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Age Versus Experience: Evaluation of Video Feedback Intervention For Newly Licensed Teen Drivers

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16. Abstract Previous studies have shown that event-triggered, video-based interventions have the potential to improve driving safety among young drivers. Nine states including Iowa have some type of restricted driving license that allows drivers younger than 16 to independently operate motor vehicles. While these license types typically restrict the kind of driving permitted, little is known about how these younger drivers compare to traditional 16-year-old drivers in terms of risky driving behaviors. This project examined the effects of age, experience, and video-based feedback on the rate of unsafe driving events captured on video event recorders for 90 newly licensed teen drivers. Half the participants received feedback and the other half were assigned to a control (no feedback) condition. The results show that young drivers who received feedback, regardless of their age or level of driving experience, had lower rates of unsafe driving events relative to the control group. Young drivers in the control condition with 4 months or more of experience behind the wheel before obtaining their intermediate license had fewer unsafe driving events than drivers without that experience. The results of this study indicate that video-based feedback could have safety benefits for young drivers.			
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EXECUTIVE SUMMARY

BACKGROUND

There were 3,885 young drivers involved in fatal motor vehicle crashes in 2014 (National Center for Statistics and Analysis, 2016). Young drivers have higher crash risk due to factors including inexperience, immaturity, and a tendency to engage in high-risk driving behaviors (Williams, 2003). Crash risk is relatively low when young drivers are learning to drive with an adult in the vehicle but has been shown to increase about 10-fold when teens begin driving independently (Mayhew, Simpson, & Pak, 2003). At the time of this study, nine states including Iowa had some type of restricted driving license that allowed drivers younger than 16 to drive independently. While these license types typically restricted the kind of driving permitted (e.g., only travel between home and school and school-related activities), little is known about how these younger drivers compare to the traditional 16-year-old driver—or how this early experience might influence their driving later. Studies of 16- and 17-year-old drivers in rural and suburban settings have shown that event-triggered, video-based interventions have the potential to improve driving safety among young drivers (McGehee, Carney, Raby, Reyes & Lee, 2007; McGehee, Raby, Carney, Lee, & Reyes, 2007; Carney, McGehee, Lee, Reyes, & Raby, 2010). However, one limitation of these previous studies is that they did not include a true control group and so could not evaluate the role maturation plays in developing drivers.

OBJECTIVE

This project examined the effects of age, experience, and video-based feedback on the rate of unsafe driving events captured on video event recorders in the vehicles of three groups of newly licensed young drivers:

1. 14.5- to 15.5-year-old drivers who held minor school licenses that allowed these teens to drive independently to and from school between 5 a.m. and 10 p.m.;
2. 16-year-old drivers with intermediate licenses who were driving unsupervised for the first time; and
3. 16-year-old drivers with intermediate licenses who had previously driven unsupervised for at least 4 months with school licenses.

METHODS

Technicians equipped each participant's vehicle with an event-triggered video recording device for 24 weeks. Half the participants received feedback regarding their driving, and the other half received no feedback and served as a control group. The number of unsafe driving events per 1,000 miles (i.e., "event rate") was analyzed for the 90 participants who completed the study.

RESULTS

The young drivers who received the feedback intervention had significantly lower event rates than the control group participants who received no feedback. This finding was consistent for all three participant groups. Among 16-year-olds who did not receive the feedback intervention, those without driving experience had significantly higher event rates than those with experience. Analyses showed no statistically significant effect of age on event rates.

CONCLUSIONS

Young drivers in this study who received video-based feedback, regardless of their age or level of driving experience, had lower rates of unsafe driving events than did members of a control group who did not receive feedback. Findings indicated that experience, but not driver age, had an effect on the rate of unsafe events. Young drivers in the control group with 4 months or more of additional experience behind the wheel before obtaining their intermediate license had fewer unsafe driving events than did those without driving experience.

INTRODUCTION

Motor vehicle crashes are the leading cause of death for teenagers in the United States. More than one-third of all deaths of people 12 to 19 years old are caused by unintentional injury due to motor vehicle crashes (Miniño, 2010). Even though the annual number of teenage drivers involved in fatal motor vehicle crashes has been declining for several years—in part due to broad implementation of graduated drivers licensing—a total of 4,283 drivers 15 to 20 years old were involved in fatal crashes in 2012; of these 1,875 lost their lives. According to a report, the fatal crash rate for newly licensed teenagers was approximately four times the rate for drivers of all ages (Insurance Institute for Highway Safety, 2008). A number of factors, such as inexperience, immaturity, and a tendency to engage in risky driving behaviors (e.g., speeding, not wearing seat belts, being distracted or drowsy, driving at night, and driving while using drugs or alcohol) have contributed to the disproportionate number of teens involved in motor vehicle crashes (Williams, 2003).

