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Original article

The Effect on Teenage Risky Driving of Feedback From a Safety Monitoring System: A Randomized Controlled Trial

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A B S T R A C T

Purpose: Teenage risky driving may be due to teenagers not knowing what is risky, preferring risk, or the lack of consequences. Elevated gravitational-force (*g*-force) events, caused mainly by hard braking and sharp turns, provide a valid measure of risky driving and are the target of interventions using in-vehicle data recording and feedback devices. The effect of two forms of feedback about risky driving events to teenagers only or to teenagers and their parents was tested in a randomized controlled trial.
Methods: Ninety parent-teen dyads were randomized to one of two groups: (1) immediate feedback to teens (Lights Only); or (2) immediate feedback to teens plus family access to event videos and ranking of the teen relative to other teenage drivers (Lights Plus). Participants' vehicles were instrumented with data recording devices and events exceeding .5 *g* were assessed for 2 weeks of baseline and 13 weeks of feedback.
Results: Growth curve analysis with random slopes yielded a significant decrease in event rates for the Lights Plus group (slope $= -.11$, $p < .01$), but no change for the Lights Only group (slope $= .05$, $p = .67$) across the 15 weeks. A large effect size of 1.67 favored the Lights Plus group.
Conclusions: Provision of feedback with possible consequences associated with parents being informed reduced risky driving, whereas immediate feedback only to teenagers did not.

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IMPLICATIONS AND CONTRIBUTION

Reducing elevated *g*-force events resulting from hard stops and sharp turns could reduce crash rates among novice teenage drivers. Using materials from the DriveCam For Families Program we found that feedback to both teens and parents significantly reduced rates, whereas feedback only to teens did not.

Teenage drivers have higher crash rates than older drivers [1–3]. The typical pattern among novice drivers of highly elevated crash risk during the early months of licensure, rapid decline for a period of months, and then slow decline over a period of years appears to be exacerbated by early age at licensure [4,5]. In addition to young age, high teenage crash rates are generally attributed to inexperience and risk taking [2,3,6]. Relative to older drivers, young drivers engage in high levels of risky driving, including excessive speed [2,7], close following [7], and elevated gravitational-force (*g*-force) events [3].

Advances in accelerometer technology have made elevated *g*-force event rates a popular measure of risky driving and focus of crash reduction efforts. Elevated *g*-force events are largely the result of poor speed management practices such as accelerating

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rapidly, decelerating late and abruptly, sharp cornering, and overcorrecting after a turn [8]. Higher rates of elevated g-force events are associated with the likelihood of a crash in the near future among teenage [8], adult [9], and bus drivers [10]. Relative to experienced adults, novice teenage drivers have five times higher rates of elevated g-force events [3]. High rates of events among young drivers could be due to inexperience or intentional risk taking. Notably, feedback about elevated g-force events can be provided to drivers by devices connected to accelerometers and records of events can be made available to supervisors or parents. These technologies are commonly employed to reduce crash risk among commercial fleet drivers, with notable success, and novice teenage drivers [11].

In general, feedback can provide information about performance, increase attention to discrepant behavior, reduce uncertainty, establish and reinforce expectations for behavior, and serve as a source of social comparison [12]. Feedback is available in a wide range of vehicle devices important to driver performance and a common element of driver training, traffic safety efforts, and research on driver behavior [13–15].

Although personalized feedback is essential to behavioral self-regulation to the extent it provides information about one's approximation to the standards of a task, its effect on behavior can be complicated and may depend on individual motivation and perceived or actual consequences [12,15,16]. Accordingly, elevated g-force event rates could be expected to decrease if the driver receives feedback that an event has just occurred, learns from this feedback how to avoid similar events in the future, is motivated to improve performance, and associates the feedback to meaningful consequences. If the high rate of elevated g-force events among teenage drivers is due primarily to inexperience, lack of knowledge about the types of maneuvers that cause events, deficiencies in vehicle management skills, and unsafe driving judgment, then immediate feedback to the driver about what constitutes an event would be expected to reduce event rates, assuming the driver is intrinsically motivated to improve his or her driving performance in this regard. However, if high rates of risky driving among teenage drivers are due to other factors, such as a preference for risky driving, feedback to the driver would not dampen rates unless it were linked to meaningful consequences, for example, from concerned parents alerted to the teen's risky driving.

