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Adolescents and Driving: Factors Influencing Behavior

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INTRODUCTION

With excitement and anticipation, many teenagers celebrate their 16th birthday with a trip to the local Department of Motor Vehicles to take their driver's examination and get their license. Passing the test for the driver's license is an important benchmark for young people, demonstrating that they have acquired the knowledge and experience sufficient to qualify for, and a willingness to accept, this major responsibility. Like high school graduation, the experience of learning to drive and passing the driving test can be considered one of the major rituals for entering adulthood today. Traditional rituals typically involve a communal sequence having a religious or sacred purpose (Prevos, 2001). Rituals and rites of passage are important transitional experiences that require behavior that is consistent with that of the adult society (Blumenkrantz and Gavazzi, 1993). Many new drivers are proud that they have achieved this milestone representing adulthood and a more responsible, elevated status.

The intent of this monograph is to give an overview of adolescence and driving, with particular attention to developmental factors and behaviors specific to adolescence that are associated with high risk driving. Below, we summarize the history of driving and the state of the issue today.

A Brief History of Driving

Nicolas Joseph Cugnot is credited with inventing in 1769 the first self-powered, steam engine automobile (Bellis, 2004). He is also credited as being the first person to have a motor vehicle accident, when in 1771 he drove one of his vehicles into a stone wall. Cugnot was a French engineer and mechanic who used a steam engine to power a military tractor for the French Army. At the time, the tractor was able to haul artillery at a speed of 2.5 miles per hour on three wheels and had to stop every ten to fifteen minutes to build up steam power.

Steam engines, which proved too heavy for automobiles, were replaced by electrical engines, followed by gasoline-powered engines. The first automobile to be mass-produced in the United States was the 1901 Curved Dash Oldsmobile (Bellis, 2004); 425 of them were produced. The growth in automobile production was exponential: by 1927 Ford had manufactured 15 million Model Ts. The escalating number of cars on the road meant the federal government had to become more directly involved in road development, and in 1916 Congress passed the Federal-Aid Highway Program under which funds were made available on a continuous basis to state highway agencies to assist in road improvements.

While inventors approached automobiles from an interest in

mechanics, the general public came to value the capability to travel in a faster, more comfortable, more convenient way than using a horse and buggy. In the United States, the fascination with cars exists to this day (see, for example, *The Sacramento* (CA) *Bee*, which has "Automotive" sections twice per week, including a regular column on Fridays in which readers write about their 'dream' cars.) Automotive companies have increasingly targeted young drivers through their advertising with a focus on speed and excitement. It is not surprising that in a society that values automobiles, youth look forward to the day when it's their turn to join the majority of society in the excitement and independence that can come from driving a car.

Adolescents are significantly more likely than adults to be involved in traffic accidents.

At the same time period that cars were being developed, the concept of adolescence as a life stage was itself being created. During adolescence, youth experience physical, cognitive, social, and emotional changes. This unique life stage was not recognized as a period separate from either childhood or adulthood in the past. In a book about adolescence, Hine (1999: 4) called the adolescent period "an invention of the Machine Age." In preindustrial societies, there was a briefer transition period between childhood and adulthood. Teenagers did work similar to that of adults, and they often married and started families at a relatively young age. Modern society recognizes adolescence as a developmental stage different than and distinct from adulthood. Recent research indicates that the transition to adulthood is longer than in previous generations. Youth need more time than they did in the past to learn skills and to become self-sufficient. Emerging adults (ages 18-25) are marrying, having children, achieving financial independence, and accepting responsibility for themselves at a later age than did their predecessors (Arnett, 2000).

The recognition that adolescents are fundamentally different than adults, with distinct skills and abilities, has only recently been considered important when establishing regulations for driving a vehicle. Driving began as a behavior available to almost anyone who could afford a car and reach the pedals. However, over time it has become increasingly clear that young drivers (particularly those of 16 or 17) exhibit driving behaviors that are more dangerous and in many ways more problematic than drivers of all other ages (National Highway Traffic Safety Administration, 1993).

