

Drivers' Attitudes toward Front or Rear Child Passenger Belt Use and Seat Belt Reminders at these Seating Positions

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ABSTRACT

Objective: Passengers, especially those in rear seating positions, use seat belts less frequently than drivers. In-vehicle technology can inform drivers when their passengers are unbuckled and encourage passengers to use belts. The current study collected information about drivers' attitudes towards passenger belt use and belt reminders for front passengers and children in back seats.

Methods: A national telephone survey of 1,218 people 18 and older was conducted, of which 477 respondents were drivers who transport a front-seat passenger at least once a week and 254 were drivers who transport an 8-15 year-old child in the back seat. Respondents were asked about their attitudes toward belt use by their front passengers or rear child passengers and preferences for different passenger belt reminder features.

Results: Ninety percent of drivers who regularly transport front-seat passengers said the passengers always use seat belts. Reported belt use was even higher among 8-15 year old children in the back seat (97%). Among the drivers whose children do not always buckle up, about half said the child unbuckled the belt during the trip. Almost every full-time belt use driver (96%) would encourage front passengers to buckle up if not belted, compared with 57 percent of part-time belt users and non-users. Drivers who would not encourage their front passengers to buckle up frequently cited passenger personal choice or responsibility as reasons. In contrast, nearly every driver who transports children in the back seat would encourage their belt use, regardless of the driver's belt use habits. Most drivers who transport front passengers wanted passenger belt reminders that encourage passengers to buckle up and provide information to the driver about front passenger belt use. Most of these drivers wanted a chime/buzzer or warning light or text display and wanted the reminder to last indefinitely. Most drivers who transport rear child passengers wanted notifications via a visual diagram of seating positions and belt use, a chime/buzzer, and a warning light or text display. These drivers also wanted the vehicle to provide belt use information until the child buckled up.

Conclusions: Many drivers, especially those who always use seat belts, said they would encourage unbuckled passengers to buckle up and supported auditory and visual belt reminders for passengers, particularly for children sitting in the back seat. Front and rear passenger reminders that last

indefinitely would be acceptable to most drivers who transport these passengers. An auditory alert may be especially useful to alert drivers to children unbuckling in the back seat during a trip.

Key words: Seat belts; Seat belt reminders; Passenger belt use; Child belt use

INTRODUCTION

Passengers typically use seat belts less frequently than drivers. In 2012, 87 percent of drivers observed in vehicles were belted compared with 84 percent of front-seat passengers (Pickrell & Ye 2012). Rear passenger belt use rates are even lower. In 2011, observations at intersections found that 84 percent of occupants 8 and older were belted in front seats compared with 74 percent in back seats (Pickrell & Ye 2013).

Getting every vehicle occupant to buckle up is critical to reducing the number of crash injuries and their severity. Seat belts prevent occupants from hitting structures inside the vehicle, minimize forces from the impacts that do occur, and reduce the likelihood that occupants are ejected. As a result, lap and shoulder belts reduce the risk of fatal injury by 45 percent for front-seat car occupants 14-97 years old (Kahane 2000) and by 44 percent for back-seat outboard car occupants 5 and older (Morgan 1999).

Seat belts also can prevent occupants from colliding with one another in a crash. Unbelted backseat passengers can be propelled into drivers or front passengers in a frontal crash or collide with neighboring occupants in a side impact crash. One study found that the risk of injury among belted occupants involved in a crash increased by 90 percent if another occupant was unbelted (MacLennan et al. 2004).

Campaigns such as "Click It or Ticket" have increased driver and front passenger belt use through well-publicized enforcement (Solomon et al. 2009; Williams et al. 1996). Belt use is higher in states with primary enforcement seat belt laws; in 2012, observed belt use rates among front-seat occupants were 90 percent in states with primary enforcement seat belt laws compared with 78 percent in states with secondary enforcement laws or no law (Pickrell & Ye 2012). Similarly, states with laws requiring belts in all seating positions had higher belt use rates among back-seat occupants 8 and older (83 percent) in 2011 than states that require belt use only in the front seats (67 percent) (Pickrell & Ye, 2013). Although strong enforcement of belt use laws is effective in increasing belt use, some communities

have limited resources and can conduct special enforcement campaigns only at certain times during the year. Thus, many people who do not buckle up go undetected.

In-vehicle seat belt reminders are another successful strategy for increasing belt use. Unlike enforcement, reminders can provide continuous, immediate feedback about non-use. Seat belt reminders use auditory and/or visual signals to remind occupants to buckle up and can further motivate belt use by removing these signals only after the belt is fastened. Currently, vehicles are required to have an auditory and visual reminder for the driver that lasts 4-8 seconds after the vehicle is turned on. The National Highway Traffic Safety Administration (NHTSA) has been prohibited by Congress from requiring an auditory reminder that lasts longer than 8 seconds, but vehicle manufacturers can install them voluntarily. Enhanced seat belt reminders that exceed the federal minimum requirement increase U.S. driver belt use by 5-6 percentage points (Ferguson et al. 2007; Williams et al. 2002) and reduce driver fatality risk by 6 percent (Farmer & Wells 2010). Enhanced reminders also may increase belt use among front passengers (Freedman et al. 2007).

