What are Australian drivers doing behind the wheel? An overview of secondary task data from the Australian Naturalistic Driving Study

Kristie L. Young[1], Rachel Osborne[1], Sjaan Koppel[1], Judith L. Charlton[1], Raphael Grzebieta[2], Ann Williamson[2], Narelle Haworth[3], Jeremy Woolley[4], and Teresa Senserrick[2]

[1] Monash University Accident Research Centre, Monash University, Australia
[2] Transport and Road Safety (TARS) Research Centre, University of New South Wales, Australia
[3]Centre for Accident Research and Road Safety – Queensland (CARRSQ), Queensland University of Technology, Australia
[4] Centre for Automotive Safety Research (CASR), University of Adelaide, Australia

Corresponding Author: Kristie Young, 21 Alliance Lane, Clayton, Victoria, kristie.young@monash.edu*,* +613 9905 1258.

This peer-reviewed paper was first presented as an Extended Abstract and Oral Presentation at the 2018 Australasian Road Safety Conference (ARSC2018) held in Sydney, NSW, Australia and first published in the ARSC2018 Proceedings in the form of an Extended Abstract. It was expanded into a 'Full Paper' and underwent further peer-review by three independent experts in the field. It is being reproduced here with the kind permission of the authors and is now only available in this edition of the JACRS.

Key Findings

- Driver engagement in secondary tasks is frequent;
- Drivers engage in a secondary task every 96 seconds, on average;
- It is not unusual for drivers to engage in multiple tasks at once;
- Drivers were significantly more likely to initiate a secondary task when stationary;
- Only 5.9% of the secondary tasks events were associated with a driving incident.

Abstract

Using data from the Australian Naturalistic Driving Study (ANDS), this study examined patterns of secondary task engagement (e.g., mobile phone use, manipulating centre stack controls) during everyday driving trips to determine the type and duration of secondary task engaged in. Safety-related incidents associated with secondary task engagement were also examined. Results revealed that driver engagement in secondary tasks was frequent, with drivers engaging in one or more secondary tasks every 96 seconds, on average. However, drivers were more likely to initiate engagement in secondary tasks when the vehicle was stationary, suggesting that drivers do self-regulate the timing of task engagement to a certain degree. There was also evidence that drivers modified their engagement in a way suggestive of limiting their exposure to risk by engaging in some secondary tasks for shorter periods when the vehicle was moving compared to when it was stationary. Despite this, almost six percent of secondary tasks events were associated with a safety-related incident. The findings will be useful in targeting distraction countermeasures and policies and determining the effectiveness of these in managing driver distraction.

Keywords

Distracted driving, Secondary tasks, Road safety, Naturalistic driving study; Safety-related incident

Introduction

Distracted driving is widely acknowledged as a significant threat to the safety of all road users (WHO, 2011). While the exact role of distraction in road crashes in Australia is difficult to quantify, given a lack of systematic reporting, there is growing evidence that it is an important contributor to both fatal and serious injury crashes. Indeed, in an in-depth crash investigation study, driver distraction was identified as the main contributing factor in almost 16 percent of serious injury road crashes resulting in hospital attendance in Australia (Beanland et al., 2013). Similar figures are reported in the United States, where distracted driving is a main contributing factor in 10 percent of fatal and 15 percent of injury crashes (NHTSA, 2017).

Research shows that drivers spend a vast amount of driving time engaging in secondary tasks that are unrelated to driving (Dingus et al., 2016; Lansdown, 2012; Young & Lenné, 2010). A secondary task is a discretionary task, performed concurrently with driving, but that is not critical to the primary driving task. Engagement in secondary tasks plays a large role in distracted driving because it requires drivers to divert their visual and/or cognitive resources away from the primary driving task of safe vehicle control. To date, much of our knowledge of Australian drivers' engagement in distracted driving has been informed by self-report surveys and crash data, both of which are subject to reporting bias (Shinar, 2017). The Australian Naturalistic Driving Study (ANDS) involved instrumenting everyday Australian's vehicles with driving sensor and video recording equipment and offered a unique opportunity to capture driver engagement in secondary tasks under real-world driving conditions and for an extended period of time (e.g., four months).

