%	.
Animal	FARS	92%	8%	.	0%
	GES	90%	10%	0%	.
Pedestrian	FARS	89%	10%	0%	1%
	GES	87%	13%	0%	.
Pedalcyclist	FARS	94%	5%	0%	1%
	GES	95%	5%	0%	.
Lane Change	FARS	91%	8%	0%	0%
	GES	90%	10%	0%	.
Opposite Direction	FARS	87%	12%	0%	0%
	GES	85%	15%	0%	.
Rear End	FARS	92%	7%	0%	0%
	GES	88%	12%	0%	.
Crossing Paths	FARS	93%	7%	0%	0%
	GES	89%	11%	0%	.

Note: Values based on average of 2011-2015 FARS and GES data for an LV making the critical action.

Table 30. Percentage Distribution by Lighting Conditions

Pre-Crash Scenario Group	Database	Lighting					
		Daylight	Dark	Dark / Overhead Light	Dawn / Dusk	Other	Unknown / Not Reported
Control Loss	FARS	44%	37%	15%	4%	0%	0%
	GES	56%	22%	17%	5%	0%	.
Road Departure	FARS	42%	37%	16%	4%	0%	1%
	GES	49%	20%	27%	4%	0%	.
Animal	FARS	20%	66%	7%	7%	.	.
	GES	26%	54%	12%	8%	0%	.
Pedestrian	FARS	21%	36%	39%	4%	0%	0%
	GES	58%	9%	29%	4%	0%	.
Pedalcyclist	FARS	48%	23%	24%	6%	.	0%
	GES	76%	4%	15%	5%	0%	.
Lane Change	FARS	62%	19%	15%	4%	0%	0%
	GES	76%	5%	16%	3%	0%	.
Opposite Direction	FARS	60%	27%	8%	5%	0%	0%
	GES	68%	14%	14%	4%	0%	.
Rear End	FARS	51%	26%	19%	4%	0%	0%
	GES	80%	4%	13%	3%	0%	.
Crossing Paths	FARS	68%	10%	17%	4%	0%	0%
	GES	76%	4%	16%	3%	0%	.

Note: Values based on average of 2011-2015 FARS and GES data for an LV making the critical action.

Table 31. Percentage Distribution by Roadway Surface Condition

Pre-Crash Scenario Group	Database	Roadway Surface Condition				
		Dry	Wet / Slippery	Not Trafficway	Other	Unknown / Not Reported
Control Loss	FARS	70%	30%	0%	0%	1%
	GES	35%	64%	0%	0%	1%
Road Departure	FARS	86%	13%	0%	0%	1%
	GES	79%	19%	1%	0%	1%
Animal	FARS	88%	12%	.	.	.
	GES	79%	13%	0%	0%	8%
Pedestrian	FARS	85%	14%	1%	0%	1%
	GES	79%	17%	3%	0%	1%
Pedalcyclist	FARS	91%	8%	1%	.	1%
	GES	85%	6%	8%	0%	1%
Lane Change	FARS	88%	12%	0%	.	0%
	GES	84%	15%	1%	0%	1%
Opposite Direction	FARS	83%	17%	0%	0%	0%
	GES	76%	24%	0%	0%	0%
Rear End	FARS	90%	10%	0%	0%	0%
	GES	82%	17%	0%	0%	1%
Crossing Paths	FARS	87%	9%	2%	0%	1%
	GES	73%	15%	12%	0%	0%

Note: Values based on average of 2011-2015 FARS and GES data for an LV making the critical action.

Table 32. Percentage Distribution by Roadway Alignment

Pre-Crash Scenario Group	Database	Roadway Alignment			
		Straight	Curve	Not Trafficway	Unknown / Not Reported
Control Loss	FARS	57%	42%	0%	1%
	GES	63%	34%	0%	3%
Road Departure	FARS	62%	37%	0%	1%
	GES	76%	20%	1%	4%
Animal	FARS	84%	16%	.	0%
	GES	81%	9%	0%	9%
Pedestrian	FARS	92%	5%	1%	2%
	GES	88%	3%	3%	6%
Pedalcyclist	FARS	90%	6%	1%	3%
	GES	84%	2%	8%	6%
Lane Change	FARS	87%	12%	0%	1%
	GES	89%	6%	1%	4%
Opposite Direction	FARS	69%	30%	0%	1%
	GES	67%	31%	0%	2%
Rear End	FARS	94%	5%	0%	1%
	GES	92%	5%	0%	3%
Crossing Paths	FARS	91%	4%	2%	3%
	GES	79%	2%	12%	7%

Note: Values based on average of 2011-2015 FARS and GES data for an LV making the critical action.

Table 33. Percentage Distribution by Roadway Grade

Pre-Crash Scenario Group	Database	Roadway Grade			
		Level	Not Level	Not Trafficway	Unknown / Not Reported
Control Loss	FARS	62%	34%	0%	4%
	GES	50%	26%	0%	23%
Road Departure	FARS	69%	28%	0%	4%
	GES	63%	17%	1%	19%
Animal	FARS	71%	27%	.	1%
	GES	51%	19%	0%	31%
Pedestrian	FARS	79%	14%	1%	7%
	GES	70%	7%	3%	19%
Pedalcyclist	FARS	76%	15%	1%	8%
	GES	63%	8%	8%	20%
Lane Change	FARS	72%	22%	0%	5%
	GES	70%	10%	1%	18%
Opposite Direction	FARS	66%	31%	0%	3%
	GES	57%	26%	0%	16%
Rear End	FARS	74%	22%	0%	4%
	GES	69%	13%	0%	18%
Crossing Paths	FARS	76%	14%	2%	7%
	GES	54%	7%	12%	27%

Note: Values based on average of 2011-2015 FARS and GES data for an LV making the critical action.

