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Prevalence of mobile phone vs. child-related driver distraction in a sample of families with young children

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Abstract

Motor vehicle crashes are the leading cause of accidental death in Australia, with substantial societal costs. Unlike crash test dummies, child vehicle passengers rarely sit still and their behaviour can often be unpredictable. Analysis of naturalistic driving video data from journeys undertaken by 12 families with young children revealed that children accounted for 12% of all potentially distracting activities, with drivers in this study interacting with rear seat child occupants 12 times as often as they did with mobile phones. Educational interventions to reduce driver distraction are discussed and the use of the naturalistic driving methodology is proposed to investigate the

potential benefits of a novel, best practices-based road safety education program targeting child-related driver distraction. Outcomes of such an evaluation could be used to inform and refine future education strategies designed to minimise child-related driver distraction and crash risk, and to improve overall road safety in Australasia.[1]

Keywords

Child restraint systems, CRS, Road safety, Road safety education

Introduction

Driver distraction is the diversion of attention away from activities critical for safe driving towards a competing activity [8, 12]. A distraction can be either in-vehicle ('internal') or outside the vehicle ('external'). Generally, there are four potential sources of driver distraction: (i) visual (e.g. looking away from the road at a non driving-related object or person); (ii) cognitive (e.g. thinking about something other than the driving task); (iii) physical (e.g. dialling a mobile phone or tuning a radio); and (iv) auditory (e.g. responding to a passenger or a ringing mobile phone). There is ample evidence that driver distraction impairs driving performance, making it a significant cause of motor vehicle crashes [6, 12, 17]. The costs of distracted driving are undeniable. In New Zealand, for example, research suggests that distraction contributes to at least 10% of fatal crashes and 9% of injury crashes, with an estimated social cost of NZ$413 million (in 2008) [18].

In recent years, interest in driver distraction as a source of crash causation has increased due to the increasing prevalence of mobile communications and 'infotainment' technology, such as mobile phones. The observed prevalence of mobile phone use while driving varies depending on the country or jurisdiction in which it is assessed. In Australia, where the use of handheld devices by drivers is prohibited in all states and territories, a recent roadside observational survey found 5% of drivers to be engaged in mobile phone use, including 3.4% of drivers who were using it in handheld mode, including text-messaging [14, 20] (hands-free phone use in that study was recorded in cases where a driver was wearing an earpiece or headset, or a speaker phone was visible, and the driver was talking in a conversational manner with no passengers in the vehicle). This use rate is similar to those observed in previous surveys of jurisdictions within the United States and Canada where handheld mobile phone use is also banned [3, 9, 10]. A recent internet survey of 287 Victorian drivers found that almost 60% reported using a mobile phone while driving, and over one-third of those drivers admitted using it in the illegal, handheld mode [19].

In 2006, approximately nine million Australians, or 51% of the adult population living in a family situation, had children aged 15 and under [2]. In the 12 months ending 31 October 2007, there were an estimated 14.8 million vehicles registered in Australia, most of which (78%) were passenger vehicles. Travel survey data from the Australian state of Victoria indicate that children under the age of 15 spend, on average, approximately four and a half hours per week travelling as passengers in cars [5]. In New Zealand, where travel survey data is more comprehensive, yet the environment similar to Australia, 35% of passenger vehicle trips had passengers present, with children accounting for 26% of those passengers [11]. It is clear that the practice of transporting children as passengers in motor vehicles is common.

Anecdotally, the carriage of children as passengers is recognised by many as a significant, though unavoidable, source of driver distraction. Survey studies also implicate child passengers as a significant source of driver distraction. A United Kingdom survey revealed that children were far more likely to distract drivers from their task than anything else; 53% of over 500 people surveyed reported child passengers to be the biggest distraction while driving [15]. In Australia in 2011, 35% of over 3700 driver respondents to an internet survey [1] reported children in the car to be the most common source of driver distraction. Regrettably, there have been few systematic evaluations of the effect of child passengers on driver performance.

