Contribution of Behavioral Aspects of Older Drivers to Fatal Traffic Crashes in Florida

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Fault in a set of fatal traffic crashes that occurred on state roadways in Florida, primarily in the year 2000, was examined. A case-study approach by a team of trained investigators was taken to examine data compiled from a variety of sources, including traffic homicide reports and crash scene photographs. Crash types were identified in which older drivers were significantly over- and underrepresented in fault. Finally, for crashes in which older drivers were at fault, various contributing factors were identified, including driver errors. Older drivers were overrepresented in fault by a factor of 1.37 compared with younger drivers in the data set. Older drivers were significantly overrepresented in fault in left turn crashes versus oncoming traffic and cross-traffic. Consistent with other work, older drivers were responsible for more intersection than nonintersection crashes. Among other factors, misjudging speeds of other vehicles, failure to observe other vehicles, disregarding traffic signals, and improper (disallowed) left turns were the major driver errors in intersection crashes. Sudden loss of control and driving under the influence of alcohol were the major contributing factors in nonintersection crashes. Approximately 10% of crash contributing factors indicated confusion, inappropriate action, or illegal maneuvers, with more than two-thirds of these cases being attributed to drivers aged 75 years and older. Another important finding of the study is that investigating officers have a tendency to frequently use the term "failure to yield right-of-way," rather than identifying more specific contributing factors.

The United States has experienced a tremendous demographic transition in recent decades. The elderly constitute nearly 13% of the population of the United States. This group, aged 65 and above, is increasing in percentage of the population every year (*1, 2*). By 2030, there will be approximately 70 million older people, that is, 20% of the entire population and more than twice the number in 1999 (*3, 4*). Senior citizens now constitute the fastest growing segment of the U.S. population. Similarly, trends toward an increasing number of older drivers have been well documented in the recent past and are expected to continue in the future (*2, 5*).

A rapidly increasing number of older people may require the urban landscape and transportation systems to be reinvented to cope with the demographic transition of the society. Finding ways to design more accessible living environments and to help the elderly maintain mobility in the wake of their growing number is a significant challenge to society. In 1995, the average older American made 3.4 trips per day, totaling 24.4 mi per day, which works out to be approximately 7.2 miles per trip (*4*). An increasing number of older adults will continue to travel, both as drivers and as pedestrians, as they age. Age-related changes could be relevant to safe driving performance. From an older traveler's perspective, highway signs and other traffic control devices are frequently not large enough, not bright enough, or not properly located (*6, 7*) for safety. Complex intersections can be too confusing, and required walking speeds can be too fast for many older pedestrians (*4*).

To investigate various factors potentially affecting older drivers, this paper examines contributing factors of fatal crashes in which the older drivers were involved as at-fault drivers. The analysis involved investigating the crashes on a case-by-case basis, looking for driver, vehicle, environment, and roadway factors that might have contributed to the fatal crashes. Individual data elements plus photographic evidence were compiled to assess whether more general deficiencies such as inadequate sight distances, inadequate pavement markings, inadequate pedestrian safety measures, and so forth existed at a specific site. Driver behavior and driver errors were noted, and vehicle speeds were reconstructed where possible. The goal of the research was to identify crash types in which older drivers were more frequently at fault and then to examine contributing factors in those crashes. A better understanding of factors contributing to older drivers' crashes will help engineers and policy makers to create a more accessible transportation system.

LITERATURE REVIEW

Motor vehicle crash rate comparisons by age and gender are usually based on the extent to which drivers in a particular age or gender category are injured or involved in crashes. A number of studies have identified high crash rates or certain prevalent crash types among older drivers (*2, 8*). Owsley et al. found that older drivers have among the highest rates of motor vehicle collision involvement per mile driven of all age groups (*9*), and McGwin and Brown concluded that both younger (15–34 years) and older drivers (65+ years) have higher rates of fault in traffic crashes (*10*). In this study, failure to yield to the right-of-way was the leading contributor of crashes caused by older drivers, followed by lack of vehicle control and then misjudging of stopping distance. Older drivers had higher fault rates when turning maneuvers were involved, particularly left-hand turns (*10*).

