The Role of the Passenger in Everyday Driving:

Understanding how Passengers Assist Adult Drivers

A thesis

submitted in fulfilment

of the requirements for the degree

of

Master of Science

at

The University of Waikato

by

SHAWN JASON READER

THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

2019

Abstract

Previous research has indicated that adult drivers are at a lower risk of crashes when accompanied by at least one passenger. One potential reason for this is that passengers can assist drivers on the road via expanding situation awareness, reducing cognitive load and encouraging responsible driving behaviour. Both passengers and drivers report that passengers can be helpful on the road. However, no study has investigated if and how passengers assist adult drivers during everyday driving. The objective of this study was to use passenger and driver conversation to examine ways passengers assist drivers, how what drivers ask for compares to what passengers provide unprompted and how driver and passenger perceptions compare to what actually happens on the road. Twenty drivers aged between 25 and 65 were recruited for this study, along with passengers that they regularly drove with. Participants were recorded completing an on-road navigational task, and subsequently interviewed about their views and experiences with passenger interaction. On the road, passengers did assist drivers by navigating, pointing out hazards, watching for traffic at intersections, expanding the driver's situation awareness, performing secondary tasks on behalf of drivers and giving feedback or criticism of driver behaviour. While patterns of assistance varied over different driver-passenger pairs, passengers initiated a higher proportion of assistance on average than drivers. During the interview, participants identified that passenger assistance is highly dependent on contextual factors. Participants discussed several ways that passengers assist drivers during everyday driving including increasing driver situation awareness, keeping the driver awake and alert, encouraging responsible behaviour and performing secondary tasks on the driver's behalf. This is the first study to demonstrate the various ways that passengers assist adult drivers on the road. Passenger assistance does occur during everyday driving and can help to explain the reduction in crash risk associated with driving with a passenger. Further exploration of these findings could further increase our understanding of how passengers assist drivers, what forms of assistance are beneficial and how passengers can be encouraged to be better co-drivers and increase road safety.

Acknowledgements

Thank you first to Professors Samuel Charlton and Nicola Starkey, who have proved time and again to have incredible wisdom, knowledge, humour and an amazing well of patience. I am truly grateful for your support and supervision throughout this project and beyond. Without you, this thesis would no doubt still be covered in references to ‘Situational Awareness’

Thank you to the Transport Research Group (TRG) at the University of Waikato, for the experience, support and encouragement when I felt overwhelmed.

Thank you to my dear friends David, Chris and Cherie. Without you, this thesis would have proved entirely impossible.

Thank you to my family, my mother Yvonne, father Stan and of course my brother Brian. I would not be where I am now if it were not for you, and I am so grateful that you are part of my life.

Table of Contents

List of Figures

List of Tables

List of Appendices

Chapter One: Introduction

Driving is one of the most common forms of transport in New Zealand, with over half of all household travel time accounted for by driving (Ministry of Transport, 2018). Driving is a particularly common mode of transport among adults; people aged between 25 to 65 years spend between 69-76 percent of their travel time driving, and an additional 10-16 percent of their travel time as a passenger (Ministry of Transport, 2018). Driving is also a dangerous activity. During 2018, 379 people were killed and 14, 163 were injured in crashes on New Zealand roads (Ministry of Transport, 2019). While some factors contributing to these incidents were beyond driver control (e.g. weather conditions), many crashes were affected by driver mistakes or decisions. Drivers contributed towards crashes both through unintentional errors or lapses and by intentionally violating road safety rules. Common errors included misjudging factors such as distance or speed, being distracted or having their attention diverted, and failing to see another vehicle. Common violations included speeding, driving while under the influence of alcohol, using an inappropriate following distance or driving while tired and falling asleep (Ministry of Transport, 2019). Understanding factors that impact driving errors and violations is therefore an important part of understanding and enhancing road safety.

Passengers are one factor that could influence both driving errors and driving violations. Passengers are a common part of everyday driving. Within New Zealand, one third of trips taken in cars, vans and utes include at least one passenger (Ministry of Transport, 2014). Passengers are independent agents within the vehicle; actions they take could reduce or increase a driver's likelihood to make errors or violations. Given the high number of road journeys that include the presence of a passenger, understanding the various impacts that passengers have on road safety and crash risks, if any, is an important part of understanding the factors that cause crashes and potential ways that driving crash risk can be reduced.

1.1 Passengers and Crash Risk

Perhaps the first step in investigating the effects of passengers on driving safety is to understand how driving with a passenger affects crash risk on an epidemiological level. Using vehicle crash data and broad statistical analysis can

give an indication of whether the presence of a passenger is associated with any increase or decrease in crash risk when compared with driving alone. That is, does travelling with a passenger make driving safer, riskier, or have no impact at all? Conventional wisdom states that passengers are a distracting influence. This assertion is used to justify graduated license programmes which prohibit new drivers from driving with unlicensed passengers until they have demonstrated sufficient experience and capability.

A case-control study within the Auckland region of New Zealand provides some support to the potential detrimental effects of passengers accompanying inexperienced drivers (Lam, Norton, Woodward, Connor, & Ameratunga, 2003). All drivers or passengers in eligible vehicles who were hospitalized or died as a result of a car crash within the study region over the course of a year were selected as cases. Controls were selected via cluster sampling vehicles passing through randomly selected sites on the road network during the same period. Drivers were labelled as either young (<25 years) or older (25+ years) drivers, while passengers were noted as either being the same age category of the driver, or a different age. Logistic regression was then used to investigate any associations between the presence of a passenger and case control status, that is, whether the driver was involved in a car crash or not. Odds ratios were adjusted to take into account potential confounding factors; driver sex, self-reported alcohol consumption, average kilometres driven per week, driver sleepiness and whether it was night at the time of the sample. Compared to driving alone, young drivers were found to have a higher risk of being involved in a crash that caused injury or death when accompanied by two or more passengers, both when accompanied by older passengers (OR = 10.19, 95% CI = 2.84, 36.65) and same-aged passengers (OR = 15.55, 95% CI = 5.76, 42.02). No significant effect on crash risk was found when young drivers carried a single passenger, or when older drivers carried any passengers regardless of passenger age or number.

A more recent study (Orsi, Marchetti, Montomoli, & Morandi, 2013) found similar results when focusing on crash injury outcomes. Data from crashes resulting in a police call out were collected from the Italian province of Pavia over a two year period (2004 and 2005). Logistic regressions were then used to examine the effect of passenger presence on the driver outcome (i.e. unharmed or

injured/deceased). For young drivers (below 25 years) the risk of injury in a crash was higher when accompanied by passengers (OR = 1.42, CI = 1:00-2.02), while for older drivers the presence of passengers appeared to have no effect on crash outcome. The effect of passenger age on driver outcome was analysed with another logistic regression, returning no significant relationship, though this data was not reported. A further analysis then examined the effect of passenger gender on young, male drivers' crash outcomes. Driving with female or mixed male and female passengers had no significant impact on driver outcome in crashes. In contrast, young male drivers travelling with only male passengers had a higher risk of being injured or killed in a crash than when driving alone (OR = 2.08, CI = 1.29-3.35).

While these studies show a neutral or negative effect on driver safety when accompanied by passengers depending on the age of the driver, other studies suggest that passenger presence is associated with a reduced crash risk. Vollrath, Meilinger, and Krüger (2002) examined the effect of passenger presence on risks of colliding with another vehicle. Vehicle collision data recorded by police in the district of Mittelfranken in Germany between 1984 and 1997 was used to perform a responsibility analysis. A logistic regression was calculated to determine how the presence or absence of passengers affected the odds of a driver being responsible for a crash compared to being involved in a crash but not at fault. Overall, drivers travelling with at least one passenger had a lower chance of being responsible for a crash than drivers travelling alone (OR = 0.791, $p<0.001$), though this effect was reduced when the driver was less than 25 years old (OR = 0.848). The ages of the passengers were not reported in this study, no differentiation could be made between drivers travelling with peer passengers, children or older passengers such as parents. The number of passengers in the vehicle was also not included as part of the analysis, only the binary presence or absence of passengers was examined.

A later study in Sweden also identified an association between the presence of a passenger and a reduction in crash risk (Engström, Gregersen, Granström, & Nyberg, 2008). All crashes between 1994 and 2000 reported to police in Sweden were examined in light of exposure data collected from the same period. Exposure was estimated using survey data from male and female drivers

in young (18-24 years), adult (25-64 years) and older (65+ years) age groups, including the number of passengers in the car. Compared with driving with one passenger present, drivers were more likely to be involved in a crash when driving alone regardless of whether the driver was young (IDR = 2.42, 95% CI = 2.33, 2.53), adult (IDR = 2.95, 95% CI = 2.89, 3.01) or older (IDR = 4.40, 95% CI = 4.15, 4.67). The beneficial effects of carrying a passenger for both young drivers (2 passengers OR = 3.20, 95% CI = 2.95, 3.47; 3 passengers OR = 4.72, 95% CI = 4.23, 5.27) and adult drivers (2 passengers OR = 5.73, 95% CI = 5.48, 5.99; 3 passengers OR = 11.87, 95% CI = 11.12, 12.67) increased when the driver carried more than one passenger. Once again, passengers were associated with a reduction in crash risk for all drivers, though the effect was lower with drivers under twenty-five. Passenger age was again not reported in this study.

Driver age is clearly an important factor in determining the effect of a passenger. While passenger presence is associated with a reduced effect, or at least a neutral effect on crash risk when the driver is over 25, young drivers show more mixed results, ranging from small reductions in crash risks when accompanied by a passenger to increased risks of being involved in serious crashes that lead to hospitalization or death. A systematic literature review on the effect of passenger presence on young drivers' safety by Ouimet et al. (2015) further supported the association between passengers and increased risk for young drivers. Fifteen articles investigating the effect of passenger presence on drivers under 25 that included a no-passenger comparison group and some measure of exposure were examined. Passenger presence was associated with an increased risk of fatal crashes compared to when driving alone, with estimates ranging between 1.24 and 1.89. The presence of two or more passengers was associated with still higher increased risk for young drivers, estimates ranging from 1.90 to 2.92. Studies investigating nonfatal and combined fatal and nonfatal crashes showed mixed results. Given the difference in findings between young and adult drivers, the question is raised as to why exactly young drivers are put at higher risk by travelling with passengers.

1.2 Young drivers and Passengers

Simons-Morton et al. (2011) examined data collected from forty-two newly licensed teenagers to explore factors that exacerbate young driver crash rate, including passenger presence. Data recording systems including a GPS device, accelerometer and cameras monitoring the driver, dashboard, roadways and passengers were installed in participants' vehicles within three weeks of them receiving a driver's license. Data was then collected on every drive within the next eighteen months. Self-report scales were used to obtain a measure of driver's sensation seeking, risky behaviour and risk-taking friends. Compared to driving alone, carrying an adult passenger was found to reduce rates of crashes or near crashes (IRR = 0.25, p = 0.001) and rates of risky driving (IRR = 0.33, p = 0.000). Carrying a teenage passenger had no effect on rates of crashes or near crashes, but did reduce the rates of risky driving, (IRR = 0.82, p = 0.000). Having friends who engaged in risky behaviour however, did increase rates of both crashes or near crashes (IRR = 1.96, p = 0.013) and risky driving (IRR = 2.09, p = 0.13). This study makes an interesting contrast to previously epidemiological studies that show that passengers increase crash risk for young drivers; passenger presence alone is not sufficient to explain this increased risk. A followup study found that the presence of a teenage passenger did not significantly influence driver speeding behaviour, but that having risky friends (r = 5.78, p = 0.01) was associated with choosing to speed more often.

Given these findings, it is possible that young drivers are only put at risk by certain passengers. A focus group study discussing how others influence speed choice identified that young male drivers were the only demographic of driver to admit to increasing their speed when their friends were in the car as they didn't want their friends to think they were a slow driver (Fleiter, Lennon, & Watson, 2010). This may be further complicated by the finding that young (18 years) male drivers tended to expect their friends to speed significantly more than they did (Møller & Haustein, 2014). The same effect was not found in adult male drivers (28 years). It seems likely that at least with certain passengers, if not all, young drivers are more likely to adopt riskier behaviours.

Further evidence for this increase in risky behaviour was found by Ross, Jongen, Brijs, Brijs, and Wets (2016). Young drivers were asked to complete a 28km daylight driving scenario with several hazards using a driving simulator. Drivers first completed the drive on their own, then again with one of their friends as a passenger. Data was collected on driving errors, where a crash occurred due to a lapse in cognitive judgement; and driving violations, where the driver intentionally violated the law or safe driving behaviour. The stop signal reaction time test (Verbruggen & Logan, 2008) was used as a measure of driver inhibitory control. Overall, the presence of peer passengers did not influence driver speeding behaviours. However, drivers with low inhibitory control did tend to drive faster when accompanied by passengers than alone. This effect was not seen in drivers with high inhibitory control. Driving violations (such as running red lights) increased when drivers were accompanied by a passenger compared to driving alone, but driving errors decreased in the company of a peer passenger. The number of collisions was significantly lower in the drive with peer passengers than when driving alone. The authors concluded that passengers had both a protective effect, but could also elicit risky driving in young drivers with low inhibitory control.

Peer passengers show both protective and detrimental effects for young drivers. The risky behaviour encouraged by peer passengers, especially high-risk peers could explain the overall detrimental effects on road safety observed in crash data analysis. It is important to note, however, that even though the overall impact of peer passengers is detrimental for young drivers passengers do have some positive effects including intervention when a driver is about to drive under the influence of alcohol (Møller & Haustein, 2014), reduced rates of errors in some circumstances (Ross et al., 2016) and lowered speeding behaviour due to concern for the passenger's safety (Fleiter et al., 2010).

1.3 Passengers as a Distraction

Despite the association between passenger presence and decreased crash risk with adult drivers, several studies have conceptualized the passenger as a potential source of distraction. Distractions, as defined by Pettitt, Burnett, and Stevens (2009) are events, activities, objects or persons that compel the driver to

shift attention away from fundamental driving tasks via compromising the driver's visual, auditory, biomechanical or cognitive functions and thereby impact the driver's ability to safely maintain control of the vehicle.