It is of benefit to quantify and describe the nature of driver distraction caused by children in order to develop and propose countermeasures that are effective while, at the same time, logical and feasible. An extensive literature review revealed few empirical studies that considered rear seat child occupants as a source of distraction. In an observational study conducted by Stutts and colleagues [16], the most common reported distractions in terms of overall event durations were eating and drinking, distractions inside the vehicle (reaching or looking for an object, manipulating vehicle controls), and distractions outside the vehicle (often unidentified). Children were found to be about four times, and infants almost eight times, more likely than adults to be a source of distraction to the driver, based on the number of distracting events per hour of driving.

The collection of naturalistic observational data during vehicle trips is an effective means to investigate child-driver interaction in vehicles and to more systematically quantify the relationship between rear seat child passengers and driver distraction. Comparing the prevalence of potentially distracting child-driver interactions to the prevalence of another source of driver distraction—mobile telephone use—can also frame the issue in relative terms. If a problem is identified, it may be possible to limit child-related driver distraction through the development and implementation of effective educational countermeasures. The research and results described here represent a portion of a larger naturalistic observational pilot study that was designed to evaluate the positioning of child vehicle passengers within their Child Restraint Systems (CRS) and their interactions with drivers [3,8,16]. The focus of the present paper is on driver distraction associated with rear seat child passengers. In particular, the paper considers the prevalence of this type of distraction in the context of other more widely studied/recognised sources of distraction including mobile telephone use, with the aim of informing future targeted educational programs to limit driver distraction.

Method

Experimental Design

A naturalistic observational study design was used to investigate whether, and to what extent, child rear seat passengers are a source of driver distraction.

Participants

Twelve families volunteered to participate in the study. The families included at least one licensed driver aged between 25 and 39 years, and at least one child aged between one and eight. All drivers were experienced (licensed for > 5 years), reported driving between five and ten kilometres per week with children as passengers, and at least 100 kilometres per week on average, and had not been involved in a crash in the previous two years. All participant drivers had normal or corrected-to-normal vision. Across all families, there were 25 child passenger participants. Families were recruited through word-of-mouth and through an existing participant database. Ethics approval for the study was obtained from the Monash University Human Research Ethics Committee. Participants were compensated $100 for their time and as partial recompense for petrol costs.

Equipment

The vehicle used in the study was a luxury model, large family sedan with automatic transmission. The study vehicle was fitted with a discrete camera and recording system which comprised four cameras, providing images of the driver and front seat passenger, the rear seat child passengers and the traffic ahead. The video recording system, which also recorded audio data, was strategically positioned to gain an overall view of the forward road scene and the interior of the cabin with minimal disruption to the driver's view and concealed so as not to be obvious to the vehicle passengers.

Procedure

Participants were required to drive the instrumented study vehicle on their regular journeys for a period of three weeks. Vehicle handover took place at the participants' homes. A CRS fitting specialist attended each participant's home to make sure that all CRS were installed correctly. All children used their regular CRS, booster seats, or H-harness while travelling in the study vehicle. At the end of the three-week observational study period, the study vehicle was collected, and CRS were re-installed in the family's own vehicle.

Video data coding

To aid in the analysis of the video data, each trip made by participants was divided into three sub-sections: pre-journey, journey, and post-journey. The 'journey' sub-section began when the vehicle began to move and ended when the vehicle was put into 'park', and is the trip section reported in this report. Key journey variables that were coded included: duration, time-of-day, driver ID, presence of front seat passenger, and number of child passengers. Road and traffic conditions such as traffic density (low, medium, high) were also classified, as were child passenger activities and communication patterns (e.g., whether they were talking, crying, fighting, amusing themselves, eating or drinking, sitting quietly, watching DVD, or sleeping). All activities with the potential to divert attention away from activities critical for safe driving [8] were coded. All activities that involved the driver looking away from the forward roadway for more than two seconds were also coded. Glances away from the forward roadway of greater than two seconds are associated with approximately twice the near-crash/crash risk compared to normal, baseline driving [6]. Data coding was conducted using Snapper performance analysis software (Webbsoft Technologies, UK), which provided a viewing platform that facilitated the logging of events into a database. Inter-rater agreement for two data coders measured across 10% of trips was adequate at 87.8%.