Using naturalistic driving data from the ANDS, this study examined patterns of secondary task engagement during everyday trips to determine the type and duration of secondary task engagement and the number and type of safety-related incidents (e.g., errors, risky driving behaviours and conflicts) associated with secondary task engagement. To extend previous naturalistic driving study research which has focussed on mobile phone use (Funkhouser & Sayer, 2012; Tivesten & Dozza, 2015), this paper examined a wide range of technology- and non-technology based secondary tasks, including interacting with centre stack and steering wheel controls, eating, drinking, mobile phone use and interacting with passengers.

Methods

This study used data collected as part of the ANDS (Williamson et al., 2015). Three hundred and forty-six privately owned vehicles (n = 185 from New South Wales; n = 161 from Victoria) were equipped with Data Acquisition Systems (DAS) and driven for a period of four months by 346 primary drivers and 33 additional drivers who also drove the participating vehicles on some occasions (n = 379).

The DAS equipped to each vehicle was supplied by the Virginia Tech Transportation Institute (VTTI) and had been used in the Strategic Highway Research Program (SHRP2) study (Antin et al., 2011). These comprised sensors and data-loggers, allowing the continuous recording of vehicle data and video while the vehicle ignition was on. Variables captured included: acceleration in multiple axes, gyroscopic motion, indicator status, speed and Global Positioning System (GPS) position (see Antin et al., 2011 for further details). A continuous multi–camera video recording system captured the driver's face, forward- and rear-views, and a view of driver interaction with the dashboard and other devices at a rate of 15 Hz. The resolution of the cameras was not high enough to determine what specific tasks were being performed in relation to the vehicle controls and buttons (e.g., using radio or climate controls) or portable devices (e.g. texting or dialling a phone), thus broader categories of 'manipulating phone' and 'adjusting centre stack controls' were used.

Trip selection and coding

Approximately 1.95 million kilometres of driving was collected during the study from the 379 participating drivers. The data used in this paper comprised randomly selected trips from the available data set of 194,961 trips. A random number table conforming to the Trip ID parameters was used to select the trips for analysis. A total of 185 trips (i.e., 2,592 minutes of driving) were viewed and manually coded for secondary task engagement, of which 175 (95%) contained one or more secondary task events and only ten trips involved no secondary tasks. The average length of the coded trips was 14 minutes (SD = 10.9 mins; Range: 2-54 mins). In total, 117 different drivers were observed during the coded trips (M = 46.7 years, SD = 12.3 years; 45% males). The number of trips coded for each driver ranged from one to 12.

Two analysts viewed entire driving trips and manually coded sections where drivers were observed engaging in at least one secondary task (termed secondary task events). Trips were not coded if they lasted less than one minute, longer than one hour or if a camera view was missing. The four camera angles were viewed using Camtasia video viewing and editing software and the coded secondary task event data was entered into an electronic database.

A range of categorical variables were coded for each secondary task event identified using the video data. These included: secondary task type, passenger presence, driving context, self-regulatory behaviour (task interruptions) and any safety-related incidents that occurred while the driver was engaged in the secondary task. All variables were coded once at the point of secondary task initiation for each secondary task event, apart from self-regulation and incidents which were coded whenever they occurred. The start of each secondary task event (and the coding) depended on the specific task being carried out, but was typically defined as the first glance to an area, object or event of interest, when the driver's hand first touched an object, or they first opened their mouth to speak. The end of the event was defined as the last glance to the area, object or event, when the hand was first removed from the object or drivers closed their mouth. Drivers had to disengage from the task for at least 20 seconds for it to be classified as the end of the task, otherwise it was coded as an interruption, whereby drivers would temporarily stop the task and turn their attention elsewhere (usually the roadway) and then resume the same task.

Safety-related incidents involved driving errors (e.g., failing to indicate), unsafe driving behaviours (e.g., swerving in lane) and conflicts with other road users (e.g., failing to yield to pedestrians) that appeared to be directly caused by engagement in the secondary task(s).