In journeys where drivers are accompanied by at least one passenger, drivers spend a considerable amount of time talking and interacting with their passenger. Metz, Landau, and Just (2014) found that when a passenger was present, drivers spent an average of 35% of their driving time engaging with their passenger, while Nevile and Haddington (2010) found that on average, drivers spent more than half their driving time (58.6%) engaged in conversation with their passengers. During these periods, drivers would not only speak with their passenger but take their eyes off the road, remove their hands from the wheel or even turn physically in their seat to orient themselves towards their passenger (Nevile, 2012). In another study, Koppel, Charlton, Kopinathan, and Taranto (2011) found that interacting with a passenger accounted for the largest proportion of activities where the driver was looking away from the forward roadway for at least two seconds (37%).

Given the amount of time that passengers spend interacting with passengers and the fact that this interaction can include drivers looking away from the road or performing other dangerous activities, we would expect that driving with a passenger should be associated with an increase in crash risk. However, epidemiological studies appear to show the opposite effect; passengers are instead associated with a decrease in crash risk. This apparent contradiction suggests that interacting with passengers may not be as distracting as it may immediately seem, or that the benefits of carrying a passenger are substantial enough to outweigh any distracting influences. To understand this, it is important to examine the impact of interacting with passengers on driving ability.

Gkikas and Richardson (2007) investigated the impact of different forms of conversation on driver performance in a simulated route. Participants (n=24) were asked to complete the virtual route either with no conversation, while conversing with an experimenter on an informal topic, or while conversing with an experimenter on a more involved, technical topic. In each condition, the experimenter was seated behind the participant to remove any impact of visual

distraction. Across the experimental conditions participants showed a reduced ability to control the vehicle (as measured by the number of times they left the route or had an crash), increased subjective mental demand (as measured by the NASA TLX) and reduced performance on the lane change test (indicating higher distraction) while talking with an experimenter compared with driving alone, and again while having a technical conversation compared to an informal conversation. The authors concluded that having a conversation had a detrimental effect on driving performance and a driver's ability to laterally control the vehicle. This conclusion should be examined with caution however as the experiment occurred in a highly artificial environment; the simulation used a racing game as a base, the experimenter was seated behind the participants and conversation was artificially prompted by questions rather than allowed to arise naturally. This lack of similarity with more naturalistic, everyday driving could detract from the applicability of the results to more real-world situations.

Precht, Keinath, and Krems (2017) used a more naturalistic approach to investigate various factors affecting both driving errors and driving violations in everyday driving. Using video data from the Strategic Highway Research Program (Virginia Tech Transportation Institute, 2017), Precht et al. (2017) selected 108 ten minute video segments from drives. Each ten-minute video was coded to examine driving errors and driving violations as defined by Reason, Manstead, Stradling, Baxter, and Campbell (1990). Additionally, several independent variables including presence of passengers, driving task demands, appearance of emotion and secondary tasks such as "Talking without looking at passenger in adjacent/rear seat" and "Talking while looking at passenger in adjacent/rear seat" were coded from the same video segments. Generalized mixed linear models were then used to investigate potential relationships between the independent variables and driving errors or violations. In contrast to the findings by Gkikas and Richardson (2007), talking with a passenger either with or without looking at them did not significantly affect driving errors or violations. This suggests that naturalistic conversation while driving does not detrimentally distract the driver. Alternatively, there may be other positive effects that counteract the distractive effect of conversations, or any distractive effects may be dependent on the conditions of the specific driving situation.

1.4 Passengers and Situation Awareness

One explanation for why natural driving conversation has a negligible effect on driving errors is that passengers show evidence of situation awareness, and are thus able to modulate their conversation based on the complexity of the surrounding environment. Both Charlton (2009) and Drews, Pasupathi, and Strayer (2008) used a driving simulator to compare the effect of passenger conversation on driving ability with the effects of talking on a hands-free cellphone. Both found that drivers performed almost as well when talking with a passenger as they did when driving alone, and significantly worse when talking on a cellphone. Both also noticed that passengers would alter their conversation depending on the surrounding environment, reducing speech speed and complexity as the driving environment became more complex. In effect, passengers were able to manage their own level of distraction by tailoring their conversation to reduce demand on the driver during points where the driver required more concentration. This ability to manage their own distraction may explain why natural conversation while driving does not show a detrimental effect during everyday driving (Precht et al., 2017).

Maintaining an awareness of the driving environment may have additional benefits beyond allowing passengers to manage their own distractive influence. One driver error that has the potential to lead to a crash is that drivers may overlook or fail to see another vehicle, hazard or aspect of the driving environment. Passengers who are situation aware have the possibility of seeing something that the driver has missed and alerting them to it. Indeed, a focus group study by Regan and Mitsopoulos (2001) examining potential roles that the passenger can play in the car found that participants viewed passengers as able to warn drivers of approaching danger or hazards.

Drews et al. (2008) noted that drivers and passengers would occasionally switch to talking about the driving task they were completing, superseding the other conversational task they were instructed to carry out. Charlton (2009) observed that drivers and passengers conversing together had a notable frequency of utterances related to the current driving situation (Situation Awareness Utterances), including warning the driver of approaching hazards.

Another study used ethnographic methods to examine passenger and driver interaction in a car sharing community where drivers are matched with passengers heading in the same direction. Researchers joined in with journeys where a front-seat passenger had already been recruited, taking ethnographic notes from the back seat. Similar to findings from previous studies, the authors observed that passengers would modulate their own conversation; falling silent while the driver was concentrating before resuming the conversation once the driver was under less cognitive demand. Passengers remained aware of the situation, paying attention to situational cues noting speed limits and other details of their surroundings and using this information to advise the driver (Perterer, Sundström, Meschtscherjakov, Wilfinger, & Tscheligi, 2013). In summary, by remaining aware of the current driving environment, passengers can not only moderate their own distractive influence but also act as a second pair of eyes, potentially spotting something that the driver missed.

1.5 Passenger Assistance in Managing Secondary Tasks

In addition to managing their own distracting influence, passengers can affect how other distracting tasks impact the driver. Secondary tasks can distract the driver, taking their attention away from the driving task. These tasks can result in the driver spending cognitive resources on tasks not relevant to the safe operation of the vehicle, or even looking away from the road in order to complete the task. Such tasks can be dangerous. Precht et al. (2017) found that driving errors increased by a factor of 3.51 ($p < 0.05$) when the driver was reaching for something they had dropped, and using a cellphone to text while driving increased errors by a factor of 6.62 ($p < 0.001$).

Metz et al. (2014) observed that although the total time engaged in secondary tasks increased when driving with a passenger (due to the fact that interacting with a passenger was included as a secondary task), the frequency of all other secondary tasks decreased. The exact mechanism for this is unknown, but one possibility might be that passengers manage a driver's emotional state, especially by reducing driver boredom. Driver boredom or under stimulation can result in more risky driving behaviours (Heslop, Harvey, Thorpe, & Mulley, 2010), as well as engagement in other secondary tasks such as using the radio,

phones, grooming or singing to themselves. (Precht et al., 2017) noted that drivers talking and singing without a passenger in the car were less prone to driving errors, but much more prone to driving violations. They hypothesized that this higher rate was not caused directly by the acts of talking and singing, but instead a result of the emotional states responsible for the talking or singing behaviour.

Another suggestion that may explain the reduction in secondary tasks when drivers travel with passengers is that passengers can assist drivers in managing distractions while on the road. When asked within the context of a focus group about the roles passengers can play in the car, drivers and passengers identified that passengers can act as navigators for the driver, answer the phone, adjust settings on the radio or air conditioner or otherwise take over distracting tasks from the driver (Regan & Mitsopoulos, 2001). While accompanying drivers and passengers within a car-sharing community, Perterer et al. (2013) observed passengers carrying out tasks on behalf of the driver such as turning on the car heater or wiping fog off the windshield, or using mapping software on their phone to help direct the driver when needed. Nevile and Haddington (2010) report that drivers manage distractions by asking passengers to carry out tasks such as handing over objects, answering phones or writing down notes. Even young children are used by the driver as tools to manage distractions. Cycil, Perry, Laurier, and Taylor (2013) present two case studies where mothers driving with young daughters ask their children to help by finding objects, taking notes or otherwise engaging with tasks that the driver is unable to focus on while they are driving.

The benefits of having a passenger to manage secondary tasks on behalf of the driver are clear. If the driver does not have to concentrate on secondary tasks, they can give their full attention to the driving task, which results in less errors and therefore a lower crash risk.

1.6 Altering Driver Behaviour

Another potential way to explain the association between passenger presence and lower crash risk is that passenger alter driver behaviour, encouraging more responsible driving. Indeed, there is evidence that the presence of a passenger results in more responsible behaviour. Lee and Abdel-Aty (2008)

investigated crash data from a stretch of freeway in Orlando, Florida recorded over five years. Bivariate probit models were developed to investigate the effects of the presence of any passengers, driving with more than one passenger and the effects of younger drivers driving with younger passengers. In accordance with previous studies, the presence of passengers in the vehicles was associated with a reduced risk of the driver being at fault in a crash, or the driver experiencing fatal or severe injuries from a crash. In addition, drivers showed evidence of safer driver behaviours when accompanied by a passenger. While passengers were present, drivers were more likely to wear a seatbelt, less likely to be cited by police and less likely to be under the influence of alcohol. This evidence that drivers act more cautiously and responsibly when they are not alone in the vehicle is likely to explain at least some of the reason that passengers are associated with a reduced crash risk, especially in adult drivers.

The suggestion that drivers behave more responsibly when accompanied by passengers is further supported by Rosenbloom and Perlman (2016) in an observational study of passenger presence and drivers' tendencies to commit traffic violations. Four pedestrian crosswalks with traffic lights were selected for this study. Trained observers recorded details about vehicles stopped at the red lights, estimating the age of vehicle occupants. In total, 1008 drivers were observed, of which 6.5% were estimated to be younger than twenty-five. The number of passengers was recorded, as were four different driving violations; seatbelt usage, proper signalling, using handheld phones and keeping an appropriate distance to the car in front. The tendency of drivers to commit at least one violation was significantly higher when driving alone than when accompanied by passengers, including child passengers. The number of violations committed was also negatively associated with the number of passengers in the vehicle.

Fleiter et al. (2010) examined passenger influence via investigating how social influences and pressure affect drivers' speed choice. Eight categories of focus groups were formed, based on age (Young, mid-age or older drivers), gender, and an additional two for self-reported rare and frequent speeders. Participants could self-select into one group, with some screening to ensure that the two speed-related groups contained drivers with extremes in self-reported behaviour. Transcripts of each focus group were examined using a Thematic

Analysis using an interpretive framework. Across most groups including in the Excessive speeders group, it was agreed that having passengers in the car lead to them driving more slowly. While with a passenger, drivers were more conscious of passenger safety and comfort, leading to a reduction in speed. Some drivers reduced speed in order to present a better impression of themselves, or to comply with a passenger's desires; particularly in the case of young drivers accompanied by parents. In contrast, when driving alone drivers identified that since they were only responsible for their own safety they could drive more recklessly.

Nakagawa and Park (2014) studied the various psychological effects of carrying a passenger using a survey targeting married individuals in Japan who drove with their spouse at least once a month. Items were developed to correspond to various psychological effects (e.g. Relief, Distraction) supported from the literature, or brainstormed by the researchers. Factor analysis was applied to these items, deleting items until all items with low loadings, or loadings on more than one factor were removed. At the end of this process, twenty-six of the original ninety-three items remained, loading onto five separate factors. Three factors ("Pique", "Flattery, vanity and overdependence" and "Annoyance") represented psychological factors related to carrying a passengers associated with an increase in crash risk. The remaining two psychological effects found were potentially more protective; "Relief", where the driver was more calm, relaxed and alert with the passenger in the car, and "Responsibility", where the driver felt a sense of responsibility for the passenger's safety and comfort, leading to more cautious driving. The study did not provide any evidence of how prevalent these different psychological aspects were in the driving population, nor could it indicate the magnitude of the effects on driving safety. Further, the study was limited to the impact of the drivers' spouses on driving behaviour. It's possible that other psychological effects may be seen when the relationship between the passenger and driver is different.

In addition to shaping the driver's behaviour simply by being present, passengers can potentially alter the driver's choices by providing the driver with feedback or criticism. Once again, this was observed by Perterer et al. (2013). The authors noted that passengers would offer feedback to their drivers, either explicitly critiquing the driver's behaviour or by talking about other drivers on the

road in a way that reminded the driver of appropriate behaviour (e.g. “The majority of the road users are driving too fast”).

Dillon and Dunn (2005) investigated perceptions of passenger criticism by surveying 52 couples, with ages of participants ranging between 20 to 63. Each couple was sent two surveys, one to be filled out by the usual driver and the other by the usual passenger regarding the driver’s behaviour. The survey included four parts; demographic data, the Driving Habits Questionnaire (a measure of risky behaviour in typical situations), the Driving Vengeance Questionnaire (Wiesenthal, Hennessy, & Gibson, 2000) and information on driving ability, safety and previous crashes. Both drivers and passengers indicated that the more risky a driver’s behaviour the more the passenger would complain; but also identified that the more a passenger complained, the less likely the driver would respond and drive more responsibly. As the study is based on a survey, it is not possible to determine whether the passenger’s complaints were altering the driver’s behaviour; though it does provide evidence that passengers do complain in an attempt to alter driver’s riskier behaviour.

Hutton, Sibley, Harper, and Hunt (2001) examined whether passenger feedback could be used to positively alter driver behaviour. Two drivers (one aged 60 and one aged 20) and two passengers they were familiar with were recruited. Each driver completed a 10-15 minute long drive, while accompanied by their front seat passenger and a researcher in the back seat acting as an observer. Time sampling was used to measure driver speed, following distance, mirror checking and hazard checking. After a baseline was established, the passenger was instructed to give the driver feedback; first on mirror checking alone and then on a ‘problem area’ for each driver. Finally, passengers were instructed to discontinue their previous habits of feedback, and provide feedback on any other behaviours until the final follow up. Both participants showed improvements in the percent of time engaging in the appropriate behaviours targeted by passenger feedback, demonstrating that the frequent, individualized feedback was an effective way to change driver behaviour.

