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Contributing Factors for Young At Fault Drivers in Fatal Traffic Crashes in Florida

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This state level case based study is aimed at providing a complete picture of contributing factors for fatal crashes caused by younger drivers (younger than age 25) in Florida. Results showed that nonhuman factors were primary contributing causes in only 6% of the crashes, but secondary and tertiary contributing factors in up to 25% of those crashes. The most common nonhuman factor was tire blowout/tread separation. Common human factors included alcohol use, inattention, and high speed. Younger drivers were at fault in 62% of crashes in which they were involved, and they were highly overrepresented in fault in forward impacts with control loss due to high speeds and abrupt steering input. At the time of the fatal crash, younger drivers were more likely to have had passengers in the vehicle than older drivers and approximately one in four younger at fault drivers was under the influence of alcohol. However, most of the youngest (16 to 17 year olds) at fault drivers were in compliance with nighttime and passenger restriction statutes of graduated driver licensing at the time of the fatal crash. The findings imply that there still remains gaps and weaknesses in current driving programs aimed at younger drivers.

Keywords younger drivers, fatal crashes, case based analysis, contributing factors.

1. Introduction

With 1.71 traffic fatalities per 100 million vehicle miles traveled (VMT) in 2003, Florida ranks 17th highest in the United States (U.S. Census Bureau, 2003). A pilot study of fatal crashes involving automobiles and heavy trucks on state highways indicated that there are significant differences among the driving behaviors of different age groups (Spainhour, Brill, Sobanjo, Wekezer, & Mtenga, 2003). The pilot study found that fault skews more heavily toward younger and older drivers, with 70% of the drivers aged 11 to 20 years at fault, as were 67% of the drivers aged 81 to 90 years. These preliminary findings hinted that age might be a significant contributing factor to fatal crashes, a factor that was investigated more thoroughly in a state wide study that investigated human and nonhuman contributing factors for fatal crashes. The youthful age and inexperience are attributes blamed for the increase in

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crash rate by young drivers (Mayhew, Simpson, & Pak, 2003; Shope, Waller, & Lang, 1996). Irrespective of age, drivers with few years of experience are more susceptible to high crash rates (Committee on Injury and Poison Prevention and Committee on Adolescence, 1996). Because young drivers usually have fewer years of experience than their counterparts, one may argue that young drivers are more vulnerable to a higher rate of crashes than more experienced drivers (Ballesteros & Dischinger, 2002; Cooper, Pinili, & Chen, 1995).

In the United States, driving laws and licensing practices are determined by each of the 50 states, the District of Columbia, and its territories (Braitman, Kirley, McCartt, & Chaudhary, 2008; Williams, Fergusson, & Wells, 2005). Unlike other nations, there is no national (federal) licensing law in the United States, although several states have similar licensing regulations. A few states allow learner's permits at age 14, whereas the majority of states allow permits at age 15, and a few postpone any driving privileges until age 16. Currently, and starting with Florida in 1996, numerous states have taken steps to combat young driver crashes by employing what is commonly referred to as a Graduated Driver's Licensing (GDL) system, in which younger student drivers are permitted incrementally greater autonomy and driving privileges (Braitman et al., 2008; Insurance Institute for Highway Safety [IIHS], 2006). Studies indicate that states with GDL systems had larger reduction of crash rate by young drivers than those without GDL restrictions (Fohr, Layde, & Gude, 2005; Ohio Department of Public Safety, 2001; Rice, Peek-Asa, & Kraus, 2004; Shope & Molnar, 2004; Zwicker, Williams, Chaudhary, & Farmer, 2006).

Numerous studies have examined crashes involving younger drivers. Existing studies have considered certain behaviors such as driving after drinking and non-seat-belt use as risky, whereas other behaviors such as transporting multiple friends and eating while driving were not perceived as risky (Rhodes, Brown, & Edison, 2005). Others found that the vast majority of accidents involving young drivers stemmed from attributes like errors in attention, visual searches, hazard recognition, speeding relative to conditions, and emergency maneuvers (McKnight & McKnight, 2003). Carrying teenage passengers and driving at night have been explored as two important contributing factors for fatal crashes (Chen, Baker, Braver, & Li, 2000; Masten & Hagge, 2004; Mayhew et al., 2003; Ulmer, Williams, & Preusser, 1997; Williams et al., 2005) and nonfatal injury crashes (Rice et al., 2004) caused by young drivers. Driving without a license has also been shown to be an important factor for fatal crashes caused by young drivers (Hanna, Taylor, Sheppard, & Laflamme, 2006). Studies further find driving under the influence of alcohol as a growing contributing factor as the age increases and proceeds toward 21 (Ballesteros & Dischinger, 2002).