A modified version of the SHRP2 coding protocol was used to classify 29 different types of secondary tasks. Table 1 lists the secondary tasks engaged in during the 1,603 secondary task events identified. A secondary task was defined as a discretionary task, performed concurrently with driving, but that is not critical to the primary driving task. Thus, secondary tasks do *not* include tasks such as changing gears, using indicators, checking the speedometer or mirrors (unless drivers were clearly using the mirrors to perform a non-driving task), or looking out the windows to check traffic or perform head checks. A range of non-critical vehicle tasks are included, however, such as adjusting mirrors, windows, seatbelt and sun visor, because these tasks are not directly related to the primary tasks of vehicle control and safe travel. If drivers engaged in multiple secondary tasks at the same time (e.g., pressing radio button while conversing on a hands-free phone), the number and type of secondary tasks engaged in were recorded.

Results

Secondary task engagement and duration

A total of 1,603 secondary task events were identified from the coded driving trips. On average, drivers engaged in a secondary task every 96 seconds (1.6 mins) of driving. Table 1 displays an overview of driver engagement in secondary tasks. The most commonly performed tasks were of short duration (< 5 seconds) and involved drivers adjusting the centre stack controls (e.g. radio) and vehicle devices and controls that are not critical to driving (e.g., seat belt, mirrors, sun visor). Looking at events and objects outside the vehicle (e.g. pedestrians, buildings) was also common.

Table 1. Number of secondary tasks and mean (SD) duration (seconds) of individual secondary tasks when moving and stationary

Secondary Task	Moving		Stationary	
	N	Duration	N	Duration
All secondary tasks	*1,176*	*41.3 (159.1)*	*427*	*47.3 (190.8)*
Adjusting steering wheel buttons	44	1.7 (2.3)	11	2.9 (2.5)
Adjusting centre stack controls (e.g. radio, climate controls)	217	4.3 (8.3)	45	3.4 (3.5)
Adjusting non-critical vehicle devices (e.g. seatbelt)	263	2.5 (4.9)	42	5.6 (7.7)
Drinking	14	72.1 (121.8)	10	81.2 (121.9)
Eating	17	253.2 (311.7)	1	414.8 (0)
Holding object (other than phone)	18	53.7 (73.8)	9	16.4 (15.6)
Looking at an object/event OUTSIDE vehicle	117	8.3 (12.7)	79	14.2 (14.6)
Looking at object INSIDE vehicle (not reaching/ touching it)	42	3.9 (6.0)	24	6.5 (8.7)
Manipulating object (other than phone)	16	56.0 (122.9)	22	17.9 (18.6)
Mobile phone, holding	14	116.4 (211.6)	3	95.2 (153.3)
Manipulating phone (hand-held)	31	24.3 (24.6)	23	30.7 (25.1)
Manipulating phone (hands-free)	12	28.2 (45.5)	6	6.4 (7.7)
Mobile phone, talking/listening (hand-held)	5	398.2 (485.6)	2	55.8 (30.7)
Mobile phone, talking/listening (hands-free)	13	273.3 (310.5)	3	517.1 (515.3)
Personal hygiene	84	9.3 (15.3)	57	12.7 (11.6)
Reaching for object/phone (includes moving object/phone)	67	6.3 (8.7)	49	8.5 (10.0)
Reading	0	-	1	9.0 (0)
Talking to front passenger	82	296.6 (433.3)	17	522.0 (659.9)
Talking to rear passenger	5	281.0 (319.8)	7	541.3 (395.4)
Talking/Singing to self	94	33.1 (57.0)	7	9.0 (11.3)
Writing	0	-	1	36.8
Other	21	12.8 (13.9)	8	14.9 (7.5)

Using a mobile phone, including holding, manipulating or talking on a hand-held or hands-free phone, accounted for 7.4 percent of the secondary tasks observed. Of concern, 7.2 percent of the secondary tasks involved drivers engaging in the high-risk task of reaching for objects (e.g., hairbrush, book) or their mobile phone, with over half of these reaching events (57.8%) undertaken while the vehicle was moving. The least common tasks were (paper-based) reading and writing and both of these tasks were initiated only while the vehicle was stationary.