Table 34. Percentage Distribution by Relation to Junction

Pre-Crash Scenario Group	Database	Relation to Junction - Specific Location					
		Non-Junction	Intersection	Intersection-Related	Driveway Access	Other	Unknown / Not Reported
Control Loss	FARS	89%	1%	4%	0%	5%	0%
	GES	79%	2%	12%	1%	6%	.
Road Departure	FARS	87%	1%	7%	0%	4%	0%
	GES	80%	1%	14%	2%	3%	.
Animal	FARS	95%	2%	1%	0%	2%	.
	GES	97%	1%	2%	0%	1%	.
Pedestrian	FARS	66%	13%	16%	2%	2%	0%
	GES	37%	19%	38%	5%	0%	.
Pedalcyclist	FARS	56%	26%	12%	5%	1%	0%
	GES	17%	36%	30%	16%	0%	.
Lane Change	FARS	62%	13%	7%	8%	9%	0%
	GES	52%	15%	21%	7%	5%	.
Opposite Direction	FARS	93%	3%	2%	0%	1%	0%
	GES	86%	5%	7%	2%	1%	.
Rear End	FARS	65%	8%	15%	5%	7%	0%
	GES	42%	5%	47%	4%	4%	.
Crossing Paths	FARS	0%	84%	2%	12%	1%	0%
	GES	0%	75%	5%	19%	0%	.

Note: Values based on average of 2011-2015 FARS and GES data for an LV making the critical action.

Table 35. Percentage Distribution by Traffic Control Device

Pre-Crash Scenario Group	Database	Traffic Control Device						
		No Traffic Controls	3-Color Signal	Stop Sign	Other Signal, Sign, etc.	Flashing Signal	Yield Sign	Unknown / Not Reported
Control Loss	FARS	91%	1%	1%	6%	0%	0%	0%
	GES	86%	5%	2%	4%	0%	0%	3%
Road Departure	FARS	90%	2%	3%	5%	0%	0%	0%
	GES	86%	3%	4%	3%	0%	0%	3%
Animal	FARS	95%	.	0%	5%	0%	.	.
	GES	89%	0%	0%	4%	0%	0%	7%
Pedestrian	FARS	81%	14%	2%	2%	0%	0%	0%
	GES	54%	32%	8%	2%	0%	0%	3%
Pedalcyclist	FARS	77%	16%	4%	2%	0%	0%	0%
	GES	48%	28%	19%	1%	0%	1%	4%
Lane Change	FARS	89%	6%	2%	3%	0%	0%	0%
	GES	72%	20%	2%	2%	0%	2%	3%
Opposite Direction	FARS	93%	1%	0%	5%	0%	0%	0%
	GES	87%	5%	1%	5%	0%	0%	2%
Rear End	FARS	81%	12%	1%	5%	0%	0%	0%
	GES	53%	34%	4%	2%	0%	4%	3%
Crossing Paths	FARS	37%	29%	30%	1%	1%	1%	0%
	GES	34%	36%	25%	1%	1%	1%	2%

Note: Values based on average of 2011-2015 FARS and GES data for an LV making the critical action.

Table 36. Percentage Distribution by Highway

Pre-Crash Scenario Group	Database	Highway	
		No	Yes
Control Loss	FARS	78%	22%
	GES	76%	24%
Road Departure	FARS	79%	21%
	GES	89%	11%
Animal	FARS	83%	17%
	GES	87%	13%
Pedestrian	FARS	81%	19%
	GES	98%	2%
Pedalcyclist	FARS	89%	11%
	GES	99%	1%
Lane Change	FARS	55%	45%
	GES	82%	18%
Opposite Direction	FARS	87%	13%
	GES	98%	2%
Rear End	FARS	55%	45%
	GES	84%	16%
Crossing Paths	FARS	100%	0%
	GES	100%	0%

Note: Values based on average of 2011-2015 FARS and GES data for an LV making the critical action.

Table 37. Percentage Distribution by Speeding

Pre-Crash Scenario Group	Database	Speeding Related			
		No	Yes	No / Unknown if Driver	Unknown / Not Reported
Control Loss	FARS	35%	61%	0%	4%
	GES	44%	53%	0%	3%
Road Departure	FARS	62%	31%	0%	7%
	GES	73%	14%	0%	13%
Animal	FARS	81%	15%	.	4%
	GES	96%	2%	.	2%
Pedestrian	FARS	90%	5%	1%	4%
	GES	87%	2%	1%	11%
Pedalcyclist	FARS	88%	8%	0%	3%
	GES	91%	1%	0%	8%
Lane Change	FARS	78%	18%	1%	3%
	GES	90%	3%	0%	7%
Opposite Direction	FARS	83%	13%	0%	4%
	GES	85%	8%	0%	7%
Rear End	FARS	54%	42%	0%	3%
	GES	76%	20%	0%	4%
Crossing Paths	FARS	93%	6%	.	2%
	GES	95%	2%	0%	3%

Note: Values based on average of 2011-2015 FARS and GES data for an LV making the critical action.