1.7 Navigation Based Tasks and Passenger Assistance

The concept of passenger assistance has often been approached by looking specifically at the roles of navigation and wayfinding. Bryden, Charlton, Oxley, and Lowndes (2014) investigated driver/passenger collaboration in older drivers, focusing specifically on wayfinding tasks. Older drivers (>65 years, n=194), along with their regular passengers participated in a survey on wayfinding and passenger assistance. Each driver was recruited from membership of a motoring club within Victoria, Australia. A high proportion of passengers reported assisting the driver regularly in some part of wayfinding; 62.7% of passengers reported regularly assisting the driver to plan the route, 81.5% reported regularly giving some form of directional guidance during the drive, 84.7% reported regularly searching for visual cues such as street signs and landmarks along the drive and of the pairs where the driver did own a navigation system, 40.6% of the passengers reported regularly assisting the driver to use the device. Whether a passenger would assist the driver in wayfinding was largely influenced by the perceived relative abilities of the driver and passenger in terms of wayfinding. Most participants responding to this study consisted of married couples, usually with a male driver and female passenger. It is possible that other populations of older drivers may show different approaches to passenger/driver collaboration dependent on their social roles, relationships and relative experience driving together.

Forlizzi, Barley, and Seder (2010) set up a navigation task to investigate how relative experience and familiarity between drivers and passengers impacted how passengers acted as navigators. Ten pairs of participants were recruited, five consisting of teenage drivers with a parent, three of couples self-selecting a driver and two pairs who were randomly assigned with passengers unfamiliar with their drivers. In each case, the passenger was taken aside and asked to plan a route to a specified destination. The passenger would then accompany the driver along the route, guiding them to their destination while both participants were observed by a pair of experimenters in the back seat. After the drive, the pairs of participants

were interviewed regarding their drive and navigation interactions. Drivers indicated a preference for receiving auditory instructions from passengers along the route, and for receiving line-by-line directions when navigating to unfamiliar areas. Drivers also mentioned that passengers could "help look for street signs" while on the road. While interactions varied across different pairs, the relative familiarity and experience between driver and passenger seemed to have a large effect on how exactly passengers collaborated with drivers. Where drivers and passengers were less familiar, the roles of navigator and driver were more explicit. Passengers gave more exact descriptions including lanes and turns, gave directions more often and worked harder to establish shared knowledge between themselves and the driver. In contrast, in couples that were familiar with each other the instructions were at a higher level, made more use of a shared knowledge and context (for example, by referring to a location in relation to an event or acquaintance both were familiar with), and there was more conversation that was not about the driving route

Another study also examined how passengers interact with drivers as navigators (Antrobus, Burnett, & Krehl, 2017). Here, thirty-two drivers were required to complete a ten-minute drive to an unfamiliar location, directed by either a GPS navigation device or by a passenger navigator. Participants shared a working relationship with each other, Each navigator self-reported being confident at wayfinding and was given a map of the route along with a video of driving along the route to familiarize themselves with before the experiment. Participants were recorded via cameras installed into the vehicle during each drive. After the route, each participant completed two route-learning tests to measure how familiar they were with the route just taken and interviewed separately about their experiences and what was helpful or unhelpful during the drive. Collaborative navigation was significantly different to individual GPS-aided navigation. While the SatNav device provided navigation prompts on approach to and immediately before each driving manoeuvre, passengers also confirmed manoeuvres once completed, reassured the driver that they were going the correct way and provided orientation information that made the driver aware of their current location in relation to the general surroundings. Passengers were able to confirm that drivers had received and understood information via non-

verbal feedback. Drivers were able to ask clarifying questions from passengers and to seek reassurance that they were completing manoeuvres correctly. Passengers were also able to tailor their instructions to the driver's perceived workload and current context. Although both methods resulted in the driver arriving at their destination with minimal errors, drivers who had travelled with a passenger showed greater familiarity with the route on each route-learning measure. However, passengers' comments and greater amounts of information was occasionally identified as being unhelpful; increasing the driver's cognitive workload where a simpler instruction would have sufficed.

Mårdh (2016) collected comprehensive data on four couples with older drivers (at least 70 years) to examine collaboration between co-drivers. In each case, the driver was male and the passenger was female. Each pair was asked to complete a drive along the same 35 minute route; participants were able to read the map of the route before driving, though the passenger read the map during the route. Before the drive, each participant was fitted with equipment to measure head rotations. A trained ethnographer accompanied participants in the back seat of the car, taking notes. Driver and passenger conversation was recorded, transcribed and analysed according to grounded theory. After the drive, participants were interviewed as a pair, with topics focusing on planning, support given/received, driving behaviour and support systems. Analysis of the driving conversation revealed two primary categories of passenger assistance based on whether the support was given unprompted or was initiated by the driver. For support requested, three sub-categories emerged; 'Traffic driving and strategic help' which included questions like asking the current speed limit or gear the driver was in, or asking for help with look-out; 'On-going directional support' which included confirmations ("This is where I go left"), or questioning ("Are we going left here?"); and 'Guiding' where drivers informed passengers about landmarks or areas they were passing through. For support given, two sub-categories were identified; 'Suggestions for appropriate traffic and driving strategies' and 'On-going directional support'. Data from recorded head rotations showed that passengers were rotating their heads as much or more than their drivers at intersections, suggesting that they were also keeping watch out for traffic. During interviews, participants did talk about some ways in which

passengers assisted the driver, namely reading the map, keeping track of the current speed, keeping track of traffic, and directing the driver where to turn. Support was mentioned as something that wasn't explicitly discussed between the driver and passenger, it just 'came naturally'.

1.8 Current Study Objectives

Driving with a passenger is associated with a decrease in crash risk compared to driving alone for adult drivers. Previous studies have suggested that this may be due in part to passengers actively assisting drivers by providing a second set of eyes (increasing situation awareness), completing tasks on behalf of the driver (decreasing workload and reducing distractions), and influencing drivers to behave more responsibly. Studies with older couples have explored the collaborative partnership of driving as a team-based approach, but little research has examined passenger assistance for the age group between young and older drivers; the age range between 25 and 65 years that make up the bulk of driving traffic (Ministry of Transport, 2014). Ethnographic note taking has given some detail of what kinds of interaction occur, but we don't yet know what form passenger assistance takes or how often it occurs during everyday driving. Qualitative studies from phone surveys and interviews have given good indications of driver and passenger perceptions of passenger assistance and collaboration, though the relationship between this and what actually happens on the road is unclear. It is also unclear whether the support that passengers provide is the same as support that drivers want from their passengers.

This exploratory study attempted to provide more information on passenger assistance by focusing on three questions:

1. In what ways do adult passengers assist adult drivers during everyday driving?
2. How does assistance offered unprompted by passengers compare with what drivers ask for assistance with?
3. How do driver and passenger perceptions of assistance compare with what actually happens on the road?

Chapter 2. Method

2.1 Participants

Participants were recruited via advertisements (Appendix A) placed on local University or community noticeboards, circulated via mailing lists and posted on the intranet of a local non-governmental organization, the University and the local district health board. Participants were recruited in pairs consisting of one driver and one passenger that regularly drive together. All drivers were required to hold a full New Zealand driver's license, be between 25 and 65 years old and have access to a registered and warranted motor vehicle.

In total, twenty-five pairs of participants were recruited; three pairs took part in the pilot study, the remaining twenty-two participated in the full experiment. Due to recording equipment failure, data from two pilot pairs and two full experiment pairs were not included in the study. Participant demographics for the twenty pairs included as part of the full experiment are summarised in Table 1. As shown in the table, the ages of the drivers in this study ranged between 26 and 65 years with an average age of 36. Drivers had been a licensed driver for an average of 18 years. The age of passengers ranged from 23 to 62 years. Of the twenty passengers, seventeen reported having a New Zealand driver's license and two reported having a driver's license from another country. As shown in Table 2, most pairs in this study (70%) consisted of a driver and passenger with different genders. Most drivers (60%) were male, while most passengers (60%) were female.

Ethical approval for the recruitment and data collection protocols for this study was obtained from the School of Psychology, University of Waikato Ethics Committee. Written consent (Appendix B) was obtained from all participants after they had been informed about the details of the study and procedure. Participants were given opportunities to ask questions about the research project as well as the option to receive a summary of the study's findings.

Table 1

Participant demographics by role (driver and passenger).

	Drivers		Passengers	
	Mean (SD)	Range	Mean (SD)	Range
Age	36 (11.75)	26-65	32 (9.45)	23-62
Years licensed	18 (12.53)	5-48	13 (9.8)	0-43
Average km driven/week	189 (223.37)	30-1000	121 (156.46)	0-650

Table 2

Driver and passenger gender (n)

		Driver		
		M	F	Total
Passenger	M	3	5	8
	F	9	3	12
	Total	12	8	20

2.2 Materials

The study consisted of two components; an on-road driving task where participants were asked to drive around local city roads, followed by an interview designed to capture participant views and experiences around passenger and driver interactions. Both the drive and the interview were recorded using a GoPro Hero Session 4 camera, mounted in the vehicle behind and between the passenger and driver using a retort stand (Figure 1). A camera was thought to be less intrusive than having the researcher traveling with the participants along the drive.

A map of the city was provided to participants. The map included an outline of the route using orange highlighter, including start and end points and arrows showing the direction to travel along the route. A contact number for the

researcher was also included on the map in case participants required assistance or wanted to withdraw.

A short questionnaire (Appendix C) was used to collect data on participants' demographic information and driving habits.

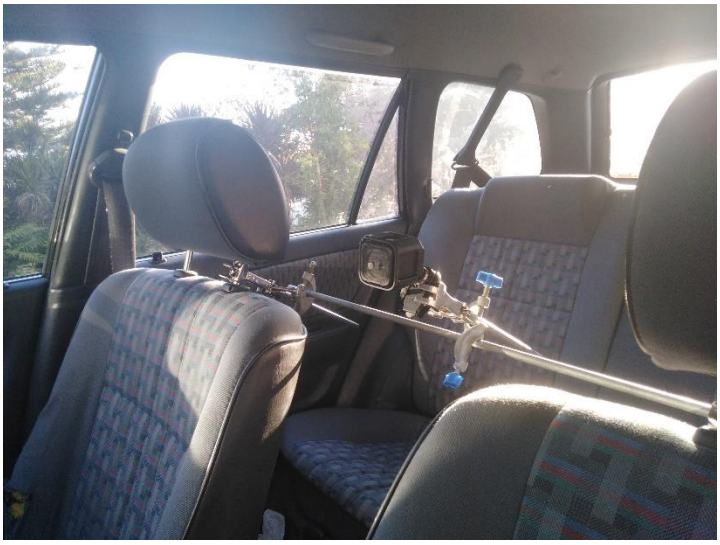


Figure 1. Camera, mounting equipment and positioning

2.2.1 On-road task

The on-road driving task took approximately 35-45 minutes to complete and consisted of two sections. The first section (Unplanned Route section) required participants to select their own route between a specified starting point (The University of Waikato Campus) and a specified destination (Rotoroa Drive by the Hamilton Lake). The distance of the Unplanned Route section varied in length between 4 and 7km dependent on participant's choice of route..

The second section (Planned Route section) began once participants reached their destination from the Unplanned Route portion of the experiment. Participants were asked to follow a set route, 10.8km in length as outlined on the map of the city to return to the University campus (Figure 2). To elicit driving conversation and different forms of passenger assistance the route was designed to take participants through a variety of different driving environments and challenges that are typically faced during normal everyday driving (Table 3). Participants were asked to drive in the same way they would on any everyday drive (so they were able to use navigation tools such as google maps).

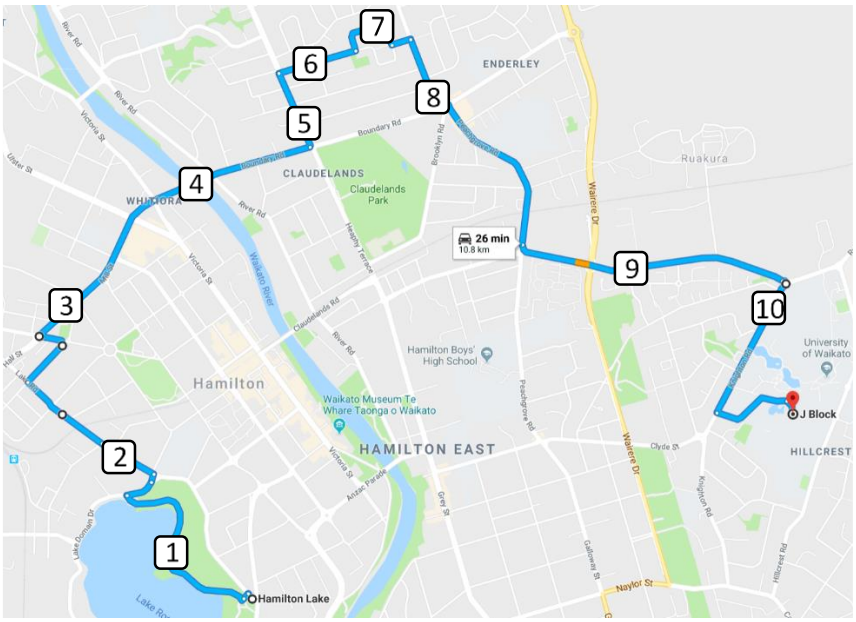


Figure 2. Planned route section of the on-road portion of the experiment, showing start and end points. The numbers signify different sections of the route as illustrated in Table 3

Table 3.

Different driving environments and challenges along the planned route

Route Section	Road type	Likely Driving Challenges	Posted speed limit	Picture
1	One-way, parking area	High traffic and foot traffic	30	
2	Two-lane with flush median moving through commercial area	High traffic Roundabouts	50	

3	Wide four-lane, several traffic lights along route	Wide road with low speed limit Traffic lights	50	
4	Four-lane narrowing to three lane clearway	Bridge Clearway	50	
5	Two-lane through busy commercial area with several side streets	High traffic	50	
6	Two-lane through residential area with speed bumps and warning signs	Speed bumps Low speed limit	40	
7	Two-lane, unmarked through residential area, no speed bumps	Low speed limit Right turn onto busy road	40	
8	Two-lane, median centre through roundabout with five exits	High traffic Roundabout	50	

9	Two-lane with dashed centre line	Higher speed limit Traffic lights	60	
10	Two-lane with dashed centre line	-	50	

2.2.2 Interview

After the drive, a semi-structured interview was conducted. The interview was intended to capture passenger and driver perceptions on the drive they had just completed, their usual interactions together, and passenger and driver interactions more generally. This data served two primary purposes; to examine how participants' perceptions of their interactions compared to what actually happened on the road, and to capture participants experiences of driver-passenger interaction that were outside the scope of the on-road experiment.