Whether the vehicle was stationary or moving at the time of secondary task initiation was examined. Stationary included any time during the trip that vehicle speed was 0 km/h, including when stopped in heavy traffic, at traffic lights or stop signs, or when parked. When looking at the overall numbers, drivers initiated engagement in a greater number of secondary tasks while the vehicle was moving (M = 6.3 tasks) compared to when stationary (M = 2.3 tasks). However, it is important to take into account the fact that drivers in the sample spent an average of 80.6% of their trip with the vehicle moving, meaning there was greater opportunity for drivers to engage in secondary tasks while in motion. A negative binomial regression was conducted to examine if the number of secondary tasks engaged in per minute of driving differed according to whether the vehicle was moving or stationary, taking into account the proportion of time spent moving and stationary. The Generalised Estimating Equation (GEE) model was specified with a negative binomial error function and a log link function, while the inter-correlation between the repeated measures was specified as unstructured. The natural log of duration moving and stationary was used as an offset variable. A significant difference was found in the number of secondary tasks initiated per minute of driving when moving versus stationary (Wald χ^2 (1) = 20.3, $p < 0.001$). The incidence rate of secondary tasks initiated per minute was 47% higher when stationary than when moving (Incidence rate ratio (IRR) = 1.465, p < 0.001). In other words, drivers initiated a secondary task every 107 seconds, on average, while the vehicle was moving and every 68 seconds, on average, while the vehicle was stationary.

The mean duration (in seconds) of the secondary tasks engaged in when driving was also examined to identify if drivers regulate the time they spend engaged in secondary tasks according to whether they initiated the task when moving versus stationary. There was large variability in the duration of the secondary tasks, even within the task categories, as reflected in the high standard deviation values (Table 1). Across all secondary tasks combined, drivers spent longer engaging in individual tasks that were initiated when the vehicle was stationary (M = 47.3 s) compared to those tasks initiated when the vehicle was moving (M = 41.3 s); however, this difference was not statistically significant, t(114) = -0.54, p = 0.592. When looking at the secondary task categories individually, it is apparent that around half of the tasks had longer mean durations if they were initiated while in a moving vehicle, while the other half had longer mean durations if they were initiated when stationary. Two general patterns were discernible when comparing the task duration and vehicle movement data. First, drivers spent longer talking with passengers when these tasks were initiated while moving, likely reflecting that drivers spent more of their driving time with the vehicle in motion than stationary. Second, drivers limit their exposure to phone-related secondary tasks, with the mean duration of the phone tasks considerably lower when initiated while the vehicle was moving compared to when it was stationary.

A Mann-Whitney U test was also conducted to examine if the number of secondary tasks engaged in differed according to passenger presence. Tasks involving talking with passengers were excluded from this analysis. Results revealed that, while there was a trend for drivers to engage in a higher number of secondary tasks per trip when no passengers were present (M = 8.7 vs. 6.9 tasks), this was not a statistically significant difference (U = 3770.5, p = 0.701).

Just over 20 percent (20.7%) of the secondary task events identified involved the driver engaging in multiple non-driving tasks at once. When multiple tasks were engaged in, this typically involved drivers interacting with passengers while also adjusting non-critical vehicle controls or devices (i.e. adjusting seatbelt), performing personal hygiene tasks or looking at objects and events outside the vehicle.

Safety-related incidents

A total of 95 (5.9%) of the secondary tasks events were associated with a safety-related incident (Table 2). Many of these incidents involved a failure to use the indicators or a delay in drivers detecting that the traffic lights had turned green or that vehicles in front had moved away from the lights. However, several incidents were more serious, with drivers veering out of their lane, drivers failing to detect the vehicle ahead braking suddenly and failing to yield to pedestrians on a pedestrian crossing. There was also a number of incidents where it was clear that the directing of attention away from the driving task to secondary tasks led to 'poor situation awareness', or attentional failures. Examples of these failures included not seeing a cyclist until the last second, failing to react to a bus indicating to pull out of a stop, driving much slower than the surrounding traffic and failing to see traffic backed up on the other side of a roundabout and then blocking the roundabout.

The majority of the observed incidents occurred while drivers were engaged in secondary tasks that have been shown in previous research to have a high crash/near crash risk (Klauer et al., 2006). Just under one quarter (23.2%) of the incidents observed occurred while the driver was using a mobile phone (hand-held or hands-free). A further 20% of incidents occurred while the driver was engaging in personal hygiene tasks, 10.5% occurred when drivers were reaching for an object or phone and 9.5% occurred when drivers were holding or manipulating an object other than a mobile phone (e.g., sunglasses). Finally, 20 (21%) of the incidents occurred while drivers were engaging in more than one secondary task at once (e.g., adjusting controls while also interacting with passengers).