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However, others have argued that older drivers are not at higher risk for traffic crashes, even when exposure measures such as number of driver licenses are considered. In a study of driver licensing rates in Australia, Tay found that increasing the number of licenses issued to drivers in age cohorts of 60 to 69 and 70 and above had little to no impact on increasing the number of fatal crashes (*11*). A Finnish study also showed no significant increase in crashes per kilometer when older drivers' (65+ years) driving habits and crash rates were compared with a control group of younger (25–40 years) drivers (*12*). Janke argued that the use of accidents per mile as a measure of risk exaggerates the apparent risk of low-mileage groups, including older drivers, because people driving low mileages tend to accumulate much of their mileage on congested city streets with two-way traffic and no restriction of access, whereas high-mileage drivers typically accumulate most of those miles on freeways or other limited access roadways where the driving task is simpler (*13*). Langford et al. echoed this conclusion by showing that, regardless of age, a lower annual distance traveled increased the chances of being involved in crashes by sixfold (*14*).

Although some studies show that older drivers cause fewer crashes that are severe in nature (*5, 9, 15*), other studies show that their age-related vulnerability results in a higher risk of fatality. Li et al. concluded that drivers older than 74 years have much higher driver death rates per vehicle miles traveled (VMT) compared with drivers aged 30 to 59 years old. This study also showed that age-related fragility begins to increase between the ages of 60 and 64 and increases steadily with advancing age, accounting for approximately 60% to 95% of the excess death rates per VMT in older drivers, depending on age group and gender (*16*). A study by Zhang et al. indicates that physical disabilities increase the risk of fatality by a factor of five for drivers 75 to 79 years of age and a factor of 3.5 for those 80 years and older. However, in the age group 65 to 74, the same study showed that medical and physical condition does not appear to be related to risk of fatality (*17*).

Pending roadway and environmental causative factors, drivers in fatal single-vehicle crashes are generally assumed to have responsibility for the crash. However, older drivers are characterized by crashes involving more than one car, especially at intersections. In general, the literature (*16–19*) suggests that older drivers are more frequently involved in intersection crashes than other age-specific driver groups. These drivers usually enter into the intersection violating the right-of-way of oncoming vehicles from other directions and thereby are involved in fatal crashes (*15*). Thus other vehicles hit the vehicles of older drivers more than the vehicles of older drivers hit other vehicles (*15, 19–21*). When considering crash prevention among older drivers, Daigneault et al. concluded that prior crashes are a better predictor for crash risk than prior convictions. These trends steadily increase with each age group, from 65 years old to 80 years or more (*18*).

Several potential factors have been cited among studies investigating the causes of traffic crashes among elderly drivers. Hu et al. found that several factors correlate with increased crash involvement by older drivers, including demographic attributes, limitations in performing physical activities, chronic conditions, physical features, psychosocial characteristics, symptoms, drug use, and other health-related factors (*22*). Owsley et al. suggested that visual processing impairments increase crash risk among older drivers. The study showed that many older drivers meet the legal requirements for licensing despite having vision impairments that elevate crash risk (*9*). A study by Mortimer and Fell indicated that there is a substantial increase in risk of fatal crash involvement by older male drivers in darkness. The crash involvement for these drivers is greater in multivehicle crashes where they are struck in the side or rear by another vehicle and single-vehicle crashes where they run off the road on a straight section (*23*).

Educational programs that promote safe driving strategies among seniors are a popular approach for addressing driving safety, but their safety benefit has yet to be demonstrated. A study by Nasvadi and Vavrik looking at crash rates following attendance at a mature driver education program found that drivers 75 years and older, surprisingly, had an increased rate of crashes after attendance at the program. Further, there was no effect on subsequent crashes for younger men and women of all ages (*24*). Roenker et al. showed that older drivers' field of vision can be improved by training in a driving simulator, but that results were only durable for approximately 18 months without retraining (*25*).

The effect of driving cessation on older drivers has generally been shown to be negative. Fonda et al. showed worsening depressive symptoms in older adults when driving stopped or lessened (*26*). Freeman et al. correlated driving cessation with entry into long-term care. In this study, elderly who had recently ceased driving and those who had never driven showed higher risk of long-term care entry. Furthermore, for the elderly in a household with no other drivers, this became an independent risk for long-term care entry (*27*).

METHODOLOGY AND DATA SET

The research presented here is part of a larger study investigating contributing causes of fatal traffic crashes involving drivers of all ages. A major objective of the research was to provide an in-depth analysis of the relationships between the ages of the at-fault drivers and different aspects of roadway, traffic, weather, and other related contributing factors. This portion of the study focuses only on crashes involving older drivers. The scope is limited to fatal traffic crashes because of the importance of ameliorating such serious crashes, to which older drivers have been shown to be more vulnerable (*5, 16, 17*), and because of the wealth of additional data available on fatal crashes.

