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Teen drivers' awareness of vehicle instrumentation in naturalistic research

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Abstract

Introduction—Naturalistic driving methods require the installation of instruments and cameras in vehicles to record driving behavior. A critical, yet unexamined issue in naturalistic driving research is the extent to which the vehicle instruments and cameras used for naturalistic methods change human behavior. We sought to describe the degree to which teenage participants' self-reported awareness of vehicle instrumentation changes over time, and whether that awareness was associated with driving behaviors.

Method—Forty-two newly-licensed teenage drivers participated in an 18-month naturalistic driving study. Data on driving behaviors including crash/near-crashes and elevated gravitational force (g-force) events rates were collected over the study period. At the end of the study, participants were asked to rate the extent to which they were aware of instruments in the vehicle at four time points. They were also asked to describe their own and their passengers' perceptions of the instrumentation in the vehicle during an in-depth interview. The number of critical event button presses was used as a secondary measure of camera awareness. The association between self-

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reported awareness of the instrumentation and objectively measured driving behaviors was tested using correlations and linear mixed models.

Results—Most participants' reported that their awareness of vehicle instrumentation declined across the duration of the 18-month study. Their awareness increased in response to their passengers' concerns about the cameras or if they were involved in a crash. The number of the critical event button presses was initially high and declined rapidly. There was no correlation between driver's awareness of instrumentation and their crash and near-crash rate or elevated g-force events rate.

Conclusion—Awareness was not associated with crash and near-crash rates or elevated g-force event rates, consistent with having no effect on this measure of driving performance.

Practical applications—Naturalistic driving studies are likely to yield valid measurements of driving behavior.

Keywords

naturalistic driving; instrumentation; awareness; teenage drivers; passengers

Problem

The question of whether direct observation influences human behavior is of enduring interest (McCambridge, Witton, et al., 2014). The phenomenon was first described by Mayo when researching factory workers in Hawthorne, Illinois, where he found that attention of any sort increased factory workers' effort (Mayo, 1933), and it has remained a topic of interest to behavioral scientists. Naturalistic driving studies require the use of in-vehicle cameras and instrumentation that are visible to study participants for the duration of data collection. As the use of naturalistic driving methods has increased around the world (National Academies of Science Engineering and Medicine, 2012; Eenink, Barnard, et al., 2014; University of New South Wales, Australia, 2017), the effect of cameras and vehicle instrumentation on driver behavior has become increasingly relevant.

A common concern in naturalistic driving is that awareness of being observed may affect driving behavior. However, little is known about drivers' awareness of the instrumentation in their vehicle, and the influence this may have on their behavior. Notably, video footage of crashes shows drivers engaging in risky, and at times, illegal behaviors (Simons-Morton, Ouimet et al., 2011; Klauer, Guo et al., 2014). This suggests that at least some drivers forget or disregard the presence of cameras and instruments and drive as they normally would some of the time. It is also plausible that the presence of a camera may encourage risky behaviors by providing an imagined audience for a driver. Participants in the 100-Car Naturalistic Driving Study drove cautiously for the first few hours of data collection, based on their accelerometer data, suggesting there may have been a short-term moderation in this risky driving behavior (Neale, Dingus et al., 2005).

Novice teenage drivers are at much higher crash risk when compared to experienced adult drivers; crash rates per mile driven for 16- to 19-year-olds are four times the rates for adult drivers (Insurance Institute for Highway Safety, 2015). Naturalistic driving methods are

ideal for studying this unique population as they offer detailed and accurate precrash information, including objective information about driving behavior, as well as exposure information (Campbell, 2012). Findings from these studies have informed national policy on distracted driving (National Highway Traffic Safety Administration [NHTSA], 2012; U.S. Department of Transportation, 2017). However, the extent to which teen drivers' awareness of instruments in their vehicles may have influenced their driving behavior is unknown.