Table 38. Percentage Distribution by Posted Speed Limit

Pre-Crash Scenario Group	Database	Posted Speed Limit (MPH)													
		≤ 20	25	30	35	40	45	50	55	60	65	70	≥ 75	Not Trafficway	Unknown / Not Reported
Control Loss	FARS	0%	4%	5%	10%	6%	13%	5%	31%	4%	10%	7%	4%	0%	2%
	GES	1%	8%	4%	11%	4%	11%	3%	23%	4%	8%	8%	1%	0%	12%
Road Departure	FARS	1%	4%	5%	11%	6%	14%	4%	31%	3%	9%	6%	2%	0%	3%
	GES	3%	20%	11%	14%	5%	10%	2%	12%	2%	3%	3%	0%	1%	14%
Animal	FARS	0%	1%	2%	4%	3%	9%	5%	41%	7%	12%	7%	7%	0%	0%
	GES	0%	2%	1%	6%	3%	13%	4%	37%	1%	7%	4%	0%	0%	22%
Pedestrian	FARS	1%	8%	10%	18%	13%	19%	5%	13%	2%	5%	2%	1%	1%	4%
	GES	5%	20%	10%	17%	6%	6%	1%	2%	0%	1%	0%	0%	4%	29%
Pedalcyclist	FARS	1%	8%	10%	17%	12%	20%	6%	18%	1%	3%	1%	0%	1%	4%
	GES	4%	23%	11%	16%	5%	7%	1%	1%	0%	0%	0%	0%	8%	24%
Lane Change	FARS	0%	2%	3%	6%	6%	11%	4%	24%	7%	19%	13%	3%	0%	2%
	GES	1%	6%	8%	17%	9%	16%	4%	8%	4%	5%	3%	0%	1%	18%
Opposite Direction	FARS	0%	1%	2%	7%	5%	15%	5%	41%	5%	9%	5%	2%	0%	1%
	GES	3%	14%	8%	18%	8%	13%	2%	19%	1%	1%	0%	0%	0%	13%
Rear End	FARS	0%	2%	3%	6%	5%	12%	5%	24%	7%	18%	12%	4%	0%	2%
	GES	1%	5%	5%	19%	11%	22%	5%	10%	4%	5%	3%	0%	0%	11%
Crossing Paths	FARS	1%	6%	7%	13%	9%	19%	5%	23%	2%	4%	1%	0%	2%	9%
	GES	1%	13%	8%	18%	9%	13%	2%	4%	0%	0%	0%	0%	12%	19%

Note: Values based on average of 2011-2015 FARS and GES data for an LV making the critical action.

Table 39. Percentage Distribution by Known Travel Speed

Pre-Crash Scenario Group	Database	Travel Speed (MPH)																		
		Stopped Vehicle in Transport	1 to 5	6 to 10	11 to 15	16 to 20	21 to 25	26 to 30	31 to 35	36 to 40	41 to 45	46 to 50	51 to 55	56 to 60	61 to 65	66 to 70	71 to 75	76 to 80	Over 80	Unknown / Not Reported
Control Loss	FARS	0%	0%	0%	0%	0%	0%	0%	1%	1%	2%	2%	5%	4%	4%	4%	3%	3%	5%	65%
	GES	0%	0%	1%	1%	1%	2%	3%	4%	4%	5%	3%	5%	3%	3%	2%	1%	0%	0%	61%
Road Departure	FARS	0%	0%	0%	0%	0%	0%	1%	1%	1%	3%	3%	7%	3%	4%	4%	2%	2%	4%	63%
	GES	0%	1%	1%	1%	2%	3%	3%	4%	3%	4%	2%	3%	1%	2%	1%	0%	0%	0%	68%
Animal	FARS	1%	0%	0%	.	0%	0%	0%	1%	2%	4%	4%	7%	3%	4%	3%	1%	1%	2%	65%
	GES	0%	0%	0%	0%	0%	1%	1%	4%	4%	7%	6%	10%	2%	3%	1%	0%	0%	0%	59%
Pedestrian	FARS	0%	1%	1%	1%	1%	2%	3%	6%	6%	8%	3%	4%	2%	2%	1%	0%	0%	1%	59%
	GES	2%	7%	4%	3%	2%	3%	2%	2%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	72%
Pedalcyclist	FARS	0%	1%	1%	1%	1%	2%	4%	6%	7%	9%	5%	5%	1%	1%	0%	0%	0%	1%	52%
	GES	2%	13%	6%	3%	3%	3%	2%	2%	1%	1%	0%	0%	0%	.	0%	0%	.	0%	64%
Lane Change	FARS	4%	2%	3%	2%	1%	1%	1%	1%	1%	2%	2%	3%	2%	4%	5%	2%	2%	3%	60%
	GES	1%	5%	4%	3%	3%	2%	2%	2%	1%	2%	1%	1%	1%	2%	1%	0%	0%	0%	68%
Opposite Direction	FARS	0%	0%	0%	0%	0%	0%	1%	2%	2%	4%	4%	10%	3%	3%	2%	1%	1%	2%	65%
	GES	1%	1%	1%	1%	2%	3%	3%	5%	3%	5%	2%	3%	1%	1%	0%	0%	0%	0%	67%
Rear End	FARS	0%	0%	0%	0%	0%	0%	1%	1%	2%	3%	3%	6%	5%	5%	5%	3%	2%	5%	58%
	GES	0%	6%	5%	4%	4%	3%	3%	4%	2%	3%	1%	1%	1%	1%	0%	0%	0%	0%	63%
Crossing Paths	FARS	0%	4%	6%	6%	3%	2%	1%	2%	1%	3%	2%	3%	1%	1%	0%	0%	0%	1%	62%
	GES	0%	7%	8%	5%	3%	2%	2%	2%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	67%

Note: Values based on average of 2011-2015 FARS and GES data for an LV making the critical action.