Table 2. Number and percentage of safety-related incidents occurring during secondary task engagement

Incident	N	%
All incidents	*95*	*100*
Apparent failure to see traffic lights change from red to green/ vehicle ahead move off	48	50.5
Poor situation awareness	20	21.1
Lane excursion	11	11.5
Swerving in lane	8	8.4
Failure to indicate	5	5.3
Hard braking	2	2.1
Failure to yield to pedestrians	1	1.1

Discussion

The ANDS data revealed some interesting findings regarding Australian drivers' engagement in secondary tasks and context in which they choose to engage. Driver engagement in secondary tasks was frequent, with drivers engaging in a secondary task once every 96 seconds, on average. It was also not unusual for drivers to engage in multiple tasks at once. The more common secondary tasks tended to involve short (< 5s), discrete button presses of the centre stack controls or interactions with non-critical vehicle controls and devices, such as the seat belt and mirrors. However, tasks of longer duration and those shown in previous research to be high-risk were also observed. Using a mobile phone, for example, accounted for seven percent of all secondary tasks and was associated with almost one quarter of the safety-related incidents observed. Hand-held phone use was more common than hands-free (82.1% of phone tasks) despite being illegal in both Victoria and New South Wales. There was, however, there was some evidence that drivers attempted to limit their exposure to risk, with the duration of hand-held phone tasks typically lower when initiated while the vehicle was moving. Another high-risk activity frequently observed was reaching for objects or a phone, which made up 7.2% of the secondary tasks observed. Previous naturalistic driving research has shown that reaching for an object is associated with up to a 9.1 greater odds of being involved in a crash or near-crash (Dingus et al., 2016; Klauer et al., 2006). Both these findings highlight that there is much more work to be done to reduce the prevalence of hand-held phone use and to educate drivers of the dangers of some non-technology based tasks, such as reaching for objects, that they may view as innocuous, but that present a real crash risk.

After exposure was taken into account, it was found that drivers were significantly more likely to initiate engagement in secondary tasks when the vehicle was stationary. Indeed, drivers initiated 47 percent more secondary tasks per minute of driving when stationary (one task every 68 seconds) compared to when moving (one task every 107 seconds). This finding is consistent with the results of previous naturalistic driving work, which has found that drivers were more likely to engage in secondary tasks when stationary (Funkhouser & Sayer, 2012; Tivesten & Dozza, 2015). The current study extends the findings of these two studies as it included a large range of secondary tasks, whereas Funkhouser and Sayer (2012) and Tivesten and Dozza (2015) both focused on mobile phone use only. The results of this and previous studies suggest that drivers do engage in some level of self-regulation with respect to being more likely to initiate secondary tasks when stationary. There were also some secondary task categories, such as (paper-based) reading and writing, which drivers did not initiate at all while the vehicle was moving and only very infrequently while stationary. However, when looking at the absolute numbers, almost three quarters of the secondary tasks observed were initiated while the vehicle was moving and some of the tasks initiated have been shown in other studies to have high crash and near crash risk, such as reaching for objects and manipulating a mobile phone. Moreover, although not formally captured in the current data coding, there were a large number of cases observed where drivers, who initiated a secondary tasks while stationary, continued to perform that task after the vehicle has started moving. Most commonly, this involved drivers entering an intersection after moving off from traffic lights while they were still engaging in the secondary task. Thus, while a degree of self-regulation was evident, drivers still regularly place themselves at risk by either initiating secondary tasks while moving or continuing to engage in tasks once the vehicle has started moving.

In addition to deciding when to engage, it appears that drivers further attempted to limit their exposure to risk by engaging in some secondary tasks for shorter periods when the vehicle was moving compared to when it was stationary. For example, the mean duration of phone tasks initiated when the vehicle was moving was considerably lower than the phone tasks initiated when the vehicle was stationary. This suggests that while drivers are willing to initiate phone tasks when moving, they do at least limit the amount of time they spend engaged in these activities. There were, however, a number of secondary tasks that had higher mean durations when the vehicle was in motion, including manipulating objects (other than phone) and reaching for objects/phone. It is possible that these higher duration values reflect that drivers were sharing the tasks with driving and thus it took them longer to complete them compared to when stationary. Further analysis of the data will examine if drivers interrupted the secondary tasks more often and for longer while the vehicle was in motion compared to when stationary.