A goal of the research, therefore, was to go beyond the data currently available from the Florida Traffic Crash Report (FTCR), incorporating data from additional resources. Crash reports are often lacking in detail, especially regarding driver attitudes and actions, making it difficult to differentiate causative factors and assign fault. A key source of information was obtained from the Florida Highway Patrol (FHP) and local law enforcement agencies in the form of Traffic Homicide Investigating (THI) reports. Photographs of the crash scenes were obtained from the law enforcement agencies or from Florida Department of Transportation's video log system. Where necessary, site visits were conducted to gain better insight into questionable sites.

The data set originally consisted of 2,080 fatal crashes that occurred on state roadways of Florida, primarily in 2000. A total of 3,825 drivers were involved in these crashes, of which 3,585 were reviewed as part of the study of at-fault drivers; the remaining cases were eliminated either because age or fault status could not be identified. Of the 3,585 drivers of known age and fault status, 1,764 were at fault and 1,821 were not at fault. The median age of the at-fault drivers was 38 years. The mode of the ages was 19 years, indicating that most of the at-fault drivers were very young. The kurtosis is negative, which indicates that the age data has a flat distribution with short tails. Overall, 474 older drivers were involved in fatal crashes; at 301 crashes, they were found to be at fault (64%).

To identify contributing factors, the study used a case-based approach in which available data for each crash were examined in great detail by a diverse team of homicide investigators, researchers, traffic engineers, and safety engineers. Contributing causes were identified on the basis of the detail investigation of the photographs of the intersections, officer and witness statements, posted speed limits at the intersections, actual speeds, positions and travel lanes of the vehicles, and so forth. A simplified, yet statistically significant, approach of frequency distributions, called overrepresentation factors (ORF), was used to examine the results of the case studies. This method is based on the approach used in the Crash Analysis Reporting Environment (CARE) software (*28*). An ORF indicates whether a factor occurs more or less frequently in a subset of crashes than in its complement. The ORF was computed for various crash subtypes, as follows:

$$\text{ORF} = \frac{R\_\text{set}}{R\_\text{comp}} = \frac{\dfrac{A}{A+B}}{\dfrac{C}{C+D}}$$

where

A = number of positive outcomes for the set,
B = number of negative outcomes for the set,
C = number of positive outcomes for the set's complement,
D = number of negative outcomes for the set's complement,
R_set = proportion of positive outcomes for the set, and
R_comp = proportion of positive outcomes for the set's complement.

For instance, given the 3,585 drivers in the study set (of which 474 were older and 3,111 were not), 64% of the 474 older drivers [R_set = 301/(301+173) = 0.64] were found to be at fault, whereas only 47% of the 3,111 younger drivers [R_comp = 1,463/(1,463 + 1,648) = 0.47] were found to be at fault. This implies that fault was overrepresented in older drivers with an ORF of 1.35 (ORF = 0.64/0.47).

An ORF of 1.0 indicates that the characteristic occurs in the crash subset at the same rate that it does in the complement of the set. An ORF higher than 1 means that the characteristic occurs more frequently in the subset (i.e., is overrepresented); an ORF less than 1 means that it occurs less frequently in the set than in its complement. The default overrepresentation threshold used by the CARE researchers for high levels of over- or underrepresentation is 1.5 and 0.667, respectively. These numbers mean that a characteristic can be said to be highly over- or underrepresented in a data set if the characteristic occurs 50% more or less frequently in the observed set than in the complement. The basis of the overrepresentation method is that it is unlikely that a countermeasure will reduce the crash rate of a set (e.g., alcohol-related crashes) below that of its complement (non–alcohol-related crashes). Thus, by focusing on highly overrepresented characteristics within a set, there is an increased chance of having a productive result.

The overrepresentation method is very useful in differentiating trends between two different crash subsets. However, the reliability of this factor depends on the sample sizes of the two subsets in consideration. The smaller the sample size is, the less significant the result is. To improve its usefulness in looking at smaller data sets, such as those involved when examining only fatal crashes, the researchers in this project have extended the concept of overrepresentation to include confidence intervals (CIs). The overrepresentation factor is very similar to a relative risk, which is the ratio of percentage of positive cases from the total population to the nonpositive cases from the total population. Hence, the CI for an overrepresentation factor was computed using techniques similar to those used for relative risk factors.

$$\text{Var} = \frac{\left(\dfrac{B}{A}\right)}{(A+B)} + \frac{\left(\dfrac{D}{C}\right)}{(C+D)}$$

$$LL = \text{ORF} \times e^{-z*\sqrt{\text{Var}}}$$

$$UL = \text{ORF} \times e^{z*\sqrt{\text{Var}}}$$

where

LL = lower limit of confidence interval,
UL = upper limit of confidence interval,
z = z statistic given the selected confidence interval, for example, 1.96 for 95% confidence, and
Var = Var (ln ORF) = variance of the natural log of the overrepresentation factor.

