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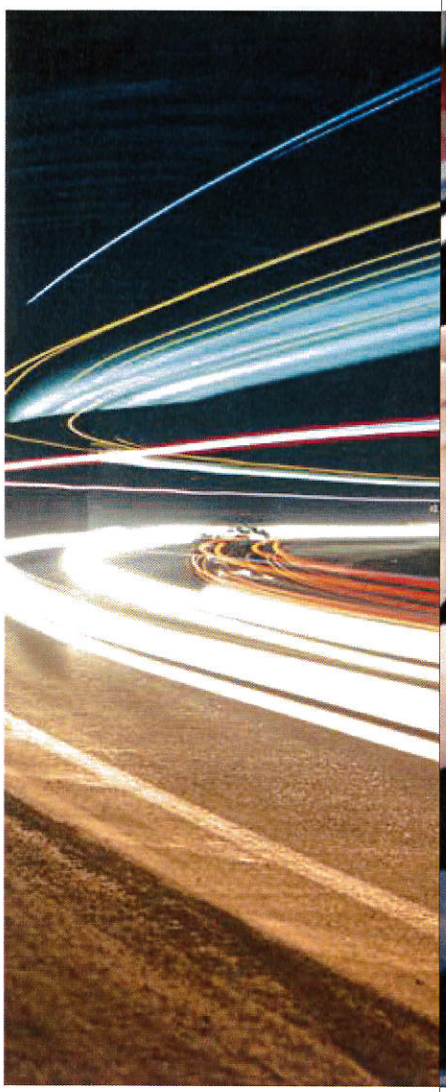

Speeding-Related Fatal Crashes Among Teen Drivers and Opportunities for Reducing the Risks

Susan A. Ferguson, PhD
Ferguson International LLC

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Dr. Susan Ferguson, Principal, Ferguson International LLC authored the report.

Jill Graygo, Impact Research, conducted the data analysis.

Dr. Allan Williams, Allan F Williams LLC,
Troy Costales, Administrator, Oregon Safety Division and
Lauren Stewart, Director, Maine Bureau of Highway Safety, reviewed drafts.

Barbara Harsha, Executive Director, GHSA and
Jonathan Adkins, Deputy Executive Director, GHSA
and
Vicki Harper and **Lisa Joyce**, State Farm Public Affairs oversaw the report.

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Speeding-Related Fatal Crashes Among Teen Drivers and Opportunties for Reducing the Risks

Summary

New analyses of fatal crash data draw attention to the continuing contribution of speeding in the fatal crashes of teen drivers. Crash data from 2000-2011 show that speeding is one of the primary factors in fatal crashes involving young male and female drivers and is implicated in about a third of all such crashes. In fact, speeding as a contributor in fatal crashes has inched up in the past decade from 30 percent in 2000 to 33 percent in 2011. The youngest drivers have a bigger problem with speeding than older drivers. Speeding is more prevalent among males, at night, and in the presence of other teen passengers and more often leads to single-vehicle and run-off-road crashes. In fact, half of fatal crashes involving 16-year-old drivers with three or more passengers are speeding-related.

Despite the well-known role of higher speeds in crash incidence and injury, the issue of speeding among young drivers does not garner as much attention as other risk factors such as distracted or alcohol- or drug-impaired driving. Speed limits have been going up in the United States in the last two decades, with some states posting speed limits of 80 mph and higher. Speeding is a generally accepted behavior among drivers young and old, with the vast majority admitting they speed on all road types. Unless speeding is recognized as a dangerous behavior, much the same as alcohol-impaired driving, it will continue to be difficult to address as a society. More attention must be paid to this issue at the federal, state and local levels, and within the private sector. As well, parents should be taking the lead to do more to address speeding behavior among their teen drivers.

One effective way to reduce speeding among drivers of all ages is through the use of automated speed cameras (Wilson et al., 2010). Although more common in other countries, the use of speed cameras in the United States is growing. A recent study has indicated that in Washington D.C., a community where speed cameras have been in place for over a decade, about 70 percent of drivers support them (Cicchino et al., 2013). State and local communities that wish to address speeding should consider use of these technologies.

There is clear evidence from observational, naturalistic and crash studies that young drivers speed much more at night and in the presence of their friends, so GDL laws that place nighttime and passenger restrictions on newly-licensed drivers take on particular importance. Many more lives could be saved if states strengthened their night and passenger restrictions (Insurance Institute for Highway Safety (IIHS), 2012). Passenger restrictions are difficult for parents to enforce when teens are driving unsupervised, so the burden lies with law enforcement to ensure that beginning drivers do not transport other teens. One tool that may help enhance enforcement is the use of license plate decals on the vehicles of beginning drivers. In 2010, New Jersey was the first state in the U.S. to enact a law to require decals for permitted and probationary drivers younger than 21 years of age. A recent study provides some evidence that the decal law has been effective, resulting in increased police citations and reduced crashes among the affected population, despite its relative unpopularity and only partial compliance (Curry et al., 2012).

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Summary

Parents hold the keys to the car, yet vehicle ownership is a factor that rarely is considered in discussions about young driver safety. Newer and larger vehicles provide better crash protection and are equipped with the latest safety features. On the other hand, parents should steer away from high-performance cars which can encourage speeding behavior. Parents also might want to consider waiting to provide their teens a vehicle of their own, as studies have shown that teens who are considered to be primary users of their vehicles are more likely to speed.