Enhanced belt reminders for front-seat occupants are increasingly common. Of 2012 vehicle models available in the United States, 91 percent had enhanced reminder systems for the driver and 77 percent had reminder systems for the right-front passenger. In 2012, the Moving Ahead for Progress in the 21st Century (MAP-21) law lifted the prohibition on requiring a driver belt reminder lasting longer than 8 seconds, so NHTSA now can require a stronger reminder for drivers. Because driver and front passenger reminders in a vehicle generally are the same, a stronger requirement for driver belt reminders likely would result in stronger front-seat passenger reminders as well. The European New Car Assessment Programme (Euro NCAP) gives credit to vehicles with enhanced reminders for front seats that comply with its design requirements including reminder duration; it requires a 90-second continuous or intermittent auditory and visual signal that is "loud and clear" for front seating positions. European research shows that belt use in vehicles with reminders that meet the Euro NCAP design requirements is about 12 percentage points higher than belt use in vehicles without them (Lie et al. 2008). Whether or not U.S. drivers would accept stronger, European-style reminders to encourage front passengers to buckle up is unknown.

Only 3 percent of 2012 models in the U.S. were equipped with reminders for rear passengers. Manufacturers may be reluctant to voluntarily install rear reminders because rear reminders may be prone to false warnings and thereby annoy consumers. Rear seats may be occupied by cargo or animals so reminder systems must accurately distinguish between human passengers and non-human cargo to avoid false warnings. Observational surveys conducted in 2011 found that nearly all children younger than 3 ride in rear seats (Pickrell & Ye 2013). Child seats installed using the vehicle's Lower Anchors and Tethers for Children (LATCH) system present a technical challenge for rear passenger reminders because LATCH systems do not use the seat belt.

Even if rear seat belt reminders are prone to false alarms, they still may be acceptable. In particular, parents may want to know if their children are buckled up in the back seat. In 2011, 59 percent of fatally injured, unrestrained second-row passenger vehicle occupants ages 8-15 were traveling with belted drivers (Insurance Institute for Highway Safety, 2013). It is likely that some of these belted drivers did not know that their children were unbelted. In 2007, Public Citizen and Advocates for Highway Safety petitioned NHTSA to require rear belt reminders. This is mooted, however, by a MAP-21 requirement that NHTSA begin rulemaking to require rear reminders. This means that these systems eventually will become more common. Several studies have examined how various belt reminder features influence driver belt use (e.g., Freedman et al. 2007; Kidd 2012; Lerner et al. 2007), but the features that are successful with drivers may not be acceptable ways of encouraging passenger belt use or delivering information about passenger belt use. The objective of the current study was to gauge the amount of support for passenger belt reminder technology among drivers who transport front or rear passengers and to gather detailed information about drivers' attitudes toward various types of passenger belt reminders.

METHOD

Sample Design

Three sampling phases were undertaken to achieve a target sample of 1,200 completed interviews with a minimum of 300 part-time adult belt users and non-users and 250 drivers who regularly transport 8-15 year-old children in the back seat. At least 200 drivers who regularly drive with a front-seat passenger were expected to be interviewed during the three sampling phases. National random samples

of landline and cellphone numbers were obtained from an industry supplier of telephone samples (Marketing Systems Group, Horsham, PA) and telephone interviews were conducted by OpinionAmerica, Inc. (Cedar Knolls, NJ) between May 8, 2012 and July 15, 2012. Interviews were conducted with persons 18 and older who drove or rode in a passenger vehicle at least once a week.

The first sampling phase was a national random sample of people 18 or older who drive or ride in passenger vehicles at least once per week. Interviews were completed with 799 individuals. The second sampling phase screened for people who did not use their belts all of the time. Interviews were completed with 198 part-time belt users and 32 non-users. The third sampling phase targeted people who drive with an 8-15 year-old child who rides in the back seat at least once a week. Random samples of landline numbers were drawn from a database of households known to have children 8-15 years old, and interviews were completed with 189 drivers.

In total, random samples of 59,803 telephone numbers were obtained and 8,555 households were reached. Of these, 7,337 households either refused to participate or did not meet screening criteria resulting in a cooperation rate of 14.2 percent (American Association for Public Opinion Research 2011) and 1,218 completed interviews. The final sample included 317 part-time belt users or non-users, 254 drivers who transport an 8-15 year-old child who uses a belt in the back seat, and 477 drivers who transport a front-seat passenger at least once a week.

Survey Instrument

Respondents were asked basic demographic information and questions about their seat belt use. People who do not always use their belts were asked about attitudes toward belt use technologies and reasons for non-use. Information from these questions is reported in a companion paper (Kidd et al. 2013).

Additional questions were administered to drivers who transport passengers. People who regularly transport right front-seat passengers at least once a week were asked about the frequency of their front passengers' belt use; if they encourage passengers to buckle up, and if not, the reasons why; and whether they want the vehicle to encourage passengers to buckle up. Drivers who want to know when their front passengers are unbuckled were asked how the vehicle should notify passengers (e.g., buzzer or chime, warning light) and how long the notification should last (e.g., briefly, indefinitely).