Table 40. Percentage Distribution by Gender

Pre-Crash Scenario Group	Database	Gender		
		Male	Female	Unknown / Not Reported
Control Loss	FARS	73%	26%	0%
	GES	60%	40%	.
Road Departure	FARS	75%	24%	0%
	GES	61%	39%	.
Animal	FARS	68%	32%	0%
	GES	57%	43%	.
Pedestrian	FARS	67%	31%	2%
	GES	60%	40%	.
Pedalcyclist	FARS	67%	31%	2%
	GES	56%	44%	.
Lane Change	FARS	67%	33%	1%
	GES	56%	44%	.
Opposite Direction	FARS	70%	30%	0%
	GES	63%	37%	.
Rear End	FARS	74%	25%	1%
	GES	56%	44%	.
Crossing Paths	FARS	62%	38%	0%
	GES	51%	49%	.

Note: Values based on average of 2011-2015 FARS and GES data for an LV making the critical action.

Table 41. Percentage Distribution by Age

Pre-Crash Scenario Group	Database	Age			
		Younger ≤ 24	Middle 25 to 64	Older ≥ 65	Unknown / Not Reported
Control Loss	FARS	34%	58%	8%	0%
	GES	39%	56%	5%	.
Road Departure	FARS	25%	60%	14%	0%
	GES	33%	58%	8%	.
Animal	FARS	25%	66%	9%	0%
	GES	19%	73%	8%	.
Pedestrian	FARS	20%	66%	11%	3%
	GES	19%	68%	13%	.
Pedalcyclist	FARS	21%	65%	12%	2%
	GES	20%	67%	13%	.
Lane Change	FARS	22%	61%	16%	1%
	GES	25%	63%	12%	.
Opposite Direction	FARS	24%	62%	14%	0%
	GES	28%	63%	8%	.
Rear End	FARS	22%	63%	14%	1%
	GES	33%	60%	7%	.
Crossing Paths	FARS	21%	52%	26%	0%
	GES	28%	58%	15%	.

Note: Values based on average of 2011-2015 FARS and GES data for an LV making the critical action.

Table 42. Percentage Distribution by Driver Impairment

Pre-Crash Scenario Group	Database	Driver Impairment			
		No	Yes	No / Unknown if Driver	Unknown / Not Reported
Control Loss	FARS	37%	33%	0%	29%
	GES	80%	13%	0%	8%
Road Departure	FARS	31%	37%	0%	32%
	GES	51%	29%	0%	20%
Animal	FARS	69%	13%	.	18%
	GES	93%	1%	.	7%
Pedestrian	FARS	81%	8%	1%	10%
	GES	78%	2%	1%	19%
Pedalcyclist	FARS	79%	10%	0%	11%
	GES	84%	1%	0%	15%
Lane Change	FARS	64%	15%	1%	20%
	GES	85%	2%	0%	13%
Opposite Direction	FARS	44%	27%	0%	29%
	GES	71%	15%	0%	13%
Rear End	FARS	55%	25%	0%	21%
	GES	89%	3%	0%	8%
Crossing Paths	FARS	75%	10%	.	15%
	GES	92%	2%	0%	6%

Note: Values based on average of 2011-2015 FARS and GES data for an LV making the critical action.

Table 43. Percentage Distribution by Individual Driver Impairment

Pre-Crash Scenario Group	Database	Driver Impairment*				
		Ill / Blackout	Drowsy	Physical Impairment	Emotional	Alcohol / Drugs / Medication
Control Loss	FARS	2%	2%	1%	1%	28%
	GES	3%	2%	0%	0%	8%
Road Departure	FARS	4%	5%	1%	0%	26%
	GES	2%	8%	0%	1%	18%
Animal	FARS	.	0%	1%	0%	12%
	GES	0%	0%	0%	0%	1%
Pedestrian	FARS	0%	0%	0%	0%	7%
	GES	0%	0%	0%	0%	1%
Pedalcyclist	FARS	0%	1%	0%	0%	9%
	GES	0%	0%	0%	0%	0%
Lane Change	FARS	1%	1%	1%	0%	12%
	GES	0%	0%	0%	0%	1%
Opposite Direction	FARS	2%	4%	1%	0%	20%
	GES	1%	3%	0%	0%	10%
Rear End	FARS	2%	2%	1%	0%	20%
	GES	0%	1%	0%	0%	2%
Crossing Paths	FARS	1%	0%	1%	0%	8%
	GES	0%	0%	0%	0%	2%

*A driver can have more than one impairment. The percentages above represent the presence of each impairment.
**Values based on average of 2011-2015 FARS and GES data for an LV making the critical action.

Table 44. Percentage Distribution by Driver Alcohol Involvement

Pre-Crash Scenario Group	Database	Alcohol Involvement	
		Yes	No
Control Loss	FARS	44%	56%
	GES	8%	92%
Road Departure	FARS	44%	56%
	GES	18%	82%
Animal	FARS	17%	83%
	GES	1%	99%
Pedestrian	FARS	8%	92%
	GES	2%	98%
Pedalcyclist	FARS	10%	90%
	GES	1%	99%
Lane Change	FARS	17%	83%
	GES	2%	98%
Opposite Direction	FARS	27%	73%
	GES	9%	91%
Rear End	FARS	24%	76%
	GES	2%	98%
Crossing Paths	FARS	11%	89%
	GES	2%	98%

Note: Values based on average of 2011-2015 FARS and GES data for an LV making the critical action.