A few studies have reported declines in elevated g-force events among teenage drivers whose events were signaled by a blinking light and information about them was posted to a website for the teens and their parents to view [17–20]. Three of these studies used single-group, pre-post study designs that tested the combined effect of immediate feedback to the driver (two in the form of a blinking light and one in the form of audio) plus delayed feedback to the teenage drivers and their parents [17–19]. The one previous randomized trial that compared the effect of immediate feedback to the driver only to immediate feedback to the teen plus delayed feedback to the family used a device with an accelerometer and audio alerts, but no camera. Results for elevated g-force events showed nonsignificant declines for the treatment conditions that received in-vehicle alerts plus web-based feedback to parents, and significant reductions in speeding and safety belt nonuse [19]. Devices with video may have the advantage of providing visual context for interpreting the riskiness of g-force events. The efficacy of devices with video was not yet demonstrated in a randomized controlled trial.

In this evaluation of the DriveCam For Families Program, we sought to determine the extent to which two forms of feedback altered elevated g-force event rates among novice teenage drivers. The research question of interest was, "what is the effect on elevated g-force event rates of immediate feedback of these events to teenage drivers compared with immediate feedback plus delayed feedback to teen-parent dyads in the form of a weekly report card, video footage of events, coaching tips, and a comparison to other teenage drivers?" We hypothesized that the decline over time in elevated g-force event rates would be greater among teenage drivers who received immediate plus family feedback and access to event videos.

Methods

Participants

Parent-teen dyads were recruited from high schools in Ann Arbor, Michigan, and screened. Inclusion requirements were as follows: a Level 2 Michigan driver license (allows independent, unsupervised driving) issued in the prior 30 days; regular access to a vehicle that could be instrumented for the 15-week study period; access to the Internet; living at home with at least one parent; not older than age 18; and able to speak and read English. Incentives of $100 to the parent and teenager at pretest and $150 each at the end of the study were provided. Study participants provided signed consent (parent) and assent (teen) according to the protocol approved by the University of Michigan Institutional Review Board. Participants' privacy and data were protected by a certificate of confidentiality.

Study design

Separate randomization lists were prepared for male and female participants and then assigned at random by a computer program to one of the two study conditions within fixed blocks of four such that each block contained two males and two females. Survey administrators, data coders, and statistician for preliminary analyses were blind to group assignment. During the first 2 weeks, the data recording devices were set to record g-force events, but no feedback was provided. Thereafter, feedback was provided according to the assigned conditions.

Treatment group 1: Lights Only. From weeks 3 to 15, the Lights Only (LO) condition provided participating teenage drivers with immediate feedback in the form of a green light in the absence of a g-force event, a red and green flashing light following an event, and then a red light indicating that the video footage of the event had been saved.

Treatment group 2: Lights Plus. During weeks 3 to 15, the Lights Plus (L+) condition received immediate feedback about events as described in the LO condition plus delayed feedback sent to the parent-teen dyad in a weekly e-mail containing a report card indicating the teen's events and risk score for the week and a graph of the teen's weekly risk score relative to other teenage drivers. In addition, the dyads had access to a secure website that allowed them to view reports and video footage of a few seconds before and after each event. Parents were encouraged to view and discuss the videos together with their teen, and the website included tips for parents on coaching their teen to be a safer driver.

Families in the L+ group were sent an e-mail that included a welcome to the DriveCam for Families Program, a link to the login page, and username and password. In addition, parents received