People who did not regularly transport front passengers but regularly transport 8-15 year-old children who primarily use a seat belt in the back seat rather than sitting in a child safety seat were asked about their child passengers' belt use patterns. People with child passengers who do not always buckle up were asked if they agree with various statements about the situations of non-use. Drivers who indicated they want to know when child passengers are unbuckled were asked how the vehicle should notify them and how long the notification should last.

At the end of the survey, respondents who drove at least once a week (n=1,090) were asked if they would encourage unbuckled passengers of various ages (6, 11, 16, 21, 40, 60, and 80 years) to buckle up.

Data Analysis

Data from the three sampling phases were combined for analyses. To incorporate the oversampled groups, weights were calculated by separating respondents from the random sample into six groups according to two variables: reported belt use (full-time, part-time, non-user) and regularly transporting 8-15 year-old passengers who sit in the rear and primarily use seat belts rather than sitting in a child safety seat (yes, no). The composition of each sample according to these variables is listed in Table 1.

For each of the six groups, weights were calculated by dividing the number of respondents in that group from the random sample by the total number of respondents in the random sample plus the two oversamples. For example, responses from part-time belt use drivers who transport an 8-15 year-old child in the back seat were weighted by 0.05 [i.e., 2/(2+27+13)]. Applying the corresponding weight to each of the 1,218 cases resulted in a weighted combined sample of 799 cases. In the weighted sample about 46 percent of respondents transport a front-seat passenger at least once a week (weighted n=365.6), and, by design, about 7 percent transport an 8-15 year-old child passenger in the back seat at least once a week (weighted n=53). The sampling tolerance for the combined sample (n=1,218) was about ± 3 percentage points at the 95 percent confidence level. The sampling tolerance for the sample of respondents who regularly transport front-seat passengers or children using seat belts in the back seat was ± 4 and ± 6 percentage points, respectively.

All analyses were performed using the weighted data. Responses to the survey questions were analyzed as a function of driver belt use. Only a few non-users regularly transport front-seat passengers (n=17, weighted n=4.1) or children in the back seat (n=4, weighted n=2), so responses from non-users were combined with part-time belt users. Chi-square tests were used to assess the statistical significance of differences in responses between full-time belt users and other respondents. Missing responses, refusals, or cases where respondents indicated they did not know an answer were not included in the analyses. In some analyses, more than 25 percent of the expected frequencies were below five, so the Chi-square test may not have been valid. These analyses are included and should be considered exploratory.

A repeated measures logistic regression was used to examine whether or not drivers would tell unbuckled passengers of different ages to buckle up. Driver belt use (full-time belt user, part-time belt user, non-user), passenger age, and the interaction between these two variables were used to predict the likelihood of encouraging an unbuckled passenger to buckle up. A random intercept was included in the model and a compound symmetry covariance structure was assumed to account for association between multiple responses from individual drivers.

RESULTS

Interviews with Drivers who Transport Front-seat Passengers

Phone interviews were completed with 477 (weighted n=365.6) people who transport a front-seat passenger at least once a week. Most of these drivers always buckle up (90%) and most of the others use belts part of the time (9%). More than half of the drivers transporting front passengers were male (56%) and 30-59 years old (51%). About 45 percent said they had received a college degree or additional education. Around one-third reported their annual income is \$15,000-\$49,999. Drivers more often drove a car (55%) rather than an SUV, minivan, or pickup. The demographic characteristics of full-time belt users, part-time belt users, and non-users are listed in Table 2. A greater proportion of the part-time belt users and non-users were male compared with full-time belt users.

Age and belt use among front-seat passengers. More than two-thirds of drivers who transport front passengers said their passengers are 25 or older. About 15 percent said their front passengers are 16-24 years old, and 13 percent said their front passengers are 15 or younger. About 90 percent of

drivers said their front passengers always use seat belts. The reported frequency of front passenger belt use was significantly different between drivers who always use their seat belts and drivers who do not regularly or never use their seat belts (χ^2 [4]=51.4, p<0.001). Ninety-three percent of drivers who always use seat belts said their front passengers always buckle up, about 5 percent said their passengers are belted most or some of the time, and 2 percent said their passengers rarely or never use a belt. In contrast, slightly more than half (55%) of drivers who do not always use belts said their front passengers always use them; 38 percent said their front passengers use belts most or some of the time, and 14 percent said passengers rarely or never use belts.

Driver willingness to encourage front-seat passengers to buckle up. Drivers who transport front-seat passengers were asked if they would encourage their unbuckled passengers to use a seat belt. Nearly all drivers who always buckle up said "yes" (96%), compared with 57 percent of drivers who do not always buckle up; this difference was statistically significant (χ^2 [1]=60.9, *p*<0.001). Drivers who would not encourage their front passengers to buckle up were asked if they agreed with five potential reasons (Table 3). The drivers who always buckle up most often agreed with the statement that belt use is the passenger's responsibility (64%), followed by the statement that drivers do not want to monitor passenger belt use (45%). Drivers who do not always buckle up most often agreed with the statement that passengers' belt use is a personal choice (88%) or the passenger's responsibility (80%). Few respondents indicated that the lack of a legal requirement for passenger belt use factors into their decision not to encourage passenger belt use.