Statistical analyses

The study used a naturalistic methodology to study driver behaviour and the potential for driver distraction. Dependent measures included the driver's engagement (frequency and duration) in potentially distracting activities. Associations between driver characteristics (e.g., gender) and their engagement in potentially distracting activities were compared using *t*-tests. In all cases, a two-tailed α-level of .05 was used to determine statistical significance. Prior to all analyses, data were checked for violations of statistical assumptions, outliers and missing data points. Parents' responses to the questionnaire were summarised using descriptive statistics. Univariate analyses were used to investigate sources of driver distraction and to examine the types of child-related activities that drivers engaged in while driving.

Results

Child passenger characteristics

A total of 25 children (56% male) participated in the study as passengers. The majority of children used either a forward-facing CRS (44%) or booster seat (40%) when travelling. Most families (7 of 12) had two children, two families had one child, and three families had three children.

Observed 'potentially distracting activities'

To limit the video data analysis to a manageable size, analysis of only a select number of journeys per family was conducted, including data from the first four journeys for all families (48 total) plus four randomly selected journeys for 11 of the 12 families (44 total). For the 92 journeys analysed, 19 drivers and 25 children were observed for a total of 24 hours and 54 minutes.

Video analysis revealed the mean journey duration to be 16 minutes, 14 seconds (range 2 minutes to 3.5 hours). Most journeys (89%) were made during the day, and did not include a front seat passenger (65%). Almost all of the journeys

analysed took place in urban areas (97%), on suburban roads (94%), and under low complexity (91%) (defined as minimal traffic congestion). Use of the DVD player was observed in only 6% of trips.

Drivers were observed to engage in at least one potentially distracting activity in 98% of the journeys analysed. In total, across all of the journeys analysed, drivers were observed to be engaged in 2439 potentially distracting activities. Male drivers (fathers) were significantly more likely to engage in potentially distracting activities, $t(32.147) = -3.094, p < .01$, and were distracted for significantly longer periods of time, $t(32.761) = -2.945, p < .05$, than female drivers (mothers). The most common potentially distracting activities were grooming-related (37%), followed by those that involved some kind of in-vehicle adjustment (e.g., to the seat, seatbelt, or rearview mirror) (13%). Interactions with children accounted for 12% of the potentially distracting activities, while interactions with mobile phones accounted for 1% of all activities (Figure 1).

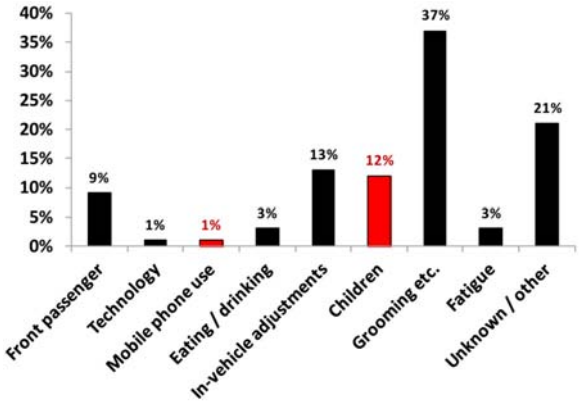

Figure 1. Relative frequency of the types of potentially distracting activities engaged in by drivers

Interactions with rear seat child passengers

Examples of some of the interactions with rear seat child passengers observed are presented in Figure 2.

Activity type. The most frequently observed child passenger-related activities engaged in by drivers were checking on their children by either turning back to look at them or by viewing them through the rearview mirror (76%), engaging in conversation with the children (16%), and assisting the children (8%; for example, passing food and drink—see Figure 2, below).