The interview began with general questions about the drive that participants had just completed, and of roles that passengers generally played during driving. The questions were open ended to encourage free-recall without suggesting any specific types of interaction. The next section of the interview asked participants to comment on how often they engaged in specific forms of driver assistance during everyday driving; route planning, navigating, pointing out hazards, watching for traffic at intersections, looking for street signs, change settings on air conditioner or radio, give the driver feedback. These forms were drawn from previous findings of roles that passengers played in the car (e.g. Bryden et al., 2014; Mårdh, 2016; Regan & Mitsopoulos, 2001). Finally, participants were asked general questions to capture their views and experiences around driving with passengers, and driver-passenger interactions. The full list of interview questions is found in Appendix D.

2.2.3 Pilot study

To test the procedure, route and equipment, three pairs of participants were recruited for a pilot study. The procedure for the pilot study was identical to that used in the main experiment as described below (section2.3), with the exception that participants were provided with a printout from Google Maps detailing the route (Appendix E) instead of a physical map of the city with the route outlined. Data from the pilot study were not included in the subsequent analyses.

2.3 Procedure

Participants indicated their interest in the study via email contact with the researcher. On making contact, participants were provided with an information sheet about the study and had the opportunity to ask any questions they had. If participants wished to continue, they then contacted the researcher and arranged a mutually suitable time to complete the drive during daylight hours on any day of the week. Participants were instructed to bring their own vehicle and meet the researcher at a specific location on the University campus, indicated via a campus map and directions.

On the day of the experiment session, the pair of participants (driver and passenger) met the researcher at the arranged meeting point. Participants were asked to sign a consent form and were given the opportunity to ask questions about the experiment and procedure. While participants were reading the consent form, the researcher obtained verbal consent to install the camera in the participant's vehicle. On finishing signing the consent form, participants were asked to enter their vehicle, and the researcher read out the following instructions.

> *"The purpose of this study is to look at how passengers interact with and assist drivers during everyday driving.*
>
> *For the first part of the session today, you will drive around some local Hamilton roads while being video and audio recorded from this camera here. The drive should take you about thirty to forty minutes and will end with you back at the same parking lot here. While you're driving, try to relax and*

treat this like any normal day to day drive. Make sure you drive the same way that you would on your usual trips together and follow all the road rules. Please don't use the radio during the trip, as the music makes it difficult to hear what's happening on the recording."

Participants were informed that the camera record of the drive would be confidential and deleted once the project was complete. They were then given a chance to ask questions before the recording was started. Once participants' questions were answered, the researcher informed the participants that the camera was recording, handed them the city map and read the following instructions.

"This is a map of the route that you will be driving. You will note that the route starts on Rotoroa drive, by the Verandah café at the Hamilton lake. Choose your own route to get to that starting point and from there, follow the set route as outlined on the map to get back here; starting by travelling through the parking lot by the lake along Rotoroa drive."

Participants were informed that they were free to withdraw from the experiment at any time without penalty. They were provided with a contact number for the researcher in case of further questions, or if they wished to withdraw. They were then given another opportunity to ask questions, before being asked to contact the researcher when they returned from their drive The researcher then left the car, leaving the participants to begin the drive. On their return, the researcher entered the car again and welcomed them back. Participants were asked if they were ready for the interview. Once participants were ready, the following instructions were read.

"For this part of the study, I'm going to ask you a few questions in the form of an interview. The purpose of the interview is to capture your views and experiences around passenger and driver interactions. You don't have to have the same answer to any question as your fellow driver or passenger; since the purpose of this study is to capture your individual views and

experiences anything you have to say that might be different, or shed a different light on the same point, is welcome."

The interview was completed with both participants in each pair, allowing them to bring up and develop ideas together. At the conclusion of the interview, participants were informed that the camera was now being turned off and the recording was stopped. They were then asked to complete the short demographics questionnaire while the camera was uninstalled from their vehicle. Participants were provided with signed copies of their consent forms for their own records, along with a $20 voucher in appreciation for their time taking part in the study.

2.4 Data Processing

The camera record of the drive and interview were partially transcribed and anonymized. Transcription of the drive began at the point where the car began moving, ending when the participants had returned to the University and the car came to a full halt. As the focus of the experiment was on driving-related interactions between the driver and passenger, any segments of the drive of at least one minute in length where participants made no reference to the driving task or environment were summarized (e.g. "*Participants continue along Knighton road, then enter Gate One and drive through the university continuing conversation around work between timestamps 6:15 and 8:15*"). Segments of the interview where the participants talked about topics not related to driving with a passenger were similarly summarized. All transcripts were anonymized to remove names of locations or people that could potentially be used to identify the participants in the study.

2.4.1 Drive Transcript Coding

The transcripts of the drive were used to identify points where the passenger assisted the driver. Passenger Assistance (PA) was defined as times where the passenger directly interacted with the driver in a way that either provided information to the driver, encouraged the driver to behave more safely or made the drive easier for the driver in some way. Indirect assistance (e.g. talking about the condition of the road, or the behaviour of other drivers not posing an immediate hazard) was not included in the analysis. PA instances could be initiated by either the driver or passenger and could vary in length and

complexity, ranging from the passenger performing an action on behalf of the driver without a request or acknowledgement to long conversations on a single topic (such as determining where the participants were in relation to the route). PA instances were defined as ending when the participants shifted to a new topic, after a long pause with no discussion, or after the completion of the driving manoeuvre being discussed.

PA instances could vary in complexity between a single instruction or action, and a complex conversation where passenger and driver took turns speaking. As such, PA instances can be conceptualized of being made up of some number of interactions between the passenger and driver. Interactions can include both short, non-spoken gestures (e.g. mock-bracing oneself against the dashboard as an indication that the driver has braked too sharply), verbal utterances ranging from one-word statements to long, continuous utterances formed from several sentences. In this study, interactions were defined as ending when the speaker changed, or after a short pause with no verbal interaction. The number of interactions that each instance of PA was comprised of was used as a measure of complexity. Each PA instance was also coded as one of six categories (Table 4).

Table 4

Coding categories and scoring criteria for instances of passenger/driver assistance or collaboration

Category	Description	Examples
Immediate Hazard	Passenger alerts driver to a hazard that requires, or may require immediate action	"Watch out for that kid on the bike there" "What the hell?"
Situational Awareness	Passenger draws driver attention to a part of the driving environment, not including warnings about immediate hazards	"Judder bars along here" "What's the speed along here?" "Go, light's green"
Feedback and Driver Behaviour	Passenger comments on driver behaviour Can be non-verbal (e.g. sound or gesture of discomfort) Can include praise, criticism or instructions to change the way the driver is driving	"That was an orange light" "Slow down!"
Clearance	Passenger looks out for a gap in traffic (e.g. at an intersection) where it is safe to pull away	"My side's clear" "You're good after this silver car" "Can't see anything out of this road"
Direction and Navigation	Passenger gives navigation instructions or talks about the route	"Straight through the roundabout, then down into Frankton until you reach Commerce street" "You need to get into the left lane" "Maybe Cobham drive? Less traffic that way."
Action	Passenger carries out a non-driving task for the driver	"Can you call <name>?" "It's hot here, turn the temperature down"

The categories were developed by identifying types of assistance described in the literature, comparing these types of assistance to the post-drive transcripts to identify sections relevant to those forms of assistance and then labelling these groups with descriptive titles that described their function (Bryden et al., 2014; Mårdh, 2016; Perterer et al., 2013; Regan & Mitsopoulos, 2001). Categories were mutually exclusive; no instance of assistance could be coded as multiple categories. For each PA instance the researcher recorded the number of the participant pair, the timestamp where it had occurred (including whether it was during the Unplanned or Planned section of the drive), the category of assistance assigned, whether the instance was initiated by the driver or the passenger, and the number of interactions comprising the instance. The compilation of participant demographics and the list of PA instances formed the dataset used for analysis.

2.4.2 Interview analysis

In order to analyse the interview data, participants' interview answers were grouped by interview question. Points where participants mentioned passengers providing assistance, being beneficial, or being detrimental to drivers as well as points where participants discussed contextual factors that impacted passenger assistance were identified and labelled with the type of interaction (e.g. Operating GPS technology, Answering a phone call, Pointing out a speed sign), whether it was seen as useful or not, and any contextual factors mentioned, as well as the pair number and question so the quote could be found again. For example, a response to the question "What things do you think passengers should be doing to help drivers drive more safely?"

> *"D4: When we get to a maybe kind of hazardous situation, uh, making me more kind of calm and relaxed. Cause you know just hard situation in driving gives me enough stress by itself. Having someone next to me calming me down is much more helpful."*

This response would be labelled as 'Calming the driver down' (type), 'Helpful' (helpful/unhelpful), 'In complex or stressful situations' (context). Labels were then collected in a second document and grouped by similarity on the bases

of either the type of assistance or the context. For example, “Rolling a smoke for the driver” and “Passing something to the driver” both involve performing a non-driving related task on behalf of the driver. The larger groups were given a descriptive title and the quotes associated with each label were checked against the group to ensure that the title was a good reflection of the data, and was adjusted as necessary to form the final Themes describing different roles that passengers played in the car, and what contextual factors influence how passengers assist drivers.

Chapter 3: Results

3.1 Driver-Passenger Interactions

Over the twenty drives, 525 PA instances were identified. Table 5 shows the frequency of occurrence of each type of PA instance averaged across the 20 driver-passenger pairs. The right-hand panel of the table shows the average proportion of each type of PA calculated for each of the driver-passenger pairs. Unsurprisingly, as the drive was based around a navigation task, the most frequently occurring type of PA was assistance with directions or navigation, comprising 80% of all PA instances (And notably, this was the only form of PA seen in one pair). Passengers commenting on the behaviour of their driver was the second most common type of PA. However, this occurred much less often, comprising only 5.4% of the PA instances. The other forms of PA (Passengers bringing driver attention to immediate hazards, increasing drivers' situation awareness, assisting with safe gap selection or doing secondary tasks on behalf of drivers) all showed similar proportions, comprising between 3-4.1% of the PA instances.

Table 5

Summary of the mean number, standard deviation, range and relative proportions of PA Instances across pairs of participants

	Number of PA Instances		Proportion of PA Instances	
	Mean (SD)	Range	Mean (SD)	Range
Immediate Hazard	1.05 (1.15)	0-3	0.035 (0.038)	0-0.13
Situation Awareness	1.05 (1.05)	0-4	0.037 (0.034)	0-0.1
Feedback/Driver Behaviour	1.65 (2.03)	0-6	0.054 (0.063)	0-0.2
Clearance	0.95 (1)	0-3	0.030 (0.032)	0-0.095
Direction/Navigation	20.65 (5.72)	8-34	0.803 (0.107)	0.6-1
Action	0.9 (1.17)	0-4	0.041 (0.059)	0-0.2
Mean total PA Instances per drive	26.25 (8.42)	10-43		

3.1.1 PA complexity

As a measure of the complexity of PA Instances, the number of interactions between the driver and passenger comprising each PA instance was recorded. Table 6 shows the total number of each type of instance identified, and the average number of interactions for each type of PA instance across the twenty pairs. The second panel shows the number of PA instances initiated by the drivers and passengers overall, along with the average number of interactions for each instance initiated by either a passenger or a driver. Finally, the lower panel shows the average number of interactions for all PA instances.

Table 6

Average number of interactions per PA Instance by type, initiator and overall

	N	Average number of Utterances (SD)	Range (Utterances)
Immediate Hazard	21	1.62 (0.59)	1-3
Situational Awareness	21	2.48 (1.97)	1-8
Feedback/Driver Behaviour	33	3.24 (2.31)	1-11
Clearance	19	4.11 (2.54)	1-10
Direction/Navigation	413	5.08 (4.63)	1-35
Action	18	2.78 (2.34)	0-9
Driver Initiated	192	4.13 (3.89)	0-33
Passenger Initiated	333	5.44 (4.89)	1-35
All Instances	525	4.61 (4.32)	0-35

As can be seen from the table, most PA instances were fairly simple, averaging at 4.61 utterances per interaction. Individual PA instances ranged from no spoken interaction at all (only occurring when the passenger performed an action on behalf of the driver unprompted and without acknowledgement from the driver) to more lengthy conversations involving collaborating on orientation, navigation or route planning. PA involving Direction / Navigation, or those initiated by the passenger tended to involve more interactions on average than PA of other forms, or those initiated by the driver. PA instances where the passenger

alerted the driver to an Immediate Hazard had fewer interactions on average than other forms of PA.

3.1.2 Comparison of the Planned and Unplanned Route Sections

The Planned segment of the route, which involved following the pre-set route according to the map was designed to be an indirect route back to the starting position, taking participants through different driving environments. As such, it is unsurprising that participants spent more time on the Planned section of the route (an average of 25 minutes) than on the Unplanned section of the route (an average of 11 minutes), which involved a free choice of route to a specified destination. Because of this difference in time, and thus difference in opportunity for passenger/driver interactions to occur, the number of PA instances of each type cannot be directly compared between the Planned and Unplanned route sections. As such, average rates of each PA instance type were calculated separately for the Planned and Unplanned route sections. Table 7 shows the average rate per hour of each type of PA for both the Planned and Unplanned route sections.

Table 7

Average rate of different types of PA instances for the Planned and Unplanned route sections

	Mean (SD) Instances/hour		*2-tailed t-test (df=38)*	
Assistance Type	Unplanned	Planned	*t*	*p*
Immediate Hazard	1.36 (2.52)	1.81 (2.29)	-0.60	0.55
Situation Awareness	0.26 (1.18)	2.46 (2.56)	-3.48	<0.01**
Feedback/Driver Behaviour	2.66 (4.94)	2.64 (3.41)	0.01	0.99
Clearance	0.46 (1.42)	2.05 (2.19)	-2.71	0.01**
Direction/Navigation	21.48 (14.5)	41.12 (10.8)	-4.85	<0.01**
Action	1.97 (3.22)	1.46 (2.31)	0.57	0.57

An independent 2-tailed t-test assuming unequal variances showed that the relative rate of Situation Awareness, Clearance and Direction/Navigation PA instances was significantly higher along the Planned section of the route when

compared with the Unplanned section of the route, while the rate of PA instances related to Immediate Hazards, Feedback/Driver Behaviour and Actions performed on behalf of the driver were not significantly different between the route sections.