Seat belt reminders for front-seat passengers. All drivers who transport front-seat passengers were asked about seat belt reminders for front passengers. A significantly larger proportion of full-time belt use drivers (91%) than part-time belt users and non-users (61%) said they are responsible for passenger belt use (χ^2 [1]=25.5, *p*<0.001). Overall, full-time belt use drivers had more positive opinions than part-time belt users and non-users about belt reminder technology for front passengers (Table 3). A significantly larger proportion of full-time belt use drivers (82%) than part-time belt users and non-users (52%) want the vehicle to tell them when their front passenger is unbuckled. Additionally, significantly more full-time belt use drivers want the vehicle to encourage front passengers to buckle up (81% vs. 67%). Three-quarters of full-time belt use drivers (75%) and about half of part-time belt users and non-

users (51%) want the vehicle to serve the dual functions of notifying drivers when front passengers are unbuckled and encouraging passengers to buckle up.

Drivers were asked what kind of passenger reminder they would like if their vehicle notified them about front passenger belt use. Table 4 presents the responses for drivers who want to be notified about front passenger belt use. Most of these drivers who also want the vehicle to encourage front passengers to use belts would like the vehicle to use a chime or buzzer (84%) or a warning light or text display (84%). About three-quarters (78%) would like a visual diagram of seating positions showing belt use. The majority of drivers who want the vehicle to encourage front passengers to buckle up would like notifications to last until the passenger buckles up (63%). In contrast, about three-quarters of drivers who do not want the vehicle to encourage front passengers to buckle up would like the vehicle to use a visual diagram of seating positions; 60 percent would like a chime or buzzer, and 56 percent would like a warning light or text display. Forty percent wanted the notification to be brief, and about half wanted it to be moderately long (17%) or last until the passenger buckles up (35%). Respondents' opinions about the types of notifications and desired length of notifications did not vary significantly by driver belt use.

Interviews with Drivers who Transport 8-15 Year-olds in the Back Seat

Interviews were conducted with 254 drivers (weighted n=53) who transport 8-15 year-olds using a seat belt (rather than a child safety seat) in the back seat at least once a week. Table 2 lists the demographic characteristics and vehicle types of these drivers by their reported belt use. Nearly all these drivers said they always use a seat belt (92%), 4 percent use a seat belt part of the time, and 4 percent never use a belt. Ninety-two percent were 30-59 years old and more than half were female. The most frequent vehicle type driven was a car (37%), although 48 percent of the drivers who did not always buckle up drove pickup trucks. More than 60 percent of the respondents who transport 8-15 year-olds in the back seat received a college degree or advanced degree, and the most frequently reported annual income level was \$100,000 or higher.

Age and belt use among back-seat child passengers. Among drivers transporting children in the back seat, about 17 percent said the child is younger than 10, 39 percent said the child is 10-12 years old, and 44 percent said the child is 13-15 years old. Nearly all drivers said the child always buckles up (97%). Only 15 of the 254 drivers interviewed (weighted n=1.5) indicated the child does not always buckle

up; 11 (weighted n=1.1) said the child buckles up most of the time and 4 (weighted n=0.4) said the child uses a belt only some of the time.

Drivers who said their children do not always use seat belts were asked if they agreed with eight statements about the situations of their children's non-use of belts (Table 5). Parents most often agreed with the statements that the child did not like the seat belt (84%), never fastened the belt at the outset of the trip (77%), or took the belt off during the trip (55%). Fewer than 1 in 5 parents agreed that improper fit (16%) or not having a seat belt available (17%) were factors.

Seat belt reminders for back-seat child passengers. Nearly every driver said that they were responsible for the belt use of the children. Most wanted their vehicle to tell them when the child was not buckled up in the back seat (82%) and to encourage the child to buckle up (72%). Drivers who wanted their vehicle to tell them when the child was unbuckled were asked about several methods of notification (Table 6). The largest proportion of drivers agreed that they would want a visual diagram of seating positions and corresponding belt use (87%), followed closely by a visual warning light or text display (85%). A somewhat smaller percentage said they would want a chime or buzzer notification (79%). The majority of drivers thought the rear reminder should last indefinitely until the child buckles up (63%); about 17 percent said the rear reminder should be moderately long, and 19 percent said it should be brief. None of these survey items varied by driver reported belt use.

Reminding Passengers of Different Ages to Buckle Up

Drivers were asked if they would encourage an unbuckled passenger to use a seat belt if the passenger was 6, 11, 16, 21, 40, 60, or 80 years old. A larger proportion of drivers who said they always use their seat belt than those who use their belt part of the time or never said they would encourage passengers in each age category to use their belt (Figure 1). The pattern of responses for all driver belt use groups, however, varied substantially by passenger age. Passengers 6 or 11 years old would be encouraged to buckle up by virtually all drivers who always buckle up or who buckle up part of the time and by more than 85 percent of drivers who never buckle up. Passengers who are 16 years old would be encouraged to buckle up by virtually all drivers who always buckle up, 87 percent who buckle up part of the time, and 75 percent who never buckle up. In contrast, more than 90 percent of drivers who always

buckle up said they would encourage an unbuckled passenger 40, 60, or 80 years old to use a seat belt, compared with about half of part-time belt users and 20 percent of non-users.