Factors Influencing Driving Behavior

Adolescent Development

Learning how to drive is not without risk. Automobiles have evolved into sleek, fine-tuned machines, capable of extremely high speeds. However, 16-year-old drivers haven't evolved at the same pace to be fully prepared to safely handle those machines. Adolescents are significantly more likely than adults to be involved in traffic accidents (Subramanian, 2005). A large part of the reason for this is inexperience, but there are developmental factors specific to adolescence that may also help to explain the higher crash rates. Arnett, Irwin, and Halpern-Felsher (2002) describe several developmental reasons why driving may be more dangerous at 16 or 17 than in early adulthood.

- Peer relationships are particularly significant in adolescence. While peer relationships may have many benefits, the importance of these friendships may contribute to risky behavior. Teenagers sometimes act irresponsibly when they are together or encourage each other to participate in high-risk behaviors. This is supported in a study by Shope, Raghunathan, and Patil (2003), who found that adolescents who had a higher susceptibility to peer pressure and those whose friends had higher support for drinking were more likely to be involved in high-risk driving behaviors, compared with other adolescents.

- More than adults, teenagers tend to exhibit optimistic bias: they tend to believe they have a lower chance than do others of experiencing a negative event.
- Adolescents tend to be emotional and are particularly susceptible to negative mood swings. These emotions may influence driver behavior.
- Adolescent males' high levels of testosterone, combined with a social system that equates maleness with fast driving, negatively influence the risk behaviors of teenage boys.
- The importance of freedom to adolescents and young adults may contribute to riskier driving behaviors at these ages.
- As youth emerge to adulthood around age 18, they may become more aware of the importance of responsibility; such awareness builds gradually, being lower among 16- and 17-year-olds than in early adulthood.

Risk Perception

In a review of adolescent driving and development, Harré (2000) describes factors influencing the judgments of drivers at any particular moment. Objective crash risk is the actual risk of an accident given the driving situations on the road at the time. Harré suggests that more experienced drivers will tend to keep this risk low at all times. Perceived risk, which refers to the driver's feelings about the level of risk for a particular situation, has been demonstrated to be lower for adolescents than for older drivers: for a given situation, adolescents tend to have reduced risk perception. Young male drivers, in particular, consistently have a reduced crash-risk perception compared with older drivers. Teenagers underestimate their risk of a crash both for a given situation and also relative to their peers: they believe they would have a lower risk of a crash than other teens would in the same situation.

In a recent study, Gardner & Steinberg (2005) found that the presence of peers influenced risky decision making and perceived risk in adolescents when in a simulated driving situation. When they were in peer groups, participants took more risks, focused more on the benefits than the costs of risky behavior, and made riskier decisions than they did when they were alone. Peer effects on risk taking and risky decision making were stronger among adolescents and youths than among adults (Gardner & Steinberg, 2005). An examination of developmental trajectories associated with high risk driving among more than 2,000 youth in Michigan using problem behavior theory found that levels of parental monitoring and permissiveness were strongly associated with high risk driving behavior (Bingham and Shope, 2004). Results also showed that the highest-risk drivers reported lower levels of conventional behavior, parent orientation, and school grades; a higher tolerance of deviant behavior; and more substance use. High risk driving is one component of a cluster of problem behaviors that some youth experience. Experimentation and exploration are essential to healthy development, but those who deviate from the normal range of experimentation may experience poor life outcomes.

Greene et al. (2000) identified the egocentrism of adolescence as an additional developmental factor influencing risk-taking behaviors. Previous research has shown that girls who believe pregnancy "could never happen to" them are more likely to use contraception unreliably. Adolescent egocentrism includes a component of invulnerability, which relates to a higher participation in risk-taking behaviors. Such feelings of invulnerability likely contribute to increased risk-taking in driving.

Personality and Sensation Seeking

Personality factors are recognized as important predictors of driving style. A sensation-seeking personality and aggressiveness have both been identified as risk factors for unsafe driving (Arnett,

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Offer, and Fine, 1997). A Canadian survey of college students found that those who scored highly on a sensation-seeking scale were significantly more likely than those with a low level of sensation-seeking to report speeding, not wearing seatbelts, and driving after drinking alcohol; they were also more likely to believe they had a low risk of being caught if they were driving while impaired (Jonah, Thiessen, and Au-Yeung, 2001). Arnett (1996) used two samples of high school and college students to examine correlations between sensation-seeking and aggressiveness and several dangerous or illicit behaviors, including several different aspects of reckless driving, such as driving faster than 80 miles per hour, racing other cars, and driving while intoxicated; having sex without using contraception; theft; illicit drug use; and binge drinking. He found that a high score on his sensation-seeking scale was a highly significant predictor of reckless behavior.