The purpose of this study was to examine teen drivers' awareness of instrumentation in their vehicles while they participated in a naturalistic driving study, using a mixed methods approach. Qualitative data about teens' awareness of the cameras and instruments in the vehicles were collected during an in-depth interview. Quantitative data about teen drivers' crashes and near-crashes were collected throughout the study. The association between participants' awareness of the instrumentation in their vehicle and their driving performance, measured by observed crash and near crash rates, was tested. The number of critical event button presses was used as a secondary measure of camera awareness.

Method

Participants

A convenience sample of 42 newly licensed male and female drivers participated in an 18-month study of new drivers, that included vehicle instrumentation, periodic surveys, test track driving assessment, and a semi-structured exit interview (The Naturalistic Teen Driving Study; Lee, Simons-Morton et al. 2011). Participants were required to be younger than 17 years of age and obtained a provisional driver's license allowing independent driving within the past three weeks. Sampling was stratified in order to have similar numbers of males and females. Drivers with diagnosed attention deficit disorder, with or without hyperactivity, were excluded. Identical twins (which would make it difficult to distinguish when coding the identity of the driver), those who needed to enter restricted areas (i.e., that do not allow cameras for security reasons), and only access to a pick-up truck (due to lack of a concealed space to install the instrumentation) were also excluded.

Consent and Incentives

Two consent forms were required for the study: parental consent and teenagers' assent for their participation. Teenager assent was obtained separately from the parent to ensure their participation was voluntary. The confidentiality section of the consent form for teenagers contained an extensive description of the steps that have been taken to treat the data gathered in the study confidentially (e.g. Certificate of Confidentiality that prevents authorities from subpoenaing study data) and that driving videos would not be released without participants' written consent. The final paragraph of the confidentiality section stated that investigators may disclose information to authorities if offenses such as child abuse or habitual driving under the influence are observed.

Participants were provided \$75 for each month of participation in the naturalistic part of the study up to 18 months, and \$20 per hour for completing questionnaires and other tasks, such as test track assessments of driving behavior. Each participant received a bonus of \$450 for

completing all aspects of the study. The protocol was reviewed and approved by the Virginia Tech Institutional Review Board for the Protection of Human Subjects.

Self-Reported Data

Qualitative Interviews

The 41 (one participant was lost to follow up and did not complete the exit interview) interviews analyzed in the current study were conducted at the end of the 18-month study on driving behavior. The interview was designed as an exit interview with direct questions regarding drivers' experiences in the study. The interview questions about participants' awareness of instrumentation comprised one of seven sections in the interview guide. Other topics included teens' perceptions of their parents and peers as passengers, and cell phone use while driving. A trained research assistant at the Virginia Tech Transportation Institute conducted the interviews.

The focus of this study was drivers' awareness of the instrumentation in the vehicle during the course of the 18 month study (see Table 1 for questions). To enhance recall, participants were asked to draw their awareness of the instruments on a graph, which was given to the interviewer (see Figure 1). The shape of the graph was used by the interviewer as the basis for the questions that followed. For example, if there was a general pattern (i.e., increase or decrease) the interviewer would ask participants why it changed. After each question block, the interviewer asked participants if they have anything to add. Teens were asked about their passengers' awareness of the cameras and instruments in the vehicle and how the instrumentation may have effected passengers' behavior.

The average length of each interview was about 46 minutes. Interviews were digitally recorded and professionally transcribed. Transcripts were entered into ATLAS.ti software (Version 7.0). This software allows text to be coded and retrieved for ease of summarization and interpretation (Strauss & Corbin, 1998). Content analysis of participants' responses was used taking an inductive approach. Our research team, including an injury epidemiologist with an expertise in young driver research and a developmental psychologist with expertise in qualitative methods and adolescence, reviewed four transcripts (2 male, 2 female) to identify an initial list of themes. A coding manual was developed based on these four interviews and modified as subsequent interviews were coded. Additional codes were added to represent subthemes and to accommodate new themes that emerged as the coding progressed. Complex passages of text could be assigned multiple codes to adequately capture content.

Double coding was used to improve trustworthiness and rigor (Strauss & Corbin, 1998). Two coders were responsible for coding all transcripts. Meetings among coders and senior researchers were held weekly to ensure consistency and resolve coding discrepancies. A systematic review of the text assigned to specific codes was performed after the first 10 interviews and any identified adjustments to the coding scheme were implemented with previously completed transcripts re-coded as necessary. The quotes included in this report were edited for readability (removing extra words such as "like," and "I mean"), but without changing meaning.