Parents are concerned about their children's speeding and express interest in having feedback when it happens. There are a variety of aftermarket devices, some of which are specifically targeted toward a parent/teen audience, as well as in-vehicle options available on new cars that can provide this information. Studies show that monitoring devices can reduce teen drivers' risky driving and speeding, but there is some reluctance on the part of parents and teens to use them because of concerns about trust or privacy. This hesitancy would need to be overcome for this to be an effective countermeasure. Given the high costs associated with beginning teen drivers, financial incentives might be one way to overcome these reservations. The growth in the consumption of usage-based insurance both to attract safe drivers and to teach safe driving skills is one trend that could accelerate the acceptance of driver monitoring among parents and teens. The growing availability of driver assist technologies offered in new vehicles, including those that keep drivers informed of speeds and speed limits, may also help to moderate these views as these technologies become more commonplace.

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Introduction

"Six Teens Killed in Ohio Car Crash Were Moving at a High Rate of Speed." A recent headline and an all too frequent tragedy, but just one of many cases in which teen drivers and their friends have died in speed-related crashes. Unfortunately, very few of them are brought to the attention of the public.

It is widely acknowledged that teen drivers pose the greatest crash risk to themselves and other road users. And for good reason. Motor vehicle injuries are the leading cause of death among males and females 13-19 years old (Centers for Disease Control (CDC), 2012). Their fatal crash rates per mile traveled and per licensed driver are higher than for all but the very oldest drivers (Ferguson et al., 2007). In the United States, the fatal crash rate per mile driven for 16-19-year-olds is nearly three times the rate for drivers ages 20 and over. Moreover, risk is highest at ages 16-17 when the fatal crash rate per mile driven is nearly twice as high as it is for 18-19-year-olds (IIHS, 2011). In addition to having higher death rates as a group, teen drivers are a greater danger to others on the road. They pose the highest risks of death to their passengers, occupants of other passenger vehicles, and non-occupants such as pedestrians and cyclists (Braver and Trempel, 2004).

Examination of fatal crash characteristics provides insight into some of the factors contributing to the high fatal crash rates among teen drivers. Teen drivers in fatal crashes are more likely than drivers 20 and older to have been speeding. They are also more likely to have committed a driver error, be involved in a single vehicle crash and follow too closely. These characteristics become more prevalent when multiple teen passengers are in the vehicle (Ferguson et al., 2007, Simons-Morton et al., 2005, Williams et al., 2007). Speeding is implicated in about 33 percent of all fatal crashes involving teen drivers ages 16 through 19, but only 19 percent among drivers ages 26-49.

The incidence and risks of speeding and speeding-related fatal crashes

Speeding is one of the most prevalent factors contributing to serious and fatal crashes, yet it does not command nearly as much attention as other safety issues such as alcohol-impaired or distracted driving (Sprattler, 2012). On the contrary, speeding and high-performance vehicles often are glamorized and legitimized in the movies and in vehicle advertising which portrays the upside of high-speed travel without depicting the potential negative consequences (Ferguson et al., 2003a). Speed limits are widely flouted and drivers freely admit that they engage in speeding on a regular basis. In a 2007 national observational survey of vehicle speeds, the National Highway Traffic Safety Administration (NHTSA) found that most free-flowing traffic exceeded speed limits, with nearly half of traffic exceeding speed limits on limited access roads and about 60 percent of traffic exceeding speed limits on arterials and collectors. About 15 percent of traffic exceeded the speed limit by 10 mph or more on freeways, arterials and collector roads (Huey at al., 2012). A recent national survey of drivers found that speeding on freeways is widespread. Fifty-two percent of drivers say they have driven 15 mph over the speed limit on a freeway in the past month, and nearly one in four say they consider it acceptable to

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do so (AAA Traffic Safety Foundation, 2012). In another driver survey conducted by NHTSA in 2002, the vast majority of drivers of all ages admitted to speeding on most road types (about 80 percent), but younger drivers ages 16 to 29 were even more likely to report speeding. Males were generally 50 percent more likely than females to report driving over the posted speed limit (NHTSA, 2004).

In 1973, Congress, in response to oil shortages, directed the U.S. Department of Transportation to withhold highway funds from states that did not adopt a maximum speed limit of 55 mph. By 1974, all states had adopted the 55 mph national maximum speed limit. As concerns about fuel supply faded, in 1987, Congress allowed states to increase speed limits on rural interstates to 65 mph. Then, in 1995 the National Maximum speed limit was repealed, returning the authority to set speed limits to the states. Since then, states across the country have adopted increasingly higher speed limits. According to IIHS, 19 states now have maximum speed limits of 70 mph and 14 states have maximum speed limits of 75 mph on some portion of their roadway systems. In Texas and Utah, speed limits are 80 mph on some rural sections of interstates, and last year a new stretch of Texas 130 opened with a speed limit of 85 mph (IIHS 2013a). The result of higher speed limits is even higher speeds. Many studies have demonstrated that as speed limits are raised motorists increase their speeds and exceed those new limits (IIHS, 2013a).