Some research indicates that sensation-seeking peaks in adolescence (Zuckerman, 1994; Arnett, 1994), and thus could be considered both a developmental and a personality factor influencing adolescent driving. Arnett (1996) comments that the higher levels of sensation-seeking present during adolescence could be a developmental factor influencing the higher risk of automobile crashes during this time period.

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Inexperience

When one considers the accident statistics of today's young drivers, perhaps Cugnot's steam engines that required frequent stops for 'build up time' aren't such a bad idea. Driving, like other skills, improves with practice. New drivers tend to have more accidents than those who have been driving longer and the rate of accidents per driver is highest at first and falls over time. Not surprisingly, adolescents have a higher risk of traffic accidents than do adults. A study of teenage drivers in eleven high schools in the Northeastern United States found that the students experienced about 5.9 crashes for every 100 licensed drivers during the first six months of driving; this rate subsequently fell to 3.4 crashes per 100 drivers for the next six months, and then to between 1.3 and 3.0 crashes per 100 drivers for the months following (McCartt, Shabanova, and Leaf, 2003). In sum, the risk of a crash is highest when new drivers start to drive, and decreases rapidly over the first 1,000 miles driven. Crash rates finally stabilize around 0.5 crashes per 100,000 miles driven.

The importance of experience was demonstrated in an Australian study using traffic crash data in New South Wales (Lam, 2003). The author examined the impact of environmental factors such as narrow roads, curves, and steep grades on crashes, by driver's age. Only for 16-year-old drivers were those effects relevant; older drivers were able to navigate those situations without an increased risk of accidents.

As a result of the higher rate of crashes among new drivers, adolescents experience more injuries resulting from crashes than do drivers or passengers from other age groups. Adolescents may be injured in crashes when they themselves are driving, but also often are hurt when they ride with friends who are new drivers. A study of injured passengers in crashes during 1992-93 found that 45 percent of all nonfatally injured passengers were between 15 and 19 years of age, and an additional 21 percent were 10 to 14 (Miller, Spicer, and Lestina, 1998).

The most serious repercussions of inexperience are fatal crashes. New drivers are more likely to cause fatalities among their own passengers and other drivers than are more experienced drivers at all ages. Motor vehicle traffic accidents are the leading cause of death in the United States for children ages 3 and older, as well as for adults up to age 33 (National Center for Statistics and Analysis, National Highway Traffic Safety Administration). A study of all fatal automobile accidents in Colorado

between 1995 and 2001 found that 158 fatalities were due to novice drivers; these young drivers were more likely than other drivers to be speeding, driving recklessly, and to be involved in rollovers or single vehicle accidents (Gonzales, Dickinson, DiGiuseppi, and Lowenstein, 2005). In contrast, fatalities among older drivers tended to involve alcohol use or adverse weather (ibid). Liu, Mooney, Meyer, and Shorter (1998) examined fatal crashes between 1991 and 1996 in New Hampshire involving teenage drivers. They found that fatal accidents typically fell into two clusters: those involving new, inexperienced drivers, which typically occurred during the day on single-lane roads, and another cluster involving more experienced drivers who were driving at night and had been drinking.

Drivers ages 15 to 21 are also more likely than older drivers to fall asleep at the wheel (McConnell, Bretz, and Dwyer, 2003). Experience may be needed for some drivers to distinguish times when they are not capable of driving safely.

Dangerous Driving Behaviors and Accidents

In surveys, young people typically report high rates of risky driving behaviors. For example, a small study of suburban twelfth-graders found that 80 percent of boys and 70 percent of girls reported driving more than 80 miles per hour at least once during the past year (Arnett, Offer, and Fine, 1997). A study of student drivers in Southern California found that 41 percent said they had ridden with a reckless driver (Sarkar and Andreas, 2004).

Males are more likely than females to report reckless driving (cf., Sarkar and Andreas, 2004). In addition to more dangerous on-road behaviors, evidence from crashes demonstrates that seatbelt use tends to be lower in cars driven by adolescent males; a study of injured passengers who were not wearing seatbelts found they tended to be riding with male teenage drivers (Miller, Spicer, and Lestina, 1998). In the New Hampshire study of fatal accidents mentioned above, two-thirds of the teenage drivers involved in fatal accidents were male (Liu, Mooney, Meyer, and Shorter, 1998).