This article deals with the contribution of age of at fault drivers on the occurrence of fatal crashes and looks specifically at crashes involving younger drivers. To explore the myriad of factors that potentially affect younger drivers, the article examines the contributing factors of fatal crashes in which younger drivers were cited as being "at fault." The analysis involved investigating individual fatal crashes on a case by case scenario, looking for driver, vehicle, environment, and roadway factors that may have contributed to the crash. Individual data elements were compiled with the help of photographic evidence to assess whether more general deficiencies such as inadequate sight distances, pavement markings, pedestrian safety measures, etc. existed at specific crash sites. Driver behavior and driver error was also noted, and vehicle speeds were reconstructed where possible. The goal of the research was to identify crash types in which younger drivers were more frequently "at fault," and then examine the contributing factors in those crashes. A better and more thorough understanding of factors relating and/or contributing to younger drivers' crashes could help engineers and decision/policy makers to create more accessible and safer transportation systems. Although some studies (Ulmer et al., 1997; Williams et al., 1995; Williams, Preusser, Ulmer, &

Weinstein, 2005; Williams, Preusser, & Fergusson, 1998) have focused on 15 or 16 year old drivers, this article primarily reports on the contributing factors of drivers age 16 to 24 years because there are age and maturity related similarities among drivers of this cohort. One exception is the examination of compliance with GDL statues, which applies to 16 and 17 year old drivers. Many other studies, including Lestina and Miller (1994), National Highway Traffic Safety Administration (1993), and Robertson (1982), have studied the same cohort. Although studies exist on similar topics, most of them use a national data set instead of focusing on a specific state. However, driving laws are made at state level in the United States. Therefore, a microscopic picture of such contributing factors at a state level, as is done in this article, is necessary for better policy making.

2. Data Set and Methodology

The research presented henceforth is part of a larger study investigating the contributing factors of fatal traffic accidents involving drivers of all ages (Spainhour, Brill, Sobanjo, Wekezer, & Mtenga, 2005). A major objective of this portion of the research was to provide an in depth analysis of the relationships between the ages of "at fault" drivers and different aspects of roadway, traffic, and weather related contributing factors; however, this portion of the research focuses only on the subset of fatal crashes involving younger drivers. For the purposes of this analysis, younger drivers are defined as those younger than age 25. The scope is limited to fatal traffic crashes because of the importance of ameliorating such serious crashes and because of the abundance of available data on these types of crashes.

One goal of the research was to expand beyond the available data from the Florida Traffic Crash Report (FTCR) by incorporating data from additional resources. Crash reports often lack detail, especially regarding subjective driver information (e.g., attitudes and actions), and thus make it difficult to differentiate causative factors and assign fault. Key sources of information were the Traffic Homicide Investigating (THI) reports obtained from Florida Highway Patrol (FHP) and local law enforcement agencies. Photographs of crash scenes were gathered from the various law enforcement agencies and/or the Florida Department of Transportation's (FDOT) video catalog system. Site visits were also conducted to gain insight into questionable crash sites.

The data set originally consisted of 2,080 fatal crashes that occurred on Florida state roadways, primarily during the year 2000; it has been the focus of numerous traffic safety studies examining the state of Florida (Spainhour et al., 2005). A total of 3,825 drivers were involved in this set of crashes, of which age and/or fault status was unknown for 240 drivers. Of the 3,585 drivers of known age and fault status, 1,764 were identified as being at fault, and 1,821 were considered not at fault. There were a total of 632 younger drivers in the database, of which 419 were found to be at fault. The median age of the at fault drivers was 38 years; the mode of the ages was 19 years old, indicating that the majority of at fault drivers were quite young. The kurtosis was negative, indicating that the age specific data has a flat distribution with short tails.

To identify the contributing factors in the fatal crashes, this study utilized a case-based approach whereby available data for individual crashes was scrutinized in greater detail by a diverse team of homicide investigators, researchers, traffic and safety engineers, and crash reconstructionists. The team members were trained to study, analyze, and reconstruct (whenever necessary) crashes on a case by case basis before they started actual data entry and analysis of overall trends in the study. The team leader monitored all data analysis, making it possible to establish and maintain inter rater reliability and ensure the high quality of the data set. Contributing causes were identified based on the detailed investigation of photographic evidence, officer and witness statements, posted speed limits, actual vehicle speeds/positions/travel lanes, etc.

Overrepresentation factors (ORF), a simplified but statistically significant approach to frequency distributions, were used to determine the results of the case studies. This method is based on the approach utilized by the Crash Analysis Reporting Environment (CARE) software (Parrish, Dixon, Cordes, Vrbsky, & Brown, 2003). An ORF indicates whether a certain factor occurs more or less frequently in a subset of crashes than in its complement. The ORF was calculated for various crash subtypes as follows:

$$ORF = \frac{R\_set}{R\_comp} = \frac{\frac{A}{A+B}}{\frac{C}{C+D}}$$

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 632 were younger and 2953 were not), 66% of the 632 younger drivers (R_set = 419/(419+213) = 0.66) were found to be at fault, while only 46% of the 2953 nonyounger drivers (R_comp = 1367/(1367+1586) = 0.46) were found to be at fault. This implies that fault was overrepresented in young drivers with an ORF of 1.44 (ORF = 0.66/0.46) compared to older drivers.