Responses to this question were modeled using a repeated measures logistic regression to assess the interaction of driver belt use (full-time belt user, part-time belt user, non-user) and passenger age on the likelihood of encouraging passengers to buckle up. Table 7 shows the contribution of each predictor to the full model. Overall, drivers were significantly less likely to encourage older passengers to buckle up compared with younger passengers (p<0.001). The odds of telling a passenger to buckle up decreased by about 50 percent for every 10-year increase in passenger age. As a group, full-time belt users were 24 times more likely than non-users to encourage a passenger to buckle up and part-time belt users were nearly twice as likely as non-users to encourage belt use; these differences were statistically significant (p<0.001 and p<0.01 respectively).

The interaction between passenger age and driver belt use approached statistical significance. Compared with drivers who said they always buckle up, those who never buckle up were less likely to encourage older passengers to use a belt than younger passengers (p=0.06). For example, the predicted probability of encouraging a 15-year-old passenger to buckle up was 0.98 for full-time belt use drivers and 0.61 for non-users. In contrast, the predicted probability of full-time belt use drivers telling a 60 year-old passenger to buckle up was slightly lower than the probability of their telling a 15 year-old to buckle up (0.95 vs. 0.98), but for a non-user the probability was drastically lower (0.20 vs. 0.61). The probability of part-time belt use drivers encouraging passenger belt use for passengers of different ages was not significantly different from non-users (p=0.11).

DISCUSSION

Passenger belt use rates typically are lower than driver belt use rates, especially rates among rear seat passengers (Pickrell & Ye 2013). Seat belt reminders potentially can increase passenger belt use by encouraging passengers to buckle up or informing drivers of non-use. The enactment of MAP-21 allows NHTSA to require stronger belt reminders and requires the agency to begin rulemaking for rear seat reminders. Little is known about attitudes toward reminders for passengers and what kinds of passenger reminders are acceptable to drivers. The current study gathered information about drivers'

perceptions of passenger belt use and reminders for front and rear passengers to identify passenger belt reminders that will increase belt use, while being acceptable to most drivers.

Consistent with observations of driver and front passenger belt use (Nambisan & Vasudevan 2007), driver-reported front passenger belt use rates were substantially higher with drivers who said they always buckle up. Attitudes about passenger belt use also differed between drivers who always use belts and drivers who do not. Nine out of 10 full-time belt use drivers said they were responsible for front passengers' belt use, compared with only 6 out of 10 part-time belt users and non-users. Nearly all drivers who always use belts said they would encourage unbuckled passengers to use belts, compared with slightly more than half of part-time belt users and non-users.

Drivers who do not always use seat belts frequently said they would not encourage front passengers to buckle up because it is the passenger's personal choice or responsibility. However, nearly all drivers, regardless of their own belt use habits, said they were responsible for the belt use of 8-15 year-olds riding in the rear seat and that they would encourage a 6 or 11 year-old passenger to buckle up. This reported behavior is somewhat inconsistent with observations of restraint use; in 2011, restraint use among children younger than 8 was considerably lower with unbelted drivers (67%) than with belted drivers (95%) (Pickrell & Ye 2013). It is possible that some part-time belt users and non-users in the current survey were responding in a socially desirable manner and may not, in reality, be likely to encourage children to buckle up. In addition, unbelted drivers who do, in reality, encourage children to buckle up may not always be aware of their child's belt use during a trip.

Previous research on belt reminders has identified reminder signals that motivate driver belt use (e.g., Kidd 2012; Lerner et al. 2007), but these same signals may not be acceptable for encouraging passenger belt use or informing drivers about passenger belt status. Most drivers who transport front passengers wanted reminders that encourage passengers to buckle up and also provide information to the driver on passenger belt use. Most wanted either a warning light/text display or a chime/buzzer to encourage passengers to buckle up and reminders that last indefinitely until the front passenger buckles up. These findings suggest that stronger front passenger reminders, such as those meeting Euro NCAP's design requirements, may be acceptable to most drivers who transport front passengers.

Reminders that continue indefinitely are perceived to encourage belt use more effectively than reminders that stop after a short period of time (Lerner et al. 2007), but a drawback is that they can be more annoying, especially if they are auditory. A small proportion of drivers did not want the vehicle to encourage front passengers to buckle up and wanted only information about front passenger belt use. These drivers preferred less intrusive reminders and most frequently wanted a visual reminder and reminders that do not last indefinitely. Long-lasting, auditory front passenger reminders might not be acceptable to these drivers, so it is important to find ways to reduce the potential annoyance of front passenger reminders without compromising their effectiveness. Kidd (2012) found that among reminders meeting Euro NCAP design requirements, reducing the proportion of time an auditory reminder is present (i.e., duty cycle) helped reduce annoyance without sacrificing the perceived effects on driver belt use.