3.1.3 Comparison of Driver Initiated PA with Passenger Initiated PA

On average, passengers initiated almost twice as many PA instances as did drivers (Mean Driver initiated = 36.6%, SD = 16.8%, Range = 9.7%-76.5%), though the percentage varied substantially across different pairs of participants. Some drivers initiated as few as 10% and as many as 75% of all PA instances. In other words, most of the support given to drivers from passengers was provided unprompted rather than in response to a request or prompt from the driver.

As can be seen in Figure 3, however, the percent initiated by the passenger differed greatly depending on the type of PA. All of the Immediate Hazard PA instances were passenger initiated, whereas Action PA instances were more often requested rather than offered unprompted (on average, 64.17% were driver initiated). The most common type of PA, Direction/Navigation, was most often initiated by the passenger (M(SD) = 59.15% (18.56%), range 20.00%-89.29%)

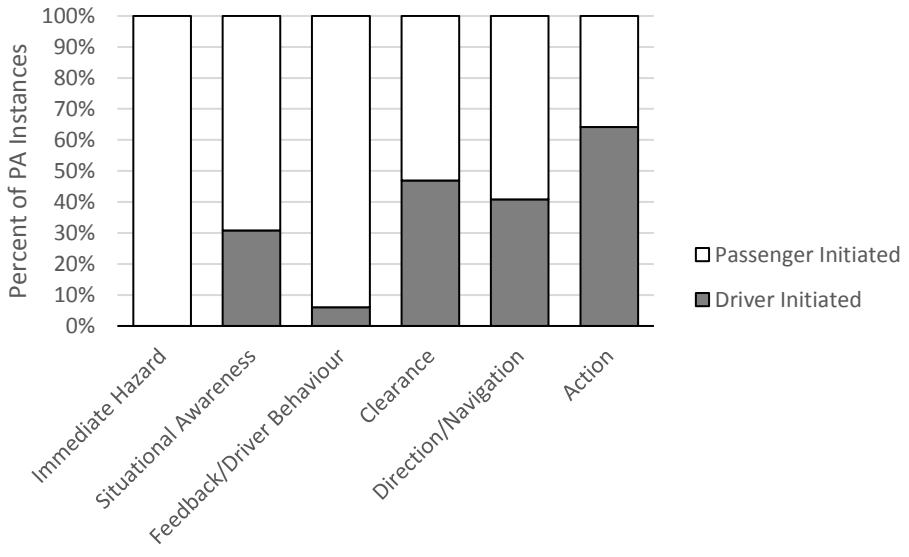


Figure 3. Average percent of each type of PA instance initiated by the driver and passenger

Table 8 shows the average percentage of PA instances initiated by the driver for each combination of driver and passenger gender. Despite the common saying of male drivers never asking for help, the average percentage of PA instances initiated by male drivers (40%) was similar to those initiated by female passengers (38%). On average, in pairs where the driver and passenger were different genders, the driver initiated more PA instances than in pairs where the driver and passenger were the same gender. Despite this, male drivers with male passengers showed the highest average percentage of driver-initiated PA instances at 61.6%; the only pairing where the driver initiated more PA instances on average than the passenger.

Table 8

The Mean, Standard deviation and Range of percent of PA instances initiated by the driver for each combination of driver and passenger gender

Gender	n	Mean Driver Initiated (SD)	Range
MaleDriv, MalePass	3	61.6% (20%)	33.3% - 76.5%
MaleDriv, FemalePass	9	33.1% (10%)	9.7% - 43.5%
FemaleDriv, MalePass	5	38.5% (13%)	19.4% - 53.3%
FemaleDriv, FemalePass	3	36.8% (16.5%)	23.1% - 60%
Same Gender	6	49.2% (22.1%)	23.1% - 76.5%
Mixed Gender	14	35% (11.5%)	9.7% - 53.3%
Male Driver	12	40.2% (18.1%)	9.7% - 76.5%
Female Driver	8	37.9% (14.5%)	19.4% - 60%

3.1.4 Types and Nature of Passenger Assistance

While instances of passenger assistance were placed into one of six categories as described, the nature and topographies the interaction varied substantially within the broader categories of assistance type. What follows is a deeper exploration of each of the six categories, providing examples of what happened on the road to illustrate what the different forms of Passenger Assistance actually look like in practise.

3.1.4.1 Direction and Navigation

As the driving task was navigation-based, it is not surprising that direction and navigation assistance was the most common form of passenger assistance observed in this study. Though drivers occasionally consulted the map, the passenger was almost always responsible for navigation throughout the route; holding the map, giving instructions or confirming directions. When the map was handed out between passenger and driver, the passenger would almost always be the one to take and consult it first.

Both the amount of navigation assistance given by the passenger, and the way that this assistance was given appeared to be affected by how well the drivers knew the route or areas which they were driving through. Some drivers specifically asked for assistance in navigating to the lake during the unplanned section of the drive. Some drivers were entirely dependent on their passenger for navigation along the planned section of the route, only consulting the map if a wrong turn was made or there was some confusion about directions. Other drivers studied the route themselves and only confirmed with their passenger that they had the correct directions as they were driving. Typical direction assistance was in the following five forms

The first form or direction assistance, Route planning, occurred when the passenger assisted with the driver's decision on which route to take to get to a destination. This occurred only during the Unplanned section of the route, as the Planned section had a pre-mapped route for participants to follow. Route planning was a collaborative process with the driver and passenger discussing different options before settling on a given path, taking into account features such as traffic, speed zones and traffic lights on the way. Often the discussion could be quite long and complex in comparison to other forms of passenger assistance.

"D8:What's the best way to the lake?
P8: I don't know! You think it's past your place =or over the bridge=?
D8: =Are we going to the carpark with= the, oh it's basically <name>'s flat right
P8: Yeah

D8: Are we going to the carpark with um, the playground? That one?

P8: Uh, yes. Yes. Yeah so we are going, that entrance you know where, like you if you're coming from the hospital to turn onto like Lake road

D8: Yeah. =Go left?=

P8: Yeah like there's that entrance there yeah.

D8: Yeah. So we just go back

P8: Past yours and stuff? Or?

D8: Oh yeah, we'll just go down like Te Aroha street like as if =we're going to <name>'s place=

P8: =Oh yeah yeah.= Yep."

Direction instruction occurred when the passenger gave the driver instructions on how to get to a location, or how to follow the route. Instructions included lane choice, upcoming turns and references to landmarks. Almost all passengers gave instructions during the Planned section of the route. Some passengers also gave direction instruction during the Unplanned section, particularly if the driver was less familiar with the area they were travelling in. During the Unplanned section, Direction instruction was often much more general than during the Planned section, with passengers directing the driver to head towards areas of the city or known landmarks rather than street-by-street instruction. Passengers varied in when they gave instructions, some giving many instructions well ahead of the driving operations and confirming before specific manoeuvres. Others gave line by line instructions, often given immediately after the prior driving manoeuvre was completed.

"P11: That's true. So straight through this one, this is Hill street

D11: Yeah. And straight through. Yep. Cool

P11: And then you'll be taking the right on Commerce which is =this one here=

D11: =By those banks=

P11: By the banks.

D11: It's like the main street in Frankton, right?

P11: Yep, that's the one."

Orientation or Location assistance occurred when the passenger helped to provide the driver with information as to where they were in the city in relation to landmarks, other areas of the city or shared knowledge. By doing so, the driver was made more familiar with their current position and the route itself, allowing for better shared understanding and communication. This usually occurred in the Planned route section while participants were travelling along roads or areas that were unfamiliar to them.

"P: So do you know where you are?

D: Yep. More or less

*P: More or less! *Both laugh* Do you know which big roundabout I'm talking about?*

D: No

P: So if you go up with Grey, that one, after you've passed Claudelands events centre, that big one there? We're going to hit it from this side

D: Oh"

Confirmation assistance occurred when the driver used the passenger to act as a second check on the route the driver was taking. This usually occurred on the Planned route section, where the driver confirmed the next few directions, often immediately before the manoeuvre. During the Unplanned section, the driver would occasionally double check their turns with the passenger, confirming that a road they intended to head down did indeed lead to their destination. Occasionally, the driver would get the road or direction wrong, leading to a correction from the passenger.

"D7: So we're turning left onto Heaphy terrace?

P7: Yes, at the roundabout

D7: Yeah yeah yeah I know"

Collaborative problem solving occurred only on the Planned route, where the driver and passenger collaborated to figure out where they were and how to

complete the next section of the route. This often happened after the participants missed a turn. The interactions were very lengthy and often involved the car being pulled over to the side of the road so that both participants could look at the map and concentrate on the discussion. For example, in one drive the participants missed the turn off to continue the route, instead following the road around to loop back into an area they had already driven. At first, the driver and passenger express confusion over where the turn off was, then talk about where they were headed and agree that they must have missed the turn as they are back in familiar roads. The driver suggests a specific street they had passed as being the turn-off, the passenger consults the map and agrees. They then discuss how to get back to the turn-off, deciding on repeating the same section of the road they had progressed down previously, this time finding and continuing with the route.

3.1.4.2 Immediate Hazard

PA instances related to an immediate hazard could occur along any section of the route. By definition, they were always initiated by the passenger. In practise, passengers reacted to hazards in the environment in a range of different ways. Some passengers actively warned the driver of potential hazards, bringing the hazard to the driver's attention direction.

"P1: Mind the little girl on the bike
D1: Yep. Hello"

At other times, passengers gave a more generalized reaction, not pointing out any specific hazard but instead instructing the driver to wait or reacting to the hazard in a way which caused the driver to draw their attention to the hazard in question.

*"*Driver starts to pull away at a roundabout, a car comes around the circle at the same time**
P8: Wait, wait, wait, wait."

3.1.4.3 Situation Awareness

Passenger assistance involving Situation awareness involved the passenger acting as a second pair of eyes in order to make sense of things in the environment, or double check things that the driver had missed. Over different

pairs, it included activities such as looking out for a parking spot, keeping watch as a driver backed out to ensure they didn't reverse into another parked car, alerting the driver to the speed they were travelling and informing the driver of the current speed limit in response to a prompt.

"D8: Is it sixty here, fifty right?
P8: Yeah it is fifty"

At one point, a passenger kept look out for the location of an ambulance after the siren was heard, informing the driver of where the ambulance was and therefore confirming for the driver that they didn't need to move to clear the path

*"*Siren is heard**
D15: I don't know where that's coming from
*P15: *Points the ambulance out* It's in front of you*
D15: Oh yep, sweet"

Passengers could also act as cues to bring the driver back from a distracting task to focus on the road again when needed. Most commonly, passengers prompted drivers when a traffic light turned green that they could pull away, bringing the driver's attention back away from reading the map, talking or other distractions.

3.1.4.4 Feedback/Driver Behaviour

Passenger comments on driver behaviour was primarily critical, drawing attention to a driving error, violation or a behaviour that the passenger was not comfortable with. At times, feedback consisted of gestures or sounds of discomfort following a point where the driver hit a speedbump too fast or rapidly stopped the vehicle. Drivers occasionally prompted comment by observing a driving error themselves, acknowledging the mistake. Passengers very rarely complimented the driver on a driving decision or manoeuvre. Criticism could be in the form of a serious complaint, or could be framed as part of a joke.

"P9: Oh, man you're going to get in trouble didn't even stop for the stop sign!
*D9: *Laughs* There was no stop sign there, it was a give way!*
*P9: Yeah, I'm colourblind! *Laughs**

D9: Shut up!

Both laugh

D9: Didn't even look at it ay, I was off with the fairies."

3.1.4.5 Clearance

Clearance occurred at points where the driver was unable to see part of the road due to weather conditions or restricted view (e.g. from overgrown plants blocking some of the street. Usually, there was also relatively high road traffic. At times, the driver would explicitly ask the passenger to keep watch in one direction or would mention the road conditions and prompt the passenger into assisting. At other times, the passenger would be the one to mention road conditions, or would simply begin informing the driver when it was clear to pull away without being asked. Most Clearance PA instances occurred at one particular intersection along the route involving a right turn across a busy road.

"D7: I cannot see that way. Cause of the sun

*P7: *Looks to the left* Ah, you're fine.*

D7: It's all good?

P7: All good, yup!

3.1.4.6 Action

Actions taken on behalf of the driver often involved manipulating their phone, including things like checking the calendar or messages. Several different drivers asked the passenger to phone ahead to the researcher when approaching the end of the route. Occasionally, passengers would do something on behalf of the driver that was more detrimental than helpful, including adjusting the sunshade or restricting the driver's view with an unwanted GPS device. In one pair, the passenger was responsible for rolling smokes while on the road.

3.2 Interview Analysis

On analysing the interview, five themes were identified. Four of these related to different roles that passengers play in the car; Passengers increase driver situation awareness, passengers perform tasks on behalf of the driver, passengers help keep the driver alert, awake and focused and passengers influence drivers'

safe and unsafe driving behaviour. The remaining theme was that when passenger assistance is useful, given, and appreciated is affected by both the driving situation and relationship between driver and passenger. Presented here are a summary of these themes. A full write up of the interview analysis can be found in Appendix (F)

3.2.1 Passengers increase driver situation awareness, acting as a second pair of eyes

Passengers were seen as able to assist the driver by expanding the driver's awareness of the situation, acting as a 'second pair of eyes'. While drivers were expected to focus their attention on the road, participants saw passengers as more able to watch both the road and the surrounding environment; their positioning and the lack of a driving task to focus on allowing them to see things that the driver missed. Passengers with good situation awareness could give drivers information about hazards or potential hazards as well as other environmental features like open parking spaces or the current speed limit. Some participants identified that this was particularly useful at times when the driver had low visibility *"like in the rain or at night"* (Driver 5), or in complex driving environments.

One example alluded to by almost half of the participants was the passenger looking out for traffic at a busy intersection. Even when the driver does not explicitly ask for assistance, participants mentioned that the passenger would automatically keep lookout and warn the driver in case of a lapse, error or something the driver didn't see. Participants suggested that they had learned to keep lookout in this manner from their own experiences as drivers.