Some car crashes result from "drag racing" or street racing. An analysis of national automobile crash fatality data for the U.S. between 1998 and 2001 found 399 deaths associated with street racing (Knight, Cook, and Olson, 2004). Street racers were far more likely than other drivers involved in fatalities to be teenage and male. Drag racing may be more common than generally believed: the Sarkar and Andreas study referred to above found that 24 percent of student drivers reported having ridden with someone who was drag racing.

Cell phone usage is often implicated in popular media pieces discussing dangerous driving. Many adolescents use cell phones, so they may be at particular risk of erratic driving associated with cell phone use. Several research articles have indicated that use of a cell phone puts any driver at higher risk of a crash (e.g., McEvoy, Stevenson, McCartt, et al., 2005). A study that asked about 1,300 college students about their driving and cell phone use found that among the accidents they reported, about 21 percent involved at least one driver who was talking on a cell phone at the time of the accident (Seo and Torabi, 2004).

Several studies have indicated that when adolescents drive with other teenage passengers, they have a higher risk of accidents (Lin and Fearn, 2003). These findings are one reason behind passenger restrictions in driver licensing laws for teenagers (discussed below). Chen, Baker, Braver, and Li (2000) used national fatal accident data and a national transportation survey to examine the occupants of cars in crashes in which drivers died, comparing 16- and 17-year-old drivers to drivers ages 30 to 59. Not surprisingly, they found that 16- and 17-year-old drivers had substantially higher fatality rates than older drivers. In addition, young drivers who were carrying passengers in their teens or

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twenties also had significantly higher fatality rates than drivers who were carrying passengers over the age of 30. Young drivers who were carrying male passengers also had significantly higher crash rates than those carrying female passengers. The same authors (2001) used national data for 1995 to demonstrate that there were 1,181 traffic fatalities among 16- and 17-year-old drivers whose passengers were all younger than age 20; they estimated that if these young drivers were prohibited from carrying teenage passengers, a large number (between 83 and 493) of these deaths could have been prevented.

Rice, Peek-Asa, and Kraus (2003) used data from the California Highway Patrol accident data system to compare teenage drivers who were injured and at fault in accidents (cases) with teenage drivers who were also involved in crashes but who were found not to be culpable (controls). Results showed that injured drivers who were at fault were more likely than the controls to be carrying two or more passengers, as well as to be carrying male passengers, and to be driving late at night.

Night driving is often one component of driving restrictions for adolescents, because young drivers are particularly susceptible to accidents while driving at night. Williams and Preusser (1997) reported that although only about 15 percent of miles driven by 16- and 17-year-olds are driven between 9:00 p.m. and 6:00 a.m., this time period accounts for 40 percent of fatal crashes. Several studies (reviewed in Lin and Fearn, 2003) have shown that states that have implemented driving curfew laws for young drivers have experienced significant reductions in accident rates.

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Alcohol- and Drug-Impaired Driving

Alcohol and illicit substance use are common among adolescents. One study using multiple survey data sets found about one in five high school age youth report binge drinking, or drinking five or more drinks at one sitting (Hingson, Assaily, and Williams 2004). Alcohol use is also implicated in a large number of car crashes. The study of southern California student drivers referred to above found that 22 percent of these new drivers said they had ridden with a drunk driver (Sarkar and Andreas, 2004). Studies in other states as well as other countries have also reported high rates of riding with a drinking or drug-impaired driver (e.g., van Beurden, Zask, Brooks, and Dight, 2005).

Peer and other social norms influence driving behavior in general among adolescents. They also influence alcohol-involved driving among young people. Grube and Voas (1996) examined normative and control-related beliefs around drinking and driving using a random-digit-dial survey of 706 drivers ages 16 to 20 in seven Western states. They found that youth who reported driving while intoxicated and those who reported riding with an intoxicated driver tended to have lower perceptions of risk associated with drinking and driving and reduced feelings of control around drinking and driving situations. For example, youth who reported driving drunk tended to believe that when drunk they had no transportation alternatives other than driving. In addition, those who reported drinking and driving or riding with a drunk driver were less likely to report that their friends would disapprove of such behaviors. Another study found reported alcohol use and friends' support for drinking to be predictive of high-risk driving (Shope, Raghunathan, and Patil, 2003).