Most drivers who transport rear child passengers want the vehicle to tell them if their children are unbuckled. These drivers had positive opinions about both auditory and visual reminders but somewhat preferred visual reminders like a warning light/text display or visual diagram of seating positions over a chime/buzzer. Most drivers also thought that the reminder should last until the child buckles up. In addition to being less annoying, visual reminders may be easier to understand than auditory reminders and can provide information about belt status more discretely. However, a drawback of visual reminders is that they may not be as effective as auditory reminders in alerting drivers when passengers unbuckle their belt during the trip. This is important because many drivers whose children did not always buckle up mentioned that the child took the belt off during the trip. Hence, notifying drivers about changes in belt status is an important feature for rear reminders. For this reason, automakers may want to supplement visual rear reminders with an auditory tone to draw attention to changes in rear passenger belt use.

As noted above, in 2012 Congress required NHTSA to begin rulemaking to require rear reminders. Euro NCAP gives credit to vehicles with rear reminders meeting certain design requirements. These requirements can serve as a starting point for NHTSA's deliberations. Euro NCAP requires a continuous or intermittent rear seat belt reminder with a visual signal lasting at least 30 seconds at the start of a trip and an auditory and visual signal when a rear seat belt is unbuckled during a trip. Although most of Euro NCAPs design requirements are consistent with drivers' preferences expressed in the

current survey, many drivers would like a reminder to last indefinitely until the child buckles up. NHTSA may want to consider a stronger duration requirement as well as the activation of an auditory reminder if belts are unbuckled during the trip.

There are some technical challenges in accurately detecting rear passenger presence. If they cannot be overcome, these may limit the effectiveness and the acceptance of rear seat reminders, especially reminders with long durations. Weight sensors are commonly used in front seating positions to detect adult occupants for airbag deployment, and these should work well for front passenger reminders. However, the sensors may not reliably discriminate between people, children in child restraints, animals, and cargo in rear seating positions. Parents might ignore or disable rear reminders that issue numerous false warnings, and false warnings also may annoy drivers without rear passengers. Future research should examine the effects of belt reminder system reliability on driver trust, acceptance, and detection of changes in rear passenger belt use.

There are some limitations to the current survey findings. Information on the population of drivers who transport front passengers or rear child passengers was unavailable, but the demographic characteristics of drivers in this survey differ in some respects from the U.S. population (U.S. Census Bureau, 2010). Compared with the entire U.S. population, a larger proportion of drivers who transport front passengers in this survey were 60 or older or had at least a college degree. Drivers who transport rear passengers interviewed in this survey were more affluent compared with U.S. households with children younger than 18, had a higher educational attainment than U.S. households with children 6-17 years old, and were older than the U.S. population with children younger than 12.

The relatively high educational attainment and income may explain why the driver-reported belt use of 8-15 year-old rear passengers (97%) in the current study was substantially higher than observed belt use rates for this group in 2011 (80%; Pickrell & Ye 2013). A recent national survey found selfreported belt use among those earning more than \$100,000 or those with at least a college degree was higher than those with lower income or educational attainment (Boyle & Lampkin 2008). Most full-time belt use drivers in the current study felt responsible for their children's belt use, nearly all would encourage their children to buckle up, and most support reminders. This means that the opinions

expressed in this survey may be positively biased and portray a more favorable view of rear reminders than would be found among the general population of drivers transporting children in the back seat.

In conclusion, passenger belt reminders can increase belt use by motivating passengers to buckle up and providing information about non-use to drivers. Many drivers, especially those who always use seat belts, said they would encourage passengers to buckle up and supported belt reminders for front or rear passengers. Most drivers wanted visual and auditory reminders for front and rear passengers, and also wanted reminders to last until passengers buckled up. Passenger belt reminders, especially reminders for rear seating positions, are less common in newer model year vehicles than reminders for drivers. The information from the current study suggests broad support for reminders for passengers, especially children in the back seat.

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REFERENCES

American Association for Public Opinion Research. *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys.* 7th ed. Lenexa, KS: Author; 2011.

Boyle JM, Lampkin C. 2007 Motor Vehicle Occupant Safety Survey Volume 2: Seat Belt Report. Report no. DOT HS-810-975. Washington, DC: National highway Traffic Safety Administration; 2008.

Farmer CM, Wells JK Effect of enhanced seat belt reminders on driver fatality risk. *J Safety Res.* 2010;4:53-57.

Ferguson SA, Wells JK, Kirley BB. Effectiveness and driver acceptance of the Honda belt reminder system. *Traffic Inj Prev.* 2007:8;123-129.

Freedman M, Levi S, Zador P, Lopdell J, Bergeron E. *The Effectiveness of Enhanced Seat Belt Reminder Systems – Observational Field Data Collection Methodology and Findings*. Report no. DOT HS-810-844. Washington, DC: National Highway Traffic Safety Administration; 2007.

Insurance Institute for Highway Safety. [Unpublished analysis of 2011 data from the Fatality Analysis Reporting System]. Arlington, VA: Author; 2013.

Kahane, CJ. Fatality Reduction by Safety Belts for Front-seat Occupants of Cars and Light Trucks: Updated and Expanded Estimates Based on 1986-99 FARS Data. Report no. DOT HS-809-1999. Washington, DC: National Highway Traffic Safety Administration; 2000.

Kidd, DG. Response of part-time belt users to enhanced seat belt reminder systems of different duty cycles and duration. *Transportation Res Part F*, 2012:15(5);525-534.