Awareness of Vehicle Instrumentation

As part of the interview process described in the previous section, study participants were asked to estimate on a graph the percentage of time they were aware of the cameras and instruments in the vehicle across four time points (1, 6, 12, and 18 months), using a modified ‘timeline follow back’ technique (Sobell, Brown et al. 1996). Participant responses were categorized into three groups: (a) those who *quickly forgot*, reporting less than 25% awareness at 6-months, (b) those who *slowly forgot*, reporting greater than 25% awareness at 6-months and less than 25% awareness at 12-months, and (c) those who *remained aware*, reporting more than 25% awareness at each time point.

Instrumented Vehicle Data

Critical Event Button Presses

The vehicle instrumentation included a critical incident button located above the rear-view mirror. Participants were instructed to press this button when an incident such as a crash or near-crash had occurred, and were asked to describe the event by speaking into a microphone that would collect 30 seconds of audio data. The purpose of the critical incident button was to flag incidents that occurred during driving that may require video review. In this study, we propose that the critical event button may be considered as a proxy objective measure of camera awareness to corroborate the self-reported measures described earlier.

Crashes and Near-Crashes

Participants drove a vehicle equipped with a data acquisition system that received and stored continuous data from: accelerometers that measured longitudinal, lateral, and yaw inputs; vehicle network that collected speed, turn signals, brake, and throttle pedal usage; a global positioning system (GPS) that calculated vehicle position and speed; and six cameras. Four cameras continuously monitored the driver’s face, the dashboard, and areas reachable by the driver’s hands, as well as the forward and rear roadway. Coders identified each crash and near-crash (CNC) by viewing video footage of highly elevated gravitational-force events recorded by accelerometers. A crash was defined as contact with an object at any speed in which kinetic energy was measurably transferred or dissipated. A near-crash was a close call that did not result in actual contact due to successful evasive maneuvers taken at the last moment (Klauer, Dingus, et al. 2006; Guo, Klauer, et al., 2010). The CNC rate was calculated using CNC counts and dividing by the distance driven for each driver. Rates were standardized and expressed per 1,000 miles driven.

Elevated Gravitational (G-Force) Force Events

A composite variable of elevated gravitational-force (g-force) events was created by counting each g-force event over the threshold set for each of the 5 individual measures: longitudinal deceleration/hard braking (> -0.45 g); longitudinal acceleration/rapid starts (0.35 g); hard left and hard right turns (> 0.50 g); and yaw (± 6 degrees within 3 seconds). Yaw is the change in velocity between an initial turn and the correction. A composite variable was created by counting any event over the threshold set for each of the five individual measures. The Cronbach’s alpha for the composite measure was 0.78 (Simons-

Morton et. al., 2011b), and was highly correlated with crashes and near crashes ($r = 0.60$). In receiver operating curve analyses the area under the curve was 0.76, showing high predictive validity (Simons-Morton et. al., 2012). Elevated g-force event rates were calculated accounting for the number of miles driven by each teenage driver.

Analysis

The qualitative interview data were compiled by themes and the main findings are presented according to these topics in the results.

To determine whether changes in the frequency of critical event button presses were due to an improvement in driving (leading to fewer crashes and near-crashes) or due to a change in awareness of the instruments in the vehicle, we tested the association between participants' button presses and the average monthly CNC rate using the Spearman's rank correlation.

The association between the percentage of time each participant was aware of instruments in the vehicle and their CNCs and elevated g-force event rates was initially tested using the Spearman's rank correlation. Then we used generalized linear mixed models to examine the association between participant awareness and objective driving data across four time points because correlations do not account for multiple observations for each participant over time.

