



Review article

Young Driver Distraction: State of the Evidence and Directions for Behavior Change Programs

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 A B S T R A C T

Adolescent drivers are overrepresented in distraction-related motor vehicle crashes. A number of potential reasons for such an elevated risk include driving inexperience, high adoption of communication technology, increased peer involvement, and tendency to take risks, which render young drivers particularly vulnerable. Major legislative efforts in Graduated Licensing Systems that include passenger restrictions have shown positive effects. Restrictions on cell phone use are also being introduced; however, it is challenging to enforce such regulations. This article argues that such contextual, legislative interventions are an essential prevention strategy, but there is an unfilled need to introduce behavior change programs that may target adolescents, parents, and friends. A theoretical framework is applied in which risk and protective factors are identified from research within the contexts of community and jurisdiction. In the literature on distraction, social context and normative influences are key elements used to inform program design for adolescent drivers, with parental monitoring informing interventions targeting parents. Following from this assessment of the message content assessment, the design of strategies to deliver the messages is reviewed. In the current literature, school-based programs, simulations, and Web-delivered programs have been evaluated with supplementary strategies delivered by physicians and parents. Such developments are still at an early stage of development, and ultimately will need controlled implementation and evaluation studies. Of course, there is no likely single approach to prevent adolescent driver distraction. Complementary approaches such as the further development of technological interventions to manage phone use are needed.

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IMPLICATIONS AND CONTRIBUTION

This article describes the intervention design process and key research in young driver distraction, and includes selecting target behavior and the audience, theoretically derived strategies, and delivery strategies. Currently graduated driver licensing and technology use and acceptance and parent–adolescent and adolescent–peer interactions are opportunities for further research and exploration.

Young drivers appear to be most susceptible to distraction-related crashes; 16% of all distraction-related fatal crashes in

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2008 in the United States (US) are attributed to drivers < 20 years of age, the highest proportion of all drivers [1]. Distraction has been defined as “a specific type of inattention that occurs when drivers divert their attention from the driving task to focus on some other activity” ([2], p. 1). Young drivers are inexperienced compared with older drivers, and this inexperience potentially extends to a reduced ability to judge driving demands in relation to other potentially distracting tasks [3].

Many reasons are proposed to explain the proportionally higher rate of distraction-related crashes among young drivers. For example, their inexperience means they necessarily allocate

greater attention to aspects of driving that may later become automatic, which leaves fewer attentional resources available for secondary tasks [4]. In addition, it has been suggested that adolescent inexperience is associated with lower comprehension of driving safety, risk, and consequence, and less fully developed processing capabilities aligning with the stage of development [5]. The development of regulatory competence involving the prefrontal cortex rapidly grows during adolescence [5] and enhances an individual's ability to accomplish tasks despite major distractions [6]. Lee [7] pointed to the adoption of technology, susceptibility to peer pressure, and tendency to take risks, as factors rendering young drivers vulnerable to distracted driving situations. Despite these risks, research has also shown that young drivers express greater willingness to undertake distracting tasks while driving than do older adults [8]. Such effects may be compounded if the driver is impaired, perhaps by fatigue, alcohol, or drug use.

The behavioral science approach to intervention identifies a number of components for effective program design, including the selection of target behaviors, target individuals, risk and protective factors that underpin such target behavior (theoretically derived), and implementation strategies appropriate to the target audience [9,10]. The program design components are followed by implementing, evaluating, and monitoring the newly constructed behavior change program [10]. This review describes the application of this process specifically applied to reducing adolescent distracted driving. Figure 1 provides an overview of the process.

Identifying the Target Behavior and Identifying the Target Individual

To begin the process of identifying the target behavior for change, an initial objective is clearly specified. A clear objective enables program material to be designed with a common purpose and outcomes measured against the objective. After a broad objective is specified, specific goals are identified that are

related to the objective. For example, from the broad objective of “reducing injury from motor vehicle crashes to adolescent drivers who were engaged in a secondary, distracting task” a behavioral goal could be “preventing adolescents from sending text messages while driving.” The specific goal or goals are selected based on evidence supporting the link between the goal behavior and the broad objective [10], and are thus measurable. Related to the specification of a target behavior is specification of the target group of individuals who perform such a behavior. Much research on adolescents driving while distracted has focused on distractions by peer passengers and cell phone use.