Because driving under the supervision of an adult in the vehicle is typically the first step toward a full driver's license, most parents actively participate in the initial phase of their teen's development as a driver. Crash rates for supervised learners are the lowest of all young drivers (Mayhew, Simpson, & Pak, 2003). A review of the literature on parental involvement in novice driving suggests that during the supervised driving period, much of what the teen learns is basic vehicle control (Simons-Morton & Ouimet, 2006). This conclusion was supported in a naturalistic study that used event-triggered video to observe families during a full year of supervised driving (Goodwin, Foss, Margolis, & Waller, 2010). During this supervisory period, parents tended to limit driving to safe conditions, restrict risky behaviors, and act as an involved passenger, providing the driver with feedback regarding the driving environment. As a result, young drivers still had much to learn once they began driving independently. Independent driving requires young drivers to take responsibility for the higher-order skills, such as scanning and decision-making, that parents may have assisted with when they were in the vehicle (Simons-Morton & Ouimet, 2006). This may underlie research findings that teen drivers' crash rates increase more than tenfold when they begin driving independently, regardless of the amount of supervised practice they have had (Mayhew, Simpson, & Pak, 2003).

At the time of the current study, nine states had some type of restricted driving license that allowed drivers under age 16 to independently operate a motor vehicle: Kansas (14 years), Montana (15 years), North Dakota (15 years), Iowa (14 years, 6 months), South Dakota (14 years, 3 months), Nebraska (14 years, 2 months), Idaho (15 years), New Mexico (15 years, 6 months) and South Carolina (15 years, 6 months). The restrictions accompanying these licenses, which varied by state, included time of day, trip purpose, the number of passengers, seat belt use, and/or cell phone use.

While early licenses have been available in some rural states for over 75 years, there is concern that such licenses result in higher crash and fatality rates, posing a risk not only to these youngest drivers, but also their passengers, and the general public. According to the Iowa DOT (2006), 14.5- to 16-year-old school license drivers were 6.5 times more likely to receive a moving violation conviction and 11.5 times more likely to be involved in a traffic crash than drivers in the same age group who only held an instruction permit (and so drove only with supervision).

A number of technical systems available at the time of this study purported to help parents monitor their young drivers. Some employed GPS to track location, together with data recorders that connect to a vehicle's on-board diagnostics port to record speed and other measures. Farmer, Kirley, and McCartt (2010) documented the effectiveness of one such device that could provide in-vehicle auditory alerts to young drivers and/or web-based feedback to parents for speeding, sudden braking/accelerating, and non-use of seatbelts. The results suggested that, when parents were informed of their teens' risky driving behaviors, the device reduced risky driving behaviors, but that in-vehicle alerts alone had little effect on driving behavior.

The University of Iowa performed two studies that evaluated an in-vehicle system that used event-triggered video feedback. The first study examined 25 rural drivers 16 and 17 years old who had held driver licenses for 6 to 12 months (McGehee, Carney, Raby, Reyes & Lee, 2007, McGehee, Raby, Carney, Lee, & Reyes, 2007). Participants' vehicles were equipped with event-triggered video recorders for 1 year. Results showed that the intervention significantly reduced the rate of unsafe driving events, especially for the drivers who had the highest rates of unsafe driving events before the intervention. The second study differed in that it examined a group of 36 suburban drivers who were 16 years old and had held driver licenses for less than 5 months (Carney, McGehee, Lee, Reyes, & Raby, 2010). Results of this study showed again that the intervention was effective in reducing the rate of unsafe driving events. After the intervention ended, the frequency of events remained significantly lower than it had been during baseline driving. Although both of these studies showed significant benefits, due to their experimental design in which all participants received the intervention, they did not examine the extent to which maturation contributed to reduced risky driving behaviors.

The current study of age and experience addressed some research gaps. First, little is known about how risky driving behaviors of unsupervised drivers under 16 compare to those of traditional 16-year-old novice drivers. Second, it is not clear how independent driving experience before 16 affects teens' driving behaviors when they obtain a traditional intermediate license, and whether drivers younger than 16 will respond to video feedback similarly to 16-year-old drivers. This study provided data to help understand how age and experience affected young driver behavior, in both the presence and absence of feedback.

Specifically, the study examined:

1. The effect of feedback: Relative to a control group, did the feedback intervention reduce unsafe driving events among three groups of participant teen drivers:
 - School license drivers (14.5- to 15.5-year-old drivers)?
 - Inexperienced intermediate drivers (16-year-old drivers who just obtained their intermediate licenses but had not driven independently)?
 - Experienced intermediate drivers (16-year-old drivers who just obtained their intermediate licenses but had driven independently with a school license for at least 4 months)?

2. The effect of age: How did the rate of unsafe events compare for the two age groups without independent driving experience (the school license drivers and the inexperienced intermediate drivers)?
3. The effect of experience: How did the rate of unsafe events compare for the inexperienced and experienced intermediate drivers?

METHODS

PARTICIPANTS

Participants were recruited from Iowa high schools in a 30-mile radius of the Iowa City area. These schools included West High School, City High School, and Regina High School in Iowa City; Clear Creek Amana High School in Tiffin; Solon High School; West Branch High School; and Williamsburg High School. The research team mailed parents of ninth and tenth grade students a recruitment letter (Appendix B) providing information about the study. Parents who were interested were instructed to contact the study team for additional details and to determine their son's or daughter's eligibility.