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 1.0 indicates that the characteristic occurs more frequently in the subset (i.e., is overrepresented); an ORF less than 1.0 indicates that the characteristic occurs less frequently in the set than in its complement. The default overrepresentation threshold utilized 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 accidents) below that of its complement (non-alcohol-related accidents). Therefore, by focusing attention on highly overrepresented characteristics within a set, there is an increased chance of having a productive result.

The overrepresentation method is quite useful when differentiating trends between two different crash subsets; however, the reliability of this factor depends on the sample sizes of the two subsets in consideration. To improve its usefulness when analyzing smaller data sets such as those involved in examining only fatal crashes, the researchers in this project have extended the concept of overrepresentation to include confidence intervals (CIs). The overrepresentation factor is similar to a relative risk or the ratio of percentage of positive cases from the total population to the nonpositive cases from the total population. Thus, the CI for an overrepresented factor was calculated using techniques similar to those used for relative risk factors.

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

Table 1
Driver age versus driver fault

	At fault		Not at fault					
Age group	*f*	%	*f*	%	At-fault ORF	Min CI	Max CI	Level
0–14	1	0.1	1	0.1	1.036	0.065	16.556	Unsure
15–24	419	22.7	257	13.4	1.690	1.467	1.946	Over
25–34	354	19.2	404	21.1	0.908	0.799	1.032	Unsure
35–44	345	18.7	442	23.1	0.809	0.714	0.917	Under
45–54	232	12.6	374	19.6	0.643	0.553	0.747	Under
55–64	138	7.5	204	10.7	0.701	0.570	0.862	Under
65–74	118	6.4	113	5.9	1.082	0.843	1.389	Unsure
75–84	130	7.0	50	2.6	2.694	1.957	3.710	Over
85–94	51	2.8	8	0.4	6.606	3.144	13.882	Over
95–104	2	0.1	0	0.0	N/A	N/A	N/A	N/A
Unknown	56	3.0	60	3.1	0.967	0.676	1.384	Unsure
Total	1846	100.0	1913	100.0	1.000			

$$LL = ORF * \hat{e} - z * \sqrt{Var}$$
$$UL = ORF * \hat{e}z * \sqrt{Var}$$

where, LL = lower limit of CI, UL = upper limit of CI, z = z statistic given the selected CI, for example, 1.96 for 95% confidence, Var = Var (in ORF) = variance of the natural log of the overrepresented factor.

3. Results and Discussions

As indicated previously, there were 632 young (younger than age 25) drivers involved in fatal crashes, of which 419 were found to be at fault. Table 1 shows the distribution of fault among drivers of various ages. Drivers between 15 and 24 years old are highly overrepresented in fault when compared to other drivers, a result that is statistically significant at 95% confidence level. The only other age groups that are highly overrepresented in fault are those older than age 75.

3.1. Crash Types

Table 2 shows crash types of the crashes in which younger drivers were at fault. The categorization scheme was developed following an initial review of all the cases in the study, and a literature review of related studies wherein crash data is being summarized by crash type codes (Eskandarian, Bahouth, Digges, Godrick, & Bronstad, 2004; National Safety Council [NSC], 2002). It is primarily based on crash types used in the General Estimates System (GES) crash database (NSC, 2002), with enhancements for classifying pedestrian crashes. The first two categories are intersection crashes involving turning and intersecting paths, respectively, whereas the remaining four categories are nonintersection crashes. Within each crash type, crashes are broken into mutually exclusive categories

Table 2
Crash types of crashes caused by younger drivers

Type	Subtype	Younger at fault		Other at fault					
		f	%	*f*	%	ORF	Min CI	Max CI	Level
Change Trafficway/Turning	Initial same direction	0	0.0	20	1.5	0.000	N/A	N/A	N/A
	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	19	4.5	121	9.0	0.506	0.316	0.810	Under
	Turn/merge into same direction	5	1.2	18	1.3	0.895	0.334	2.396	Unsure
	Evasive action to avoid turning/merging vehicle	1	0.2	2	0.1	1.611	0.146	17.722	Unsure
	Initial opposite directions/oncoming traffic	35	8.4	160	11.9	0.705	0.497	0.999	Under
Intersecting Paths	Backing	1	0.2	4	0.3	0.805	0.090	7.187	Unsure
	Not at fault approaching from left	20	4.8	65	4.8	0.991	0.608	1.617	Unsure
	Not at fault approaching from right	28	6.7	63	4.7	1.432	0.930	2.205	Unsure
	Not at fault unknown direction	0	0.0	4	0.3	0.000	N/A	N/A	N/A
Opposite Direction	Forward impact with control loss	16	3.8	22	1.6	2.343	1.242	4.420	Over
	Sideswipe angle	0	0.0	3	0.2	0.000	N/A	N/A	N/A
	Head-on	36	8.6	101	7.5	1.148	0.798	1.653	Unsure
Pedestrian	Exit vehicle	0	0.0	10	0.7	0.000	N/A	N/A	N/A
	Unique	0	0.0	1	0.1	0.000	N/A	N/A	N/A
	Walking along road against traffic	1	0.2	0	0.0	N/A	N/A	N/A	N/A
	Crossing at intersection in crosswalk	2	0.5	4	0.3	1.611	0.296	8.764	Unsure
	Crossing not at intersection–first half	4	1.0	9	0.7	1.432	0.443	4.626	Unsure
	Crossing not at intersection–second half	4	1.0	14	1.0	0.921	0.305	2.782	Unsure
	Other in road	0	0.0	6	0.4	0.000	N/A	N/A	N/A
	Vehicle turn/merge	1	0.2	7	0.5	0.460	0.057	3.730	Unsure
	Walking along road with traffic	1	0.2	3	0.2	1.074	0.112	10.297	Unsure