Using this approach, one can be 95% confident that the true overrepresentation of fault in older drivers is between 1.249 and 1.460.

DISCUSSION OF RESULTS

Figure 1 examines the distribution of at-fault and not-at-fault drivers in the data set by age. In Figure 1, bars are used to represent the percentage of drivers in each age cohort, whereas lines are used to indicate the number of drivers in each cohort when normalized by the total population in the state within that cohort. For drivers younger than 25 and older than 64, at-fault drivers outnumber not-at-fault drivers within each age group, whereas not-at-fault drivers outnumber at-fault drivers for age groups between 25 and 64 years old. When the driver ages are normalized by the total population within each age group, the not-at-fault drivers follow a bell-shaped curve, with the highest crash involvement of not-at-fault drivers per population steady in the 25-to-54-year-old range and lower for older and younger drivers. However, for at-fault drivers, the trend is generally reversed, with the rate of crash involvement per population higher for younger drivers, decreasing for drivers up to age 74 and then increasing again for the oldest drivers. This implies that extreme older and younger drivers are much more likely to be at-fault when involved in a fatal traffic crash.

As stated previously, older drivers were involved in 474 fatal crashes and were responsible for 301 fatal crashes (64%). Table 1 shows crash types and subtypes of the crashes in which older drivers were at fault. The categorization scheme was developed after an initial review of all the cases in the study and a literature review of related studies wherein crash data are summarized by crash type codes (*4*, *29*–*32*). It is primarily based on crash types used in the general estimates system (GES) crash database (*4*), with enhancements for classifying pedestrian crashes. The first two categories are intersection crashes involving turning and intersecting paths, respectively, whereas the next three categories are nonintersection crashes. Pedestrian crashes include both intersection and nonintersection crashes. Within each crash type, the crashes are broken into mutually exclusive categories. The confidence level is stated as "over" when the lower limit of the 95% confidence interval is above 1.0 and "under" when the upper limit is below 1.0.

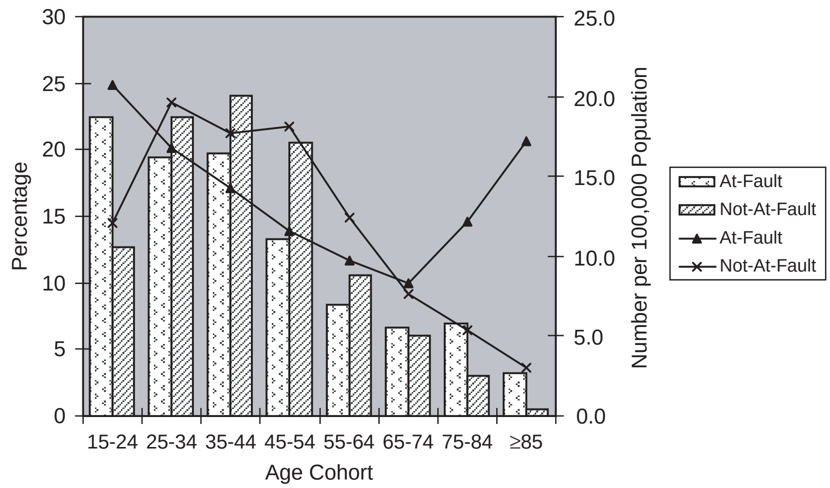

FIGURE 1 Distribution of at-fault and not-at-fault drivers according to age.

Older drivers were significantly overrepresented in three crash types, all of which involved turning movements at intersections. The overrepresented types involved vehicles heading initially in opposite directions (oncoming traffic), turning into opposite directions (cross-traffic), and initially headed in the same direction. The first two crash types generally involved older drivers who had difficulty judging gaps in crossing and oncoming traffic, especially at busy intersections on stop-sign controlled movements, uncontrolled movements, or signalized movements with permissive phasing. The "initial same direction" crashes tended to involve confusion or late decisions by the driver, including turns from the wrong lane. However, although older drivers were significantly overrepresented in this crash type, it still represented only 3% of all crashes in which an older driver was at fault. Case studies showed that most of these crashes occurred at intersections with no advance street name signs or less visible signs. Older drivers were highly underrepresented in fault in most other crash types.