Participants were recruited for each of the following groups.

- School Group - Drivers between 14.5 and 15.5 obtaining minor school licenses (see Appendix A for the provisions of the Iowa code governing minor school licenses)
- Inexperienced Intermediate Group - Drivers 16 and older obtaining their intermediate licenses who had never driven with a school license
- Experienced Intermediate Group - Drivers 16 and older obtaining their intermediate licenses and who had driven independently under a school license for more than 4 months.

To qualify for the study, a participant had to be the primary driver of a vehicle and drive on average at least 90 minutes per week (around 15 minutes/day). Parents and teens had to be fluent in English and have access to computers on which they could view the videos of the unsafe driving events. Table 1 shows the breakdown of the 90 study participants who were enrolled and completed the study by license group and intervention condition.

**Table 1. Number of Participants Enrolled
by Participant Group and Intervention Condition**

	Feedback	Control	Total
School Group	16	16	32
Inexperienced Intermediate Group	14	14	28
Experienced Intermediate Group	15	15	30
Total	45	45	90

INSTRUMENTATION

Technicians equipped each participant's vehicle with an event-triggered video recording system made by DriveCam. The system was a palm-sized device that integrated two video cameras, a two-axis accelerometer, a 12-second video data buffer, an infrared illuminator for lighting the vehicle's interior at night, and a cellular transmitter. The device was mounted on the inside of the vehicle's windshield behind the rearview mirror (Figure 1). It captured video from both inside and outside the vehicle (see Figure 2), as well as audio.



Figure 1. DriveCam Event-Triggered Video Data Recorder



Figure 2. Exterior and Interior Video View Captured by DriveCam Cameras

The system continuously buffered video data but only wrote to internal memory when the driver exceeded an acceleration threshold. Each video clip captured the 8 seconds preceding and the 4 seconds following a threshold exceedance. DriveCam used thresholds that roughly corresponded to g-forces ($\pm 10\%$). These thresholds refer to accelerometer readings that reflected changes in vehicle velocity or the lateral forces acting on the vehicle when cornering. The system triggered an event when the acceleration exceeded the threshold value. The trigger thresholds for this research project were:

- *Shock trigger threshold, $\pm 1.50g$* : The force level for a “shock trigger” from any direction, most often caused by severe impacts.
- *Longitudinal trigger threshold, $\pm 0.45g$* : The force level required to trigger the system with a positive or negative acceleration, most often caused by hard braking.
- *Lateral trigger threshold, $\pm 0.50g$* : The force level required to trigger the system with a lateral acceleration, most often caused by hard cornering or swerving.

The research team selected settings based on the guidance of the manufacturer and on criteria used in another naturalistic driving study. In the 100-car naturalistic driving study, Dingus et al. (2006) used $-0.5g$ as the threshold for defining hard braking and $\pm 0.4g$ as the threshold for defining rapid steering maneuvers. The research team’s objective was to maximize the number of unsafe driving events captured, while reducing the number of invalid triggers.

The DriveCam device automatically encrypted all data and uploaded them to DriveCam’s fleet services server on a daily basis via a secure cellular connection, usually between 2 a.m. and 3 a.m. DriveCam video analysts performed a preliminary examination of the videos to ensure that only valid triggers were being captured before these data were made available to the University of Iowa team for coding.

PROCEDURE

Staff from the local Best Buy store installed each DriveCam system; this took approximately 30 to 45 minutes per vehicle. During installation, technicians (study personnel) placed window clings inside the vehicle (i.e., on the front passenger side window and both rear passenger side windows) in an effort to notify all occupants that they might be recorded (Figure 3).

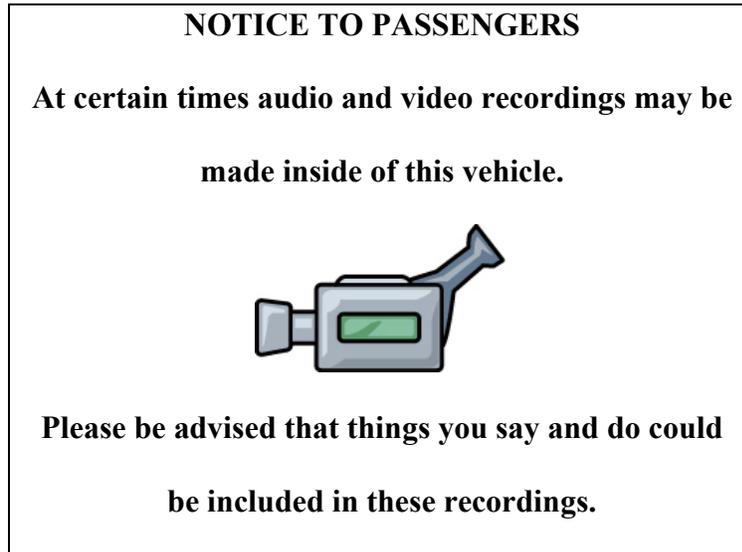


Figure 3. Window Cling Notifying Occupants of Video Recording

The technicians adjusted the cameras to ensure that the view inside the vehicle captured all occupants, and recorded the starting odometer reading. Participants reported their weekly odometer reading on the same day of the week on which their participation began. Study staff sent each participant a reminder each week via e-mail, and most participants simply responded to the e-mail.