Table 45. Percentage Distribution by Vision Obstruction

Pre-Crash Scenario Group	Database	Vision Obscured			
		No	Yes	No / Unknown if Driver	Unknown / Not Reported
Control Loss	FARS	95%	1%	0%	3%
	GES	94%	1%	0%	5%
Road Departure	FARS	94%	1%	0%	4%
	GES	81%	2%	0%	17%
Animal	FARS	95%	2%	.	2%
	GES	95%	1%	.	4%
Pedestrian	FARS	88%	8%	1%	3%
	GES	75%	10%	1%	15%
Pedalcyclist	FARS	89%	8%	0%	3%
	GES	82%	7%	0%	11%
Lane Change	FARS	95%	3%	1%	2%
	GES	88%	2%	0%	11%
Opposite Direction	FARS	95%	2%	0%	3%
	GES	86%	4%	0%	10%
Rear End	FARS	93%	4%	0%	3%
	GES	93%	1%	0%	6%
Crossing Paths	FARS	93%	5%	.	2%
	GES	89%	7%	0%	5%

Note: Values based on average of 2011-2015 FARS and GES data for an LV making the critical action.

Table 46. Percentage Distribution by Driver Distraction

Pre-Crash Scenario Group	Database	Driver Distracted				
		Not Distracted	Distracted	Looked-Didn't See	No / Unknown if Driver	Unknown / Not Reported
Control Loss	FARS	64%	8%	0%	0%	28%
	GES	85%	7%	0%	0%	7%
Road Departure	FARS	60%	9%	0%	0%	31%
	GES	60%	20%	0%	0%	20%
Animal	FARS	79%	7%	.	.	14%
	GES	91%	2%	0%	.	7%
Pedestrian	FARS	74%	8%	3%	1%	14%
	GES	65%	10%	6%	1%	18%
Pedalcyclist	FARS	73%	10%	3%	0%	14%
	GES	71%	9%	7%	0%	13%
Lane Change	FARS	70%	9%	1%	1%	19%
	GES	73%	10%	4%	0%	12%
Opposite Direction	FARS	64%	9%	0%	0%	26%
	GES	73%	13%	0%	0%	13%
Rear End	FARS	54%	23%	1%	0%	22%
	GES	67%	24%	1%	0%	8%
Crossing Paths	FARS	71%	8%	3%	.	18%
	GES	78%	10%	5%	0%	7%

Note: Values based on average of 2011-2015 FARS and GES data for an LV making the critical action.

Table 47. Percentage Distribution by Driver Avoidance Maneuver

Pre-Crash Scenario Group	Database	Driver Avoidance Maneuver											
		None	Steer Left	Steer Right	Brake	Brake and Steer Right	Brake and Steer Left	Accelerate	Accelerate & Steer Left	Accelerate & Steer Right	Unknown	Other	No / Unknown if Driver
Control Loss	FARS	33%	16%	12%	7%	3%	4%	0%	0%	0%	24%	2%	0%
	GES	15%	3%	3%	7%	0%	0%	0%	0%	0%	69%	2%	0%
Road Departure	FARS	57%	6%	5%	3%	1%	1%	0%	0%	0%	26%	0%	0%
	GES	21%	3%	4%	2%	0%	0%	0%	0%	0%	68%	1%	0%
Animal	FARS	32%	19%	16%	7%	4%	5%	0%	.	.	15%	1%	.
	GES	21%	4%	6%	4%	0%	0%	.	0%	.	61%	3%	.
Pedestrian	FARS	58%	4%	2%	8%	1%	2%	0%	0%	.	24%	1%	1%
	GES	32%	2%	2%	9%	0%	0%	0%	0%	.	52%	1%	1%
Pedalcyclist	FARS	56%	5%	2%	6%	1%	3%	0%	.	.	26%	1%	0%
	GES	37%	2%	1%	4%	0%	0%	0%	0%	.	54%	1%	0%
Lane Change	FARS	60%	5%	5%	3%	1%	1%	0%	0%	0%	24%	0%	1%
	GES	28%	3%	3%	1%	0%	0%	0%	0%	0%	64%	0%	0%
Opposite Direction	FARS	59%	5%	5%	3%	1%	1%	0%	0%	0%	25%	0%	0%
	GES	20%	5%	13%	4%	1%	1%	0%	0%	0%	55%	1%	0%
Rear End	FARS	56%	5%	3%	8%	2%	1%	0%	0%	0%	25%	0%	0%
	GES	21%	1%	1%	20%	1%	0%	0%	0%	0%	54%	0%	0%
Crossing Paths	FARS	66%	1%	0%	4%	0%	1%	0%	0%	0%	27%	0%	0%
	GES	26%	0%	0%	2%	0%	0%	0%	0%	0%	70%	0%	0%

Note: Values based on average of 2011-2015 FARS and GES data for an LV making the critical action.