A small percentage (5.9%) of the secondary tasks events were associated with a driving incident. Many of these incidents were minor and involved a delay in drivers detecting that the traffic lights had turned green or that vehicles in front had moved away; however, several of the incidents were more serious, with drivers veering out of their lane or failing to detect the vehicle ahead braking suddenly. Not surprisingly, the majority of the incidents occurred while drivers were engaged in secondary tasks that have been found to be associated with a doubling of the odds of being involved in a crash and near crash, including using a hand-held phone, manipulating objects and reaching for objects/phone (Dingus et al., 2016; Klauer et al., 2006). Given that only data related to the secondary task events was coded, it is not known what proportion of normal, baseline driving involved safety-related incidents. Future work should establish the relative proportion of unsafe incidents occurring when drivers are engaged in secondary tasks and when they are not.

The findings in this paper need to be interpreted in light of a number of strengths and limitations. One of the key strengths is the use of naturalistic driving data which allows the examination of the patterns and prevalence of drivers' secondary tasks engagement in a natural, real-world driving setting, free from the constraints and artificial nature of more traditional experimental environments. The sheer amount of data collected, however, meant that only a fraction of the available data set was coded and analysed for this paper. The manual coding of the 185 trips took two analysts approximately 700 hours (over 95 working days) to complete. Future work with NDS data should examine ways to at least partially automate the coding of secondary task events to ensure that larger amounts of data can be analysed without the burden and expense of manual coding. Further, the random selection process used to select trips for coding meant that there was variability in the number of trips analysed for each driver; the number of trips coded for individual drivers ranged from 1 to 12. Thus, individual differences in the propensity to engage in secondary tasks may have had more of an influence on the data for those drivers with a greater number of trips coded. Future analysis of the ANDS data will include a greater number of trips with a more even distribution of coded trips across drivers. Finally, given the available resources, the secondary task data were only coded for the point at which the secondary tasks were initiated, not for the entire duration of the secondary tasks. It was, therefore, not possible to examine certain aspects of task engagement such as the percentage of moving and stationary time engaged in secondary tasks, or if drivers disengaged from the task once the vehicle started moving again, or the impact of dynamic contextual factors that can change throughout the duration of engagement (e.g., traffic density and road curvature). Future work with the ANDS data will seek to code the secondary task data for the entire duration of the task events.

Conclusions

This study is one of only a handful to use naturalistic driving data to examine driver engagement in secondary tasks beyond mobile phone use. The findings will be useful in targeting distraction countermeasures and policies and determining the effectiveness of these in managing driver distraction. In particular, the findings suggest that countermeasures such as continued driver awareness and education programs may need to target the dangers of non-technology based tasks such as reaching for objects, which are performed commonly and are associated with a high crash risk. Improved enforcement of existing hand-held mobile phone laws through the use of widespread automated enforcement cameras is also indicated, as hand-held phone use is still common and there is a perception among drivers that they are unlikely to get caught using their phone (Young & Lenné, 2010). Finally, our findings indicate that even though secondary task engagement is prevalent when driving, drivers are capable of making strategic decisions about when they engage, such as waiting until stationary, and reducing the amount of time engaged when the vehicle is moving. Driver training programs could take advantage of these natural self-regulatory behaviours by encouraging drivers to adopt those strategies that are effective at mitigating the negative impact of distraction when engaging in secondary tasks.

Acknowledgements

The ANDS study was funded by the Australian Federal Government's Australian Research Council (ARC) under the infrastructure LIEF scheme (grant No. LE130100050) and research Linkage scheme (grant No. LP130100270) that were awarded to the Transport and Road Safety (TARS) Research Centre at the University of New South Wales (UNSW) in partnership with Monash University Accident Research Centre (MUARC), the Centre for Accident Research and Road Safety – Queensland (CARRSQ) at Queensland University of Technology (QUT), the Centre for Automotive Safety Research (CASR) at the University of Adelaide, the Centre for Road Safety, Transport for NSW (TfNSW), NSW's State Insurance Regulatory Authority, Victoria's Transport Accident Commission, the Victorian Road Authority (VicRoads), South Australia's Motor Accidents Commission, the National Roads and Motorists Association (NRMA) in NSW, Seeing Machines, the Office of Road Safety, Government of Western Australia, and the Hyundai Motor Company. Supply of equipment and assistance with ANDS data was provided by The Virginia Tech Transportation Institute (VTTI) under the leadership of Professor Jon Antin.