Kidd, DG, McCartt AT, Oesch NJ. *Attitudes toward Seat Belt Use and In-vehicle Technologies for Encouraging Belt Use*. Arlington, VA: Insurance Institute for Highway Safety; 2013.

Lerner N, Singer J, Huey R, Jenness J. *Acceptability and Potential Effectiveness of Enhanced Seat Belt Reminder System Features.* Report no. DOT HS-810-848. Washington, DC: National Highway Traffic Safety Administration; 2007.

Lie A, Krafft M, Kullgren A, Tingvall C. Intelligent seat belt reminders: Do they change driver seat belt use in Europe? *Traffic Inj Prev.* 2008:9:446-449.

MacLennan PA, McGwin Jr G, Metzger J, Moran SG, Rue III LW. Risk of injury for occupants of motor vehicle collisions from unbelted occupants. *Inj Prev.* 2004:10;363-367.

Morgan C. *Effectiveness of Lap/shoulder Belts in the Back Outboard Seating Positions*. Report no. DOT HS-808-945. Washington, DC: National Highway Traffic Safety Administration; 1999.

Nambisan SS, Vasudevan V. Is seat belt usage by front seat passengers related to seat belt usage by their drivers? *J Safety Res.* 2007:38(5);545-555.

Pickrell TM, Ye TJ. Seat Belt Use in 2012 – Overall Results. Report no. DOT HS-811-691. Washington, DC: National Highway Traffic Safety Administration; 2012.

Pickrell TM, Ye TJ. Occupant restraint use in 2011: Results from the National Occupant Protection Use Survey Controlled Intersection Study. Report no. DOT HS-811-697. Washington, DC: National Highway Traffic Safety Administration; 2013.

Solomon MG, Preusser DF, Tison J, Chaudhary NK. *Evaluation of the May 2007 Click It or Ticket Mobilization*. Report no. DOT HS- 811-239. Washington, DC: National Highway Traffic Safety Administration; 2009.

U.S. Census Bureau. *People and Households: Data by Subject*. Washington, DC: U.S. Department of Commerce; 2010. Available at: http://www.census.gov/people/. Accessed: Dec 5, 2012.

Williams AF, Reinfurt D, Wells JK. Increasing seat belt use in North Carolina. J Safety Res. 1996:27(1);33-41.

Williams AF, Wells JK, Farmer CM. Effectiveness of Ford's belt reminder system in increasing seat belt use. *Inj Prev.* 2002:8;293-296.

Table 1. Unweighted frequency and percentage of respondents in each sampling phase as a function	of
belt use and drivers who transport 8-15 year-olds in the back seat.	

				Part-time belt users and		Child in back seat		at	
8-15 year-olds Random sample		non-user oversample			0\	oversample			
in the back		(n=799)			(n=230)			(n=189)	
seat who use	Full-time	Part-time	Non-	Full-time	Part-time	Non-	Full-time	Part-time	Non-
seat belt	belt user	belt user	user	belt user	belt user	user	belt user	belt user	user
Yes	49	2	2	0	27	1	159	13	1
	(6%)	(<1%)	(<1%)	(0%)	(12%)	(<1%)	(84%)	(7%)	(1%)
No	677	59	10	0	171	31	16	0	0
	(85%)	(7%)	(1%)	(0%)	(74%)	(13%)	(8%)	(0%)	(0%)

Table 2. Percent distribution of the demographic characteristics of drivers who regularly transport a front passenger or a child passenger belted in the back seat and the type of vehicle by driver belt use.

	Drivers front n	transporting assengers	Drivers transporting children in back seat		
	noncp	Part-time		Part-time	
	Full-time	belt users and	Full-time	belt users and	
	belt users	non-users	belt users	non-users	
	(weighted	(weighted	(weighted	(weighted	
	n=330.2)	n=35.4)	`n=49)	n=4)	
Age			·		
18-24	9	11	2	13	
25-29	9	6	<1	0	
30-59	52	45	92	81	
60+	30	39	6	6	
Gender					
Male	55	64	46	79	
Female	45	36	54	21	
Educational attainment					
Less than high school graduate	3	1	1	15	
High school graduate	28	37	16	38	
Some college	24	20	18	24	
College graduate+	46	42	65	23	
Household income					
<\$15,000	8	7	3	0	
\$15,000-49,999	35	28	21	31	
\$50,000-74,999	24	31	21	32	
\$75,000-99,999	14	12	23	26	
\$100,000+	19	22	33	12	
Primary vehicle					
Car	57	44	38	27	
Minivan	8	8	20	18	
Pickup	15	24	14	48	
SUV	20	23	27	6	
Other type of van	1	1	1	0	