Alcohol use in the early teenage years has also been shown to be a predictor of drinking and driving over time. In a longitudinal study of about 4,400 youth in Michigan that linked survey data to DMV records over about eight years, substance use reported at age 15 was associated with a higher risk of serious crashes in later life (Shope, Waller, Raghunathan, and Patil, 2001).

The peer and family context with respect to alcohol use have been demonstrated to be predictive of driver history over the adolescent period. A

longitudinal follow-up study of 794 eighth graders in Michigan, combined with state driver history data six years later, looked at family and peer influences and alcohol use reported in eighth grade and their associations with driver behavior later on (Shope, Waller, and Lang, 1996). About 22 percent of boys and 20 percent of girls had at least one crash identified in DMV data during the follow-up period. Boys who reported in eighth grade that their parents expressed negative attitudes toward their drinking were significantly less likely to experience a crash during the follow-up period. Girls who reported low alcohol involvement among their peers also had low crash rates relative to those whose peers had higher alcohol use.

Knowing more about the situations in which youth drink and drive may help to prevent alcohol-impaired driving. One study involving a random phone survey of 1,534 California youth ages 15 to 20 found that drinking and driving primarily occurred as a result of binge drinking and/or drinking in restaurants (Walker, Waiters, Grube and Chen, 2005). The authors suggested that a greater focus on restaurant beverage service could help lower the incidence of alcohol-related traffic accidents.

Addressing the Specific Needs of Young Drivers

The higher automobile accident, injury, and fatality rates among young drivers have been known for many years, and many policies have been put in place by both public agencies and private companies (such as insurance agencies) to attempt to reduce the higher risks experienced by young drivers. One federal agency with primary responsibility in this area is the National Highway Traffic Safety Administration (NHTSA). NHTSA conducts behavioral research to increase traffic safety. Historically, the Agency worked to improve the safety of young drivers through education and training, licensing procedures, enforcement and adjudication. Over time emphasis was placed on alcohol use effects, occupant protection and community programs. Their research was expanded to include developmental factors relevant to adolescents including peer influence, risk taking attitudes and cultural norms (NHTSA, 1993). NHTSA has tried to identify and understand other characteristics of young drivers that contribute to highway safety problems besides lack of knowledge or skills, including researching how young drivers perceive risk and in what ways risk choices of young drivers differ from those of other drivers. The NHTSA and the Insurance Institute for Highway Safety (IIHS) have both worked to understand and address the intangibles associated with young driver decision making that have little to do with a lack of information or skills (Grabowski & Morrisey, 2001).

One approach some intervention researchers, and the Federal Highway Administration, have taken in attempts to reduce the rate of crashes among youth is by thinking about "the three E's": education, engineering, and enforcement. Driver's education and training may be improved; automobiles may be engineered in ways to reduce injuries if crashes do occur (such as through air bags), or to reduce the likelihood of crashes occurring; and enforcement of laws, such as graduated driver licensing rules, may reduce the risk of crashes.

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Driver Education

Under California educational code, school districts are mandated to offer driver education as one component of their course offerings. Many districts combine it with health class during tenth grade. Learning to drive is typically separated into two components: the class- or internet-based driver's education component and the hands-on, in-car driver's training component. Many students choose to take driver's education from a private organization rather than through the school system. In addition, the driver's training component of driver education is no longer included in

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education in many districts, so students often must take that piece privately. Private driving instructors must be certified by the California Department of Motor Vehicles, and the instructors must pass qualifying examinations or show proof of continuing education in traffic safety.

There has been a decline in the past several years in the percentage of young drivers who obtain a license, perhaps because of stricter driver licensing laws as well as the busy lives of adolescents (McCarron, 2005). Compared with other states, California has an especially low rate of 16- and 17-year-olds who obtain licenses. There can be perceived advantages to waiting until turning 18 to obtain a driver's license. Teens who wait to get their licenses until after turning 18 are not required to meet the criteria imposed on younger drivers, including hiring private driving instructors for the in-car driving component. Once 18, new drivers can receive their license by passing the driving and written portions of the examination.