Participants were assigned to either the intervention or control condition in blocks of two within each participant group. The first participant in a block was randomly assigned to either control or feedback, and the next participant enrolled in the group was assigned to the other intervention condition to complete the block. This method ensured that enrollment between the two conditions was uniform throughout the study.

Table 2 summarizes the three phases of the experiment for participants assigned to the intervention group, including the duration of each and the type of feedback provided. Control group participants were in the study for the same duration (24 weeks) but did not receive feedback from the event recorder or project staff. There was no distinction between project phases for the control group. Data collected for the initial 4-week period established a baseline estimate of driver behavior. No feedback of any kind was provided to any of the participants during the baseline phase.

Table 2. Phases of the Experimental Design for Participants in the Intervention Group

Phase	Duration	Feedback Provided
Baseline	4 weeks	None
Intervention	16 weeks	The LED on the event recorder flashed immediately after an event was triggered.
		Weekly report mailed to the participant's parent.
		A CD containing the driver's unsafe driving videos for the week.
Follow-up	4 weeks	None

The next 16 weeks of data collection was the intervention phase. During this phase, those in the intervention group received three types of feedback:

1. An LED on the event recorder flashed immediately after an event was triggered, informing the driver that the maneuver just completed exceeded the safety limits defined by lateral and longitudinal acceleration thresholds.
2. A weekly report documented the driver's weekly and cumulative performance regarding unsafe behaviors. This report described each unsafe driving event triggered that week, as well as seatbelt use for the driver and for any passengers. The number of times cell phone use was captured was also recorded.
3. A CD containing all unsafe driving video clips for that week. Parents were encouraged to review the videos and report card with their teen each week.

For purposes of the analysis, the 16-week intervention phase was divided into four 4-week segments. Thus, the intervention segments were the same duration as the 4-week baseline and follow-up phases, smoothing out week-to-week differences. Participants received no feedback (including no LED warning) during the 4-week follow-up phase of the project. Follow-up assessed whether the effect of the intervention persisted for drivers in each condition. After the follow-up phase, technicians removed event recorders from the participants' vehicles.

VIDEO CODING

Video reviewers coded each event captured by the system to determine its cause and classify it into one of the categories shown in Table 3. Events containing unsafe driving behaviors or appropriate responses were further coded. The coded events populated a database with the nature of the event, its cause, the number of vehicles involved, and the maneuver that triggered the event recorder (e.g., cornering or braking). Reviewers recorded drivers' seat belt use; aggressive or reckless driving; number, location, and age of passengers and whether they were belted; and environmental factors including weather, lighting, road conditions, road geometry, and road type. Reviewers also coded driver-related factors such as distraction, fatigue, and social influence of passengers. A second reviewer completed a final check of the data and examined the spreadsheet for inconsistencies in the data coding. A third reviewer reconciled these by performing an additional review of the relevant videos.

DATA ANALYSIS

Unsafe driving events were comprised of valid triggers (i.e., incidents, near-crashes, and crashes), as well as video that resulted from invalid triggers (e.g., bumpy roads) in which reviewers identified risky behaviors. Valid triggers tended to be generated by driver behaviors and invalid triggers by things like rough roads. However, both provided windows into driving behavior and captured potentially risky events. Therefore, invalid triggers that contained unsafe driving behaviors were included in the analyses of unsafe driving events.

Table 3. Classification of Event Types

Unsafe driving events	<ul style="list-style-type: none">• <i>Incident</i>: an unsafe driver’s action triggered the event recorder.• <i>Invalid trigger with unsafe behavior</i>: activation of the event recorder due to something other than unsafe driving behavior (e.g., the vehicle hitting a bump or manual activation by someone in the vehicle) in which the video reviewer observed a safety concern (e.g., unbelted occupant, cell phone use, failing to stop for traffic signs/signals).• <i>Near-crash</i>: the participant and/or another driver performed an evasive maneuver in order to avoid a collision.• <i>Crash</i>: the participant collided with an object or other vehicle.
Appropriate responses	<ul style="list-style-type: none">• Event recorder was triggered by the driver responding appropriately to an external event.
Invalid events	<ul style="list-style-type: none">• <i>Invalid trigger</i>: activation of the event recorder due to something other than unsafe driving behavior (e.g., the vehicle hitting a bump/pothole in the roadway or manual activation).• <i>Non-participant</i>: someone other than the participant was driving the vehicle. These video events were not reviewed.

RESULTS

SUMMARY OF EVENTS

The system captured 6,671 events for the 90 participants who completed the study. Table 4 shows the number and percentage of events for the different event types. As demonstrated in the table, 76 percent of the events were classified as incidents. A collision with any object was coded as a crash, which occurred in about 2 percent of the captured events. Table 5 summarizes the 5,448 unsafe driving events included in the analysis. As seen in the table, 83 percent involved improper cornering (i.e., going too fast, cutting the corner, or accelerating through when making a turn or negotiating a curve).