Results

Sample Characteristics

Of the 41 young drivers, 48.7% were males, the majority were white (92.7%), and the mean age at recruitment was 16.4 (SD 0.3). More than half the participants (56.1%) came from households with over \$100,000 of annual income. During the study period, average household income in Virginia was \$61,406 (U.S. Census Bureau 2013). At the time of the exit interview, all participants had been driving independently for the past 18 months. Two of the interviews contributed limited text due to equipment failure resulting in a loss of recording.

Self-reported data

Qualitative themes regarding awareness of cameras and vehicle instruments

—The themes emerging from the interviews are structured around the topics of (a) declining awareness of the instruments for participants and their passengers, (b) cues that increased awareness of the instruments, and (c) concerns related to the instrumentation. Included are themes that were expressed by many of the participants, as well as themes that were relevant but expressed by fewer participants. Furthermore, for several themes multiple viewpoints were expressed, often in contrast with one another reflecting diversity in the perspectives of young drivers. These findings are described below.

(1) Gradual decline in awareness of the instrumentation: The majority of participants stated that their awareness of the cameras and instruments was initially very high, and declined as the study progressed. For some the decline happened within the first 6-months (quickly forgot group, $n=8$), with all of these participants reporting little or no awareness

during the months 6 to 18 of the study. Others described their awareness declined more slowly, reaching 25% or less between months 6 and 12 of the study (slowly forgot group, n=12), with most (n=11) reporting little or no awareness of the instrumentation between months 12 and 18 of the study. The remainder of the participants reported maintaining high or moderate awareness of the instruments for the duration of the study (remained aware group n=21), with 13 of these participants reporting awareness of the camera 25% or more of the time by month 18. The percentage of time participants in each group were aware of the instruments during the four time-points in the study is shown in Figure 2.

The three examples below represent a typical response from drivers in each group:

- *At first the cameras were kind of right near my rearview mirror so every time I would look at my mirror I'd see them, but then, I don't know, I quickly got used to it because it just kind of became part of the car* (male, quickly forgot group)
- *[I] just kind of got to the point I was doing things regardless of [the cameras], you know I worried about it for the first six months, and then, I don't know if it affected my driving or anything but [I] always felt like I was kind of like nervous about it, and then it wasn't really a problem after that.* (male, slowly forgot group)
- *You just get used to them being there and just get used to driving with them and after a while you just stop thinking about it...but then you remember them and then you start forgetting about them.* (female, remained aware group)

Several participants specifically stated that their awareness of the instruments did not influence their driving behavior, while others said they felt reluctant to behave a certain way, or to execute certain driving maneuvers, at least during the first few months of the study:

- *Every time I would turn a corner, I'd be like, "Oh they were watching me," ... and then over time I just kind of forgot about it [and] I'd remember it once or twice every month, but other than that there would be no correlation to my driving and how you were watching me.* (male, quickly forgot group)
- *They intimidated me. I didn't really know what to do with them, although I was scared that I would catch myself doing stupid stuff, and forget they were there.* (female, remained aware group)

About half of participants (n=21) remained at least somewhat aware of the the instruments throughout the 18-month study. At the high extreme of this group, four participants reported no decrease in awareness over the course of the study. Similar to those for whom their awareness decreased, this group was mixed on its perception of whether or not the cameras affected their driving. These comments were typical for the group:

- *'Cause they're like right in the windshield and I always looked at them, I'd never forgot they were there, and I always thought about my actions....I always knew they were there, [I] never forgot about it.* (male, remained aware group)

- *Well, I always knew there were cameras in the car, I mean it didn't affect my driving any, but I always knew they were watching and around me.* (female, remained aware group)

Participants also described their passengers' initial reactions to the instrumentation as ranging from fascination to suspicion. Passengers appeared to behave cautiously when they first encountered the cameras, but as time progressed and the instruments became familiar, they behaved as they would have normally.