In 96% of the cases in which older drivers were at fault, the primary contributing factor was a human factor: inattention in one-third of the cases, followed by decision errors, and perception errors. Alcohol or drug use was the primary factor in almost 10% of the cases. Looking at all contributing factors, not just primary factors, the broad category of age was cited by the case reviewers in approximately 15% of the cases. This finding indicates that the age of a driver affected his or her ability to complete the driving task—because of lack of mobility and increased perception-reaction time. Other than the factors mentioned previously, crash-contributing factors included confusion, longer perception–reaction time, illegal maneuvers (e.g., wrong way or left-turn where not permitted), or inappropriate actions (e.g., stop on interstate, drive around train crossing gates). More than two-thirds of the confusion cases were attributed to drivers aged 75 years and up. The most common nonhuman factor was roadway design or geometry, which tended to be applied to wide, nonsignalized intersections or those with complicated geometry.

Driver errors were identified for all fatal crashes in which older drivers were at fault; because of the differences in error types between intersection and nonintersection crashes, they are presented separately. A total of 203 intersection crashes in the data set were caused by older drivers, out of which the causes of 9 crashes could not be identified. This represents two-thirds of the crashes in which an older driver was at fault, a much higher percentage than was seen with the younger drivers (35.5% for the drivers of age 24 years or younger). Figure 2 depicts the major contributing factors of intersection crashes caused by the older drivers. For this research, the term "misjudgment of speeds" is used for the crashes in which the case review showed that the at-fault driver failed to properly judge the speeds of the vehicles approaching from other directions. This also includes those crashes in which the vehicles were coming at a speed higher than the posted maximum speed, which the older drivers could not judge properly. The term "failed to observe" indicates a failure to observe other vehicles or all sides before entering the intersection. The term "improper left turn" includes those crashes in which the at-fault driver attempted a left turn although she or he did not have permission to make a left turn. Examples include turning from an incorrect lane and turning where no left turns are allowed. The "improper left turn" category does not include "misjudgment of speed" or "failed to observe."

The figure shows that misjudgment of speeds of other vehicles, failure to observe other vehicles or all sides before approaching the intersection, disregarding traffic signals and signs, and improper left turn were four major contributing factors, each of which contributed to more than 10% of the intersection crashes caused by the older drivers. Other driver errors causing intersection crashes involving older drivers were disregarding stop signs, driving under the influence of alcohol or drugs, confusion caused by the complexity of the intersection and traffic or billboard signs, loss of control, exceeding safe speed limits, and road crossing at unauthorized location. Other factors, including inability to see other vehicles or signage, improper U-turn, stopped improperly on the road, mechanical problems, unconsciousness, improper passing, improper lane change, and so forth each contributed to less than 1% of the intersection crashes.

Ninety-eight nonintersection crashes were caused by the older drivers, out of which the cause of 1 crash was unknown. The results are shown in Figure 3. The figure shows that loss of control contributed to more than one-third of the crashes, whereas driving under the influence of alcohol contributed to almost one-fifth of such crashes. Exceeding safe speed limits, improper lane change, failure to stop the vehicle to avoid a rear-end collision, driving in the wrong direction, and improper stopping on the roadway were the third to seventh most important contributing factors, respectively, each of which contributed to more than 4% of crashes. The term "others" in this figure include those factors that contributed to less than 2% of