Table 4. Summary of Events Captured by Event Type

	Number of events	Percent
Invalid trigger	1,163	17.4%
Unsafe driving (included in analysis)	5,448	81.7%
<i>Invalid with unsafe behavior</i>	215	3.2%
<i>Incident</i>	5,053	75.7%
<i>Near-crash</i>	69	1.0%
<i>Crash</i>	111	1.7%
Appropriate response	60	0.9%
Total events captured	6,671	100%

Table 5. Summary of Unsafe Driving Events Categorized by Driver Action

	Number of events	Percent
Cornering	4,533	83.2%
Braking	456	8.4%
Accelerating	63	1.2%
Other action	396	7.3%
Total unsafe driving events	5,448	100%

Table 6 describes the 111 crash events, which include collisions with a curb or traffic island and collisions with another vehicle, as well as the number that involved driver distraction. All crashes were minor, with little or no property damage and no injuries to study participants or other parties involved. Forty-five (40.5%) of the crashes involved some form of distraction.

Table 6. Summary of the Crash Events by Crash Type and Distraction

Crash Type	Number of crashes	Crashes with a curb or traffic island	Crashes with another vehicle	Crashes involving distraction
Lane Departure	35	35	0	12
Road Departure	33	27	0	18
Loss of Control	11	7	0	4
Intersection	1	0	1	0
Head on	12	5	0	3
Rear-end	4	0	4	3
Backing	6	2	0	2
Strike	6	1	0	3
Other	3	0	1	0
Total	111	77	6	45

In addition, 69 events were classified as near-crashes. Forty-four of these near-crashes involved some form of distraction. In more than half of the near-crash events involving distraction (25 of 44), the distracted driver nearly collided with the car ahead.

MILEAGE

The participants' mileage was aggregated for each 4-week segment of the study. A mixed-effects linear model that included repeated measures analysis for each participant revealed a significant main effect of participant group, $F(2, 87) = 14.51, p < 0.01$. Post-hoc comparisons, adjusted using the Tukey-Kramer method indicated that the experienced intermediate drivers drove significantly more miles than the inexperienced intermediate ($t(87) = 3.30, p < 0.01$) and the school license ($t(87) = 5.34, p < 0.01$) drivers. There was no significant difference in mileage for the inexperienced intermediate and school license driver (see Figure 4).

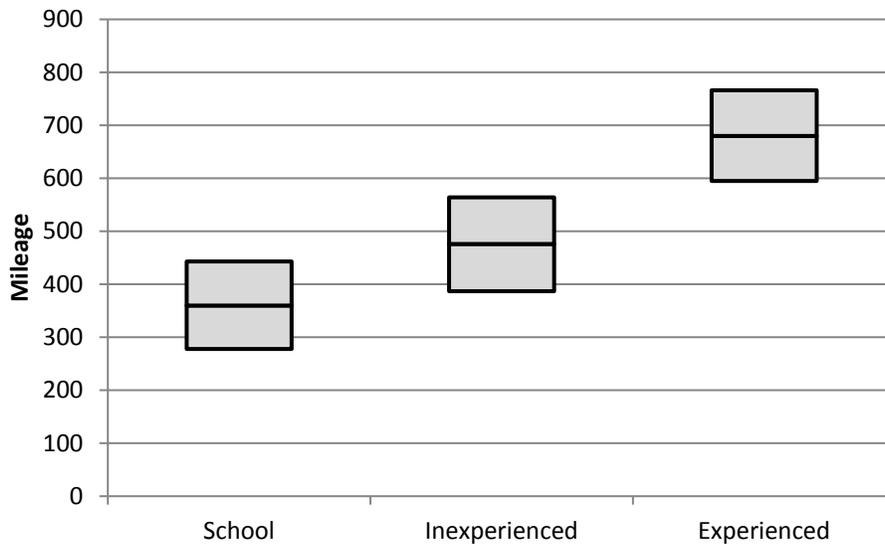


Figure 4. Mean Mileage per 4-Week Segment by Participant Group (center bar) and 95 Percent Confidence Limits

ANALYSIS OF UNSAFE DRIVING EVENT RATES

The remaining analyses consider the number of unsafe driving events per 1,000 miles driven, which will be referred to as the “event rate,” summarized over each 4-week segment of the study. The distribution of event rates for each between-subjects group for each segment was heavily skewed to the right, and one or two outliers were identified in most groups. After considering the influence statistics calculated during the initial analyses, the data analyst confirmed the extreme observations, which often came from the same participant in different segments, affected the estimation of the model parameters. Because the extreme observations reflected actual driver performance, simply omitting them from the data set was inappropriate. The observation for the most extreme outlier in each between-subjects group for each phase was “Winsorized.” That is, the number of unsafe events for the highest event rate was adjusted downward such that the resulting event rate was adjacent to yet remained greater than the next highest event rate (Tukey, 1962). The data analyst conducted all analyses reported here with the original data, with the extreme outliers omitted, and with the adjusted data, and found the results to be robust. The adjusted data resulted in smaller confidence intervals around the estimates of the means and in many cases prevented the data from the most extreme observations from overly influencing the model parameters. As such, the results from the adjusted data are presented herein.

