

Adolescent Drivers

A Developmental Perspective on Risk, Proficiency, and Safety

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Abstract: Despite considerable improvement in the rates of crashes, injuries, and fatalities among adolescent drivers, attributable in part to effective interventions such as graduated driver licensing, these rates and their associated health risks remain unacceptably high. To understand the sources of risky driving among teens, as well as to identify potential avenues for further advances in prevention, this article presents a review of the relevant features of contemporary research on adolescent development.

Current research offers significant advances in the understanding of the sources of safe driving, proficient driving, and risky driving among adolescents. This multifaceted perspective—as opposed to simple categorization of good versus bad driving—provides new opportunities for using insights on adolescent development to enhance prevention. Drawing on recent work on adolescent physical, neural, and cognitive development, we argue for approaches to prevention that recognize both the strengths and the limitations of adolescent drivers, with particular attention to the acquisition of expertise, regulatory competence, and self-regulation in the context of perceived risk. This understanding of adolescent development spotlights the provision of appropriate and effective scaffolding, utilizing the contexts of importance to adolescents—parents, peers, and the broader culture of driving—to support safe driving and to manage the inherent risks in learning to do so.

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Introduction

Driving requires a set of complex, interrelated, and simultaneous competencies, including psychomotor, cognitive, and perceptual proficiency. Although teens are generally successful at acquiring necessary driving skills, translating these skills into safe driving requires complex strategies, expertise, and concentration, with errors in execution often resulting in serious, even fatal, consequences. However, on average, adolescents are not cognitively mature enough to fully execute safe driving skills, with particular risks arising from regulatory challenges that occur in complex and distracting contexts. Given the ongoing development of adolescents' bodies and minds, seen in the context of social influences that occur during adolescence, it is not surprising that adolescent drivers are at such great risk. Reducing risky adolescent driving necessarily requires an understanding of these multiple and often competing demands of development and environment, suggesting that interventions and policies need to respond to these complex systems.

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The emerging knowledge of adolescent development has important applications to adolescent driving, providing strong support for the most successful and most promising approaches to enhancing teen driving safety, such as those related to graduated driver licensing (GDL). As discussed later in this article, further understanding of adolescent development should continue the momentum necessary to implement and expand policies that have been shown to be effective. Legislative change requires continuous effort, especially when safety has to compete with custom and convenience, as it so often does.¹ Restrictions on teen driving, for example, may on average decrease driving risk, but they also extend the period during which parents need to provide transportation for their adolescent. Further, understanding the underlying mechanisms of adolescent development could provide an impetus for closer study of approaches that have not been systematically tested, as well as some guidance on how such approaches might be more precisely focused.

Adolescent Development: Implications for Teen Driving

Adolescence marks a period of time when rapid and extreme physical, cognitive, and psychosocial changes are occurring. These sets of developmental change are

reviewed next, with particular focus on the aspects of development most germane to adolescent driving.

Physical Development

Adolescence is marked by rapid and extreme biological change, including hormonal changes and related pubertal development, as well as brain maturation. As discussed in greater detail by Dahl² in this supplement, the most exciting and relevant recent studies on adolescent development have been in the area of brain development. Advances in neuroimaging have opened a novel terrain for exploring and understanding how the individual's brain begins to change dramatically at approximately age 11 and continues to develop structurally and functionally well into the third decade of life. A particular focus has been on the prefrontal cortex (PFC), including the connections between the PFC and other brain areas. Changes within the PFC system correspond to central changes in cognitive, emotional, social, and behavioral functions during adolescence.^{3,4} The structural and functional implications are numerous and far from fully understood. But a key organizing theme for many of these changes is that the PFC system is assuming a governance, or management, function, which appears gradually to come under greater conscious control over the period of adolescence and young adulthood.³

Cognitive and Psychosocial Development

Adolescence also involves great cognitive maturation. Thinking becomes more abstract and less concrete, allowing adolescents to consider multiple aspects of their actions and decisions at one time, assess potential consequences of a decision, consider possible outcomes associated with behavioral choices, and plan for the future. These cognitive changes are coupled with psychosocial development, including susceptibility to peer pressure and increased need for autonomy.⁵ These newfound cognitive and psychosocial capacities have several implications for teen driving and safety, including (1) expertise, (2) regulatory competency, and (3) self-regulation in the context of perceived risk. These areas are reviewed next.