Extensive research literature has identified an increased safety risk for adolescent drivers associated with carrying peer passengers [11,12]. Carrying young passengers is generally associated with an increased crash risk among adolescent drivers [13]. However, carrying adult passengers is associated with a reduced risk of crashes [14]. Observations of vehicles exiting high school parking lots showed that the adolescent male driver–male passenger combination had greater than double the rate of risky driving than a general traffic group [15]. Self-report studies involving young drivers have shown that many admit to finding their friends a distraction in the car. One study found that almost all adolescents (94%) from a large sample of high school students across the US reported being distracted by passengers [16]. There are sub-groups of young drivers who may be more likely to be distracted than others: for example, males [11]. An examination of sex differences using data from the National Motor Vehicle Crash Causation Survey of crash data showed that distraction, both external and internal (with female passengers), and passengers' risk-promotion were implicated in young male driver crashes. Female young drivers were primarily influenced by distractions such as turning to look at their passengers and other internal distractions [17]. Adolescents who demonstrate impaired attention in other areas of life, such as those diagnosed with attention-deficit hyperactivity disorder, also show impaired driving behaviors [18].

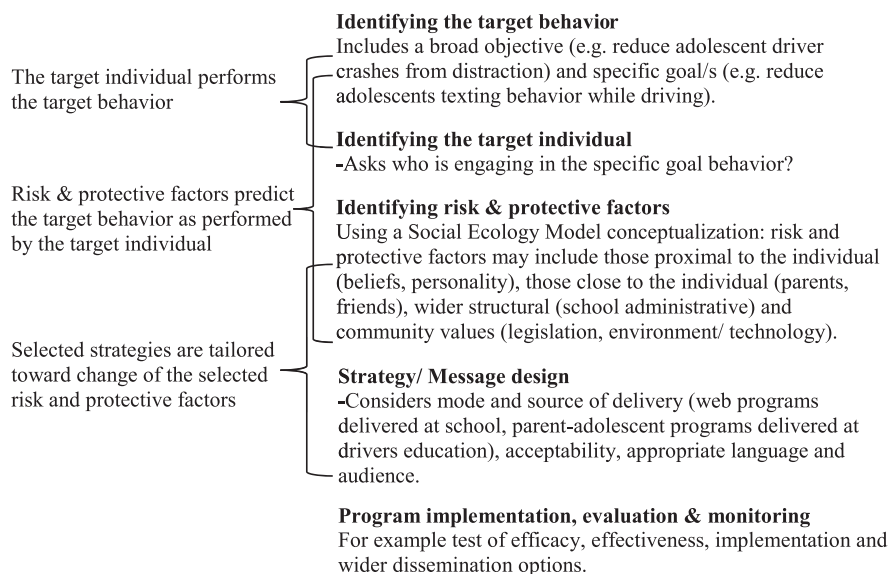


Figure 1. Design process of a behavior change program.

Recent findings from the Youth Risk Behavior Survey showed that 44% of adolescents texted or sent e-mails while driving in the past 30 days [19]. In a study comparing the behavior of young drivers with experienced drivers in an instrumented vehicle, 29% of participating young drivers interacted with a music device or cell phone and glanced away from the road for more than 3 second, whereas none of the experienced drivers glanced away for such a period [20]. Evidence shows performance decrements with biomechanical distractions (involving manual input, such as with text messaging). A simulator study showed that young drivers' texting (compared with not texting while driving) resulted in greater crashes and slower reaction times (braking) [21]. The 100-Car Naturalistic Driving Study [22] showed similar findings, and the authors concluded that tasks requiring visual and manual resources were the most serious threat to safety.

Risk and Protective Factors

After selecting specific behavioral goals (target behaviors for change), along with identifying who performs such behaviors, the next step is to understand the etiology of the selected behavior: that is, to identify risk and/or protective factors that may facilitate or reduce the likelihood that the target individual performs the target behavior. The conceptualization of risk and protective factors should explain the specific target behavior and be constrained, internally consistent, parsimonious, and theoretically grounded [9,23].