All event rate analyses were conducted using negative binomial regression models with generalized estimating equations (GEE) to account for the repeated measures observed for each participant. The number of unsafe driving events was the response variable, the log of the mileage for each 4-week segment was the offset variable, and the link function was log. Independent variables were evaluated using Type 3 score statistics. The means predicted by each

model were exponentiated to reflect events per 1,000 miles; these predictions may differ slightly between analyses because the parameter estimates differ slightly across models.

Equivalent Control/Intervention Groups within Participant Groups

Before considering the effect of the video feedback intervention, researchers confirmed the control and intervention groups’ event rates did not differ significantly during the baseline phase of the study (see Table 7). Though the groups’ means varied considerably, the differences were not statistically significant.

Table 7. Rate of Unsafe Driving Events per 1,000 Miles During the Baseline Phase

Participant group	Intervention condition	Predicted event rate	95% Confidence Limits	X ² value for difference	P > X ²
School	Control	20.7	9.1 – 47.1	0.32	0.57
School	Intervention	14.8	6.4 – 34.1		
Inexperienced	Control	29.4	13.5 – 64.0	0.76	0.38
Inexperienced	Intervention	48.1	22.4 – 103		
Experienced	Control	13.0	6.0 – 28.1	0.55	0.46
Experienced	Intervention	19.7	9.1 – 42.5		

Effectiveness of Intervention Relative to Control

This set of analyses considered whether the event rates for the participants who received feedback differed from the rates for those in the control group who did not receive any feedback about their driving behavior during the intervention phase. Data from the four segments of the Intervention phase were analyzed and each participant group was analyzed separately. For all three participant groups, the drivers in the intervention condition had significantly lower event rates than those of the control group. For inexperienced drivers, the event rate per 1,000 miles (45.7) was 4 times higher than that for the intervention group (11.3). Table 8 summarizes the results.

Table 8. Effect of Video-Based Feedback During the Intervention Phase Relative to the Control Condition

Participant group	Intervention condition	Predicted event rate	95% Confidence Limits	X ² value for difference	P > X ²
School	Control	35.4	21.6 – 57.9	7.47	< 0.01
School	Intervention	6.4	3.4 – 12.0		
Inexperienced	Control	45.7	27.5 – 76.0	6.38	< 0.05
Inexperienced	Intervention	11.3	7.8 – 16.3		

Experienced	Control	20.3	13.3 – 31.0	4.38	< 0.05
Experienced	Intervention	8.4	4.5 – 15.6		

Effectiveness of Intervention Relative to Baseline

This set of analyses considered whether the event rates for the drivers who received feedback were lower during the Intervention phase relative to their rates during the Baseline phase. As shown in Table 9, both the inexperienced and experienced intermediate drivers who received feedback had reduced events rates during the Intervention phase relative to the Baseline phase. There was a trend toward lower rates for the school permit drivers, whose event rates were about 50 percent lower relative to baseline, but the test was just above the conventional limit for statistical significance.

Table 9. Effect of Video-Based Feedback During the Intervention Phase Relative to the Baseline Phase

Participant group	Predicted event rate during baseline	Predicted event rate during intervention	X ² value	P > X ²
School	13.9	6.3	3.53	< 0.10
Inexperienced	47.1	11.2	4.98	< 0.05
Experienced	19.3	8.5	4.68	< 0.05

Note: Predictions in Table 9 vary up to one event per 1,000 miles from Table 7 because the parameter estimates vary slightly across models.

Effect of Ending the Intervention

Analyses comparing event rates during the four Intervention segments and during the Follow-up phase for each participant group indicated no significant change in event rate after the intervention ended. The intervention effects persisted as drivers maintained the lower event rate even after the intervention was discontinued.

EFFECT OF AGE: COMPARISON OF INEXPERIENCED GROUPS

One of the research objectives was to compare the two participant groups without independent driving experience (i.e., those with a school license and those with an intermediate license who did not previously have a school license). A significant difference between these two groups would indicate an effect of age, as the drivers with intermediate licenses were 16 years old while the school license drivers were 14 or 15 years old. The comparisons were made within the control and the intervention groups. The analysis revealed no statistically significant differences in event rates between the younger school license and older inexperienced intermediate drivers within the control group or the intervention group.

EFFECT OF EXPERIENCE: COMPARISON OF 16-YEAR-OLD GROUPS

The final research question concerns the effect of previous driving experience on the behavior of 16-year-old drivers who had just obtained their intermediate license. The comparisons were made within the control and the intervention groups. The analysis for the

control group indicated a significant effect of participant group ($X^2 = 4.11, p < 0.05$). As shown in Table 10, among the 16-year-olds who did not receive the intervention, those with previous independent driving experience had event rates about half those without previous experience. No significant differences were found for the experienced and inexperienced groups who received the intervention.