Expertise. The research literature on expertise is potentially highly informative for enhancing adolescent driving safety. The acquisition of knowledge and skills in specific domains is a critical task of cognitive development.⁶⁻¹⁰ More knowledge and greater ability to transfer knowledge across domains are the keys to developmental advancement. From this perspective, measures of better reasoning, faster processing, or greater mental capacity may be largely derivative of the core progress in knowledge acquisition, shifting the focus to the acquisition of expertise through experience and practice, not on age or developmental differ-

ences themselves. Indeed, the early demonstrations that young experts could outperform older novices were central to the expertise argument.⁶

There are important connections between the emerging work on expertise development and the enhancement of safety in young drivers. First, the acquisition of any complex set of skills requires a significant amount of time.¹¹⁻¹⁴ This requirement certainly applies to safe driving, as can be seen by both the number of crashes and the pattern of crash rates for all novice drivers: Crash rates are highest in the first 250 miles of independent driving, drop by almost two thirds in the next 250 miles, and show further sharp decline as independent driving experience increases.¹⁵ By requiring a greater amount of time prior to receiving an unrestricted driver's license, GDL regimes incorporate the practice component of expertise acquisition. The increasing evidence for GDL success weighs heavily on the side of moderate restrictions, and the expansion of GDL coverage to provide adequate and essential time for the acquisition of expertise for adolescents in all jurisdictions is an important goal for public health.

An important issue related to expertise acquisition involves the need for learners and the public health community to agree on the purpose of skill training. However, the goals of adolescents and the public health community are mismatched with regard to acquiring driving expertise. For the adolescent, the goal is typically to gain sufficient skill to operate a vehicle and become more independent, by quickly meeting the requirements for independent licensing. In contrast, the public health community strives to achieve safety, a goal that requires time and experience. This mismatch in goals can translate into misguidance in how expertise is acquired. Whereas the focus should be on experience and safety, instead the emphasis is often placed on rapidly acquiring driving skills so as to meet the requirements for unrestricted licensing. Thus, resetting and redefining goals may be essential for guiding the acquisition of expertise at skilled, safe driving. It is not immediately obvious how to achieve this public health goal in the face of powerful cultural and peer pressures that support a conflicting goal. However, a combination of parental reinforcement and monitoring, supported by GDL regulatory regimes^{16,17} and social marketing to enhance adolescents' acceptance or endorsement of safe driving as a goal,^{18,19} may offer some promise.

Effortful, deliberate, and guided practice is another important component of expertise acquisition.^{12,13} Acquiring expertise requires motivation to concentrate on the active components of the desired expertise. In turn, the training regime needs to be guided by a careful task analysis so as to structure the practice in a productive way. Complicating this process, however, is the fact that expertise is never acquired without deliberate effort. Indeed, learning occurs most effectively through an

understanding of one's errors and how best to remedy them. However, driving errors, especially those occurring during independent driving, can be harmful, even fatal. Although the GDL practice-driving requirements are a step closer to achieving needed practice, the high crash rates that continue to occur in the transition to independent driving suggest that more is needed. Future research and policy development could productively focus on how to afford novice teen drivers the opportunity to commit and learn from errors, while minimizing the potential cost in property, injury, and lives. Adding a restriction on the type of roadways that newly licensed drivers can traverse is one such possibility not currently included in most GDL programs, which could make early crashes less likely to be severe or fatal. One example is the GDL restriction in Ontario that prohibits novice (G1) drivers from using the high-speed expressways for the first 6 months (www.mto.gov.on.ca/english/dandv/driver/gradu/index.html).

The final component of expertise development is automaticity of subroutines. A skill will become automatic when its related competency has become incorporated into a subroutine. Automaticity of important components of skilled driving is central to road safety. It is important to note, however, that just as safe driving skills can become automatic, so can unsafe driving habits. Because significant "embedding" of automatic routines is based in the brain,^{20,21} significant risks are associated with unstructured and unsupervised acquisition of expertise.

Regulatory competence. Safe driving is not only a matter of how well one drives, but how one drives in the real world, which is hampered by complexities and multiple contexts. A key application of cognitive and brain development is regulatory competence—the ability to function proficiently under challenging circumstances. For teen driving, regulatory competence is the ability of adolescents to deploy acquired driving expertise in real world situations, even when there are major distractions. These distractions can be external (e.g., a group of rowdy friends in the car), self-generated (e.g., talking on a cell phone or eating while driving), or fully internal (e.g., ruminating on a social slight that occurred at lunchtime). Managing to stay on the task of safe driving while employing one's best expertise is a significant challenge for all drivers, and particularly for adolescents, whose regulatory competence is still developing.

The regulation of attention and emotion is an area in which regulatory competence is particularly relevant to teen driving. Driving requires an enormous amount of driver attention and judgment.²² Given that adolescents' driving skills are nascent and not yet fully automatic, it is no surprise that a large proportion of crashes are attributable to attentional distractions. Specific examples of attentional distractions include passengers

aged <18 in the vehicle; the use of cell phones, iPods, and other technology; and eating.