To provide structure to the description of potential risk and protective factors as applied to adolescent distracted driving, this review organizes factors according to elements that align with the Social Ecological Model (SEM). The theory conceptualizes adolescents and their surroundings as nested systems of influence on behavior with levels of (1) close systems of influence (the microsystem: for example, an adolescent's beliefs); (2) a meso-system of influence moving beyond immediate influences (for example, peers and parents); (3) the exo-system of larger social influences (for example, school administration); and (4) a macro-system encompassing influences associated with culture, customs, and the law [24]. In practice, all components of SEM are rarely studied together or represent the construct targets for change that are evaluated in a single program. However, the components represent elements for consideration in a behavior change program targeting reductions in adolescent distracted driving. They also highlight nested systems of influence that are pertinent to behavior change in adolescent distracted driving. For example, a program may target change at the belief level (e.g. increasing perceptions that important others have negative views of driving and texting) which may be nested within the influence of the behavior of those important others (e.g. encouraging parents to never use their phone and drive). These beliefs and the behavior of important others are nested within a legislative and community context. Such legislation may include enforced laws banning texting and driving.

Individual beliefs, personality, and personal characteristics

Research in the area of distraction and driving that examines factors most proximal to individuals and their behavior has identified factors such as individual beliefs, personality characteristics, and neurological processes. Belief-based health psychology theories such as the Theory of Planned Behavior have been used to explain adolescent distracted driving. For example,

in a sample of Australian novice drivers, greater efficacy to resist a call, less perceived advantages, and greater barriers predicted lower rates of driving with a cell phone [25]. With regard to beliefs about carrying passengers, focus group research found that adolescents believed traveling with young people is desirable and not necessarily considered risky [26]. More broadly, belief-based approaches to prevention have been evaluated, which provides an important test of risk and protective factors; that is, evaluating factors that correspondingly change with behavior, as predicted in a behavior change program. Griffin and colleagues [27] reported on a program targeting change in life skills, particularly in resistance skills and challenging norms for alcohol and drug use, as well as developing personal and social skills. They found fewer traffic offenses in an intervention group compared with a control group; however, the authors did not report specifically on distraction-related issues.

Steinberg [28] highlighted the importance of social neuroscience factors in explaining general adolescent driving risk behaviors. A personality trait-theory approach has also been used in which traits of conscientiousness and the need for arousal predicted distracted driving (including cell phone use and other in-vehicle tasks such as talking, eating, and reading a map), at least among US college students [29]. Falk and colleagues [30] provided neuropsychological research on male adolescents in a driving simulator. They found that neural responses predicted risky driving behavior more than self-reported peer pressure.

Peers

Another factor pertinent to behavior change theories explaining adolescent driving is the direct and indirect influence of peers and friends (e.g., through beliefs about norms and direct pressure). Associated with their unique stage of development, adolescents desire to please their peers and are particularly susceptible to their influence. Allen and Brown [31] argued that as young people drive with peer passengers, not only are they trying to maneuver the vehicle, they are also concerned with maintaining and strengthening relationships that they perceive to be critically important. Laboratory-based research has shown that adolescents take more risks in the presence of another adolescent, compared with being alone or with an adult, while playing a driving video game. Young passengers talk more to drivers and encourage greater risk taking, and drivers report showing off in the presence of peer passengers [6]. The peer influence extends to affecting drivers' use of technology; a focus group study examining adolescents' willingness to engage with technologies showed that peer influences may increase the tendency of young drivers to use these technologies (particularly cell phones) while driving [32]. An intervention regarding adolescents' driving with their peers thus has to take into account the real need to please their peers and maintain social standing.

Research has also shown that young people have a desire to protect friends [33] and may actively attempt to perform behaviors that reduce driver distraction and risky driving behavior [34]. Programs may thus target passengers such that they influence an adolescent driver's willingness to focus on the driving task and reduce risk taking [34]. One study showed that friends were more likely to report that they would intervene if they had less tolerance for risky driving [35]. Furthermore, in a qualitative study, confidence and perceived consequences were important factors in speaking up to stop risk taking (including driving with a cell phone) [29]. In program applications targeting peer

protective behavior more broadly, the Skills for Preventing Injury in Youth program focused on protective early adolescent friends and found changes in passenger outcomes: fewer injuries and less riding with a dangerous or drunk driver [36]. Norway's Speak Out campaign was an extensive intervention program incorporating both informational (i.e., videos, oral presentations, and promotional materials presented at schools) and enforcement components [37]. At its core, this intervention aimed to encourage passengers of vehicles with young drivers to speak out in situations involving unsafe driving (although the intervention focused on speeding and driving after drinking, rather than distraction). An evaluation of this program showed reductions in rates of passenger injuries and deaths, but no significant impact for young drivers [37].