Speeding increases fatal crash risk in a number of ways, affecting both the likelihood of being in a crash and crash severity. Vehicles traveling at higher speeds will cover an increased distance between the time a hazard is detected and the time the driver reacts, so the vehicle will travel farther before coming to a stop. This increases the likelihood that a crash will occur. Higher speeds also increase crash energy exponentially. These higher energies compromise the vehicle's ability to protect the occupants against serious injuries, even taking into account the substantial improvements in crash protection realized in recent years.

In spite of the clear evidence of the harmful effects of speeding on fatal crash rates and the over-representation of the youngest drivers in such crashes, speeding by young drivers typically remains under the radar when crash risk is highlighted. This report attempts to rectify that shortcoming. The report provides the latest data on speed-related fatal crashes among young drivers and provides evidence for their increased propensity to speed. It points to possible reasons for the speeding problem and suggests potential countermeasures.

Size of the Problem

Speeding-related fatal crashes among teen drivers

During the last 15 years, when the majority of States enacted graduated licensing for young novice drivers, the number of fatal crashes has declined significantly among teen drivers. However, a recent report indicates that deaths in 2012 were again on the rise (Williams, 2013). For this study, Fatality Analysis Reporting System data were analyzed from 2000 through 2011. A fatal passenger vehicle crash was defined as speeding-related if the driver was charged with a speeding-related offense, or if an

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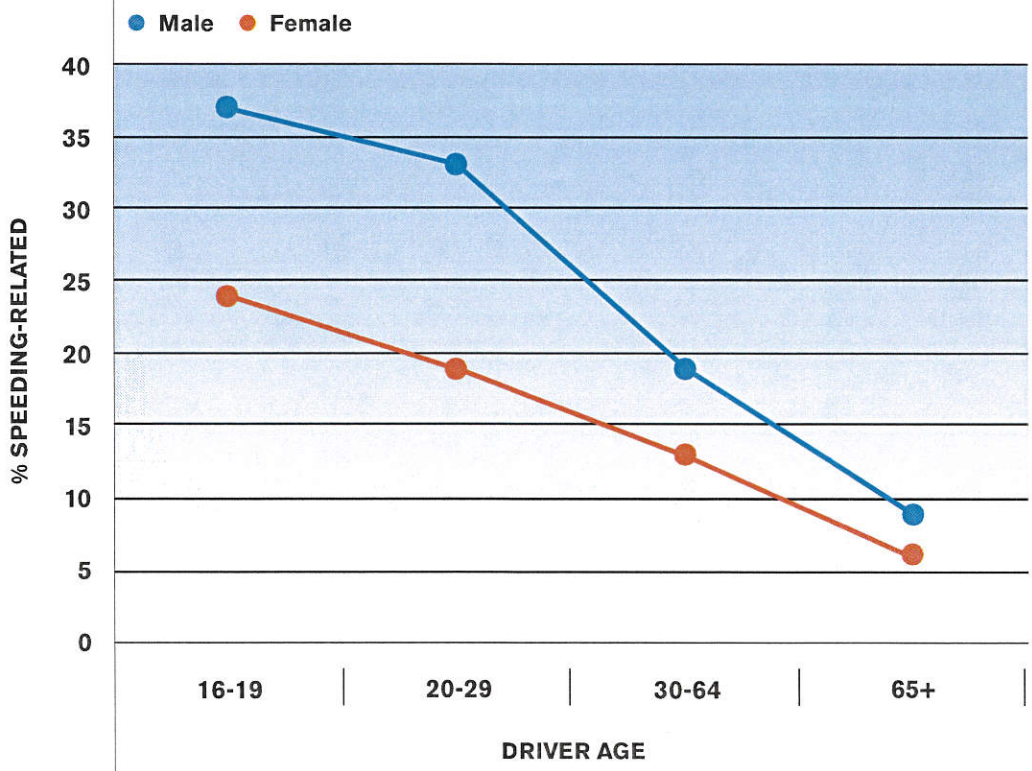
Size of the Problem

officer indicated that racing, driving too fast for conditions, or exceeding the posted speed limit was a contributing factor in the crash.

In 2000, 6,055 teen drivers ages 16-19 were involved in fatal passenger vehicle crashes compared with about half that number (2,958) in 2011. Likewise, the number of teen drivers involved in speeding-related passenger vehicle fatal crashes declined by almost half during that same timeframe, from 1,849 in 2000 to 990 in 2011. From 2000 through 2011 a total of 19,447 teen drivers were involved in speeding-related fatal passenger vehicle crashes. However, there has been no drop in the percentage of teen driver crashes that are speeding-related; in fact, the percentage has inched up slightly from 30 percent in 2000 to 33 percent in 2011. Forty percent of speeding-related fatal crashes of teen drivers occur on roads with speed limits of 55 mph and higher and 60 percent on roads with speed limits less than 55 mph.

Young male drivers have the highest rate of speeding-related fatal crash involvement, but there are clear gender differences at every age (Ferguson and Braitman, 2006, Ferguson et al., 2007). Figure 1 illustrates the percentage of speeding-related fatal passenger vehicle crashes by driver age and gender during 2007-2011 combined. Male drivers lead the pack in speeding-related fatal crashes in every age group shown, although this disparity with females diminishes with age. Most notable is that the youngest drivers (16-19) of both sexes have the greatest frequency of fatal crashes involving excessive speed, with 38 percent of males and 24 percent of female teen drivers involved in such crashes.