(Continued on next page)

Table 2

Crash types of crashes caused by younger drivers *(Continued)*

Type	Subtype	Younger at fault		Other at fault		ORF	Min CI	Max CI	Level
		f	%	*f*	%				
Run Off Road/Single Vehicle	Ramp departure	9	2.1	22	1.6	1.318	0.612	2.840	Unsure
	Forward impact	2	0.5	9	0.7	0.716	0.155	3.301	Unsure
	Left roadside departure	53	12.6	85	6.3	2.009	1.451	2.781	Over
	Left roadside departure with control loss	46	11.0	109	8.1	1.360	0.981	1.885	Unsure
	Other	1	0.2	1	0.1	N/A	0.202	51.399	Unsure
	Right roadside departure	50	11.9	171	12.7	0.942	0.701	1.266	Unsure
	Right roadside departure with control loss	28	6.7	73	5.4	1.236	0.811	1.884	Unsure
Same Direction	Sideswipe angle with control loss	3	0.7	12	0.9	0.805	0.228	2.841	Unsure
	Rear-end	38	9.1	159	11.8	0.770	0.550	1.078	Unsure
	Rear-end with avoid impact	7	1.7	29	2.1	0.778	0.343	1.762	Unsure
	Sideswipe angle	6	1.4	31	2.3	0.624	0.262	1.484	Unsure
Other/Unknown		2	0.5	10	0.7	0.644	0.142	2.929	
Total		419	100	1350	100	1.000			

according to the vehicle actions and positions, generally. The confidence level is stated as "over" when the lower limit of the 95% CI is above 1.0 and "under" when the upper limit is below 1.0.

As shown in Table 2, the most common crash types in which younger drivers were at fault were single vehicle run off the road (ROR) crashes, accounting for 45% of all fatal crashes in which younger drivers were at fault. Within this category, younger drivers were most frequently involved in left roadside departures without control loss. This crash type was strongly associated with divided highway crashes in which the ROR event involved median crossover. Because younger drivers were highly overrepresented in this crash type, countermeasures directly specifically toward younger drivers (improved driver education, etc.) might be expected to have a more significant impact, as opposed to programs directed toward older drivers. The next most frequent fatal crash types in which younger drivers were involved were rear-end crashes and head-on crashes without control loss. However, younger drivers were not overrepresented in these crash types, when compared to older drivers. This indicates that countermeasures for such crashes should be directed toward drivers of all ages, rather than geared specifically toward younger drivers.

Younger drivers were also highly overrepresented in fault in forward impacts with control loss, that is, collisions with oncoming vehicles in which the driver lost control prior to the impact. This implies that, when compared to at fault drivers of other ages, younger drivers are more likely to be involved in forward impacts with control loss. These crashes are differentiated from head-on crashes, where the drivers approaching from opposite directions impacted one another, but without loss of control due to abrupt steering input. Loss of control crashes generally involve high speeds and abrupt steering input and potentially indicate inattention and/or an inability to use sound judgment and make quick decisions. FTCR and THI reports were carefully analyzed to determine whether the abrupt steering was the initial event, or if abrupt steering was performed in response to some other events like drifting off the road, sudden appearance by an animal, etc. These factors are explored in more detail in subsequent sections of the paper. Younger at fault drivers were significantly underrepresented in crashes involving turning in front of cross traffic and turning in front of oncoming traffic, when compared to other at fault drivers.

3.2. Crash Contributing Factors

Table 3 looks at contributing factors in fatal crashes where a younger driver was found to be at fault. The purpose of the case study approach was to identify causative factors, which are those factors that contributed to the crash, as opposed to conditions that merely existed at the time of the crash. In fact, one of the key functions of the case studies was to identify or rule out potential roadway contributing factors to the degree possible. Data sources deemed particularly helpful in this effort included crash scene photographs, available video logs, and where necessary, site visits. In Table 3, primary, secondary, and tertiary contributing factors are identified. Where the factors are human related, the primary and secondary factors could belong to the same person (e.g., alcohol use and speeding by driver one), or the factors might belong to two different persons in the crash (e.g., speeding by driver one and inattention by driver two). The primary factor almost always belongs to the at-fault driver, which in these cases is the set of drivers younger than age 25.