> *"P10: I mean, as we were driving around today I was certainly checking. Um, but I never said anything because, I guess I had, I had trust in your own judgements for gap selection. But if I saw a car that was coming up at speed I might have said something."*

While passengers pointing out hazards was seen as potentially useful, passengers who overreacted to hazards or pointed out hazards that drivers were

already aware of were perceived as distracting, annoying or "*patronizing"* (Driver 12). Pairs where the driver and passenger had different driving styles were particularly at risk; journeys where each pair member had a similar style allowed the passenger to better predict when the driver was already reacting to a hazard and when it was appropriate to warn the driver.

3.2.2 Passengers perform tasks on behalf of the driver, acting as a second pair of hands

Most participants reported that the passenger can and does make driving easier by performing secondary tasks for the driver; that is, tasks that are unrelated to the operation of the vehicle. By doing so, the driver does not have to take their attention away from driving to perform these tasks, theoretically making the drive both easier and safer.

The most common method identified was that the passenger assisted the driver by helping to direct or navigate. Although participants identified that most of the time they were driving familiar routes to familiar places with little to no navigation required, passengers were seen as useful in unfamiliar environments, or in places where the passenger had more local knowledge than the driver. The availability of GPS technology impacts navigation assistance. For some pairs, GPS technology made passenger assistance redundant. With other drivers, the passenger was responsible for operating the technology and providing further context and information for the directions.

Passengers were also able to assist the driver in manipulating the environment within the car. Passing the driver objects, reaching for dropped items or performing more intricate tasks such as rolling cigarettes for the driver were all discussed as ways the passenger could prove helpful. Passenger were also relied on to operate the driver's phone, and to operate settings on the car, such as the radio or air-conditioner – Though whether this was seen as helpful or not varied between participants.

> *"P15: I get my passengers to like sort out the radio and stuff because I can't concentrate and I'm not well practised at driving enough to be able to like, change my concentration like*

that so I'm just like, bro like, sort out the air-con, sort out the music and also here's my phone I just got a text"

3.2.3 Passengers help keep the driver awake, alert and focused

Almost every pair of participants discussed passengers helping drivers to keep awake, alert or entertained while driving. While some participants identified that passenger conversation could be distracting, others found conversation to be something that increased their focus and attention to the road. For these drivers, having a passenger prevented them from getting bored and drifting off or "*zoning out*" (Driver 20) and reduced the need for other distractions such as music or audiobooks. These benefits were suggested to be particularly valuable when the driver was fatigued, such as on long drives.

Monitoring how much the driver needed to concentrate on the current situation also allowed the passenger to mitigate their own distractive influence, altering conversation by simplifying speech and pausing more often during difficult situations and physically moving to clear the driver's line of sight should the driver need to look left past them. Passengers who did not maintain awareness of the situation, or moderate their own conversation were noted as distracting, requiring the driver to tune them out and making the drive more difficult overall.

3.2.4 Passenger presence and feedback influences drivers' safe and unsafe driving behaviour

Participants viewed passengers as able to affect the driver's behaviour on the road, both positively and negatively. Through both active intervention (such as providing feedback, suggestions or encouragement) and their passive presence in the vehicle, passengers could influence drivers to behave both more and less safely.

3.2.4.1 Passenger feedback can be both helpful and unhelpful

Almost every pair referenced the passenger providing some form of feedback or criticism to the driver. Both passengers and drivers recognized that feedback could serve to refocus the driver's attention on the road, or to confront the driver on unsafe driving behaviour. Though it was recognized that it was ultimately the driver's responsibility to behave responsibly on the road,

participants noted that the passenger was also put at risk by risky driving regardless of whether it was caused by a driver's intentional choice or a lapse of attention.

> *"D1: Passengers sometimes, you know sometimes things like that you know maybe if someone's going a bit quick you might say hey mate, or, just watch your speed here or remind them that, cause that's something that you can easily do"*

Some drivers suggested that feedback from passengers could be something that was both helpful and increased their likelihood to behave more safely on the road, especially if the passenger's judgement and driving ability was respected, or their comfort was valued by the driver. For other drivers or situations, however, feedback was framed as something that was distracting, annoying or frustrating. Passengers that were perceived as overreacting to potential dangers, being overly controlling and critical or speaking up too often were said to show a lack of trust in their driver's abilities. This was then seen as patronizing, causing the driver to become anxious, distracted, annoyed or frustrated and making the drive more difficult and less safe – *"You wanna drive? Well then, shut up!"* (Passenger 20).

3.2.4.2 Passenger presence in the car affects the way drivers behave

Even when the passenger was not providing specific feedback or criticism, participants believed that the presence of a passenger in the car affected the way that drivers behaved. Several drivers identified that they tended to drive more cautiously when a passenger was in the car. Some attributed this to a worry that they would be judged or criticised for their driving, while others stated that they were more conscious of their responsibility to keep the passengers safe and comfortable on the drive. Passengers were also seen as able to change the nature of a car trip from pure commute to something that could be enjoyed for its own sake. Drivers stated that they tended to drive slower and relax more when accompanied by a passenger, as when driving alone they just wanted to get where they were going.

Finally, the presence of a passenger provided some drivers with a sense of reassurance. These drivers identified that especially in unfamiliar areas, they felt more comfortable and less anxious when accompanied by a passenger as they had

another person able to share in decision making or confirm their decisions and observations of the environment.

> *"D16: Makes me feel like we're in it together. Not just one person trying to make the decision."*

3.2.4.3 Passengers can act as a negative influence on driving safety

Participants recognized that passenger influence is not always beneficial; passengers can influence drivers to take more risks and behave less safely on the road. Drivers stated that some passengers would 'egg them on' to drive faster and behave more recklessly than when they were driving alone. Some passengers, especially peer passengers with young drivers could act as an audience for the driver, encouraging them to show off their driving prowess with risky driving. Aggravating passengers or passengers that argued with the driver could result in the driver acting more erratically by heightening the driver's emotional state. As one participant stated, passengers can act as "*the devil on the shoulder or the angel on the shoulder"* (Driver 1), using their influence to encourage behaviour that either reduces, or increases the risk of a crash.

3.2.5 When passenger assistance is useful, given, and appreciated is affected by both the driving situation and relationship between driver and passenger

Whether passenger assistance was viewed as helpful, and how it would be received by drivers was affected by context, differing across different drivers, with different passengers and across different driving environments. Most situations faced by drivers involved travelling on familiar, simple routes where passenger assistance was required less. More complex or unfamiliar driving environments were seen as times when passenger assistance was correspondingly more useful, but also times when passengers being unhelpful or distracting would be more difficult to deal with. Longer drives created more of a need for the passenger to keep the driver awake and alert, and to monitor their condition to ensure they were safe to drive.

The identity of the driver and passenger was raised as an important contributing factor. Drivers perceived as more defensive were less likely to ask for or receive passenger assistance well, while passengers who were seen as over-

reactive or not respecting the driver's abilities were less likely to find their assistance helpful or appreciated by the driver. Young or elderly passengers believed to be less likely to give assistance and more likely to be distracting and dangerous in the car while younger drivers were seen as more likely to take risks or be pressured by their peers into dangerous on-road behaviour.

Finally, the nature of the relationship between the driver and passenger was seen as important in influencing when passenger assistance was appropriate and appreciated. For example, driving with a partner was seen as different to driving with a friend, a parent or a stranger. More experienced passengers, passengers who were also drivers, or those with similar driving style to the driver were all more likely to be viewed as helpful by the driver, making the drive easier and safer. Some drivers did suggest, however, that more familiar passengers tended to allow them to relax and care less about their driving as they no longer needed to make a good impression.

Chapter 4: Discussion

This exploratory study investigated the assistance that familiar adult passengers gave adult drivers to identify why a passenger's presence leads to a reduction in crash risk. To do this, three research questions were asked. Firstly, how do passengers assist adult drivers during everyday driving? Secondly, how does assistance offered by passengers unprompted compare to what drivers request? Finally, how do driver and passenger perceptions of passenger assistance compare to what actually happens on the road?

4.1 How do passengers assist adult drivers during everyday driving?

While passenger assistance varied in frequency and type between different pairs of participants, all passengers in this study gave at least some assistance to their driver on the road. At a minimum, all passengers provided assistance with directions and navigation, and some assisted the driver by reducing cognitive load, increasing situation awareness or providing feedback or criticism of their behaviour.

4.1.1 Assistance with Navigation

Passengers assisting with navigation is well established in the literature. The results of this study provided further support that passengers play an important role in navigation. A number of different types of navigation assistance were identified in the current study, as described in the literature. Passengers helped drivers to find their way to a destination using collaborative way-finding conversations (Bryden et al., 2014), follow a pre-planned route by giving directions (Forlizzi et al., 2010; Mårdh, 2016), orient them to their location within the city, and confirm directions or reassure drivers that they were on the right path (Antrobus et al., 2017). Participant report from the post-drive interviews confirmed that many, though not all drivers viewed the passenger's navigation assistance as valuable when they were driving in an unfamiliar area, though this relationship was often altered or made redundant by GPS technology such as google maps.

Acting as a navigator may reduce the cognitive workload of the driver, allowing them better focus on the road and therefore resulting in a lower risk of crashes. Beyond that, as navigation tasks are most commonly required in complex

or unfamiliar environments, having a passenger assist the driver may produce a sense of reassurance and confidence (Nakagawa & Park, 2014), affecting the driver's emotional state and therefore potentially leading to fewer driving violations and errors (Precht et al., 2017).

4.1.2 Assistance with Secondary Tasks

Passengers were seen to assist drivers with otherwise distracting activities in the car, consistent with observations by Nevile and Haddington (2010). While passengers attempting to assist the driver in this way could be distracting or unhelpful if the passenger did not judge the situation or driver needs well, they could also be helpful in removing the need for the driver to perform the tasks themselves, allowing them to focus on the road. Consistent with previous literature, passengers assisted drivers by manipulating in-car controls such as air-conditioning or radio (Perterer et al., 2013; Regan & Mitsopoulos, 2001); however, how useful this form of assistance was perceived as (or whether it was useful at all) varied across different pairs of drivers and passengers.

Previous studies have identified that participants can assist the driver through manipulating a phone, such as by taking calls or messages (Regan & Mitsopoulos, 2001). This was further supported by this study, where participants reported that passengers could help drivers by communicating with others outside the car (i.e. with phonecalls or messages) and could even operate a driver's phone on their behalf, if they were trusted. On road observations in this study supported this report; some passengers did handle phone calls, check calendars or read messages for the driver while on the road.

Other ways that passengers assisted drivers included manipulating the environment within the car – For example, by rolling cigarettes for the driver, or passing them a dropped object. Finally, participants identified that if children were present, the passenger could help the driver by taking responsibility for dealing with the children and reducing their distractive influence on the driver. This was not observed during the on-road drive as there were no children present, though it makes an interesting contrast to (Koppel et al., 2011), who found that drivers did not interact any less with child passengers when an adult passenger was present.

Carrying a passenger has been found to be associated with the driver performing fewer secondary tasks while driving, except for those directly related to interacting with a passenger (Metz et al., 2014). Passengers performing these actions on behalf of the driver may help to explain this, their assistance allowing the driver to better focus on the road. Indeed, engaging in distracting secondary tasks while driving, especially tasks that require the driver to look away from the road such as retrieving dropped objects or using a phone are associated with an increase in driver errors and a higher crash risk (Precht et al., 2017). What is not clear is whether drivers in this study would have chosen to complete these tasks at all while driving alone, or if they would have deferred them to after the drive. For example, a driver may have chosen not to make a phonecall until after the drive if alone, but the presence of a passenger allowed them to ask their passenger to call during the drive. Actions were the one form of assistance more commonly requested by the driver than initiated unprompted and was generally framed as a useful thing for passengers to do in the interviews. On the road, however, some attempts at the passenger assisting the driver by performing a task for them were seen as unhelpful and distracting – For example, lowering the driver's sun visor without asking and thereby restricting their view. Therefore, while this study provides some evidence that passenger assistance may reduce driver workload by reducing the need for them to focus on secondary tasks, more research is needed to determine whether this occurs in practise during normal driving.

4.1.3 Increasing Situation Awareness

Passengers also assisted drivers by acting as another pair of eyes on the road, increasing driver situation awareness. While on the road, this took the form of identifying hazards, keeping lookout at intersections for a safe time to pull away, reminding the driver of their current speed or the current speed limit, or providing general information to drivers about the environment such as indicating that a traffic light has turned green. Most of the time, this form of assistance was initiated by the passenger, though drivers did occasionally prompt assistance by commenting on environmental factors or asking their passengers for aid (e.g. asking passengers to keep watch out of their side of the vehicle).

Previous research has suggested that participants do make comments that show situation awareness while in the vehicle (Charlton, 2009). It is possible that

these comments reduce the likelihood of the driver missing important information on the road that then leads to driving errors and crashes. Indeed, this may help to explain why Ross et al. (2016) found that driving with a peer passenger reduced the rate of driving errors for young male drivers, despite increasing driving violations (potentially due to peer pressure).

The expanded situation awareness provided by a passenger may also be helpful in bringing driver attention back from a distraction. Nevile and Haddington (2010) noted that drivers would often orient distracting activities to times where the risk was lower, e.g. while waiting at a traffic light. This came with a cost of being slow to react when their attention was required again. This study demonstrates that passengers can help to reduce this time, for example, by pointing out to the driver that the traffic light has turned green and it is time to pull away.

4.1.4 Passenger Feedback and Criticism

Passengers were seen to assist drivers by encouraging safer and more responsible driving behaviour on the road. Passengers may have some effect simply by being present in the car, for example by eliciting an enhanced sense of responsibility in the driver, or a worry of being judged. But passengers also actively shaped driver behaviour by providing feedback or criticism of driver actions, such as asking them to reduce their speed or instructing them to wait instead of taking a risky gap. This study also showed that passengers can give feedback with sounds of discomfort or gestures such as bracing themselves against the dashboard to indicate the driver has stopped too abruptly. Similar feedback from passengers has been seen in previous on-road studies (Perterer et al., 2013) though indirect feedback via commenting on other drivers' behaviour was not observed. Feedback has previously been shown to impact driver behaviour. For example, Hutton et al. (2001) demonstrated that passengers providing feedback along the road reduced the number of driving violations related to that feedback (e.g. giving feedback on the current speed reduced the amount of time drivers spent over the speed limit). This may partially explain why passenger presence in the vehicle is associated with reduced driver violations and therefore reduced crash risk (Precht et al., 2017; Rosenbloom & Perlman, 2016). However, as noted both in this study and by Dillon and Dunn (2005), too much

passenger feedback or complaints can become unhelpful, or even distracting or frustrating for the driver. Drivers very rarely initiated interactions regarding feedback or criticism, and often framed it as frustrating or patronizing. However, most drivers also admitted that feedback would cause them to refocus and drive more responsibly provided that it was given respectfully, by someone they trusted.