Figure 1. Percentage of drivers in speeding-related passenger vehicle fatal crashes by age and gender, Fatality Analysis Reporting System, 2007-2011.



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Speeding-Related Fatal Crashes Among Teen Drivers and Opportunties for Reducing the Risks

Size of the Problem

Table 1 shows the percentage of speeding related passenger vehicle fatal crashes involving teen drivers at ages 16, 17, 18, 19, and 30-64 by individual crash characteristics between 2007-2011. It is clear that, regardless of age, single-vehicle crashes are much more likely to be speeding-related than multiple-vehicle crashes. However, the percentage of speeding-related, single-vehicle crashes is much higher among teen drivers, with 16-year-olds having the highest rates. For example, 53 percent of single vehicle fatal crashes involving 16-year-old drivers are speeding-related. This compares with only 30 percent speeding-related single-vehicle fatal crashes among drivers ages 30-64. When you examine multiple-vehicle crashes the percentages are 18 and 9 percent respectively. Not surprisingly, many of the run-off road crashes are speeding-related, with the very youngest drivers again leading the way.

Table 1. Percent of speeding-related passenger vehicle fatal crashes involving teen drivers 16-19 by individual crash charactertics, Fatality Analysis Reporting System, 2007-2011.

Age	16	17	18	19	30 - 64
Single vehicle	53	50	48	47	30
Multiple vehicle	18	19	19	20	9
Run-off-the-road	62	59	57	57	39
Time of day					
11:00 pm – 4:59 am	63	48	46	45	28
5:00 am – 10:59 pm	33	28	29	28	15

Similar patterns can be seen when comparing nighttime and daytime crashes. Nighttime crashes are more likely to be speeding-related for the ages shown, but the highest rates are among 16-year-old drivers, followed by 17, 18 and 19-year-olds.

It has been known for some time that the presence of one or more teen passengers in the vehicle of a teen driver can negatively affect driver behavior and increase crash risk (Williams et al., 2007). This is especially evident with higher numbers of teen passengers in the vehicle. Table 2 provides percentages of drivers 16, 17, 18, and 19 years of age involved in speeding-related passenger vehicle fatal crashes by gender and number of teen passengers.

A couple of patterns in the data are worth noting. Speeding-related crashes tend to be less prevalent when drivers of both sexes are driving alone than when there are teen passengers present. But the prevalence of such crashes increases with additional teen passengers. Another key finding is that male drivers more frequently are involved in speeding-related crashes than females, whether alone in the vehicle or with other teen passengers.

Table 2. Percentage of teen driver speeding-related passenger vehicle fatal crashes by age and gender and teen passenger presence (ages 13-19), Fatality Analysis Reporting System, 2007-2011.

Age	Driver Gender	Driver Alone	Driver with 1 Teen Passenger	Driver with 2 Teen Passengers	Driver with 3+ Teen Passengers
16	Male	33	44	50	49
	Female	22	31	46	49
17	Male	30	41	46	49
	Female	24	29	31	33
18	Male	33	41	48	50
	Female	21	21	29	39
19	Male	34	42	44	48
	Female	20	21	27	45

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Why the Problem Exists

The elevated crash rates of the youngest drivers result both from inexperience and immaturity. Young drivers have not perfected their driving skills and are still developing physically and mentally. Lack of experience behind the wheel makes it more difficult for them to recognize and respond to hazards when they occur. Immaturity can be manifested in risky driving practices. The relative contribution of age and inexperience as factors in teen crash risk have long been debated, with some believing inexperience is the key factor and others pointing to immaturity as the central concern. A recent literature review confirmed that both age and experience have strong effects on driver crash risk (McCartt et al., 2009). Eleven studies that were able to disentangle the relative effects of these factors were reviewed. Findings that support age (or immaturity) as a factor look at crash rates after controlling for length of licensure. These findings consistently show that teen drivers have dramatically higher crash rates than older drivers, particularly those older than 25. Crash rates are highest among the youngest drivers, age 16, followed by 17-year-olds, and then 18- to 19-year-olds. The effects of experience can be clearly seen in the steep initial drop off in crash rates, especially among the youngest drivers in the first few months of driving (Mayhew et al., 2003. McCartt et al., 2003).

Developmental issues

Adolescents' brains differ from those of adults in a number of important ways. The higher teen driver death rates are reported to be related to problems with the control of behavior and emotion (National Research Council, 2007). The increase in risk-taking and sensation seeking between childhood and adolescence has been tied to changes in the brain's social-emotional systems that begin around puberty (Steinburg, 2008). At the same time, cognitive development is not complete until the early 20s, thus compromising various important functions that are related to safe driving. Recent evidence indicates that the teen brain, especially the pre-frontal cortex where impulse inhibition, decision making and judgment are centered, is not fully developed (Steinburg, 2008). There also is evidence from laboratory studies that teens are more impulsive, thrill seeking and more drawn to the rewards of risky behavior rather than to the costs. Teens are particularly attuned to social interaction with their peers (National Research Council, 2007), thus, the social context of driving is an important consideration. Having teen friends in the vehicle is an event in and of itself, not just a means to get people from point A to point B. Unlike adults, the mere presence of peers increases the degree to which adolescents take risks and prefer immediate rewards (Chein et al., 2011, O'Brien et al., 2011).