Table 48. Percentage Distribution by Violations Charged

Pre-Crash Scenario Group	Database	Violations*																				
		None	Reckless	Inattentive	Hit Run	Impairment	Speeding Related	Driving Too Slow	Fail to Stop for Red Light	Fail to Stop Turn on Red	Misc. Sign, Signal	Fail to Stop - Sign	Turn Violation	Yield Violation	Intersection Violation	Misc. Rules of the Road	Wrong-Way Driving	Passing Violation	Following Too Closely	Lane Change	Lamp / Brake	No / Unknown if Driver	Unknown / Not Reported
Control Loss	FARS	88%	2%	1%	0%	4%	2%	.	0%	.	0%	0%	0%	0%	.	1%	0%	0%	0%	0%	0%	0%	2%
	GES	60%	2%	4%	1%	5%	14%	0%	0%	.	0%	0%	0%	0%	.	4%	0%	0%	0%	0%	0%	0%	4%
Road Departure	FARS	90%	2%	1%	1%	4%	1%	.	0%	.	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	1%
	GES	58%	3%	7%	3%	12%	4%	.	0%	.	0%	0%	0%	0%	0%	6%	0%	0%	0%	0%	0%	0%	4%
Animal	FARS	93%	1%	.	.	2%	1%	.	.	.	.	.	.	.	.	1%	.	.	.	0%	.	.	1%
	GES	96%	0%	0%	0%	0%	1%	.	.	.	0%	.	.	.	.	0%	0%	.	0%	0%	.	.	1%
Pedestrian	FARS	83%	2%	1%	4%	4%	1%	.	0%	0%	0%	0%	0%	2%	.	0%	0%	0%	0%	0%	0%	1%	2%
	GES	81%	1%	2%	1%	1%	1%	.	0%	0%	0%	0%	0%	7%	0%	0%	0%	0%	0%	0%	0%	1%	3%
Pedalcyclist	FARS	79%	2%	2%	4%	5%	2%	.	0%	0%	0%	0%	0%	1%	.	1%	0%	0%	0%	0%	0%	0%	3%
	GES	78%	0%	4%	1%	0%	0%	.	0%	0%	0%	1%	0%	9%	0%	1%	0%	0%	0%	0%	.	0%	2%
Lane Change	FARS	80%	3%	2%	1%	5%	1%	.	0%	.	0%	0%	1%	1%	.	3%	0%	1%	0%	2%	0%	1%	3%
	GES	66%	1%	3%	1%	1%	1%	0%	0%	0%	0%	0%	2%	2%	0%	6%	0%	1%	1%	8%	0%	0%	4%
Opposite Direction	FARS	83%	3%	1%	0%	6%	1%	.	0%	.	0%	0%	0%	0%	.	3%	2%	1%	0%	0%	0%	0%	2%
	GES	64%	2%	4%	1%	7%	3%	.	0%	.	0%	0%	0%	1%	0%	9%	4%	1%	0%	0%	0%	0%	4%
Rear End	FARS	73%	5%	4%	2%	8%	4%	.	0%	.	0%	0%	0%	0%	.	1%	0%	0%	2%	0%	0%	0%	3%
	GES	51%	1%	10%	1%	2%	12%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	13%	0%	0%	0%	5%
Crossing Paths	FARS	76%	2%	1%	1%	3%	0%	0%	1%	0%	1%	2%	0%	8%	0%	1%	0%	0%	0%	0%	0%	.	2%
	GES	54%	1%	3%	1%	1%	1%	0%	4%	0%	1%	3%	1%	24%	0%	2%	0%	0%	0%	0%	0%	0%	4%

*Violations are not mutually exclusive (i.e., each driver can have more than one violation charged. The percentages above represent the presence of each violation charged.

**Values based on average of 2011-2015 FARS and GES data for an LV making the critical action.

Table 49. Percentage Distribution by Contributing Factors

Pre-Crash Scenario Group	Database	Contributing Factors*						
		Careless Driving	Erratic / Reckless / Negligent Driving	Following Improperly	Improper or Erratic Lane Change	Failure to Keep in Proper Lane**	Fail to Yield Right of way	Improper Turn
				Available for FARS only				
Control Loss	FARS	7%	11%	0%	2%	13%	0%	3%
	GES	4%	2%					
Road Departure	FARS	7%	7%	0%	1%	10%	0%	4%
	GES	7%	4%					
Animal	FARS	2%	3%	.	1%	6%	0%	.
	GES	0%	0%					
Pedestrian	FARS	2%	2%	0%	0%	1%	7%	0%
	GES	2%	1%					
Pedalcyclist	FARS	3%	2%	2%	1%	2%	6%	1%
	GES	4%	0%					
Lane Change	FARS	5%	6%	2%	16%	11%	9%	11%
	GES	3%	1%					
Opposite Direction	FARS	4%	5%	0%	1%	50%	1%	1%
	GES	3%	2%					
Rear End	FARS	12%	8%	19%	2%	3%	2%	0%
	GES	7%	1%					
Crossing Paths	FARS	3%	2%	0%	0%	1%	47%	4%
	GES	2%	0%					

*Contributing factors are not mutually exclusive (i.e., each crash can have more than one contributing factor). The percentages above represent the presence of each contributing factor.

**Changed to improper lane usage in 2015.

Note: Values based on average of 2011-2015 FARS and GES data for an LV making the critical action.

Appendix G: Attempted Avoidance Maneuver by Year

Note that in 2011 to 2013 some data was erroneously coded as "No Avoidance Maneuver" versus "Unknown." See table below for actual data on all vehicle body types. Table 47 of Appendix F contains statistics detailing individual percentages for attempted avoidance maneuvers for each scenario group.