TABLE 1 Types of Crashes Caused by Older Drivers

Type	Subtype	Older At-Fault No.	Older At-Fault Percent	Other At-Fault No.	Other At-Fault Percent	ORF	Min. CI (LL)	Max. CI (UL)	95% Confidence Level
Change of trafficway or turning	Initial same direction	9	3.0	13	0.9	3.365	1.452	7.801	Over
	Single-vehicle control loss while turning	0	0.0	2	0.1	0.000	N/A	N/A	N/A
	Turn into opposite directions, cross traffic	66	21.9	72	4.9	4.455	3.267	6.075	Over
	Turn, merge into same direction	5	1.7	18	1.2	1.350	0.505	3.608	Unsure
	Evasive action to avoid turning, merging vehicle	0	0.0	2	0.1	0.000	N/A	N/A	N/A
	Initial opposite directions, oncoming traffic	62	20.6	130	8.9	2.318	1.759	3.055	Over
Intersecting paths	Backing	1	0.3	3	0.2	1.620	0.169	15.52	Unsure
	Not at fault from left	21	7.0	64	4.4	1.595	0.990	2.570	Unsure
	Not at fault from right	20	6.6	71	4.9	1.369	0.847	2.214	Unsure
	Not at fault unknown direction	1	0.3	4	0.3	1.215	0.136	10.83	Unsure
Opposite direction	Forward impact with control loss	1	0.3	37	2.5	0.131	0.018	0.954	Under
	Sideswipe angle	0	0.0	3	0.2	0.000	N/A	N/A	N/A
	Head-on	16	5.3	121	8.3	0.643	0.387	1.066	Unsure
Run off road, single vehicle	Ramp departure	1	0.3	30	2.1	0.162	0.022	1.183	Unsure
	Forward impact	2	0.7	9	0.6	1.080	0.235	4.974	Unsure
	Left roadside departure	11	3.7	127	8.7	0.421	0.230	0.770	Under
	Left roadside departure with control loss	12	4.0	144	9.8	0.405	0.228	0.720	Under
	Other	0	0.0	2	0.1	0.000	N/A	N/A	N/A
	Right roadside departure	26	8.6	194	13.3	0.651	0.441	0.962	Under
	Right roadside departure with control loss	6	2.0	95	6.5	0.307	0.136	0.694	Under
Same direction	Sideswipe angle with control loss	1	0.3	14	1.0	0.347	0.046	2.630	Unsure
	Rear end	20	6.6	175	12.0	0.555	0.356	0.867	Under
	Rear end with avoid impact	4	1.3	33	2.3	0.589	0.210	1.651	Unsure
	Sideswipe angle	7	2.3	30	2.1	1.134	0.503	2.558	Unsure
Pedestrian	Exit vehicle	1	0.3	9	0.6	0.540	0.069	4.247	Unsure
	Walking along road against traffic	0	0.0	1	0.1	0.000	N/A	N/A	N/A
	Crossing at intersection in crosswalk	0	0.0	6	0.4	0.000	N/A	N/A	N/A
	Crossing not at intersection—first half	3	1.0	10	0.7	1.458	0.404	5.267	Unsure
	Crossing not at intersection—second half	0	0.0	18	1.2	0.000	N/A	N/A	N/A
	Other in road	0	0.0	7	0.5	0.000	N/A	N/A	N/A
	Vehicle turn/merge	1	0.3	7	0.5	0.694	0.086	5.623	Unsure
	Walking along road with traffic	1	0.3	3	0.2	1.620	0.169	15.52	Unsure
Other, unknown		3	1.0	9	0.6	1.620	0.441	5.949	Unsure
Total		301	100	1,463	100				

the crashes. These included failure to observe other vehicles, improper U-turn, mechanical problems, improper passing, improper left turn, run off road, lack of visibility, failure to negotiate curves, and so forth. It is important to note that driving under the influence of alcohol is the second major factor for the older drivers' nonintersection crashes, although it was not one of the five major causes for intersection crashes.

The case review teams found that the investigating officers had a tendency to frequently use the term "failure to yield right-of-way" for intersection crashes. Driver contributing causes for more than 73% of crashes caused by older drivers were recorded by the investigating officers as "failure to yield right-of-way" instead of further breaking down the causes. This paper investigated how and why the failure to yield occurred by reconstructing vehicle speeds, watching video logs from the viewpoint of the approaching vehicles, reviewing witness statements, and so forth. When these crashes were further broken down, as shown in Figure 4, the results showed that the overused term "failure to yield right-of-way" constituted other more detailed contributing factors, primarily misjudgment of speeds and failure to observe vehicles or all sides before entering the intersection but also disregarding traffic signals and other less common causes. The first three terms are used as defined previously; the drivers' errors such as disregarding traffic signals, disregarding stop signs, and driving under the influence do not need further definition. The term "confused" includes cases in which the older driver appears to have become confused as to what to do, in part because he or she was provided too much information by a complicated roadway, traffic, or billboard signs.

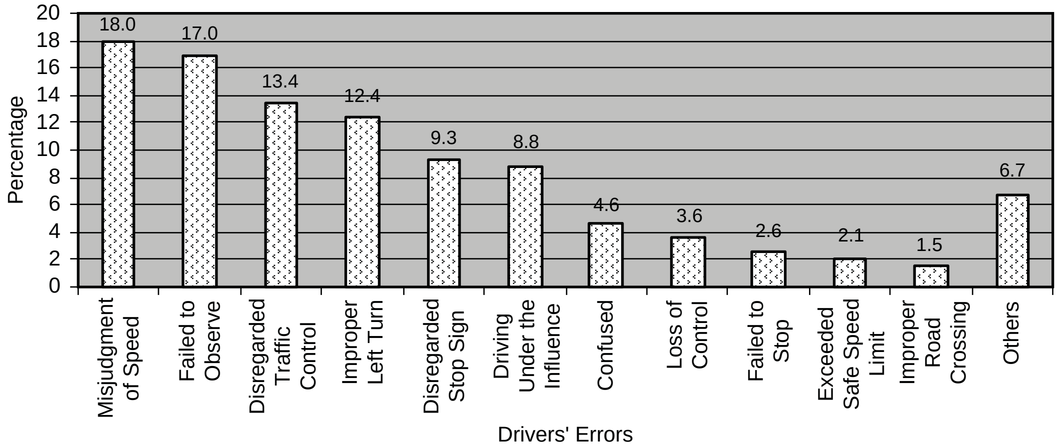

FIGURE 2 Errors of older at-fault drivers in intersection crashes.