4.2 How does assistance offered unprompted by passengers compare to assistance that drivers request?

Examining what forms of assistance drivers gives further information on how passengers assist drivers. A high percentage of passenger assistance instances initiated by a driver could suggest that the driver is making use of a passenger as a resource to help make the drive easier. In contrast, a high percentage of passenger assistance instances initiated by the passenger might suggest that the passenger has learned to anticipate the driver's needs, or that they are providing unwanted assistance. In this study, how often each partner initiated episodes of passenger assistance varied substantially across different pairs. In some pairs, the passenger initiated almost all assistance (up to 90%), while in others they initiated as few as one quarter. Overall, however, passenger assistance was more often initiated by passengers unprompted rather than being prompted or requested by the driver.

Warning the driver of an immediate hazard was always initiated by the passenger, as by definition a driver would not ask for a warning of something they have already seen. Interactions where the passenger provided the driver with other information about the environment were also more likely to be initiated by the passenger, though the driver did occasionally ask the passenger for this type of assistance such as by enquiring what the current speed limit was. Again, this is potentially because providing information to the driver is only necessary if the driver is not themselves aware of the information and is unable to quickly confirm it themselves. For example, a passenger is more likely to initiate an interaction where they inform a driver the traffic light is green than the driver is to request them to look, since checking a traffic light by glancing up is faster than asking a passenger to look for you. This suggests that passengers do in fact expand a driver's situation awareness, pointing out things that the driver has not seen or keeping watch if the driver takes their eyes off the road. Passengers expanding

driver situation awareness has not yet been observed; further research could continue to explore how this affects a driver's ability to react to hazards or changing road environments and whether this leads to safer behaviour or an expanded willingness to take risks due to an overreliance on the passenger.

In contrast, points like busy intersections where the driver was required to watch both sides of the road for a gap in traffic showed a more even split between driver and passenger initiated assistance with the driver often asking the passenger to keep an eye on their side of the road. Participants later reported, however, that passengers checking for traffic at intersections was often automatic, and that explicit conversation or warning was rarely necessary unless the passenger judged that the driver had not judged a gap correctly. This is supported by Mårdh (2016), who found that passengers turn their heads at intersections as much or more than drivers in older couples, suggesting that even without explicit conversation the passenger is keeping watch for traffic.

It was very rare for drivers to ask for feedback from passengers, or to comment on their own behaviour; drivers only initiated an average of 10% of interactions related to passenger feedback. The fact that most feedback was given unprompted could suggest that feedback is often unwanted or unwelcome, which may contribute to the negative framing of passenger feedback or criticism ("Backseat driving") often seen in the participants' interviews.

Only interactions where passengers performed actions on behalf of the driver were initiated by drivers more often than passengers. One reason for this may be that actions performed on behalf of the driver can be highly distracting if unwanted, especially if the actions involve encroaching on the driver's space or vision such as adjusting their sun visor.

The pattern of which participant would initiate more passenger assistance instances along the drive did seem to be affected by the gender of the driver and passenger. Though male and female drivers initiated a similar percentage of passenger assistance episodes, the driver initiated a higher percentage of passenger assistance episodes when they were accompanied by a passenger who identified as the same gender, as opposed to drivers who were accompanied by a passenger of a different gender. While it is important to note that there were fewer

same-gender pairs of participants than mixed-gender pairs, this suggests that the relationship between the driver and passenger may be an important factor in how passengers give assistance to drivers; mixed-gender pairs in this study were more likely to be couples than same-gender pairs, who were usually friends or family. While this study was not explicitly examining types of relationships, the impact of the driver-passenger relationship on the ways passengers assist drivers is consistent with other studies (Forlizzi et al., 2010).

4.3 How do perceptions of passenger assistance compare to what actually happens on the road?

Overall, participants viewed passengers in the vehicle as mostly having a positive impact, making the drive easier and safer. While some participants viewed passengers as inherently distracting, unhelpful or having no impact on the drive at all, each participant was able to identify scenarios or experiences where passengers could be, or had been helpful. Participants were able to identify several ways that passengers assisted drivers on the road. Similar to what was observed during the drive, passengers were seen as able to enhance the driver's situation awareness, reduce their cognitive load by performing secondary tasks on their behalf and shape the driver's behaviour using tools such as feedback and criticism.

In addition to what was seen on the road, passengers identified other ways that the passenger assisted drivers. Some passenger assistance was highly contextual; passengers were framed as helpful in interacting with child passengers to reduce their distracting influence on the driver, helping to monitor the driver during long journeys or late at night, and as able to reach for and retrieve dropped objects for the driver.

Participants also identified some passenger behaviours as useful that were not directly measured during the on-road study. Talking with the driver helped to keep the driver entertained and thus awake, alert and focused especially when fatigued or on a longer drive. It was also said to keep the driver calm and relaxed when in a stressful situation, and reduce a desire for them to speed. It is possible that passengers talking about the route with drivers may help to assist drivers to focus on the road and drive, helping to reduce mind-wandering and improve

driving safety, though this requires further research to better understand. Previous research has also suggested that passengers are aware of the role of the passenger in keeping the driver alert and awake (Regan & Mitsopoulos, 2001), though more research is required to understand if this actually happens on the road.

While passengers were observed identifying hazards and warning drivers of dangerous situations on the road, these observations likely underestimate how frequently passengers do act as a second pair of eyes. Participants reported that even when not asked, or when they don't speak up they automatically keep watch for traffic and hazards, especially at intersections. This double checking rarely requires them to explicitly talk to the driver, trusting in their driver's judgement and driving ability. However, should a dangerous situation arise or should the driver miss something, the passenger can then intervene to prevent a crash.

Participants also emphasized the passive effect of driving with a passenger. Even when passengers don't interact with drivers, simply carrying a passenger could have a variety effects on the driver's behaviour – eliciting a greater sense of responsibility, a fear of being judged, or allowing them to relax and drive more safely than if they were travelling alone. While this was not directly measured by the study, it is consistent with previous research that examines the psychological impact of passengers on drivers (Nakagawa & Park, 2014).

The highly contextual nature of passenger assistance was also emphasized by participants. Participants reported that whether passenger assistance was given, requested or helpful was dependent on the driver, the passenger, the relationship between them, the driving environment, the driver's mental state and other factors. Passenger assistance was seen as complex; what was helpful for one driver might be frustrating for a different driver, or in a different situation. This was especially true for forms of assistance that could be seen as patronizing or showing a lack of trust in the driver's abilities; pointing out hazards and giving criticism could both be helpful, but were seen to be frustrating and unhelpful if given too often when it was considered unnecessary.

Recurring themes within the interviews were that passengers should show trust in the driver, monitor the driver and the situation and be ready to assist the

driver or suppress their conversation should the driver need to concentrate. Being a good passenger means learning your individual driver, what forms of assistance they appreciate and what they find irritating and unhelpful. Being ready to take over tasks for the driver, communicate with people external to the vehicle and keep watch at intersections were all seen as useful aspects of being a passenger – As was knowing when to trust the driver to do their job.

4.4 Limitations and Future Directions

This study used a navigation-based driving task to observe on-road interactions. Using a set route meant that participants were taken through areas of the city that would give particular challenges – For example, turning right onto a busy road or passing through low speed limit areas. This allowed observation of passenger/driver interaction during common situations faced during everyday driving, but the introduction of a route and map may also have reduced the similarity to participants' normal driving experiences and as such affected passenger/driver interactions. The inclusion of the Unplanned section of the drive, where passengers had to find their own route to get to a destination gives some evidence as to how the rates of different types of assistance may be different during normal everyday driving. However, the Unplanned section of the drive was always the first part of the drive. It is possible that participants were more conscious of the camera and experiment during this first section of the drive, and that this also affected their interactions compared to later in the journey when they had had more time to get used to the situation. In future, a counter-balanced design could be used, sometimes sending participants on a set route first before requiring them to choose their own path. Alternately, letting the participants test drive the vehicle with the equipment installed may help to reduce any impact of the novelty by the time the experiment begins.

The mixed method design allowed for a large amount of data to be collected from the participants, including both on-road interactions and interviews regarding their views on passenger assistance. While this allowed for a rich and detailed analysis of the dataset, it also necessitated a smaller sample size of twenty pairs of driver and passenger. The small data size was sufficient to give a good indication of how passengers may assist drivers during everyday driving, but it

makes it difficult to generalize the results more broadly. This is especially true when considering that only three pairs had a male driver with a male passenger, and only three had a female driver with a female passenger. In addition, only one passenger in the study was not a licensed driver; it's possible that other unlicensed passengers would show different patterns of interactions than those seen in this study.

To increase similarities to normal, everyday driving, participants that regularly drive together were targeted for recruitment. Given that participants in this study reported regularly driving with each other, it is likely that passengers had had time to become familiar with their drivers' style and could better predict when assistance would be beneficial. It is also possible that passengers felt more comfortable speaking up due to their familiarity with their driver. Different patterns may be seen between drivers and passengers who are unfamiliar with each other, or who have not driven together before.

This study was the first project to investigate how passengers assist drivers during everyday driving. Familiar passengers and largely familiar roads allowed drivers to feel comfortable along the route and behave more naturally. A combination of a set route and an unplanned section allowed the examination of both specific driving challenges such as turning right onto a busy road, as well as more familiar scenarios such as finding a route to a set destination. The inclusion of interviews allowed for the comparison of driver/passenger perceptions to what actually happens on the road, revealing that drivers and passengers have good a understanding of how passengers can assist drivers. It also allowed for discussion and inclusion of additional forms of assistance, such as dealing with a child passenger's tantrum, that were not able to be observed during this study.

4.5 Conclusion

Passengers do provide adult drivers with active assistance during everyday driving. Passengers can help expand drivers' situation awareness, reduce drivers' cognitive load by performing secondary tasks on their behalf and encourage more responsible and less risky driving behaviour. The results of this study support the hypothesis that assistance passengers provide is a factor in the reduced crash risk in adult drivers travelling with a passenger, compared to driving alone. Future

studies should further expand our understanding of how prevalent passenger assistance is in everyday driving such as commuting to work, how passenger assistance benefits drivers, to what degree it affects crash risk and how passenger assistance changes as the relationship between driver and passenger evolves.

References

Antrobus, V., Burnett, G., & Krehl, C. (2017). Driver-passenger collaboration as a basis for human-machine interface design for vehicle navigation systems. *Ergonomics, 60*(3), 321-332. doi:10.1080/00140139.2016.1172736

Bryden, K. J., Charlton, J., Oxley, J., & Lowndes, G. (2014). Older driver and passenger collaboration for wayfinding in unfamiliar areas. *International Journal of Behavioral Development, 38*(4), 378-385. doi:10.1177/0165025414531466

Charlton, S. G. (2009). Driving while conversing: Cell phones that distract and passengers who react.

Cycil, C., Perry, M., Laurier, E., & Taylor, A. (2013). *'Eyes free' in-car assistance: Parent and child passenger collaboration during phone calls.* Paper presented at the MobileHCI 2013 - Proceedings of the 15th International Conference on Human-Computer Interaction with Mobile Devices and Services.

Dillon, K. M., & Dunn, D. L. (2005). Passenger complaints about driver behaviors. *Accident Analysis and Prevention, 37*(6), 1012-1018. doi:10.1016/j.aap.2005.05.004

Drews, F. A., Pasupathi, M., & Strayer, D. L. (2008). Passenger and cell phone conversations in simulated driving. *Journal of Experimental Psychology: Applied, 14*(4), 392-400. doi:10.1037/a0013119

Engström, I., Gregersen, N. P., Granström, K., & Nyberg, A. (2008). Young drivers-Reduced crash risk with passengers in the vehicle. *Accident Analysis and Prevention, 40*(1), 341-348. doi:10.1016/j.aap.2007.07.001

Fleiter, J. J., Lennon, A., & Watson, B. (2010). How do other people influence your driving speed? Exploring the 'who' and the 'how' of social influences on speeding from a qualitative perspective. *Transportation Research Part F: Traffic Psychology and Behaviour, 13*(1), 49-62. doi:10.1016/j.trf.2009.10.002

Forlizzi, J., Barley, W. C., & Seder, T. (2010). *Where should I turn? moving from individual to collaborative navigation strategies to inform the interaction design of future navigation systems.* Paper presented at the Conference on Human Factors in Computing Systems - Proceedings.

Gkikas, N., & Richardson, J. (2007). *Impact of conversational demand on driver distraction.* Paper presented at the Contemporary Ergonomics 2007.