Driver skills and driving behavior

Learning to drive takes time and extended practice, regardless of age. There are many skills that have to be mastered, including those required to maneuver the vehicle such as steering, accelerating and braking, and more complex tasks such as visual search, risk and hazard perception, and appropriate responses to the latter. Novice drivers' attention can be easily overloaded such that their ability to

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Why the Problem Exists

divide attention among the myriad of stimuli is limited. There is evidence that novice drivers are less able to assess hazards in the traffic environment and that their visual search patterns are less attuned to detect potential future risks (Ferguson, 2003b). Detailed analyses of non-fatal crashes confirm that many involve inadequate surveillance, distraction, following too closely, and driving too fast for conditions as well as speeding (Braitman et al., 2008, Curry et al., 2011, McKnight and McKnight, 2000). In-depth analyses of fatal crashes involving 16-year-old drivers also has identified driver error and speeding as critical factors (Williams et al., 1998). Drivers have different attitudes about driving and differ in their belief about what constitutes safe driving, including overly optimistic beliefs in their own driving skills (Ferguson, 2003b). Teens' elevated perception of their own driving abilities can decrease vigilance about safety.

A number of studies looking at both real world driving and crash records have demonstrated the propensity of teen drivers to speed, especially in the presence of teen passengers. Evidence from observational studies show that younger drivers adopt more risky driving styles. They have been observed driving faster, with shorter following distances and narrower gap acceptance when joining other traffic (Ferguson, 2003b). In one recent study, speeds and following distances of teen drivers were measured when they exited schools and farther down the road. In the presence of a male teen passenger, teen drivers were found to drive faster than the general traffic and follow the vehicle in front more closely. The rate of high risk driving, defined as speeds more than 15 mph over the posted limit and shorter following distances, was double that of the general traffic when male drivers were with their male peers (Simons-Morton et al., 2005). In another study where driving behavior was directly monitored from within the vehicle, teen drivers were more than twice as likely to engage in one or more potentially risky behaviors when driving with a teen passenger than when driving alone (Goodwin et al., 2012).

There also is evidence from self-reports and direct observation that teens who are considered to be primary owners of the vehicle they drive, compared with those who share a vehicle, are more likely to speed (Cammisa et al., 1999, Klauer et al., 2011). For example, teen drivers who have primary ownership of their vehicle are twice as likely to speed 10 mph over the posted limit compared with those who share a vehicle (Klauer et al., 2011). There is also evidence from naturalistic driving studies that teens' speeding behavior increases over time, possibly as they gain confidence (Klauer et al., 2011,Simons-Morton et al., 2013).

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Reducing the Problem

There is no question that speeding is a critical factor in many young driver fatal crashes. The question is, how can we reduce its incidence? There is a plethora of potential countermeasures that can be employed to address the problem of speeding. These include education, laws and enforcement, and vehicle-based and environmental modifications. Some apply to drivers of all ages, while others are specific to teen drivers.

General traffic safety laws, such as speed limits and enforcement of those limits, have the potential to deter teen drivers from speeding. But these approaches are effective only if the driving public believes there is a credible chance they will be caught (NHTSA, 2011). Automated speed enforcement, which augments the ability of police officers to detect the offense, has been an effective tool in reducing vehicle speeds in the vicinity of camera sites (Wilson et al., 2010), but is less often utilized in the United States than in other countries.

Many strategies have been used to try to impact the high crash rates of teen drivers, including countermeasures that address both inexperience and immaturity. These include driver training, modifications to novice driver licensing eligibility (e.g., the age at which they can get their learners, provisional, and full licenses) and specific restrictions on when and with whom they can drive. There are also laws that specifically target the youngest drivers, such as zero tolerance for drinking and driving. This paper will not attempt to summarize the evidence for all these approaches. Rather, it will focus predominantly on approaches that may have promise in reducing speeding-related crashes among teens or directly target such crashes.

Driver training

It makes perfect sense that beginning drivers need training to learn basic driving skills. Indeed, formal driver education programs enjoy widespread public acceptance around the world as the preferred way to prepare beginning drivers for licensure. Driver education takes many forms and programs are of varying quality, but it is recognized that many need improvement. In partnership with the American Driver and Traffic Safety Education Association, Governors Highway Safety Association and several other safety-related organizations, NHTSA has developed new driver training curricula and administrative standards. NHTSA also has developed a driver education program assessment tool to help states conduct a comprehensive review of their education and training programs and determine where improvements can be made.

When faced with the unsafe driving records of the youngest drivers, people look to driver education as a solution. But there is a mountain of evidence to suggest that traditional driver training is not an effective countermeasure in reducing crashes among young drivers (Williams and Ferguson, 2004). Several comprehensive international reviews of the best scientific evaluations of driver education programs for young beginners all come to the conclusion that there is no difference in the crash records of driver education graduates compared with equivalent groups of beginners who learned to drive without formal education (Williams and Ferguson, 2004). More recently, it has been recognized that supplementary driver education programs are needed to train teens in some of the

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higher order skills that may help in crash avoidance. These courses may offer instruction in advanced vehicle handling skills such as skid control, emergency braking and hazard avoidance, as well as cognitive skills like hazard anticipation, visual scanning and situational awareness. They almost always include an in-car training component (Hamilton, 2012). These programs show promise but have not been fully evaluated.