Driver characteristics. Interestingly, fathers (male drivers) were observed to be distracted by their children for significantly longer periods of time than were mothers (female drivers) (26 vs. 8 seconds), $t(30.321) = -1.567, p < .05$. Although not statistically significant, fathers also tended to be more likely to be observed engaging in child passenger-related activities than mothers, $t(88) = -0.619, p > .05$.

Activities where drivers' eyes were off the road for > 2 seconds and the vehicle was in motion

Technology- vs. child-related activities. Interacting with child passengers represented a significant proportion (12%) of the total number of potentially distracting activities engaged in by drivers in this study; this interaction appears to be a far more common activity than technology and mobile phone use while driving (see Figure 1). However, when a measure of driver distraction with a demonstrated increased crash risk was used, that is, the proportion of potentially distracting activities that are engaged in while the driver's eyes are off the road for more than two seconds *and* while the vehicle is in motion, a slightly different picture emerged: 40% of interactions with technology (which accounted for 2% of all distracting activities) were carried out with the driver's eyes off the road for longer than two seconds, making the relative proportion of this activity compared to all other potentially distracting activities 0.8%. On the other hand, only 10% of drivers' interactions with children (which accounted for 12% of all distracting activities) were associated with the driver's eyes off the road for more than 2 seconds and the vehicle in motion, making the relative proportion of that activity 1.2%.

Driver characteristics. Male drivers were significantly more likely to engage in potentially distracting child passenger-related activities while the vehicle was moving and their eyes were off the road for greater than 2 seconds than female drivers (41% vs. 20%), $x^2(1) = 13.434, p < .001$. As well, drivers were significantly more likely to engage in child passenger-related activities with their eyes off the road for greater than 2 seconds while the vehicle was in motion when there was a front seat passenger present (47% vs. 9%), $x^2(1) = 25.347, p < .001$.

Figure 2. Driver interactions with rear seat child passengers (left: passing drink; centre: adjusting DVD player; right: talking to child)

Discussion

Collectively, results demonstrate that drivers' interaction with rear seat child passengers has the potential to result in driver distraction and, in instances where the driver's eyes are off the forward roadway for more than 2 seconds while the vehicle is in motion, may be associated with a crash risk of twice that of normal, non-distracted, driving [6]. Drivers were observed to be engaged in potentially distracting activities with children more often than interacting with mobile phones and other in-vehicle technology. However, interactions with technology were associated with a relatively greater proportion of instances where the driver's eyes were off the road for more than 2 seconds while the vehicle was in motion. Despite this relatively greater proportion of high risk interactions, the overall prevalence of drivers' activities with children was greater than the prevalence of technology and mobile phone use. This finding underscores the need for further study in the area of child passenger-related driver distraction, and the need for effective countermeasures.

The overall prevalence results are comparable to those from another, more extensive naturalistic study, the 100-car study [6], in terms of the prevalence of potentially distracting (what Klauer et al. refer to as 'inattentive activities') behaviour in which drivers were observed to engage. While task duration was not recorded in that study, the finding that 73% of all six-second video segments analysed contained at least one form of driving inattention indicated that drivers were engaging in secondary tasks, driving while drowsy, or looking away from the forward roadway very frequently. This high frequency was mirrored in the present study, where 98% of trips involved the driver engaging in at least one potentially distracting behaviour.

The rate of mobile phone use in this study is comparable to the rate observed in a recent observational survey of Melbourne-area drivers [14, 20, 21], where 5% of drivers were observed engaging in a variety of mobile phone activities, including talking on a hand held phone. Considering that drivers in the present study were aware that their behaviour was constantly being recorded, that rate can be deemed comparable to the 2% of drivers in the present study who were observed to be using a mobile phone.