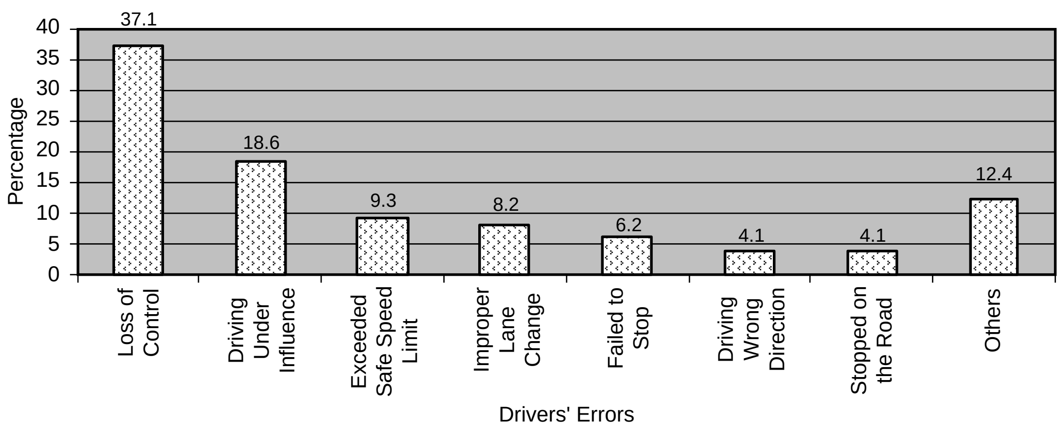

FIGURE 3 Errors of older at-fault drivers in nonintersection crashes.

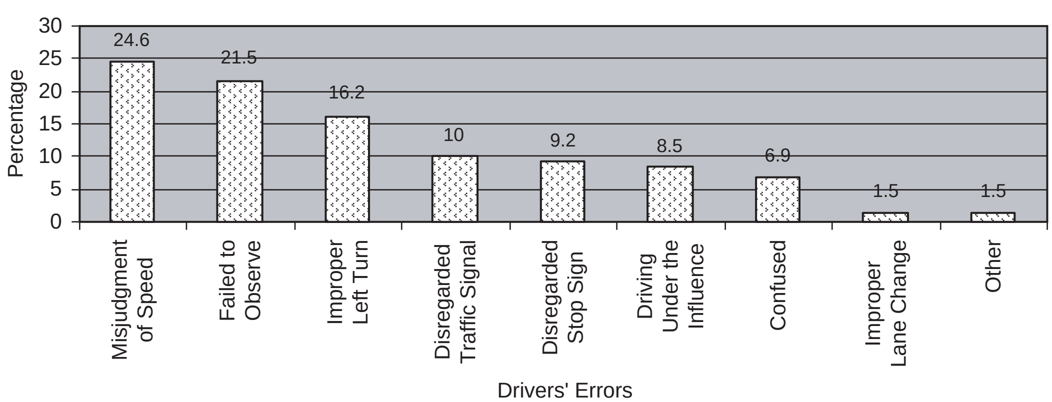

FIGURE 4 Representation of the overused term "failure to yield right-of-way."

CONCLUSIONS AND RECOMMENDATIONS

This study examined fault in a set of fatal traffic crashes that occurred on state roadways in Florida, primarily in the year 2000. A case-study approach by a team of trained investigators examined data compiled from a variety of sources, including traffic homicide reports and crash scene photographs. Crash types were identified in which older drivers were significantly over- and underrepresented in fault. Finally, for crashes in which older drivers were at fault, various contributing factors were identified, including driver errors.

Examining data on the age distribution of at-fault and not-at-fault drivers in the study showed that younger drivers were more frequently involved in or responsible for fatal traffic crashes in the data set. However, when the data were normalized by population in the state of Florida, both younger drivers and older drivers (75 years and older) have higher crash rates than middle-aged drivers. Because the main focus of the study was identifying crash types and contributing factors in older driver crashes, no further effort was made to normalize the data against other exposure measures such as driving time or miles, as was done with other studies cited in the literature (*8, 9*). Further, in this study, older drivers were found to be at fault in fatal traffic crashes at much higher rates than all except the youngest drivers. Although this result may be skewed by the fact that older drivers are at much greater risk of fatality when involved in a traffic crash (*5, 16, 17*), it does not lessen the need for research that is directed at identifying and ameliorating factors that contribute to fatal crashes involving older drivers.