Graduated driver licensing (GDL)

GDL is one of the most successful countermeasures in recent years in reducing teen crashes. The rationale for GDL is to keep newly-licensed, young drivers out of harm's way by restricting driving to times and situations demonstrated to be of lower risk. In the United States, GDL typically addresses the well-known high risks for novice drivers by limiting driving at night and with teen passengers in the initial six to twelve months of licensure, only allowing unrestricted driving after more experience has been gained. Although such restrictions do not directly target speeding, they limit driving under conditions for which speeding is known to be more prevalent – at night and with teen passengers. There is abundant evidence from evaluations conducted in U.S. states and nationally that such restrictions reduce teen crashes (Baker et al., 2007, Chen et al., 2006, Fohr et al., 2005, Foss et al., 2001, Shope and Molnar, 2004, Ulmer et al., 2000), with stronger laws leading to the greatest reductions (McCartt et al., 2010a). However, specific effects of GDL on the frequency of speeding are unknown.

Other countries have done more to try to address speeding directly through license restrictions by prohibiting novices from driving higher-powered vehicles, or limiting driving speeds or access to higher-speed roadways. Access to higher-speed roads is typically limited during the learner's stage.

In Ontario, Canada, the GDL program does not allow learners to drive on 400-series highways or high-speed expressways. Boase and Tasca (1998) found that this restriction reduced collisions of novice drivers on such Ontario highways by 61% – perhaps not surprising because they are banned from driving on them.

In Australia, New South Wales has a lower speed limit for both learner and intermediate drivers during the first phase of the provisional license. However, there is no clear evidence that this restriction is effective in reducing their crash risk and is sometimes reported to frustrate other drivers (personal communication, Barry Watson, February 26, 2013).

A number of Australian states – Victoria, New South Wales, Queensland, and South Australia – have enacted a restriction on the type of vehicles novice drivers are allowed to operate. This so-called power-to-weight restriction applies to novice drivers throughout the provisional license period, typically lasting three years. It prohibits novices from driving vehicles with V8, turbo-charged or modified engines. A recent Australian study found that licensees younger than 25 who drive high-performance cars have significantly higher crash involvement and injury rates. However, the potential for reducing crashes was estimated to be small because of the few young drivers who operate them (Keall and Newstead, 2013).

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Parents' role

In-vehicle driver monitoring

Many parents worry about how safely their teens are driving when they are not supervising them. When asked about their specific concerns, the number one issue for parents was speeding. More than half said they would want to know if their teen was speeding (McCartt et al., 2007). Various types of technology are available to assist parents in monitoring and controlling their teens' driving behavior. There are numerous aftermarket devices available that employ computer chips, GPS systems and video-based recorders. Parents in three states were asked about their interest in using any of these three types of in-vehicle devices to monitor their teens driving. Despite a strong desire to know what is going on in the vehicle, only about half said they would consider installing a computer chip or cell phone GPS in their teens' vehicle. Fewer of them were interested in using video cameras (26-39 percent). The main reasons parents gave for not considering monitoring as an option were concerns about violating their teens' trust or privacy (McCartt et al., 2007). Similar feelings were expressed among parents in an Israeli study (Guttman and Lohan, 2011).

There is some evidence that in-vehicle monitoring of beginning teens can result in less risky driving (Farmer et al., 2010, McGehee et al., 2007, Simons-Morton et al., 2013). In one study, teens' vehicles were fitted with devices that could monitor vehicle speeds and compare them with a database of posted speed limits. Young drivers ages 16 and 17 were randomly assigned to various conditions. Some of the drivers received immediate audible feedback if they drove above the speed limit. They would hear a short beep at more than 2.5 mph over the speed limit and a continuous string of beeps at 10 mph over. Reductions in speeding of more than 10 mph over the limit were achieved only if an alert sounded in the vehicle and drivers had a chance to correct behavior, thereby preventing notifications from being sent to parents (Farmer et al., 2010). If notifications were sent automatically to parents, no changes in speeding were observed.

A second study used accelerometer-activated data recorders from DriveCam, Inc. (Simons-Morton et al., 2013). In addition to recording elevated g-forces (sudden braking/accelerating/cornering), the device records video of the occupant compartment and forward and rearward of the vehicle for a few seconds before and after a high g-force event. Drivers were provided feedback with a flashing light if high g-forces were recorded. Only the teen drivers whose parents received feedback were involved in significantly fewer of these high g-force events during the study period. The authors conjectured that since in-vehicle feedback alone did not change risky behavior, the behavior was not likely the result of inexperience because they had an equal chance of learning from the event as those events for which their parents were notified. Presumably, the threat of sanctions from parents was the motivating factor.

Whether in-vehicle monitoring can be an effective countermeasure depends on whether teens change their driving behavior. That, in turn, depends on whether parents and teens are motivated to accept or install them. A number of studies have found that parents' interest in checking on their teens' driving behavior is not universal and diminishes over time (Carney et al., 2010, Farmer et al., 2010, Simons-Morton et al., 2013). To the extent that parental sanctions are an important motivator for behavior change, this may diminish

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the potential effectiveness. Parental motivation to participate in such studies has been muted in the absence of significant monetary compensation (Farmer et al., 2010, McCartt et al., 2010b). That being said, experience with in-vehicle monitoring can be quite positive. In a post-study survey of parents and teens who had used monitoring devices, parents were enthusiastic about the devices and seemed to welcome access to information about their teens' driving even if they did not always make use of it (McCartt et al., 2010b). Even more importantly, across three groups of teens who had the devices installed, 75-91 percent of teens claimed they drove more safely because of them.