Table 10. Effect of Previous Driving Experience within the Control Group

Participant group	Intervention condition	Predicted event rate	95% Confidence Limits	Wald X^2 value for difference	$P > X^2$
Experienced	Control	19.0	12.3 – 29.6	4.11	< 0.05
Inexperienced	Control	44.6	27.5 – 72.4		

DISCUSSION

The results of this study demonstrate that providing video-based feedback to young drivers and parents about unsafe driving events was effective in reducing the occurrence of these events. These findings support evidence from previous studies (McGehee, Carney, Raby, Reyes & Lee, 2007; McGehee, Raby, Carney, Lee, & Reyes, 2007; Carney, McGehee, Lee, Reyes, & Raby, 2010). Relative to a control group which did not receive feedback about their driving, the intervention was effective for 16-year-olds without independent driving experience, and 16-year-olds with previous independent driving experience while holding a school license. Relative to their own event rates during the Baseline phase, both the inexperienced and experienced 16-year-old drivers had lower event rates during the Intervention phase.

After the intervention ended none of the participant groups exhibited a significant increase in event rates. This suggests the changes in behavior seen with feedback were not solely a result of the teens avoiding parental monitoring, but rather the feedback led to at least short-term changes in driving behavior. The two previous studies reported similar findings for 6- and 8-week Follow-up periods.

With regard to the effect of age, the inexperienced 16-year-old drivers did not have a statistically significant lower event rate than the younger school license drivers. However, with regard to the effect of experience, among those in the control group, the 16-year-olds with driving experience had significantly lower event rates than those without independent driving experience. This finding could indicate that a more gradual, multi-stage transition to fully independent driving, such as the entry level offered by a school license, may have safety benefits for young drivers.

LIMITATIONS

There are a number of limitations inherent to this type of research. Clearly, it is important to mention the potential for self-selection bias associated with this study. While the sample of teens enrolled in this study, who have primary access to a vehicle and would willingly (with compensation) agree to have a video event recorder in their vehicle, may not be representative of

the whole population of teen drivers, self-selection bias is an unavoidable limitation for nearly all research involving human subjects.

Crashes and near-crashes are relatively infrequent, so these analyses were based on the assumption that the dependent measure used, the rate of unsafe driving events, was representative of crash rates, and that lowering the rate of these events would result in a decrease in actual crash risk. Other researchers (Simons-Morton, Zhang, Jackson, & Albert, 2012) analyzed data from a naturalistic driving study with teen drivers and have found elevated g-force events to predict crash and near-crash involvement.

While the analyses showed that reductions in the 16-year-old drivers' event rates persisted after the feedback was removed, these effects may have faded over time. Nonetheless, even if the effects are fleeting, the reduction in unsafe driving events while the system is in place may result in significant safety benefits.

Lastly, because it was not an aim of this study, the research team did not observe or verify interactions between parents and teens after they received report cards and videos. While discussions between parents and teens about driving can be a source of conflict, parents in previous University of Iowa studies have commented that the videos allow the parent and the teen to see what happened and this objectivity can be an asset.

CONCLUSIONS

This study examined a video-based feedback intervention that provided teens and their parents with personalized, concrete and objective information about unsafe driving. The intervention was found to reduce the rate of unsafe driving events for groups of young drivers who varied in age and independent driving experience. Younger, inexperienced drivers with school licenses as well as 16-year-old drivers with and without independent driving experience who received feedback all had lower rates of unsafe driving events compared to controls who did not receive feedback. In addition, both the experienced and inexperienced 16-year-olds had lower event rates during the Intervention phase relative to their own Baseline phase. Young drivers in the control group who had independent driving experience with a school license prior to obtaining their intermediate license had rates of unsafe driving events more than 50% lower than those who did not have the independent experience. The results of this study provide evidence of benefits of video-based feedback to young driver safety.

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APPENDIX A: IOWA MINOR SCHOOL LICENSE

MOTOR VEHICLES AND LAW OF THE ROAD, §321.194

321.194 Special minors' licenses.

1. *Driver's license issued for travel to and from school.* Upon certification of a special need by the school board, superintendent of the applicant's school, or principal, if authorized by the superintendent, the department may issue a class C or M driver's license to a person between the ages of fourteen and eighteen years whose driving privileges have not been suspended, revoked, or barred under this chapter or chapter 321J during, and who has not been convicted of a moving traffic violation or involved in a motor vehicle accident for, the six-month period immediately preceding the application for the special minor's license and who has successfully completed an approved driver education course. However, the completion of a course is not required if the applicant demonstrates to the satisfaction of the department that completion of the course would impose a hardship upon the applicant. The department shall adopt rules defining the term "*hardship*" and establish procedures for the demonstration and determination of when completion of the course would impose a hardship upon an applicant.

a. The driver's license entitles the holder, while having the license in immediate possession, to operate a motor vehicle other than a commercial motor vehicle or as a chauffeur:

(1) During the hours of 5 a.m. to 10 p.m. over the most direct and accessible route between the licensee's residence and schools of enrollment or the closest school bus stop or public transportation service, and between schools of enrollment, for the purpose of attending duly scheduled courses of instruction and extracurricular activities within the school district.