Individual- as well as contextual-level supports are likely to help adolescents acquire and solidify driving skills needed in even the most difficult circumstances. Such support includes protecting adolescents from the harmful effects of deficiencies in regulatory skills until these capabilities have matured sufficiently. For example, GDL restrictions certainly address some of these attentional deficits by restricting the number of passengers in the car, but more restrictions are needed. Extending GDL to include restrictions on cell phones and other distractions may also yield positive results, but empirical evidence of the effectiveness of such restrictions is still needed.

Another critical impingement on attention regulation is sleep deprivation, which is widespread among adolescents. Given current school and other schedules, adolescents are typically required to awake anywhere between 1 and 3 hours before their natural sleep cycle is complete, resulting in their being extremely sleepy in the morning hours as well as throughout the day. This sleep deprivation has been implicated as a nontrivial contributor to teen crashes.²³ GDL's nighttime driving restrictions may deal indirectly with some portion of this excess risk, but they certainly do not resolve all adolescent sleep issues, including those concerning driving in the early morning, when adolescents are often equally sleepy. One possible solution is to encourage high schools to begin at a later time, but this policy change has been met with criticism from school officials and parents.²⁴

Perception of driving risks. A common explanation for why adolescents take risks, including those related to driving, is that teens cannot adequately assess risk, they exaggerate the amount of control they have over their driving abilities and driving outcomes, and they perceive themselves as invulnerable to harm. Judgments about risk are viewed as a fundamental element of most theoretical models of health behavior, including social cognitive theory,²⁵ the health belief model,²⁶ the theory of reasoned action,²⁷ the theory of planned behavior,²⁸ self-regulation theory,²⁹ and subjective culture and interpersonal relations theory.³⁰ These theories posit that individuals' perceptions about the consequences of their actions and perceptions of vulnerability to those consequences play a key role in behavior.

Despite these theories, no solid evidence indicates that adolescents are at a particular disadvantage when it comes to their understanding of risk. Research does not support the notion that adolescents' cognitive grasp of the concepts of risk and safety is significantly poorer than that of adults, although adults may have some advantage in the precise estimate of risks.^{31,32}

Although research does not show significant reductions in risk recognition among adolescents compared

with adults, studies do support the notion that adolescents who take risks perceive lower personal risk (e.g., Arnett,³³ Halpern-Felsher et al.,³⁴ Weinstein and Nicolich³⁵). Despite the focus on low risk perceptions as an explanation for teen risky driving, it is equally feasible that adolescents engage in risky driving or do not emphasize safe driving in part because they are more focused on the benefits of driving, including gaining independence and looking “cool” in front of their peers (e.g., Goldberg et al.,³⁶ Halpern-Felsher et al.³⁷).

Indeed, Harre³⁸ combined the notions of perceived risks and perceived benefits to describe driver behavior. Harre generated five adolescent risk-approach “types,” which are arrayed on two dimensions: objective crash risk (high or low) and perceived crash risk (high or low). Individuals high on both dimensions may be the classic thrill seekers or those who rationally accept the level of risk to obtain a desired benefit. Habitually cautious drivers are low on both dimensions. Those with actual high crash risk but who perceive crash risk to be low have reduced risk perception, whereas the obverse pattern exists for those who are actively risk-avoidant. Of course, contextual circumstances may move an individual’s behavior into a different typology: if the benefit is high enough, many adolescents may gravitate toward the “rational” risk-taking type of behavior—that is, they do not effectively regulate their behavior if the reward dimension is too great, an apparently neurodevelopmental characteristic of adolescents.³⁹ In other words, some adolescents may be temperamentally disposed to accept high risk, which they accurately judge, because they are active risk seekers. This type is more likely to reflect an enduring personality characteristic and may not respond well to safety interventions. A different pattern characterizes those adolescents who are not active risk seekers, but who are willing to take (accurately perceived) high risks if the perceived benefits—such as maintaining peer status—are high enough. Although this may not be the sort of rational behavior that adults would prefer, it is clearly the case that when benefits are perceived to be important, they may realistically outweigh perceived risks. At the very least, perceived benefits play an equal and important role in behavior. This type of rationalization is similar to that in adults when, for example, getting to an important appointment on time outweighs the risk of marginally unsafe driving.

Several investigators have weighed in on the debate of whether and how risk and benefit perceptions influence behavior. For example, Reyna and Farley⁴⁰ propose to resolve the dilemma by acknowledging that adolescents and adults have roughly equivalent analytic skills in judging risk, but that adolescents demonstrate decidedly weaker performance when making gist-based, socially derived intuitive judgments, presumably because their experience is more limited. Adolescents’ perceptions and interpretation of risk are also likely to be

influenced by what Slovic and others have called the “affective heuristic,” which is the notion that perceived risk and behavior is also influenced by feelings, including intuitive and reactive feelings of risk. Evidence is mounting to support the role that affect plays in judging risks and making behavioral decisions.⁴¹

Taken together, these findings suggest that a key goal of future research on risk perception would be to identify (1) specific areas in which core cognitive capabilities of adolescents and adults are sufficiently different within the specific domain of driving safety to warrant prevention efforts, (2) specific areas of perceived risk that predict greater likelihood of risky driving in teens, and (3) specific driving-related benefits that are worthy of interventions to improve the primary outcomes of crashes, injuries, and fatalities among adolescents.