Aftermarket devices are not the only option for in-vehicle monitoring. Some vehicles come with optional equipment that allows parents to limit certain types of behavior when their teens are driving. Ford MyKey Technology, a standard feature on all Ford and Lincoln models, offers a special key that can be used by younger drivers. Parents can program the key to limit the vehicle top speed to 80 mph and provide audible warnings at speeds of 45, 55 and 65 mph (Ford Motor Company, 2011). (Unlike some systems described above, driving speeds are not related to posted speed limits). According to Ford materials, parents of teen drivers are very supportive of the technology, with 75 percent saying they like the speed limiting feature. Teens were not as supportive. Two-thirds said they would not want the technology. However, if MyKey would lead to expanded driving privileges, then only about a third of teens objected to it (Ford Motor Company, 2011). Systems such as MyKey have the potential to reduce speeding-related crashes, although no studies have examined their effectiveness.

Parental involvement in the learning-to-drive-process

Many programs now are available to help parents manage their beginning teens' driving in a way that will encourage safe driving behavior (Fischer, 2013). For example, the Checkpoints Program aims to work with parents to limit their teens' driving under high risk conditions and has been shown to increase limit setting and reduce risky driving and traffic violations (Simons-Morton et al., 2008). A number of states have parent education programs that show promise in engaging parents and teens to work together as the latter get behind the wheel (Fischer, 2013). Several studies examining parent/teen intervention programs and their potential impact on driver safety are in progress (Williams et al., 2012a), so more will be known about their effectiveness in the future.

Vehicle ownership is a factor that rarely is considered in discussions about young driver safety. Often teens drive smaller and older vehicles that offer less protection in a crash (Cammisa et al., 1999). Several studies have shown that teens who are considered to be the primary owner of a vehicle are more likely to speed (Cammisa et al., 1999, Klauer et al., 2011), so parents should think carefully about providing teens their own vehicle when first licensed.

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Intelligent Speed Assistance/Alert/Adaptation

There is growing interest in Australia and Europe in promoting deployment of Intelligent Speed Assistance/Alert/Adaptation (ISA). These technologies alert drivers to speed limits and in some cases control speeds if speeds are in excess of the posted limit. As of January 2013, the European New Car Assessment Program (Euro NCAP) will include ISA in their new safety rating system and reward new vehicles that have such systems. Some ISA systems display the current limit so that the driver is always aware of the maximum speed allowed on that road. The speed limit may be determined by software which analyzes images from a camera and recognizes traffic signs, or through satellite navigation that determines vehicle location. The latter relies on the most up to date digital speed limit maps being available. Current systems, which are voluntary, may or may not issue a warning when the driver is exceeding the speed limit. They can be switched off and rely on the driver responding appropriately to the warning (EuroNCAP, 2013).

It was recently reported that Ford's Adjustable Speed Limiter is selling very well in Europe (Autoweek, 2012). The system allows drivers to set a speed limit and warns them when it is exceeded, reducing fuel flow to slow the vehicle. The popularity of the system is believed, in part, to be due to the proliferation of automated speed enforcement throughout Europe. In Australia, researchers have field-tested various after-market speed alert and adaptation systems and concluded that the technology is ready for widespread implementation (Paine et al., 2009).

A number of field studies show that ISAs coupled with financial incentives can be a motivator for drivers to reduce their speeds. In a U.S. study, drivers were paid as much as $25 dollars to drive within four miles an hour of the speed limit (Reagan et al., 2013). Drivers lost money if they exceeded speed limits by more than that. The incidence of driving over the speed limit was reduced from about five percent to less than one percent. In Denmark, researchers coupled the use of ISAs with insurance discounts with similar reductions in speeding (Larhmann et al., 2012).

Usage-based insurance programs

Usage-based insurance employs a process where drivers are rated and charged based on the information gathered from a telematics device in their vehicle. Sensors plugged into the vehicle's onboard diagnostic port gather driving information to determine mileage, time of day driven, hard breaking and accelerating, and vehicle speeds. A number of insurers offer this as an option or are testing it. Such rating processes could penalize or reward drivers based on their previous driving experience, but typically the information is used to provide discounts for safe drivers and educate consumers on how to further improve their driving. In 2006, one insurance company in the United Kingdom tailored their insurance policy to discourage nighttime driving by the youngest drivers by pricing nighttime driving well above the rate for daytime driving. As the above studies on financial incentives suggest, these approaches have the potential to improve driving safety among young drivers to the extent that reduced driving costs motivate such behavior.

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Conclusions

New analyses of fatal crash data confirm the significant role that speeding plays in teen driver crashes. One third of all crashes are speeding-related, with even greater percentages occurring under certain conditions. The fatal crashes of the youngest drivers, both male and female, are much more likely to involve speeding than those of older drivers. These crashes are more prevalent among males, at night, and in the presence of other teen passengers and more often lead to single-vehicle and run-off-road crashes. Multiple teen passengers in particular result in a greater incidence of speeding, especially among young males.