(2) To a service station for the purpose of refueling, so long as the service station is the station closest to the route the licensee is traveling on under subparagraph (1).

(3) At any time when the licensee is accompanied in accordance with section 321.180B, subsection 1.

b. Each application shall be accompanied by a statement from the school board, superintendent, or principal, if authorized by the superintendent, of the applicant's school. The statement shall be upon a form provided by the department. The school board, superintendent, or principal, if authorized by the superintendent, shall certify that a need exists for the license and that the board, superintendent, or principal authorized by the superintendent is not responsible for actions of the applicant which pertain to the use of the driver's license. Upon receipt of a statement of necessity, the department shall issue the driver's license. The fact that the applicant resides at a distance less than one mile from the applicant's school of enrollment is prima facie evidence of the nonexistence of necessity for the issuance of a license. The school board shall develop and adopt a policy establishing the criteria that shall be used by a school district administrator to approve or deny certification that a need exists for a license. The student may appeal to the school board the decision of a school district administrator to deny certification. The decision of the school board is final. The driver's license shall not be issued for purposes of attending a public school in a school district other than either of the following:

(1) The district of residence of the parent or guardian of the student.

(2) A district which is contiguous to the district of residence of the parent or guardian of the student, if the student is enrolled in the public school which is not the school district of residence because of open enrollment under section 282.18 or as a result of an election by the student's district of residence to enter into one or more sharing agreements pursuant to the procedures in chapter 282.

c. (1) A person issued a driver's license under this section shall not use an electronic communication device or an electronic entertainment device while driving a motor vehicle unless the motor vehicle is at a complete stop off the traveled portion of the roadway. This subparagraph does not apply to the use of electronic equipment which is permanently installed in the motor vehicle or to a portable device which is operated through permanently installed equipment.

(2) For the period beginning July 1, 2010, through June 30, 2011, peace officers shall issue only warning citations for violations of subparagraph (1). The department, in cooperation with the department of public safety, shall establish educational programs to foster compliance with the requirements of subparagraph (1).

2. *Suspension and revocation.* A driver's license issued under this section is subject to suspension or revocation for the same reasons and in the same manner as suspension or revocation of any other driver's license. The department may also suspend a driver's license issued under this section upon receiving satisfactory evidence that the licensee has violated the restrictions of the license or has been involved in one or more accidents chargeable to the licensee. The department may suspend a driver's license issued under this section upon receiving a record of the licensee's conviction for one violation. The department shall revoke the license upon receiving a record of conviction for two or more violations of a law of this state or a city ordinance regulating the operation of motor vehicles on highways other than parking violations as defined in section 321.210. After a person licensed under this section receives two or more convictions which require revocation of the person's license under this section, the department shall not grant an application for a new driver's license until the expiration of one year.

3. *Citations for violation of restrictions.* A person who violates the restrictions imposed under subsection 1, paragraph "a" or "c", may be issued a citation under this section and shall not be issued a citation under section 321.193. A violation of the restrictions imposed under subsection 1, paragraph "a" or "c", shall not be considered a moving violation.

APPENDIX B: RECRUITMENT LETTER

FOR IRB USE ONLY
APPROVED BY: IRB-02
IRB ID #: 200810739
APPROVAL DATE: 03/24/11
EXPIRATION DATE: 03/23/12



UNIVERSITY OF IOWA TEEN DRIVING RESEARCH

The University of Iowa is in the process of recruiting participants for a study entitled "Evaluation of a video feedback intervention for newly licensed teen drivers." The study is the third of its kind to be performed by the University of Iowa.

Teenagers between the ages of 14½ and 16 are eligible to participate in this study. They must:

1. be in the process of obtaining either a school permit or an intermediate license,
2. have a vehicle that they will be the main driver of, and
3. drive at least 90 minutes per week (about 15 minutes/day).

If your teen does not currently meet these criteria, but will within the next 6-9 months, please call to be placed on our waiting list.

Teens who choose to participate will have their vehicles instrumented with a small video device. The device records a 20-second clip of video both inside and outside the vehicle when abrupt braking and/or steering occur. This could happen by braking hard at an intersection, turning a corner too quickly, or going too fast over a speed bump, for example. Some teens in the study and their parents will be given the videos and information about the behaviors shown in the video. All teens and parents will be asked to complete surveys about their driving behaviors and participation in the study. Students will be paid \$75 for the first and last month and \$25 for the four months in between.

We believe that this study will help to provide a major advance in reducing teens' unsafe driving behaviors. If this project is something you and your teen would like to participate in, please call us toll free at 1-877-611-4971. Thank you in advance and we look forward to hearing from you.

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DOT HS 812 508
July 2018



U.S. Department
of Transportation
**National Highway
Traffic Safety
Administration**