In the data set described herein, older drivers were at fault in 64% of the fatal crashes in which they were involved, compared with only 47% of the younger drivers. In keeping with other studies (*16–19*), the data suggest that older drivers are at fault more frequently in intersection crashes than nonintersection crashes. Older drivers were significantly overrepresented in fault in left turn crashes versus oncoming traffic and cross traffic; these crashes accounted for more than 42% of the crashes in which older drivers were at fault. Misjudgment of speeds of other vehicles, failure to observe other vehicles or all sides before entering the intersection, disregarding traffic signals, and improper left turn were the four major driver errors in intersection crashes, each of which contributed to greater than 10% of the intersection crashes by older drivers. Sudden loss of control contributed to more than one-third of nonintersection crashes, whereas driving under the influence of alcohol contributed to almost one-fifth of such crashes; these were the most common factors in nonintersection crashes in which older drivers were at fault. These results are in keeping with those of McGwin and Brown (*10*), which showed that older drivers had higher fault rates when turns, especially left turns, were involved, and that failure to yield to the right-of-way was the leading contributor of crashes caused by older drivers. However, the study described here separated intersection from nonintersection crashes, allowing the major contributing factors to be categorized for the two different crash types. The data are also based on extensive case studies of fatal traffic crashes, enabling researchers to separate driver errors such as misjudgment of speed, which might be indicative of delayed perception or reaction time, from those such as disregarding traffic signals and improper (disallowed) turns, which might be indicative of more serious cognitive issues. Countermeasures to effectively reduce these crash types would be vastly different.

The broad category of age was cited as a primary or secondary contributing factor by the case reviewers in approximately 15% of the cases. This finding indicates that the age of a driver affected his or her ability to complete the driving task because of lack of mobility and increased perception-reaction time. Approximately 10% of the crash contributing factors indicated potential confusion on the part of the older driver, including late decisions (e.g., turn from wrong lane), inappropriate action (e.g., stop on Interstate, drive around train crossing gates), or illegal maneuvers (e.g., wrong way or left-turn where not permitted). More than two-thirds of the confusion cases were attributed to drivers aged 75 years and up. The most common nonhuman factor was roadway design or geometry, which tended to be applied to wide, nonsignalized intersections or those with complicated geometry. Because of the prevalence of intersection crashes among older drivers, the ability to negotiate confusing intersections becomes more of an issue.

The study found that overuse of the term "failure to yield right-of-way" by the reporting officers makes it difficult for researchers relying only on crash report data to find out the exact reasons for many traffic crashes. Several factors could affect the overuse of the term. It is possible that investigating officers either do not spend enough time or do not have enough information to identify the actual causes behind the fatal crashes. Another potential explanation is that they are unwilling to provide detailed contributing factors because of the ongoing criminal investigation, especially in the case of fatal crashes. Necessary measures should be taken so the investigating officers can investigate in further detail and provide sufficient documentation to supply the actual causes of fatal crashes, so that researchers and policy makers could benefit from the reports.

Finally, although every effort has been made to accurately assess the contributing factors and driver errors associated with each crash, it should be noted that there are limitations to the approach used herein. For instance, a crash that appeared to be caused by increased perception–reaction time (e.g., failure to apply brakes to avoid collision) could actually have been caused by an undetected medical issue. Caution should be used when applying these results. In addition, further research should be conducted to investigate causes and potential countermeasures to crashes in which older drivers are more frequently found to be at fault. Simulator studies can safely investigate issues such as range of motion and age-related vision difficulties (*25*). In areas of high elderly population, ideas to reduce intersection crashes include those recommended by the Florida Elder Road User Program (FERUP), a program being implemented in the state of Florida to make the streets safer and more user-friendly for the increasing large elderly population. The FERUP is instituting safety measures such as larger lettering on street signs, more advanced signage, wider pavement markings, and use of reflective pavement markers. Implementing intersection design and signalization that decreases reliance on judgment in making left turns (e.g., protected left turns, roundabouts) could also be effective in reducing crashes involving older drivers. Before implementation of unusual designs such as roundabouts, thorough study should be conducted for the potential to confuse elderly drivers, leading to unsafe and illegal driving maneuvers.

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