Policies and Restrictions That Can Help Reduce Accidents

Many states, including California, have implemented Graduated Driver Licensing (GDL), or stricter driving rules for new drivers that gradually ease with age and/or experience. In California, after having driver education and training, youth ages 15 and a half or older may obtain a driving permit which allows them to drive with an adult 25 or older. At age 16, and after having had 50 hours of supervised driving by a parent or other adult 25 or older, 30 hours of classroom or online training, and 6 hours of behind-the-wheel training, teens who have a clean driving record may receive a provisional license. For the first 12 months of driving with the provisional license (as of January 1, 2006; previously the rule was for the first six months), teenage drivers may have no passengers under age 20 unless an adult 25 or older is present. Also, for the first 12 months, they may not drive between the hours of 11 p.m. and 5 a.m. The provisional license becomes a full license when the youth turns 18.

States that have implemented GDL laws have generally witnessed a decline in crash rates among teenagers. One study compared crash rates in two adjacent states, Florida and Alabama (Ulmer, Preusser, Williams, et al., 2000). Florida implemented a GDL law, whereas Alabama did not. Results showed that Florida experienced a reduction in crash rates among teenagers after the GDL laws came into effect, but Alabama did not experience a decline during the same time period, suggesting that the new laws were responsible for the decline. In general, states with more restrictive driving laws for teenagers tend to have lower rates of crashes. A comparison of Northeastern states found that Delaware and Connecticut, with the least restrictive laws, had higher crash rates than did Pennsylvania and New York, with greater restrictions (Ferguson, Leaf, Williams, and Preusser, 1996). A review of articles on GDL found mixed results for analyses of California data, but found that in general the GDL laws had led to modest reductions in accidents for adolescents (Hedlund and Compton, 2005).

In addition to driver licensing laws specific to young drivers, some international studies show that policies and environmental measures related to speeding can have a substantial impact on traffic deaths. A study comparing British and American road traffic deaths during the 1990s found that British road death rates declined by almost 34 percent, while the American rate dropped only 6.5 percent (Richter, Friedman, Berman, and Rivkind, 2005). According to the authors, Britain introduced a variety of traffic calming measures during the time period, including speed limit reductions, roundabouts, speed bumps, traffic cameras, and other measures. Traffic speeds have been reduced as a result, and this analysis demonstrated that the reduced speed of crash impacts was responsible for the decline in fatalities in Britain.

Positive parental involvement has been shown to be associated with safer youth driving behavior. One study found that youth who had received tickets reported fewer parental rules and restrictions than those who had not been ticketed (Beck, Shattuck, and Raleigh, 2001). Parents can also have negative effects on their children's driving. Youth who report that their parents drive aggressively are more likely than other youth to find aggressive driving acceptable (Sarkar and Andreas, 2004). Parent involvement is one potential avenue for improving adolescent driving. In one intervention study, providing parents with a video about parent limits on teenage driving showed that parental rules increased after viewing the video (Simons-Morton, Hartos, and Beck, 2004).

One reason for the decline in crashes in states that have implemented GDL may be increased parental awareness of driving risks, and consequently stricter parental rules. One comparison of two states, one with GDL laws and one without, found that parental rules about driving were on average stricter in the GDL state than in the other state (Hartos, Simons-Morton, Beck, and Leaf, 2005).

Conclusions

The high rate of accidents among younger drivers is an international problem. In the United States, graduated driver licensing rules have begun to reduce the risk of traffic crashes among adolescents in some states. Both here and in other parts of the world, developmental factors and young drivers' lack of experience are primary causes of the higher rates of accidents among teenage drivers. However, a greater emphasis on gradual learning of driving skills over time, as exemplified by graduated driver licensing laws, has led to declines in car accident rates among young drivers. In addition to stricter driving laws, program interventions with teenagers and their parents can help to reduce high-risk driving and its negative repercussions. State and federal environmental measures to reduce speeding and calm traffic can also help to reduce accident rates. Further research is needed to learn more about ways to improve safety among young drivers. In particular, little is known about events within the car, for example when carrying peers, that lead teenagers to a higher risk of having an accident. In addition, guidelines on driving education and training have been little researched. However, some interventions, both legislative and programmatic, involving youth and their parents do seem to be making a difference in reducing crash risks for new drivers. ■

A greater emphasis on gradual learning of driving skills over time, as exemplified by graduated driver licensing laws, has led to declines in car accident rates among young drivers.

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