Examining the table, it is evident that human factors are the most common primary contributing factors in fatal crashes caused by younger drivers, accounting for 393 of the 417 primary factors, almost 94%. Among human factors, alcohol, inattention, and speed

Table 3
Contributing factors in crashes where a younger driver was at fault

Factor class	Factor	Primary *f*	Primary %	Secondary *f*	Secondary %	Tertiary *f*	Tertiary %	Total *f*	Total %
Environment	Wet/slippery	4	1.0	12	3.8	22	11.8	38	4.1
	Dark	0	0.0	14	4.4	12	6.4	26	2.8
	Smoke/fog	0	0.0	5	1.6	2	1.1	7	0.8
	Dawn/dusk	0	0.0	0	0.0	1	0.5	1	0.1
	Heavy rain	0	0.0	1	0.3	0	0.0	1	0.1
	All environment	4	1.0	32	10.1	37	19.8	73	7.9
Human	Alcohol	90	21.5	8	2.5	4	2.1	102	11.1
	Inattention	82	19.6	29	9.1	9	4.8	120	13.0
	Speed	70	16.7	60	18.9	9	4.8	139	15.1
	Unknown	25	6.0	0	0.0	0	0.0	25	2.7
	Steering input	21	5.0	45	14.2	22	11.8	88	9.5
	Decision	20	4.8	28	8.8	3	1.6	51	5.5
	Drugs	20	4.8	3	0.9	2	1.1	25	2.7
	Aggression	19	4.5	9	2.8	1	0.5	29	3.1
	Fatigue	16	3.8	6	1.9	1	0.5	23	2.5
	Alcohol & drugs	12	2.9	1	0.3	1	0.5	14	1.5
	Medical	5	1.2	1	0.3	0	0.0	6	0.7
	Perception	4	1.0	3	0.9	0	0.0	7	0.8
	Distraction	3	0.7	1	0.3	2	1.1	6	0.7
	Inexperience	2	0.5	19	6.0	4	2.1	25	2.7
	Police pursuit	2	0.5	2	0.6	0	0.0	4	0.4
	Mental/emotional	1	0.2	3	0.9	1	0.5	5	0.5
	Confusion	1	0.2	1	0.3	2	1.1	4	0.4
	History	0	0.0	2	0.6	6	3.2	8	0.9
	Age	0	0.0	2	0.6	1	0.5	3	0.3
	Unfamiliar w/vehicle	0	0.0	2	0.6	0	0.0	2	0.2
	Low speed	0	0.0	1	0.3	0	0.0	1	0.1
	Other	0	0.0	0	0.0	1	0.5	1	0.1
	Physical defect	0	0.0	0	0.0	1	0.5	1	0.1
	Unfamiliar w/area	0	0.0	0	0.0	1	0.5	1	0.1
	All human	393	93.8	226	71.3	71	38.0	690	74.8
Roadway	Access point	3	0.7	3	0.9	4	2.1	10	1.1
	Obstruction	1	0.2	5	1.6	3	1.6	9	1.0
	Standing water	1	0.2	0	0.0	0	0.0	1	0.1
	Curvature	0	0.0	4	1.3	19	10.2	23	2.5
	Lighting	0	0.0	1	0.3	14	7.5	15	1.6
	Construction	0	0.0	8	2.5	2	1.1	10	1.1
	Sight distance	0	0.0	6	1.9	4	2.1	10	1.1
	Bike facilities	0	0.0	4	1.3	1	0.5	5	0.5
	Congestion	0	0.0	4	1.3	1	0.5	5	0.5
	Traffic operation	0	0.0	2	0.6	3	1.6	5	0.5
	Design/geometry	0	0.0	2	0.6	2	1.1	4	0.4

(Continued on next page)

Table 3
Contributing factors in crashes where a younger driver was at fault *(Continued)*

		Primary		Secondary		Tertiary		Total	
Factor class	Factor	*f*	%	*f*	%	*f*	%	*f*	%
	Sign/signal	0	0.0	2	0.6	2	1.1	4	0.4
	Speed limit	0	0.0	0	0.0	3	1.6	3	0.3
	Shoulder design	0	0.0	0	0.0	2	1.1	2	0.2
	All roadway	5	1.2	41	12.9	60	32.1	106	11.5
Vehicle	Tires	13	3.1	3	0.9	5	2.7	21	2.3
	Defect	2	0.5	3	0.9	2	1.1	7	0.8
	Other	1	0.2	0	0.0	0	0.0	1	0.1
	Visibility	0	0.0	7	2.2	5	2.7	12	1.3
	Emergency	0	0.0	2	0.6	1	0.5	3	0.3
	Lighting	0	0.0	1	0.3	2	1.1	3	0.3
	Overweight	0	0.0	1	0.3	1	0.5	2	0.2
	Jackknife	0	0.0	0	0.0	1	0.5	1	0.1
	Low speed	0	0.0	0	0.0	1	0.5	1	0.1
	Trailer	0	0.0	1	0.3	0	0.0	1	0.1
	View obstruction	0	0.0	0	0.0	1	0.5	1	0.1
	All vehicle	16	3.8	18	5.7	19	10.2	53	5.7
Other/Unknown		1	0.2	0	0.0	0	0.0	1	0.1
Total		419	100	317	100	187	100	923	100