The Authors acknowledge the contribution of Professor Andry Rakotonirainy from CARRSQ to the project. The Authors would like to thank Jan Eusibo and Rainer Zeller from TARS Research Centre at UNSW for their role in managing and operationalising the Australian study and the Sydney site. The contribution of the support staff Jess Hancock from TARS UNSW at the Sydney site and Yik-Xiang Hue, Andrew Lyberopolous and Samantha Bailey from MUARC at the Melbourne site is also gratefully acknowledged. The valuable contribution from John Wall and Ben Barnes from the Centre for Road Safety TfNSW in operationalising the Sydney installation site and the assistance from Hee Loong Wong from Hyundai Motor Company in providing the ANDS service vehicles for both the Sydney and Melbourne sites is also gratefully acknowledged. We thank Dr Karen Stephan for her statistical advice.

Dr Kristie Young's contribution to this paper was funded by an ARC Discovery Early Career Researcher Award (DE160100372).

The Authors would also like to thank the ANDS participants. Without their contribution to the study, this publication would not have been possible.

References

Antin, J., Lee, S., Hankey, J. & Dingus, T. (2011). *Design of the in-vehicle driving behavior and crash risk study.* Transportation Research Board: Washington DC, USA.

Beanland, V., Fitzharris, M., Young, K. L., Lenné, M. G. (2013). Driver inattention and driver distraction in serious casualty crashes: Data from the Australian National Crash In-depth Study. *Accident Analysis & Prevention, 54*, 99-107.

Dingus, T. A., Guo, F., Lee, S., Antin, J. F., Perez, M., Buchanan-King, M., & Hankey, J. (2016). Driver crash risk factors and prevalence evaluation using naturalistic driving data. *Proceedings of the National Academy of Sciences, 113*(10), 2636-2641.

Funkhouser, D., & Sayer, J. (2012). Naturalistic census of cell phone use. *Transportation Research Record, 2321*(1), 1-6.

Klauer, S. G., Dingus, T. A., Neale, V. L., Sudweeks, J. D., & Ramsey, D. J. (2006). *The impact of driver inattention on near-crash/crash risk: An analysis using the 100-car naturalistic driving study data.* Virginia Tech Transportation Institute, Blacksburg, Virginia.

Lansdown, T. C. (2012). Individual differences and propensity to engage with in-vehicle distractions – A self-report survey. *Transportation Research Part F: Traffic Psychology and Behaviour, 15*(1), 1-8.

NHTSA. (2017). *Distracted Driving 2015 Traffic Safety Facts Research Note.* DOT HS 812 381. US Department of Transportation, National Highway Traffic Safety Administration, Washington, DC.

Shinar, D. (2017). *Traffic safety and human behavior*. Emerald Publishing Limited.

Tivesten, E., & Dozza, M. (2015). Driving context influences drivers' decision to engage in visual–manual phone tasks: Evidence from a naturalistic driving study. *Journal of Safety Research, 53*, 87-96.

WHO. (2011). *Mobile phone use: A growing problem of driver distraction.* World Health Organization, Geneva, Switzerland.

Williamson, A., Grzebieta, R., Eusebio, J., Zheng, W. Y., Wall, J., Charlton, J. L., Lenné, M. G., Haley, J., Barnes, B., Rakotonirainy, A., Woolley, J., Senserrick, T., Young, K., Haworth, N., Regan, M., Cockfield, S., Healy, D., Cavallo, A., Di Stefano, M., Wong, H. L., Cameron, I., & Cornish, M. (2015). The Australian Naturalistic Driving Study: From beginnings to launch. *Paper presented at the Proceedings of the 2015 Australasian Road Safety Conference*, Gold Coast, Australia.

Young, K. L., & Lenné, M. G. (2010). Driver engagement in distracting activities and the strategies used to minimise risk. *Safety Science, 48*, 326-332.