- *Some of them...they'd act, like, put their seat belt on sometimes and act all proper. Some of the people they didn't really care, they'd just go on about their usual activities.* (male, remained aware group)
- *Everyone was really interested in them at first and then as we went on everyone who would be in my car had already seen them. They weren't anything new, they didn't really care anymore..* (female, remained aware group)

However, several participants stated that their passengers never became as comfortable with the instrumentation as they themselves had become, and their behavior may have been affected:

- *They always knew that somebody could see them so, I think they were always on their best behavior, they were scared to really do anything.* (male, slowly forgot group)
- *They kind of got used to it, but I don't really think they totally got used to it like I did. Every time they got into my car they're like, "oh, what is that"?* (female, slowly forgot group)

(2) Cues that increased awareness of the instruments: As the novelty of the equipment wore off and cameras became common place in the vehicle, several participants described scenarios where they were reminded of the instrumentation again. These situations can be grouped into two categories: (1) events related to their own driving behavior, and (2) the presence of passengers for whom the instrumentation was unfamiliar. For example, several drivers described being in a crash or near-crash as one reason they remembered the instruments in the vehicle, and others described when they ran a red light or were ticketed:

- Participant: I got used to them being in my car, and it was like they weren't even there. Interviewer: [Based on the graph] from 6 to 12 months that increased again. Can you tell me why that changed?
Participant: I got in a wreck around 6 months, and from then on I was completely aware that they were there. (female, remained aware group)
- *Every time there's like a close accident I would always remember the cameras and that was really the only time that I actually thought about the cameras.* (male, remained aware group)

A subset of drivers reported that their awareness increased when they had new passengers in the vehicle. The following example is typical:

- *I started carrying different passengers, so they reminded me they were there more often, cause they would ask questions about them... Cause I was carrying different people every time, and they hadn't seen them before, so they were just asking all sorts of questions. (female, slowly forgot group)*

(3) Concerns related to the instrumentation: Several participants stated their passengers were anxious about what the cameras and sensors were recording. Participants reported that their passengers' concerns reduced when they explained what was being recorded and the confidentiality of the data that was being collected.

- *If you're in a wreck, can the police use it against you, or you know, if you're speeding, will they call the police?... They just really were concerned I guess about if anything they did in the car could be seen on camera and if they could get in trouble for it. I was like, "no, nope you can't." (female, remained aware group)*
- *Some of them thought it was neat, some of them were kind of paranoid about them, not really knowing what they were doing. I tried to explain the best I could what they were for. After I told them that the police and my parents couldn't see it, they were like, "oh, OK, it doesn't matter. (male, remained aware group)*

Some participants described providing guidance to their passengers on how to behave:

- *At first they were a little freaked out, they weren't sure what to think about it. And they were fascinated with, "Oh, how do you act when they're in the car," and I would always tell them it was just routine for me now...for people who constantly I was driving around, my constant passengers, they started to become used to the cameras as well. But at first they were uneasy with them. (male, slowly forgot group)*

Instrumented Vehicle Data

Critical Event Button Presses—There was a total of 263 critical incident button presses over the course of study for all participants. The highest frequency of presses occurred during the first month of driving (63 or 24%) followed by the 25 presses in the second month. For the remainder of the study, there were an average of 10 presses per month.

To establish whether the decline in the frequency of critical event button presses was due to an improvement in driving (leading to fewer crashes and near-crashes) or to declining awareness of the instrumentation, the association between participants' button presses and the average monthly CNC rate was tested using a Spearman rank correlation. The association was not significant ($r = .03$, $p = .91$) (Figure 3).

Objective driving behavior—The critical question related to the use of in-vehicle cameras is whether participants' awareness of the instrumentation is associated with their behavior. The association between participants' average awareness of the instrumentation in the vehicle (drawn on the graph) and their overall CNC rate and elevated g-force event rate was tested using a Spearman rank correlation (Figures 4 and 5). Each subjects' awareness was averaged across the 18 month study period and was correlated with their CNC rate and

their elevated g-force event rate. There was no significant association between participants' awareness of the vehicle instrumentation and their CNC rate ($r = .052$, $p = .70$) or their elevated g-force event rate ($r = .18$, $p = .25$).