are the most common. Speed is the most common human reason cited as a secondary causative factor. Some factors are more common as secondary rather than primary factors among younger drivers, including abrupt steering input, decision errors, and inexperience. Roadway, environmental, and vehicle factors do not appear frequently as causative factors in the fatal crashes, but they appear more frequently as additional rather than primary factors. Overall, around 25% of fatal crashes have roadway, environmental, and vehicle factors to some degree. The most common nonhuman factor was tire blowouts/tread separation, which was the primary contributor to about 3% of crashes involving younger drivers. Wet or slippery conditions, darkness, and curvature were the most common secondary/tertiary nonhuman factors, indicating that younger drivers, who tended to drive at higher speeds and have less experience behind the wheel, had more difficulty negotiating curves and driving in inclement weather.

3.3. Critical Driver Errors

Because of the prevalence of human contributing factors, Table 4 looks more specifically at the types of drivers' errors of young at-fault drivers. The driver errors are sorted from most to least frequent. Because the characteristics of intersection crashes tend to be different than other crashes, the two crash types are also listed separately in Table 4. From the data, it is evident that about 30% of fatal crashes caused by young drivers are due to exceeding safe speeds, while around 25% are due to abrupt steering input, resulting in loss of control of the vehicle. Loss of control crashes are those in which drivers were driving within the speed limit but applied excessive steering input and lost control of the vehicle, typically

Table 4
Drivers' errors of young at-fault drivers

Drivers' errors/critical reasons	All crashes		Intersection crashes		Nonintersection crashes	
	f	%	*f*	%	*f*	%
Exceeded safe speed	121	28.9	28	18.7	93	34.6
Abrupt steering input/loss of control	106	25.3	8	5.3	98	36.4
Disregarded traffic signal	32	7.6	31	20.7	1	0.4
Failed to observe vehicles/all sides	27	6.4	19	12.7	8	3.0
Failed to slow/stop	26	6.2	10	6.7	16	6.0
Disregarded stop sign	20	4.8	20	13.3	0	0.0
Driving wrong direction	12	2.9	6	4.0	6	2.2
Improper lane change	12	2.9	0	0.0	12	4.5
Failed to negotiate curve	11	2.6	1	0.7	10	3.7
Fell asleep	6	1.4	0	0.0	6	2.2
Misjudged speed	6	1.4	6	4.0	0	0.0
Followed too closely	3	0.7	1	0.7	2	0.7
Drove left of center	3	0.7	0	0.0	3	1.1
Improper U-turn	2	0.5	1	0.7	1	0.4
Stopped in road	2	0.5	0	0.0	2	0.7
Unknown/unable to identify	30	7.2	19	12.7	11	3.7
Total	419	100	150	100	269	100

followed by events such as running off the roadway, entering into the median, etc. Despite being applicable only to intersection crashes, disregarding traffic signals is the third most common driver error, followed by failure to observe other vehicles approaching from the sides, failure to slow or stop to avoid hitting the front vehicle, and disregarding stop signs.

Thirty-six percent of fatal crashes caused by younger drivers occurred at intersections. As might be expected, disregarding traffic signals is the most common driver error in intersection crashes. Exceeding a safe speed is also a major cause of intersection crashes by young drivers, followed by disregarding stop signs and failing to observe vehicles from the sides. Combined, disregard of traffic signals and stop signs by young drivers causes more than 35% of intersection crashes. Together, abrupt steering input and excessive speed cause more than 70% of nonintersection fatal crashes caused by young drivers. These causes are understandable as young drivers have been shown to exceed safe speeds and drive carelessly, causing them to lose control of their vehicles. Although the third major type of driver error is failure to slow or stop to avoid hitting a vehicle in front, it is attributed to only 6% of nonintersection crashes.

The data reported by the investigating officers show that "careless driving" is the most common contributing cause attributed to younger drivers, cited in 37% of fatal crashes caused by younger drivers. However, case review teams found that the reporting officers had a tendency to select "careless driving" over other types of causes available to them, even when the other causes might be equally or more appropriate. As part of case-based analysis, the term *careless driving* was further categorized by the case review team, identifying the exact driver error that was the critical reason for the fatal crash. FTCR and THI reports were carefully analyzed to determine whether the abrupt steering was the initial event, or

Table 5
Breakdown of overused term *careless driving*

Driver error/critical reason	Number	%
Abrupt steering input	55	36.9
Exceeding safe speeds	54	36.2
Failure to slow/stop vehicle	14	9.4
Improper lane change	6	4.0
Failure to negotiate curvature	5	3.4
Fell asleep	4	2.7
Disregarding traffic signal	3	2.0
Others	8	5.3
Total	149	100

if abrupt steering was performed in response to some other events like drifting off the road, sudden appearance by an animal, etc. As shown in Table 5, when carelessness is narrowed down, factors such as abrupt steering input, exceeding safe speeds, and failure to stop the vehicle to avoid rear-end collision come up as the major contributing causes. In Table 5, "abrupt steering input" implies that the driver applied excessive steering input and lost control of the vehicle; it further implies that none of the other driver errors was identified in the crash. Recording these as "careless driving" by the investigation officers creates a category that is too broad to understand the actual situation and cause of the crash.