Young beginning drivers have an elevated crash risk as a result of both inexperience and immaturity. In spite of, or sometimes because of, their relative inexperience, they have a greater tendency to adopt a risky driving style. Higher speeds increase both the likelihood of being in a crash and of being seriously injured or killed. Yet the issue of speeding among young drivers does not garner as much attention as other risk factors such as distracted, alcohol- or drug-impaired driving. Speeding is a generally accepted behavior among drivers of all ages, with the vast majority of drivers admitting they speed on all road types. Increases in speed limits across the United States in the last two decades have helped to send the message that high speeds are safe and acceptable.

Unlike alcohol-impaired driving, which has become socially unacceptable due to the advocacy of MADD and other groups, speeding does not have any national organizations calling for reduced speeds and speed limits. Unless speeding is seen as a dangerous behavior much the same as alcohol-impaired or distracted driving it will continue to be difficult to address as a society. Action is needed at all levels of government and by the private sector to address this serious problem. Additionally, parents need to better comprehend the significant role speeding plays in serious and fatal crashes involving teens and find ways to address it.

Once successful countermeasure shown to reduce speeding among drivers of all ages is automated speed cameras (Wilson et al., 2010). More popular in Europe and Australia, the use of speed cameras has increased in the United States in recent years. In 1995, only four U.S. communities in Utah and Arizona used speed cameras. Today as many as 124 communities in 13 states are deploying the technology (IIHS, 2013b). A recent study in Washington, D.C., a community where automated speed cameras have been in place for over a decade, found that about 70 percent of drivers support them (Cicchino et al., 2013). State and local communities wishing to address speeding should consider use of these technologies.

Despite the proven benefits of GDL, speeding-related teen crash rates remain high. Parents have a critical role to play in their children's safety and are generally supportive of restrictions on their teens' driving when first licensed. Parents can be instrumental in decisions about when teens first get their licenses and what, where, when, and how much they are allowed to drive. There are a number studies indicating that parents can be influential in shaping their teens' driving behavior, and many other studies are in progress examining parent/teen intervention programs and their potential impact on driver safety (Williams et al., 2012a).

Vehicle ownership is a factor that rarely is considered in discussions about young driver safety. Often teens drive vehicles that are smaller and older, resulting in less protection in a crash (Cammisa et al., 1999). Several studies have shown that teens who are considered to be

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Conclusions

primary owners of the vehicle they drive are more likely to speed (Cammisa et al., 1999, Klauer et al., 2011), so parents should think carefully about providing teens their own vehicle when first licensed.

There is clear evidence that young drivers speed much more in the presence of their friends, so passenger restrictions take on particular importance. Passenger restrictions have been shown to reduce crashes involving teen passengers, but there are still many fatal crashes involving teen drivers transporting other teens (Williams and Tefft, 2012b). Parents are the primary enforcers of GDL restrictions, yet passenger restrictions can be difficult for parents to enforce when teens are not supervised. As a result, the burden lies with law enforcement to ensure that beginning drivers do not transport other teens. One tool that may help enhance enforcement is the use of license plate decals on the vehicles of learners and provisional license plate holders. Such laws have been in place for many years in other countries although no evidence exists of their benefits. In 2010, New Jersey was the first U.S. state to enact a law requiring decals for probationary license holders. Initial evidence suggests that the decal law increased police citations by 14 percent and reduced police-reported crashes by nine percent among the affected population, despite only partial compliance (Curry et al., 2012).

In the United States, GDL systems tend to limit risky driving by restricting driving to less hazardous situations, rather than target specific risky driving behaviors. Unlike other countries, no U.S. state-established GDL restrictions currently target speeding. There is the potential to do more to limit speeding by prohibiting novices from driving higher-powered vehicles or limiting driving speeds or access to higher-speed roadways. There is limited evidence that these restrictions are effective, affirming the need for further study. One concern is that adding additional components to existing GDL laws will make them too complex and harder to enforce. As the laws stand today, parents, teens and even law enforcement personnel may not be aware of or remember all of the components (Ferguson, 2003).

Parents are concerned about their teens' speeding and express interest in having feedback when it occurs. The availability of driver-assist and monitoring technologies that can provide information about, or even limit, speeding is growing rapidly. There are a number of aftermarket and in-vehicle options available. Some of the technologies are specifically tailored to the parent-teen market and others, predominantly in European and other countries, are targeted to all drivers. There is some evidence that monitoring devices can reduce risky driving and speeding. However, evidence is mixed on the role of immediate feedback to the teen and/or feedback that is provided to the parents. Additional research is underway to better understand how feedback might work best (Williams et al., 2012). One roadblock to their increased use is concerns about trust or privacy on the part of parents and teens. This hesitancy will need to be overcome for in-vehicle monitoring to be an effective countermeasure.

Given the high costs associated with beginning teen drivers, parents may be more motivated by financial incentives. The growth in the consumption of usage-based insurance to attract safe drivers and teach safe driving skills is one trend that could accelerate the acceptance of driver monitoring among parents. The increasing prevalence of driver assist technologies offered in new vehicles is another trend that may help to moderate these views as they become more commonplace.

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