Given that the awareness of the camera was highest during the first months of participation, if behavior change were to occur it may have occurred early in the study. To test this question, we divided the objective driving data into 1, 2–6, 7–12 and 13–18 months periods. We used generalized linear mixed models to examine the association between participant awareness category and objective driving data across the four time points. We found no significant association between overall participant awareness and g-force rate over time ($p = .14$). We also found no association between participant awareness group and the g-force event rate over time ($p = .49$). The same pattern of results was observed for the CNC rate. The association between overall participant awareness and CNC rate was not significant ($p = 0.84$), nor was the association between participant awareness group (quickly forgot, slowly forgot, and never forgot) with the CNC rate ($p = .71$).

Discussion

Naturalistic driving studies rely on sophisticated instrumentation to capture driver behavior. The extent to which cameras and other instruments might influence behavior is difficult to answer, and has received little research attention. The purpose of this study was to examine this question using qualitative and quantitative methods, drawing on self-reported and objective data sources. We explored teen drivers' awareness of the instrumentation using an in-depth interview and asked them to rate their awareness of the instruments over time. We also documented the frequency of critical event button presses over time. We tested the association between participants' self-reported awareness of instrumentation and their driving behavior using crash and near-crash and elevated g-force event rates.

We found that most drivers' awareness of the instrumentation was high during the first month of the study, but this generally diminished and approached zero by the end of 18 month study. This was reflected in the interview data, and in participants' self-reported awareness of the instrumentation. The number of the critical event button presses, high in the first two months of the study, declining sharply thereafter, provides some corroboration of the general decline in awareness. A subset of participants stated that their awareness of the instrumentation was high and remained unchanged throughout the study. Analysis indicated that even when accounting for time and different levels of participants' awareness of the instruments there was no association between self-reported awareness and crashes or elevated g-force event rates, consistent with having no effect on this measure of driving performance. This finding is supported by cognitive studies that explain that attention is constantly selective (Gazzaley & Nobre, 2012) and that repeated stimulus exposure is likely to lead to habituation (Schmid, Wilson, et al. 2014). For example, background music is often ignored until a favorite song appears. However, there is likely to be variation in the individuals' levels of habituation, as reflected in the range of participants' responses to the instruments.

Based on the interviews, we can infer that certain events, such as being in a crash, or passengers' reactions towards the instrumentation served as cues for participants to recall the presence of the instruments. A crash or passenger attention to the instrumentation may have had a reinforcing role on participant's awareness by maintaining interest in it. This is consistent with theories explaining that emotionally salient stimuli and affective states can determine how attention is allocated (Öhman, Flykt, et al., 2001). This finding has implications for participant orientation in future naturalistic driving studies. It seems likely that with the provision of information about the protocols in place to protect confidentiality, such as a one-page sheet that could be kept inside the vehicle, participants may be better equipped to alleviate passenger concerns related to the instrumentation. Minimizing the opportunities for participants to interact with researchers during scheduled follow-ups may also be another strategy to reduce their awareness of the instrumentation. This would need to be balanced with the demands of the particular study design, such as the need to maintain contact to keep participants engaged in a longitudinal study.

According to several participants' descriptions, the presence of the instruments made them more risk-averse. Participants were also told that their data would be confidential, unless researchers observed extremely dangerous driving behaviors (such as repeated impaired driving). Hence, it is possible that the threat of being reported had a bearing on their driving behavior. This would suggest the findings from naturalistic driving studies are conservative estimates of actual driving behavior. Given that most participants' awareness reduced over the course of the study, it is likely that the first few months of driving behavior may be influenced by the presence of the instruments, rather than the entire study period. A previous analysis of these drivers found that CNC rates declined over time while risky driving increased (Simons-Morton, Ouimet, et al., 2011). The absence of any association between self-reported awareness of the instruments and CNCs or elevated g-force events is most likely to be because awareness of the instruments did not dramatically influence driving behavior.

Limitations

The small sample size and the absence of a control group means that this study could not comprehensively examine the effect of vehicle instrumentation on driver behavior. The difficulty of recalling driving behavior is well documented (Staplin, Gish, et al., 2008), and it is unlikely that participants could accurately recall their awareness of the instruments across an 18-month study period. Participants were asked about their awareness at a single point at the end of the study, as the research team did not wish to heighten their awareness of the instrumentation during the study. Teenagers are a distinct driving population and further research is needed to determine how drivers' awareness of instrumentation may differ according to driver age. Therefore, these findings are also not likely to be generalizable to all drivers.