3.4. Alcohol Use

As seen in Table 3, 116 of the 419 younger drivers involved in fatal crashes were under the influence of alcohol (with or without illegal drugs) at the time of the crash. Alcohol was identified as the primary contributing factor in 90 of those crashes, and a combination of alcohol and drugs in 12 more. In addition, six of the 213 not at fault younger drivers were also found to be under the influence of alcohol, but not the primary cause of the crash. As such, it was deemed important to explore alcohol use among younger drivers more thoroughly. Table 6 presents blood alcohol concentration (BAC) data, as extracted from the traffic homicide report when available. This data was found to be more accurate than that provided on the original crash reports, because the information on the original crash report was frequently missing or based upon initial (incorrect) assumptions. However, the unknown cases include those where a BAC test was conducted, but no results were provided on the original crash report, and no follow up homicide report was available.

Table 6 indicates that approximately 20% of young at-fault drivers were under the influence of alcohol at the time of the crash, including those with BACs under the legal limit. Eighteen percent of the at fault drivers below the legal drinking age in the state of Florida were under the influence at the time of the crash, while 31% of those between ages 21 and 24 were under the influence. For at fault drivers younger than age 25, an average of 24% were under the influence, which is slightly less than the rate for other (25 and older) drivers, 26%. This fact is echoed in Table 6, which shows that the 95% confidence intervals for almost every row to include the value 1. This means that there is no significant difference in the alcohol use between younger and other at fault drivers, and countermeasures focused specifically at alcohol related fatalities are best directed toward drivers of all ages.

Table 6
Alcohol use among younger at fault drivers

	Young									
	Under legal	Over legal	Young		Other					
Alcohol use	age (16–20)	age (21–24)	*f*	%	*f*	%	ORF	Min CI	Max CI	Level
BAC = 0[a]	143	95	237	56.6	786	57.3	0.987	0.897	1.086	Unsure
BAC < Legal limit	11	7	18	4.3	49	3.6	1.203	0.709	2.042	Unsure
BAC 1–2 × Legal limit	13	20	33	7.9	89	6.5	1.214	0.827	1.783	Unsure
BAC 2–3 × Legal limit	14	23	37	8.8	139	10.1	0.872	0.617	1.232	Unsure
BAC >3 legal limit	2	6	8	1.9	77	5.6	0.340	0.166	0.699	Under
BAC unknown (>0)	2	2	4	1.0	6	0.4	2.183	0.619	7.699	Unsure
Unknown	48	34	82	19.6	226	16.5	1.188	0.946	1.492	Unsure
Total	233	187	419	100.0	1372	100.0	1.000			

[a]Includes BAC presumed zero (no BAC test conducted).
BAC = blood alcohol concentration; ORF = overrepresentation factors; CI = confidence interval.

Table 7
Passenger presence in vehicles of younger at-fault drivers

	Younger		Other					
Number of passengers	*f*	%	*f*	%	ORF	Min CI	Max CI	Level
0	203	51.8	786	57.5	0.900	0.804	1.008	Unsure
1	115	29.3	49	3.6	8.178	7.017	9.532	Over
2	31	7.9	89	6.5	1.214	0.867	1.699	Unsure
3	23	5.9	139	10.2	0.577	0.388	0.856	Under
4	16	4.1	77	5.6	0.724	0.449	1.167	Unsure
5+	4	1.0	226	16.5	0.062	0.023	0.163	Under
>0	189	48.2	580	42.5	1.136	1.016	1.270	Over
Total	392	100.0	1366	100.0	1.000			

3.5. Presence of Passengers

Because the presence of passengers has been shown to be a potentially distracting factor (Boase & Tasca, 1998), Table 7 compares the number of passengers in the vehicles of at fault drivers by age groups. Overall 48% of younger at fault drivers had passengers at the time of the fatal crash, whereas almost 43% of other drivers had passengers. Examining the data by passenger count, younger at fault drivers were more than 8 times more likely to have a single passenger in the vehicle with them, a significant result. Florida has no restriction on number of passengers under its GDL system; however, younger drivers were somewhat less likely to have larger numbers of passengers in the vehicle, with varying levels of significance. This likely reflects the driving habits of the different age groups, where older drivers are more likely to have higher numbers of passengers. When all passengers are combined into a single group, younger drivers are about 10% more likely (ORF = 1.136) to have some (greater than zero) passengers than other drivers, a significant result.