Parents

Parents represent an important element in adolescents' lives. Simons-Morton and Ouimet [38] reported that parent management of the early independent driving experience relates to adolescents' safety, and that parent management practices can be improved. With regard to distracted driving behavior specifically, adolescents who perceived that parents were driving while distracted reported greater engagement in distraction tasks. Furthermore, the study included parents' reports of their engagement in distracted behaviors and found that this, too, related to adolescents' distracted driving behavior [39]. Communication regarding norms and expectations appears to be important, and indeed, parents talk to their children about distraction. The Steering Teens Safe program [40] promotes communication skills for safe driving using motivational interviewing techniques delivered to parents through a guidebook, video, and 1-hour-long training session. A large proportion of parents in this program discussed safety practices related to distraction [40]. Simons-Morton [41] reported on a randomized controlled trial that evaluated immediate feedback to adolescents (light flash), compared with the condition of the same feedback plus providing summary reports to parents (regarding accelerated g-force events during their child's driving). Parents were encouraged to discuss the report with their child and were provided with information about the primary cause of the event and driver behavior (e.g., distraction, aggression). There were significantly fewer g-force events over time among adolescents in the latter condition. Although the content of the parent-child communication is not known, this study illustrates opportunities to involve parents in behavioral interventions.

School, legislation, enforcement, and the environment

Issues of culture and environment have an important role in shaping young driver behavior. However, a more proximal factor to adolescent distracted driving behaviors occurs at an organizational level, as theorized within SEM. Chapman and colleagues [42] found that positive school relationships were associated with fewer transportation injuries and risk taking by early adolescents. Also, Haggerty and colleagues [43] studied more global driving risk behaviors and described the addition of a parent-based initiative to a school health program. Those authors reported effectiveness regarding fewer alcohol-related driving risks.

The legislative context not only defines boundaries for road behavior; it also provides incentives and direction for

strengthening safety norms at individual and social levels. Legislative approaches provide positive community norms and approval of road rules and enforcement, which are important to behavior change programs. Many jurisdictions target young driver distraction through cell phone bans and restrictions placed on the number of passengers. As of January 2014, 47 US states recorded Graduated Driver Licensing (GDL) laws restricting the number of passengers to be carried during the intermediate stage of licensing [44]. Several studies have demonstrated the benefits of specific passenger restrictions in reducing fatality risk [45], and some have estimated a 9% reduction in fatal crashes among 16- to 17-year-olds [46]. In addition, as of January 2014, 37 US states banned all cell phone use by novice drivers [47]. These are relatively recent restrictions; to date, few studies have examined the impact of cell phone laws on the risk of young drivers crashing.

Goodwin et al [48] examined cell phone restrictions in North Carolina and found no effect on the behavior of young drivers 2 years after implementation of the law. The study used observations (from high school car parks) and found no difference before and after legislative change or in comparison with a state without such a ban. Of note, almost two thirds of adolescents (and 39% of parents) knew of the law; however, only 22% of adolescents (and 13% of parents) reported that the law was enforced "fairly often" or "a lot." Other research has highlighted that whereas cell phone bans exclusively for young drivers had no effect on fatal crashes, handheld cell phone bans for all drivers resulted in a significant reduction in young drivers' fatal crashes over the same period (1997–2010) [49]. Laws targeting driver distraction are difficult to enforce, and challenges for enforcement can be even more difficult when the laws are restricted to young drivers. Enforcement must be reliable and expected. Importantly, behavior change strategies may link with efforts of enforcement: for example, by targeting behavior change by parents who may use such legislation to support family rules to restrict novice drivers' access to a vehicle if they drive while using a cell phone.

Another target risk and protective factor that may be related to environmental changes is the use of technological interventions to decrease adolescent distracted driving. The impact of driver inexperience and inattention may be mitigated by new vehicle technologies and engineering advances [50]. For example, Coben and Zhu [51] suggested that engineering capabilities are available and should be used to render cell phones inoperable while a car is in gear or in motion. The role of more proximal targets for behavior change programs in this case may be to increase the acceptance of such technologies.

Delivery Strategies

A core issue for behavior change program design is selecting the way in which content (identified by risk and protective factors) can be delivered: for example, considering format, duration, and delivery source and language [9]. The medium of delivery poses differing challenges and resource considerations, such as regarding the format (including the Web, mobile applications, or television advertisements, which have different considerations of budget and reach) or language (for example, suitability for adolescents or parents). Piloting can provide valuable early information regarding the likely effectiveness and acceptance of message delivery [9].