Conclusion

As the use of naturalistic driving methods increases around the world, the extent to which vehicle instrumentation influences driver behavior becomes increasingly relevant. Using

qualitative data from an in-depth interview, we found that the majority of participants' self-reported awareness of the instrumentation in their vehicle diminished over time. Consistent with this, the number of the critical event button presses followed a similar pattern of initial high use, followed by a decline and low use later in the study. This is likely to be due to the natural process of selective attention that occurs with repeated stimulus exposure. Further, their awareness increased following a salient event, such as a crash, or their passengers' concerns towards the instrumentation in the vehicle. However, no association was observed between participants' self-reported awareness and their crashes and near-crashes or elevated g-force event rate. It is possible that the driving behavior of some participants was influenced by their awareness of vehicle instrumentation, however our findings provide no evidence that awareness affects driving performance in most participants. While it is important to minimize the experimental effects of naturalistic driving methods on driving performance, vehicle instrumentation remains an objective measure of driving behaviors while exhibiting modest to little effect on the behaviors being measured.

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Highlights

- Little is known about the extent to which the vehicle instruments and cameras used in naturalistic driving studies might change behavior
- We asked participants in a naturalistic driving study to describe the amount of time they were aware of the vehicle instrumentation and cameras during an exit interview
- Most participants' reported that their awareness of the vehicle instrumentation steadily declined
- Awareness increased in response to their passengers' interest in the cameras, if they were involved in a crash, or were contacted by the research team
- The number of the critical event button presses was highest in the first months and declined rapidly and remained low for the remainder of the study
- There was no association between driver's awareness of study instruments in the vehicle and their crash and near-crash rate or elevated g-force events rate.

Figure 1.
Example of a completed graph from study participant

Figure 2.
Study Participants' Awareness of Vehicle Instrumentation

Figure 3. Frequency of Critical Button Presses and Crash/Near-Crash Rate by Month
Spearman's $\rho = .03$, $p = .91$ (no statistically significant association)

Figure 4. Scatter Plot of Participants' Self-Reported Awareness of the Vehicle Instrumentation and their Crash-Near-Crash Rate/1,000 Miles Driven*

Spearman's $\rho = .05$, $p = .75$ (no statistically significant association)

Figure 5. Scatter Plot of Participants' Self-Reported Awareness of the Vehicle Instrumentation and their Composite Gravitational Force Rate/1,000 Miles Driven*
Spearman's $\rho = .18$, $p = .25$ (no statistically significant association)

Table 1**Structured Interview Instructions for Interviewer and Questions**

1	Participants' awareness of cameras and other instruments
	From your drawing, it appears that your awareness of the instruments <i>[describe graph]</i>
a.	The slope <ul style="list-style-type: none"> • [changed over time]: Why did it change? • [didn't change over time]: Why did it stay the same?
b.	Over the past 18 months, were there specific moments at which you thought more about the cameras and instruments while driving. <ul style="list-style-type: none"> • [If yes]: How long did that heightened awareness last?
2	Passengers' awareness of cameras and other instruments
	From your drawing, it appears that your passengers' awareness of the instruments <i>[describe graph]</i>
a.	The slope <ul style="list-style-type: none"> • [changed over time]: Why did it change? • [didn't change over time]: Why did it stay the same?
b.	Over the past 18 months, were there specific moments at which you thought more about the cameras and instruments while driving. <ul style="list-style-type: none"> • [If yes]: How long did that heightened awareness last? • How do you know? • What were their comments about it? • How do you think their behavior in your vehicle was affected by the cameras or instruments? • Were there other moments at which your teenage passengers mentioned or acted as if they were aware of the cameras or instruments?

Interviewer looks at the graphs drawn by the participant and asks questions accordingly for each of the four segments (1, 6, 12 and 18 months) of the graph and each peak. If there is a general pattern (i.e., increase, decrease, or stability over time) in the three segments, interviewer can ask one general question. After each question block, interview asks participants if they have anything to add.