3.6. Compliance with Nighttime and Passenger Restriction Statutes of GDL

Florida was one of the first states in the nation to introduce a GDL law for younger drivers (Braitman et al., 2008). Implemented in 1996, one of the main provisions of the program restricts 16 year old drivers to the hours of 6 AM to 11 PM and 17 year old drivers to the hours of 5 AM to 1 AM. These restrictions are exempted if the driver has a passenger aged 21 or older in the vehicle or is traveling to or from work. A total of 45 fatal crashes were caused by 16 year old drivers. Of those drivers, only seven (16%) were not in compliance with the provisions of the nighttime GDL statutes. Another two at fault 16 year olds were driving during late night hours but were in compliance with the statutes because of the presence of an older passenger. Only two 17 year old at fault drivers (3.5%) were not in compliance with the nighttime GDL laws. Overall, fewer than 9% of the at fault 16 and 17 year old drivers were in violation of these two GDL statutes at the time of the fatal crash. Only four drivers younger than age 16 were at fault in fatal traffic crashes, and all were driving nonstandard vehicles (go carts and bicycles).

4. Conclusions

This study examined contributing factors among crashes in Florida in which younger drivers were found to be at fault. Younger drivers were at fault in approximately 6 of 10 crashes in which they were involved, and they were highly overrepresented in fault in forward impacts with control loss and in left roadside departure crashes. These two crash types generally involved high speeds and abrupt steering input, as confirmed by the critical driver errors found in the study. Common human factors cited in the crashes included alcohol use, inattention, and high speed. These factors potentially indicate an inability to use sound judgment and make quick decisions. These findings corroborate two major crash contributing factors suggested by most researchers: inexperience and deliberate risk taking of young drivers (Mayhew et al., 2003; Shope et al., 1996).

Case studies found that nonhuman factors were the primary contributing causes in only 6% of crashes in which younger drivers were at fault, but secondary and tertiary contributing factors in up to 25% of those crashes. The most common nonhuman factor was tire blowouts/tread separation. Wet or slippery conditions, darkness, and curvature were the most common secondary or tertiary nonhuman factors, indicating that younger drivers had more difficulty negotiating curves and driving in inclement weather. The study further finds that investigating police officers have a tendency to cite "careless driving" for a large proportion of crashes though there were specific causes for those crashes. The study recommends that investigating officers should report crash contributing factors with more detailed information so the policy makers could combat the problem effectively.

Approximately one in four younger at-fault drivers was under the influence of alcohol at the time of the fatal crash. No significant differences were noted between younger drivers and older drivers, nor were there significant differences between young drivers above and below the legal drinking age. Nighttime and passenger restriction statutes of GDL have shown to have significant positive impacts on crash reduction rate per licensed drivers (Boase & Tasca, 1998; Ohio Department of Public Safety, 2001), and this study found that most 16 and 17 year old drivers were in compliance with Florida GDL statutes at the time of the fatal crash. Similarly, the current study reveals that younger at fault drivers were more likely to have had passengers in the vehicle at the time of the crash. Younger drivers were less likely to have multiple passengers, but younger at fault drivers were more than 8 times more likely to have a single passenger than older drivers. Most (91%) of the young at fault drivers were in compliance with night time GDL driving statutes at the time of the fatal crash.

Although Florida was one of the first states to implement a GDL program designed to introduce young drivers in stages to the complex task of vehicle driving (Foss, 2000), results of this study implies that gaps and weaknesses remain in current driving programs in Florida that are aimed at younger drivers. One aspect of the GDL statutes needing review and potential revision is that involving passenger restrictions. The practitioners, including the policy makers, must address these gaps and weaknesses of current programs quickly to combat the high rate of fatal crashes on highways. The study will also be useful for researchers in that it investigates traffic fatality causes of younger drivers at a more microscopic level than most current studies offer.

Most of the existing studies use a national data set instead of focusing on state level, although driving laws are made at state level in the United States. An important aspect of this study is that a case based analysis was used to improve the accuracy and completeness of the data in the original police crash report. This by far has been found to be the most accurate method of crash investigation for determining crash characteristics (Grant, Gregor, Maio,

& Huang, 1998). This state-level case-based study was aimed at exploring a microscopic picture of contributing factors for fatal crashes caused by younger drivers.

As stated previously, one of the main reasons for conducting detailed case reviews was to identify or exclude factors, especially nonhuman factors, which might have contributed to the crash. Although every effort has been made to accurately assess the potential factors associated with each crash, it should be noted that there are limitations to this approach. For instance, a crash that appeared to be caused by disregarding a traffic signal (i.e., due to inattention) could actually have been caused by inexperience (e.g., stepping on the gas rather than the brake). Further research should be conducted to investigate root causes (e.g., distraction due to internal/external factors) and potential countermeasures to crashes in which younger drivers are more frequently found to be at fault. For example, simulator studies can safely investigate issues such as appropriate steering input in response to unexpected or emergency situations.

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