It has been proposed that educational countermeasures can be developed to effectively reduce, or mitigate, the prevalence and effects of driver distraction generally, including distraction caused by mobile phone use as well as that which is child-related [4,13]. Education and public awareness campaigns have been identified by experts in road safety as a 'priority need' to minimise driver distraction [4]. Of particular relevance, recommendations regarding distraction-related educational countermeasures from the 2005 International Distracted Driving conference [4] include that awareness and educational activities should target specific behaviours and audiences (for example, parents with young children), and identified children (as so-called distraction 'influencers') as a specific target audience for distraction-related campaigns. These recommendations suggest that the development of an educational program targeting both parents *and* their children would have the potential to effectively minimise child-related driver distraction.

Although distracted driving educational programs do exist, there are few empirical evaluations that have been conducted. One evaluation study that has been identified evaluated the effectiveness of a brief, internet- and video-based, educational program on driver distraction administered to over 1400 respondents [7]. Results revealed that, while exposure to the program was not associated with respondents' self-reported anticipated future distraction-related behaviours, it was associated with increased ratings of perceived danger of certain distracting activities. One of the distracting activities that was associated with increased perceived ratings of danger following exposure to the educational program was 'tending to child', indicating that it is possible to influence drivers' perceptions in this area. This finding also suggests that an educational program targeted more specifically on child-related driver distraction may have the ability to go further and influence drivers' actual in-vehicle behaviour, and to minimise the prevalence of this type of distraction. Unfortunately, the above evaluation study used only indirect measures of driving performance—self-reported anticipated frequency of distracted driving and perceived danger of distracting activities - and so we cannot know if the increases in danger perceptions were associated with any actual changes in respondents' driving behaviour.

The naturalistic driving method, described above, offers the unique opportunity to evaluate such a brief, child-related driver distraction educational program in a much more effective manner, by collecting and analysing objective measures of rear seat child passenger behaviour as well as measures of driver distraction and performance. In fact, the naturalistic methodology is particularly well-suited for this purpose, and to elucidate any correlative relationship(s) between the two behaviours. It is anticipated that future research by the authors will include such an evaluation. The aims of the research will be to not only quantify and describe the nature of child passengers' behaviour and interactions with the driver, but to quantify and describe the nature of the resultant driver distraction and performance.

Limitations

During data analysis, some issues regarding data precision emerged that may limit some of the study findings; for example, it was difficult to distinguish whether drivers' glances in the rearview mirror were directed towards children or towards rear traffic. Rearview glances were coded as a potentially distracting activity only if drivers were also engaged in dialogue with the children while looking in the rearview mirror. An improved camera system could potentially alleviate this shortcoming in future studies.

The use of a dedicated test vehicle may be considered to be a further limitation of the study protocol, in that children and drivers may have both behaved differently because of the novel environment. This may, in fact, have been the case—not only were participants required to drive a luxury model study vehicle, but they were also instructed to drive safely and legally, and were

aware that their behaviour was being recorded by video cameras. As such, the observed results are quite probably an *underestimation* of the real world prevalence of potentially distracting child passenger-related activities in drivers carrying young children. Despite these study conditions, participants were observed to engage in a range of potentially distracting activities, some of which (hand held mobile phone use) were also illegal.

Conclusions

Observation of naturalistic video data revealed that children accounted for 12% of all potentially distracting activities, with drivers in this study interacting with rear seat child passengers 12 times as often as they did with mobile phones. The findings demonstrate that child-related driver distraction represents a distinct road safety issue that is preventable. The feasibility of the naturalistic observational method for studying child behaviour in vehicles and the potentially distracting interactions that can take place between rear seat child passengers and drivers was demonstrated. Educational programs targeting driver distraction more generally have been put forth as feasible countermeasures to the issue, and represent a potential method by which to mitigate child-related driver distraction as well. Future research using the naturalistic driving methodology should focus on the evaluation of effective educational programs that target child-related driver distraction. In the meantime, drivers who travel with children as passengers should be reminded to be prepared, be patient, and focus on the road (and not the kids!).

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Notes

[1] This paper reports data that were previously presented at the 2nd International Conference on Driver Distraction and Inattention, held in Gothenburg, Sweden in 2011 (5-7 September).

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