Contextual Influences on Adolescent Development: Implications for Teen Driving

Concurrent with physical, cognitive, psychosocial, and emotional maturation, adolescents are embedded within an ever-changing, multilayered environment. A comprehensive review of the social and cultural environments interacting with and impinging on adolescent development is not feasible here. Instead, a brief overview of the most salient contexts is provided, with particular focus on those aspects most likely to influence teen driving and relevant policies.

Parents

Parents can be the second most critical factor in reducing teen risky driving (GDL is the first; see review by Simons-Morton et al.⁴² in this issue).

Parental monitoring, involvement, and expectations remain key to reducing teen risky behavior, including driving.^{43–48} One way in which parental involvement can be effective is when parents of young novice drivers monitor their children and obtain compliance with GDL restrictions, whose enforcement through legal means can be only spotty at best, owing to insufficient resources.⁴⁹ Another effective mechanism for such parental reinforcement is for parents and adolescents to develop a driving contract. This approach, combined with incentives such as insurance discounts, reinforces and even goes beyond current GDL regulations. A third way that parents of teens can help reduce driving risks is by restricting and monitoring the presence of teens’ peers in the vehicle. Finally, parents can be effective in regulating the extent to which adolescents actually have access to motor vehicles. Parents typically support teen driving by purchasing or lending teens a car and purchasing their gasoline and car insurance. Thus, parents can be encouraged to restrict access to these,

especially when a teen violates GDL or other safe driving practices.

Peers

As adolescents mature and desire more freedom, decision-making power, and mobility, peer affiliations similarly become extremely critical. Although parents remain the most important influence, peers do become a significant source of socialization and support for youth. With respect to teen driving, certainly the most immediate risk to safe driving is the presence of passengers aged <18 in the vehicle.⁵⁰ Restricting the presence of these passengers is one of the most important components of GDL. In addition, peers are the primary mediators of cultural attitudes toward safe driving versus risky driving. The extent to which peers perceive unsafe driving as “cool” has the potential to undermine or reduce the effect that safe driving messages have on teens. Clearly, efforts are needed to reshape and reemphasize teen driving, such that safe rather than risky driving is seen as the norm.

Culture and Media

Culturally, driving—including risky driving—is portrayed as cool, youthful, and fun. Although the extent to which culture and media influence adolescents or their driving behavior is not known, it is clear that cultural messages contradict many of the messages and goals portrayed by health educators and parents. Designing a social marketing campaign to work against these greater societal messages is a daunting challenge.^{18,19,51}

Summary: A Comprehensive Perspective

Adolescent development involves a complex set of interrelated systems occurring both within the individual adolescent and between the adolescent and his or her surroundings. Understanding adolescent development and the most important influences on it has the potential to provide key explanations of why and how adolescents may be most at risk for vehicle crashes. Making great strides to reduce teen risky driving will take a similarly comprehensive approach, one that considers not only the individual adolescent but the confluence of factors that can undermine the ability of adolescents to drive safely during this vulnerable period.

Knowledge concerning adolescent development and its role in teen risky driving can be applied to the development, expansion, support, and evaluation of interventions and policies aimed at reducing teen driving risks. The most effective immediate responses to teen risky driving would be extending GDL regimes to all jurisdictions, and extending policies to increase parental involvement in monitoring their teens’ driving and placing consequences on risky driving behaviors. As Williams⁵² notes, we have one solidly evidence-based

building block in GDL, and it makes policy sense to build on it. The evidence from the research related to basic developmental mechanisms in adolescence strongly reinforces that strategy.

This review of adolescent development also supports other areas of inquiry and intervention development. For example, the extent to which habitual patterns of reactivity and judgment in the driving situation are being “sculpted” in potentially enduring ways^{20,21,53} provides added incentive for getting the initial training and expertise acquisition right. Similarly, incorporating measures to enhance regulatory competence in the early driving period would likely have a similar salutary effect. The fact that adolescence is a potentially sensitive period of development capable of embedding patterns with a long reach³ may suggest good news: The persistence of good driving habits could lead to lower crash rates throughout subsequent adult driving careers. This review also suggests that identifying how adolescents perceive driving risks and benefits, and the extent to which such modifiable perceptions can be linked to actual behavior, might prove fruitful.

No one research study, intervention, or policy effort will provide the magic answer to reducing teen risky driving. The best approach to the problem is likely to be through comprehensive, systematic means, and our understanding of adolescent development is a necessary first step.

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