A key component of message design is considering who can best deliver messages to the target individual, and in what format. For example, programs may use institutions or organizations in which a large proportion of adolescents visit near the time of licensure (e.g., driver's education or schools). Zakrajek et al [52] evaluated a program delivered by driver education instructors to parents and adolescents, and found that adolescents with a parent–child agreement had more restrictions on driving with young passengers than did those in a control group. Fewer adolescents reported high-risk driving; however, there was no statistically significant difference in offenses or crashes. Campbell et al [53] suggested that physicians may be a source of message delivery, and found that discussion between adolescents and physicians could focus on legislation and parent–child contracts. Key considerations regarding designing programs to be delivered by physicians are availability and timing. Weiss et al [54] noted that about half of the physicians they surveyed used print or computer-based resources to provide further road safety messages.

School-based approaches provide opportunities to reach a number of adolescents at a similar point in time. You Hold the Key, developed and trialed in Ohio [55], is a school-based program targeting safe driving and passenger behaviors and focusing on distractions, seatbelt use, drink driving, resistance skills to peer influence, and strategies to prevent crashes. An evaluation study involving students from three schools and examining immediate and 6-month behavior change found positive increases in a variety of safe driving behaviors, as well as an increased reported likelihood of reducing distractions while driving [55].

The use of computer or Web-based training programs has been trialed as options for delivery. One evaluation of a computer-based training program examined attitudes of young drivers (aged 18–20 years) toward and willingness to perform distracting tasks (including talking on a cell phone, changing a CD, and looking at a map) while driving [56]. This program was a self-paced computer-training session incorporating components regarding negative consequences of performing distracting tasks, as well as activities targeting metacognition and increased situational awareness. The evaluation found less willingness to perform the distracting tasks while driving, with no change within a control group. Furthermore, programs that have been designed to target and train in specific safety behaviors such as hazard anticipation and attention management have shown improved performance in driving behaviors [57].

Implementation and Evaluation

An outcome evaluation of the implemented program is needed to fully determine the effectiveness of a program; it can also help guide decisions about future developments that have considerable implications. For example, an evaluation of legislation may suggest increasing restrictions on cell phone use while driving to all drivers. If such a change is enacted, programs encouraging parents and adolescents to develop contracts might be updated to highlight the new law.

The selection of outcome measures depends on the theoretical basis of the program and should include assessment of the target behavior and target risk and protective factors [10]. However, it is difficult to measure distraction and distraction-related crashes, particularly through self-report. Another approach to measurement is to use a simulator, as occurred with

the evaluation of a pilot training program targeting communication skills between young drivers and their passengers [58]. A 2-hour facilitated training session targeting safe driving and reducing distraction was implemented with 31 pairs of male friends. A simulated driving task occurred approximately 1–2 weeks after training, and found that passengers expressed fewer unsafe comments in the car (e.g. did not discourage speeding) [58]. The ultimate measure of change, however, relates to the overall objective, and thus is likely to be the experience of a motor vehicle crash, or injury from one (an assessment that may include official licensing or crash data).

Programs are not likely implemented exactly the way in which they are designed; thus, it is important to assess amendments to the design [23]. Fidelity in the context of program design refers to the degree to which components are delivered in a comparable manner to all participants and to which they accurately present conceptual theory and the goals of the underlying research. The extent to which researchers understand fidelity to the program enables examination of the differentiation between implementation failure and program failure [23].

Evidence shows that on a regular basis, adolescents drive while engaging in tasks that may be distracting [39], and that although this is not exclusive to adolescent drivers, they are overrepresented in distraction-related crashes compared with drivers of other ages [1]. Distraction-related behavior change programs must be developmentally appropriate and must consider the social and economic benefits to driving that may be experienced by young people. A behavior change program is most likely to be effective if it is designed with an empirically tested theoretical foundation that can represent target constructs for change (e.g., perception of adolescent subjective norms of cell phone use or stopping friends' cell phone use). It should be undertaken in the context of understanding local GDL measures and how these can be used to support change. Importantly, a number of mechanisms for promoting change depend on the theoretical construct and the target audience. Key efforts against distracted driving currently center on GDL and its acceptance, parent–child and peer–peer interaction, and technology use and compliance. Ultimately, though, a behavior change intervention is likely to be effective only if it is implemented as intended. Thus, implementation and outcome assessment are required, followed by an assessment of maintenance if the program is implemented for longer periods. There is potential for considerable gains in further research for all aspects of the program design process that would substantially improve efforts to reduce adolescent distracted driving behavior.

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