Variable	Attempted Avoidance Maneuver for All Vehicles (All Body Types)									
	FARS					GES				
	Year					Year				
	2011	2012	2013	2014	2015	2011	2012	2013	2014	2015
No Driver Present / Unknown if Driver Present	255	252	253	234	268	21,379	20,163	21,297	25,408	22,676
No Avoidance Maneuver	30,628	30,337	26,579	18,577	16,837	4,483,543	5,016,773	3,709,374	2,354,167	2,478,951
Braking (no lockup)	764	852	835	668	670	277,958	327,703	350,655	295,819	215,638
Braking (lockup)	1,462	1,502	1,410	1,417	1,252	153,869	144,868	139,996	120,184	87,534
Braking (lockup unknown)	598	607	772	868	829	45,920	100,424	200,211	314,679	301,851
Releasing brakes	5	2	7	4	4	577	683	26	350	181
Steering left	2,226	2,481	2,370	2,190	2,213	142,114	150,430	144,360	166,258	148,930
Steering right	2,113	2,232	2,083	1,903	2,055	160,918	177,770	170,340	182,326	178,263
Braking and steering left	773	802	756	735	666	28,174	29,823	36,238	25,892	26,258
Braking and steering right	905	839	804	758	730	32,579	32,380	37,146	30,157	31,615
Accelerating	44	48	50	56	50	10,149	11,152	13,817	11,284	7,456
Accelerating and steering left	21	16	25	15	32	3,397	5,094	2,810	4,044	2,169
Accelerating and steering right	10	14	12	21	16	992	999	968	794	1,943
Other actions (specify:)	258	385	368	447	557	51,179	48,306	74,530	82,664	58,712
Unknown	4,057	5,591	8,778	17,057	22,744	3,982,640	3,822,973	5,150,258	7,177,593	7,694,496
Total (ALL)	44,119	45,960	45,102	44,950	48,923	9,395,385	9,889,542	10,052,026	10,791,619	11,256,675

Note:These statistic include all body types and not light vehicles only

Appendix H: Licensed Drivers

Sources:

www.fhwa.dot.gov/policyinformation/statistics/2015/dl20.cfm

www.fhwa.dot.gov/policyinformation/statistics/2014/dl20.cfm

www.fhwa.dot.gov/policyinformation/statistics/2013/dl20.cfm

www.fhwa.dot.gov/policyinformation/statistics/2012/dl20.cfm

www.fhwa.dot.gov/policyinformation/statistics/2011/dl20.cfm

Driver Age	All Licensed Drivers				
	2011	2012	2013	2014	2015
≤ 24	26,907,541	26,310,837	26,650,439	26,070,557	26,221,097
25 to 64	150,401,161	149,559,663	148,679,073	149,573,728	151,771,409
≥ 65	34,565,947	35,944,330	36,830,216	38,448,187	40,091,959
Total	**211,874,649**	**211,814,830**	**212,159,728**	**214,092,472**	**218,084,465**
	Male				
	104,899,893	104,985,117	105,007,670	105,907,684	107,649,686
	Female				
	106,974,756	106,829,713	107,152,058	108,184,788	110,434,779
Total	**211,874,649**	**211,814,830**	**212,159,728**	**214,092,472**	**218,084,465**

Appendix I: Multi-Variable Crash Characteristics

Table 50. FARS Multiple-Variable Characteristic Ranking

Pre-Crash Scenario Variable						Top 10 Percentages of each Scenario Group (FARS 2011-2015)															
Weather	Lighting	Road Surface Conditions	Road Alignment	Road Grade	Highway	Control Loss		Road Departure		Animal		Pedestrian		Pedalcyclist		Lane Change		Opposite Direction		Rear End		Crossing Paths	
						Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%
Clear	Daylight	Dry	Straight	Level	No	1	8%	1	13%	4	7%	3	13%	1	28%	1	22%	1	21%	1	20%	1	46%
Clear	Daylight	Dry	Straight	Level	Yes	7	4%	4	5%	.	.	.	.	7	2%	2	15%	8	3%	2	12%	.	.
Clear	Daylight	Dry	Straight	Not Level	No	8	4%	9	4%	6	4%	10	2%	4	6%	4	5%	4	8%	6	6%	3	8%
Clear	Daylight	Dry	Curve	Level	No	5	5%	5	5%	.	.	.	.	.	.	9	2%	3	8%	.	.	.	.
Clear	Daylight	Dry	Curve	Not Level	No	6	5%	8	4%	.	.	.	.	.	.	10	2%	5	7%	.	.	.	.
Clear	Dark	Dry	Straight	Level	No	2	7%	2	10%	1	29%	2	16%	3	13%	6	4%	2	9%	4	7%	4	6%
Clear	Dark	Dry	Straight	Level	Yes	.	.	10	3%	3	8%	4	7%	8	2%	3	7%	6	3%	3	9%	.	.
Clear	Dark	Dry	Straight	Not Level	No	10	3%	.	.	2	9%	7	3%	9	2%	.	.	7	3%	10	2%	.	.
Clear	Dark	Dry	Curve	Level	No	3	6%	3	7%	5	4%	.	.	.	.	.	.	10	3%	.	.	.	.
Clear	Dark	Dry	Curve	Not Level	No	4	5%	7	5%	8	3%	.	.	.	.	.	.	.	.	.	.	.	.
Clear	Dark/Overhead Light	Dry	Straight	Level	No	9	3%	6	5%	7	4%	1	20%	2	14%	5	5%	.	.	5	7%	2	11%
Clear	Dark/Overhead Light	Dry	Straight	Level	Yes	.	.	.	.	.	.	5	5%	10	2%	7	4%	.	.	7	5%	.	.
Clear	Dawn/Dusk	Dry	Straight	Level	No	.	.	.	.	9	3%	.	.	5	4%	.	.	.	.	.	.	5	3%
Clear	Daylight	Dry	Straight	Not Level	Yes	.	.	.	.	.	.	.	.	.	.	8	4%	.	.	8	4%	.	.
Clear	Daylight	Dry	Straight	Ukn/Not Rep.	No	.	.	.	.	.	.	.	.	6	3%	.	.	.	.	.	.	7	2%
Clear	Daylight	Wet/Slippery	Straight	Level	No	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	9	2%
Clear	Daylight	Not Trafficway	Not Trafficway	Not Trafficway	No	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	2%
Clear	Dark	Dry	Straight	Not Level	Yes	.	.	.	.	10	2%	.	.	.	.	.	.	.	.	9	3%	.	.
Clear	Dark/Overhead Light	Dry	Straight	Not Level	No	.	.	.	.	.	.	8	3%	.	.	.	.	.	.	.	.	10	1%
Adverse	Daylight	Wet/Slippery	Straight	Level	No	.	.	.	.	.	.	.	.	.	.	.	.	9	3%	.	.	6	3%
Adverse	Dark	Wet/Slippery	Straight	Level	No	.	.	.	.	.	.	9	2%	.	.	.	.	.	.	.	.	.	.
Adverse	Dark/Overhead Light	Wet/Slippery	Straight	Level	No	.	.	.	.	.	.	6	3%	.	.	.	.	.	.	.	.	.	.