	Driver belt use			
		Part-time belt	-	
	Full-time	users and		
	belt users	non-users		
	[weighted	[weighted n		
	n (%)]	(%)]	Chi-square	
Among drivers who would not encourage				
passengers to buckle up, percent who agree with				
reasons why				
Belt use is personal choice	2.9 (27)	10.9 (88)	χ²[1]=8.8, <i>p</i> <0.01	
Belt use is passenger's responsibility	6.8 (64)	10.2 (80)	n.s.†	
Do not want to be nuisance	1.0 (9)	5.6 (47)	χ ² [1]=3.9, <i>p</i> <0.05 [†]	
Do not want to monitor passenger belt use	4.9 (45)	8.7 (71)	n.s.	
Not required by law	1.0 (9)	2.3 (19)	n.s.†	
Percentage of drivers who want specific functions of				
front passenger belt reminders				
Let driver know when passenger unbuckled	269.6 (82)	18.1 (52)	χ ² [1]=16.6, <i>p</i> <0.001	
Encourage passenger to buckle up	261.8 (81)	23.3 (67)	χ^{2} [1]=3.7, <i>p</i> =0.05	
Noto: Missing responses, refugels, or seese where resp	andonto india	otod thou did p	at know on anower	

Table 3. Weighted frequency and percentage of drivers who transport front passengers who agreed with various statements about front passenger belt use and belt reminders by driver belt use.

Note: Missing responses, refusals, or cases where respondents indicated they did not know an answer are excluded. [†] Indicates more than 25% of expected frequencies less than 5.

Table 4. Weighted frequency and percentage of drivers who want to be notified about front passenger belt use who agreed with various statements about reminders as a function of whether or not they would want the reminder to encourage belt use.

	Also want vehicle to	Do not want vehicle to	
	encourage	encourage	
	passenger to	passenger to	
	buckle up	buckle up	
	[weighted	[weighted	
	n (%)]	n (%)]	Chi-square
Percentage who want various types of notification			
for front passenger			_
Chime or buzzer	215.9 (84)	13.5 (60)	χ ² [1]=7.8, <i>p</i> <0.01
Visual diagram of seating positions and belt use	198.7 (78)	17.1 (74)	n.s.
Warning light or text display	214.4 (84)	13.0 (56)	χ ² [1]=11.9, <i>p</i> <0.001
Duration of notification would want for front			
passenger			
Last until passenger buckles	160.0 (63)	8.1 (35)	
Moderately long, several miles into trip	37.8 (15)	3.9 (17)	$v^{2}[3] = 11.3 \text{ p} = 0.05$
Brief and end shortly after vehicle ignition	51.7 (20)	9.3 (40)	χ [3]-11.3, μ <0.03
Should not tell passenger at all	3.9 (2)	2.0 (8)	
Total valid responses	253.3 (100)	23.2 (100)	

Note: Missing responses, refusals, or cases where respondents indicated they did not know an answer are excluded.

Table 5. Among drivers whose children in the back seat do not always use seat belts, percentage who agree with various statements about the situations of their children's non-use of seat belts

	n=15, weighted n=1.5
Child does not like belt	84
Child never fastened belt at the beginning of the trip	77
Child took off the seat belt	55
Short trip	30
Not required by law	23
Belt not available	17
Improper fit	16
Child does not need a belt	16

Note: Multiple responses allowed; percentages sum to more than 100 percent.

Table 6. Weighted frequency and percentage of drivers who transport a rear child passenger who agree with various statements about belt reminders by driver belt use.

	Belt u		
		Part-time	-
	Full-time	belt users and	
	belt users	non-users	
	[weighted	[weighted	Chi-
	n (%)]	n (%)]	square
Percentage who agree with role of rear seat child passenger			
reminders			
Let me know when child is unbuckled	39.1 (83)	3.1 (80)	n.s.†
To encourage child to buckle up	33.2 (72)	3.0 (75)	n.s.†
Among drivers who want to be notified about rear child			
passenger belt use:			
Percentage who want various types of notification about rear			
child passenger belt use			
Chime or buzzer	31.1 (80)	2.1 (70)	n.s.†
Visual diagram of seating positions and belt use	33.0 (87)	2.9 (94)	n.s.†
Warning light or text display	32.7 (84)	3.0 (97)	n.s.†
Duration of notification would want			
Last until child buckles	25.2 (64)	1.5 (48)	
Moderately long, several miles into trip	6.4 (16)	0.7 (23)	n a t
Brief and end shortly after vehicle ignition	7.3 (19)	0.8 (28)	n.s.*
Should not tell passenger at all	0.2 (1)	0.1 (2)	
Total valid responses	39.1 (ÌÓO)	3.0 (100)	

Note: Missing responses, refusals, or cases where respondents indicated they did not know an answer are excluded. [†] Indicates more than 25% of expected frequencies less than 5.

Table 7. Log-linear regression of passenger age and reported driver belt use on the likelihood of drivers encouraging an unbelted passenger to buckle up.

	Log			95%
	odds	Standard	Odds	confidence
Parameter	ratio	error	ratio	limits
Constant	1.05	0.24		
Passenger age	-0.04	0.01	0.96	(0.94, 0.98)
Driver belt use (full-time belt users vs. non-users)	3.17	0.29	23.73	(13.55, 41.55)
Driver belt use (part-time belt users vs. non-users)	0.64	0.26	1.90	(1.14, 3.16)
Passenger age x driver belt use (full-time belt users vs. non-users)	0.02	0.01	1.02	(0.99, 1.04)
Passenger age x driver belt use (part-time belt users vs. non-users)	0.01	0.01	1.01	(0.99, 1.03)



Figure 1. Percentage of drivers who would encourage passengers to buckle up as a function of passenger age and driver belt use.