Contains at least one top-ranked combination of the scenarios
5 Highest-ranked percentages of each scenario

Note: Values based on average of 2011-2015 FARS data for an LV making the critical action.

Table 51. GES Multiple-Variable Characteristic Ranking

Pre-Crash Scenario Variable						Top 10 Percentages of each Scenario Group (GES 2011-2015)															
Weather	Lighting	Road Surface Conditions	Road Alignment	Road Grade	Highway	Control Loss		Road Departure		Animal		Pedestrian		Pedalcyclist		Lane Change		Opposite Direction		Rear End		Crossing Paths	
						Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%
Clear	Daylight	Dry	Straight	Level	No	1	5%	1	19%	2	9%	1	33%	1	43%	1	38%	1	21%	1	38%	1	34%
Clear	Daylight	Dry	Straight	Level	Yes	.	.	8	2%	.	.	.	.	.	.	3	7%	.	.	3	6%	.	.
Clear	Daylight	Dry	Straight	Not Level	No	.	.	5	3%	9	3%	6	3%	5	5%	5	4%	3	7%	4	6%	6	4%
Clear	Daylight	Dry	Straight	Ukn/Not Rep.	No	.	.	4	5%	6	4%	3	7%	2	11%	4	7%	6	5%	2	7%	2	12%
Clear	Daylight	Dry	Curve	Level	No	8	3%	6	3%	.	.	.	.	.	.	7	2%	2	8%	9	2%	.	.
Clear	Daylight	Dry	Curve	Not Level	No	10	2%	9	2%	.	.	.	.	.	.	.	.	4	7%	.	.	.	.
Clear	Daylight	Dry	Ukn/NotRep	Ukn/Not Rep.	No	.	.	.	.	.	.	8	3%	6	4%	10	2%	.	.	.	.	5	4%
Clear	Daylight	Wet/Slippery	Straight	Level	No	5	3%	.	.	.	.	.	.	.	.	9	2%	10	2%	7	2%	9	2%
Clear	Daylight	Not Trafficway	Not Trafficway	Not Trafficway	No	.	.	.	.	.	.	9	3%	4	6%	.	.	.	.	.	.	3	9%
Clear	Dark	Dry	Straight	Level	No	.	.	3	7%	1	18%	5	4%	8	2%	.	.	7	5%	10	1%	.	.
Clear	Dark	Dry	Straight	Not Level	No	.	.	.	.	4	5%	.	.	.	.	.	.	.	.	.	.	.	.
Clear	Dark	Dry	Straight	Ukn/Not Rep.	No	.	.	.	.	3	6%	.	.	.	.	.	.	.	.	.	.	.	.
Clear	Dark/Overhead Light	Dry	Straight	Level	No	7	3%	2	11%	5	4%	2	15%	3	9%	2	7%	5	6%	5	6%	4	8%
Adverse	Daylight	Wet/Slippery	Straight	Level	No	2	5%	.	.	.	.	7	3%	10	1%	6	3%	8	3%	6	4%	7	3%
Adverse	Daylight	Wet/Slippery	Straight	Level	Yes	4	3%	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Adverse	Daylight	Wet/Slippery	Curve	Not Level	No	3	3%	.	.	.	.	.	.	.	.	.	.	9	2%	.	.	.	.
Adverse	Dark/Overhead Light	Wet/Slippery	Straight	Level	No	.	.	.	.	.	.	4	5%	.	.	.	.	.	.	.	.	.	.
Clear	Daylight	Dry	Straight	Ukn/Not Rep.	Yes	.	.	.	.	.	.	.	.	.	.	8	2%	.	.	8	2%	.	.
Clear	Dark	Dry	Straight	Level	Yes	.	.	.	.	7	3%	.	.	.	.	.	.	.	.	.	.	.	.
Clear	Dark	Dry	Curve	Level	No	.	.	10	2%	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Clear	Dark	Ukn/Not Rep.	Ukn/Not Rep.	Ukn/Not Rep.	No	.	.	.	.	8	3%	.	.	.	.	.	.	.	.	.	.	.	.
Clear	Dark/Overhead Light	Dry	Straight	Ukn/Not Rep.	No	.	.	7	3%	.	.	10	3%	9	1%	.	.	.	.	.	.	8	2%
Clear	Dawn/Dusk	Dry	Straight	Level	No	.	.	.	.	10	3%	.	.	7	3%	.	.	.	.	.	.	.	.
Adverse	Daylight	Wet/Slippery	Straight	Ukn/Not Rep.	No	9	2%	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10	2%
Adverse	Daylight	Wet/Slippery	Curve	Level	No	6	3%	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Note: Values based on average of 2011-2015 GES data for an LV making the critical action.

DOT HS 812 745
August 2019

U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

14305-072619-v2