Heslop, S., Harvey, J., Thorpe, N., & Mulley, C. (2010). Factors that comprise driver boredom and their relationships to preferred driving speed and demographic variables. *Transportation Planning and Technology, 33*(1), 75-89. doi:10.1080/03081060903429389

Hutton, K. A., Sibley, C. G., Harper, D. N., & Hunt, M. (2001). Modifying driver behaviour with passenger feedback. *Transportation Research Part F: Traffic Psychology and Behaviour, 4*(4), 257-269. doi:10.1016/S1369-8478(01)00027-4

Koppel, S., Charlton, J., Kopinathan, C., & Taranto, D. (2011). Are child occupants a significant source of driving distraction? *Accident Analysis & Prevention, 43*(3), 1236-1244. doi:https://doi.org/10.1016/j.aap.2011.01.005

Lam, L. T., Norton, R., Woodward, M., Connor, J., & Ameratunga, S. (2003). Passenger carriage and car crash injury: a comparison between younger and older drivers. *Accident Analysis & Prevention, 35*(6), 861-867. doi:https://doi.org/10.1016/S0001-4575(02)00091-X

Lee, C., & Abdel-Aty, M. (2008). Presence of passengers: Does it increase or reduce driver's crash potential? *Accident Analysis and Prevention, 40*(5), 1703-1712. doi:10.1016/j.aap.2008.06.006

Mårdh, S. (2016). Identifying factors for traffic safety support in older drivers. *Transportation Research Part F: Traffic Psychology and Behaviour, 38*, 118-126. doi:10.1016/j.trf.2016.01.010

Metz, B., Landau, A., & Just, M. (2014). Frequency of secondary tasks in driving – Results from naturalistic driving data. *Safety Science, 68*, 195-203. doi:https://doi.org/10.1016/j.ssci.2014.04.002

Ministry of Transport. (2014). Driver Travel New Zealand Household Travel Survey 2010 - 2013. Retrieved from http://www.transport.govt.nz/assets/Uploads/Research/Documents/Drivers-2014-y911-Final-v3.pdf

Ministry of Transport. (2018). New Zealand Household Travel Survey 2015-2017. Retrieved from

http://www.transport.govt.nz/assets/Uploads/Research/Documents/18b14beb02/Household-Travel-Survey-intro-Dec2017.pdf

Ministry of Transport. (2019). Monthly road crash statistics update December 2018. Retrieved from http://www.transport.govt.nz/assets/Uploads/0585ae9f7f/2018-12-December.pdf

Møller, M., & Haustein, S. (2014). Peer influence on speeding behaviour among male drivers aged 18 and 28. *Accident Analysis & Prevention, 64*, 92-99. doi:https://doi.org/10.1016/j.aap.2013.11.009

Nakagawa, Y., & Park, K. (2014). Psychological effect of passenger presence on drivers and its dimensions: Scale development and validation. *Transportation Research Part F: Traffic Psychology and Behaviour, 25*, 86-97. doi:https://doi.org/10.1016/j.trf.2014.04.018

Nevile, M. (2012). Interaction as distraction in driving: A body of evidence. *Semiotica, 2012*(191), 169-196. doi:10.1515/sem-2012-0060

Nevile, M., & Haddington, P. (2010). *In-car distractions and their impact on driving activities*: Australian Government, Department of Infrastructure, Transport, Regional Development and Local Government.

Orsi, C., Marchetti, P., Montomoli, C., & Morandi, A. (2013). Car crashes: The effect of passenger presence and other factors on driver outcome. *Safety Science, 57*, 35-43. doi:10.1016/j.ssci.2013.01.017

Ouimet, M. C., Pradhan, A. K., Brooks-Russell, A., Ehsani, J. P., Berbiche, D., & Simons-Morton, B. G. (2015). Young Drivers and Their Passengers: A Systematic Review of Epidemiological Studies on Crash Risk. *Journal of Adolescent Health, 57*(1, Supplement), S24-S35.e26. doi:https://doi.org/10.1016/j.jadohealth.2015.03.010

Perterer, N., Sundström, P., Meschtscherjakov, A., Wilfinger, D., & Tscheligi, M. (2013). *Come drive with me: An ethnographic study of driver-passenger pairs to inform future in-car assistance.* Paper presented at the Proceedings of the ACM Conference on Computer Supported Cooperative Work, CSCW.

Pettitt, M., Burnett, G., & Stevens, A. (2009). *Defining Driver Distraction* (Vol. 5).

Precht, L., Keinath, A., & Krems, J. F. (2017). Identifying the main factors contributing to driving errors and traffic violations – Results from naturalistic driving data. *Transportation Research Part F: Traffic Psychology and Behaviour, 49*, 49-92. doi:https://doi.org/10.1016/j.trf.2017.06.002

Reason, J., Manstead, A., Stradling, S., Baxter, J., & Campbell, K. (1990). Errors and violations on the roads: a real distinction? *Ergonomics, 33*(10-11), 1315-1332. doi:10.1080/00140139008925335

Regan, M. A., & Mitsopoulos, E. (2001). *Understanding passenger influences on driver behaviour: Implications for road safety and recommendations for countermeasure development*.

Rosenbloom, T., & Perlman, A. (2016). Tendency to commit traffic violations and presence of passengers in the car. *Transportation Research Part F: Traffic Psychology and Behaviour, 39*, 10-18. doi:https://doi.org/10.1016/j.trf.2016.02.008

Ross, V., Jongen, E. M. M., Brijs, K., Brijs, T., & Wets, G. (2016). Investigating risky, distracting, and protective peer passenger effects in a dual process framework. *Accident Analysis & Prevention, 93*, 217-225. doi:https://doi.org/10.1016/j.aap.2016.05.007

Simons-Morton, B. G., Ouimet, M. C., Zhang, Z., Klauer, S. E., Lee, S. E., Wang, J., . . . Dingus, T. A. (2011). The Effect of Passengers and Risk-Taking Friends on Risky Driving and Crashes/Near Crashes Among Novice Teenagers. *Journal of Adolescent Health, 49*(6), 587-593. doi:https://doi.org/10.1016/j.jadohealth.2011.02.009

Verbruggen, F., & Logan, G. D. (2008). Response inhibition in the stop-signal paradigm. *Trends in Cognitive Sciences, 12*(11), 418-424. doi:https://doi.org/10.1016/j.tics.2008.07.005

Virginia Tech Transportation Institute. (2017). InSight Data Access Website. Retrieved from https://insight.shrp2nds.us/

Wiesenthal, D. L., Hennessy, D., & Gibson, P. M. (2000). The Driving Vengeance Questionnaire (DVQ): the development of a scale to measure deviant drivers' attitudes. *Violence Vict, 15*(2), 115-136.

Appendices A-F

Appendix A: Recruitment poster

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

Transport Research Group

Participants Needed

For a study investigating the role of the passenger

in everyday driving

The purpose of the study is to investigate the various roles that passengers play in the car, and the ways that passengers assist drivers in everyday driving.

We are asking participants in the study to:

1) Answer a set of questions about their driving experience.

2) In pairs of one driver and one passenger, complete a drive on the road in your own vehicle (approx. 30minutes). During the drive, each pair will be recorded by a mounted GoPro camera.

3) In the same pairs, complete a short interview discussing the various roles that passengers play in the car, and ways that they can be helpful or unhelpful to the driver.

4) The whole experimental session will take around an hour and a half. You will receive a $20 voucher as an appreciation for your participation.

All information will be treated in the strictest confidence and if you have any questions feel free to ask us. You can withdraw from the experiment at any time without penalty. The study has received Ethics approval from the School of Psychology Ethics Committee.

To arrange a booking, or for more information contact
sr108@students.waikato.ac.nz

For any other queries, please contact a member of the research team
Shawn Reader (sr108@students.waikato.ac.nz)
Prof Samuel Charlton (samiam@waikato.ac.nz)
and Prof Nicola Starkey (nstarkey@waikato.ac.nz)

This research project has been approved by the School of Psychology Research and Ethics Committee of the Faculty of Arts and Social Sciences, University of Waikato. Any questions about the ethical conduct of this research may be sent to the convenor of the Research and Ethics Committee (currently Dr Rebecca Sargisson, phone 07 557 8673, email: rebeccas@waikato.ac.nz)

Appendix B: Consent form

CONSENT FORM

A completed copy of this form should be retained by both the researcher and the participant.

Research Project: The role of the passenger in everyday driving

Please complete the following checklist. Tick (✓) the appropriate box for each point.	**YES**	**NO**
1. I have read the Participant Information Sheet (or it has been read to me) and I understand it.		
2. I have been given sufficient time to consider whether or not to participate in this study		
3. I am satisfied with the answers I have been given regarding the study and I have a copy of this consent form and information sheet		
4. I understand that taking part in this study is voluntary and that I may withdraw from the study at any time without penalty		
5. I have the right to decline to participate in any part of the research activity		
6. I know who to contact if I have any questions about the study in general.		
7. I understand that my participation in this study is confidential and that no material, which could identify me personally, will be used in any reports on this study		
8. I understand that I will be audio and video recorded during this study and that all recordings will be available only to members of the research team		
9. I wish to be contacted once my interview is transcribed		
10. I wish to receive a copy of the findings		
11. I would like to receive information about future studies conducted by TRG		

Declaration by participant:
I agree to participate in this research project and I understand that I may withdraw at any time. If I have any concerns about this project, I may contact the convenor of the Psychology Research and Ethics Committee (Dr Rebecca Sargisson, phone 07 557 8673, email: rebeccas@waikato.ac.nz)

Participant's name (Please print): _____

Signature: _____ Date: _____

If you would like to receive a copy of the research findings, or be contacted regarding your interview transcript or future studies conducted by TRG please provide your email or other contact address below:

_____

_____

Declaration by member of research team:
I have given a verbal explanation of the research project to the participant, and have answered the participant's questions about it. I believe that the participant understands the study and has given informed consent to participate.

Researcher's name (Please print): _____

Signature: _____ Date: _____

The role of the passenger in everyday driving questionnaire

1. General information

   Date of Birth: _____ Age: _____

Gender:_____

   Years of Education:_____ Years in New Zealand:_____

   Occupation (eg student, lawyer):_____

2. Ethnicity

   How would you describe your culture of origin: (e.g., European, Tongan, Maori):

   _____

3. Do you hold a current NZ driving licence? YES

   NO

4. How long have you been a licenced driver? (since you passed your learner's test)

   _____ years & _____ months

5. How many kilometres do you drive in an average week? _____ ___ km

6. How many times do you drive in an average week? _____ ___

7. In a typical week how many times do you drive on 100km/h roads? _____ ___

8. Have you been involved in any motor vehicle crashes in the last 12 months?

   YES NO

   If yes, how many? _____

9. In the past year, have you received any driving infringements (including speed camera fines)?

   YES NO (circle one)

   If yes, how many? _____

If you would like to provide any feedback about the study and/ or your experiences as a participant please do so below (this will not be linked to your name)

_____

_____

_____

_____

_____

_____

Thank you for completing the questionnaire. Let the researcher know you are finished.

Appendix D: Interview Questions

As you know from the information sheet the purpose of this study is to look at the various roles that passengers play in the car. I'd like to start off with some general demographic questions

How do you know each other?
How often do you drive together?
How long have you been driving together?
Do you both have a driver's license?
About how long for?

Let's talk about the drive you just did. How did you guys find it overall?
So was there anything particularly interesting or noteworthy along the route?
Was it easy to navigate along the route?
Were there any parts that were more challenging than other parts?
Along the drive, what was the passenger doing? Were they helping or just along for the ride?|

What kind of roles do you think passengers play in the car? Or what do they do while the driver is driving?
While driving, are there any tasks that are specifically the passenger's job?

While you guys are driving together, how often does the passenger do things like help plan the route you'll take?
How often does the passenger do something like navigate or direct?
How often does the passenger do things like point out hazards on the road?
How often does the passenger do things like watch for traffic at intersections, or when pulling away?
How often does the passenger do things like keep an eye out for street signs?
How often does the passenger do something like change the settings on the air conditioner or radio?
How often does the passenger tell the driver to speed up or slow down or otherwise change the way that they drive?

Do passengers make driving easier? In what ways?
Do passengers make driving more difficult? In what ways?

Do you think that drivers behave differently when they're carrying a passenger then when they're driving by themselves?
Do passengers ever do things to help the driver behave in safer ways?
How do you think driver's react to passengers driving to help them drive safer like that?
Do passengers ever do things that cause drivers to behave in more unsafe ways?

Studies show that talking on a phone while driving is distracting and can be quite dangerous. Do you think it's the same when drivers talk with their passengers?

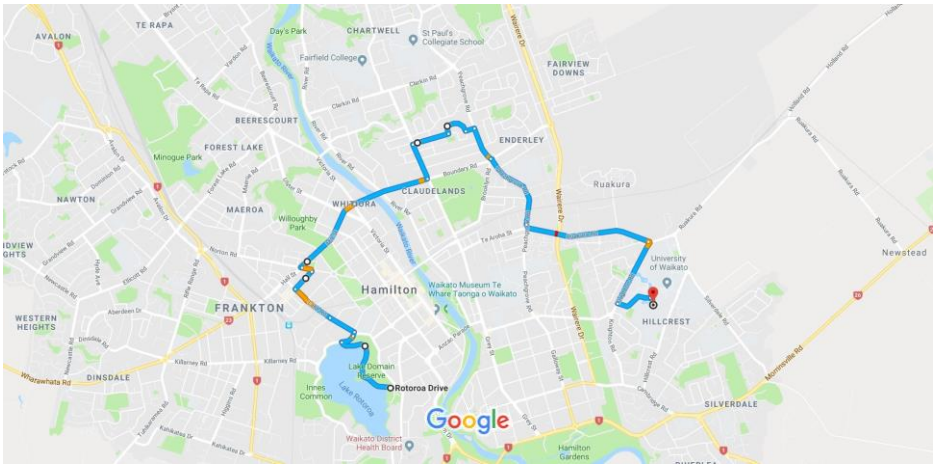
What things do you think passengers should be doing to help drivers drive more safely?

Appendix E: Google Maps Printout

Google Maps

Rotoroa Dr, Hamilton Lake, Hamilton 3204 to Unnamed Road, Hillcrest, Hamilton 3216

Drive 10.6 km, 27 min



Rotoroa Dr

Hamilton Lake, Hamilton 3204

1. Head west on Rotoroa Dr — 6 min (1.1 km)

Take Lake Rd, Mill St, Boundary Rd and Heaphy Terrace to Marshall St in Fairfield — 9 min (4.1 km)

2. Turn right onto Lake Domain Dr — 170 m
3. Keep left to stay on Lake Domain Dr — 51 m
4. Turn left onto Lake Rd — 350 m
5. At the roundabout, continue straight to stay on Lake Rd
   Go through 1 roundabout — 550 m
6. Turn right onto Commerce St — 300 m
7. Turn left onto Norton Rd — 140 m
8. Turn right onto Mill St — 1.1 km
9. Continue onto Boundary Rd/Whitiora Bridge
   Continue to follow Boundary Rd — 1.0 km

10. At the roundabout, take the 1st exit onto Heaphy Terrace

450 m

Continue on Marshall St. Take Yeats Cres to Peachgrove Rd

11. Turn right onto Marshall St

3 min (1.0 km)

450 m

12. Turn left onto Yeats Cres

400 m

13. Turn left onto Marshall St

110 m

Continue on Peachgrove Rd. Drive from Ruakura Rd to Hillcrest

8 min (3.9 km)

14. Turn right onto Peachgrove Rd

450 m

15. At the roundabout, take the 2nd exit and stay on Peachgrove Rd

1.0 km

16. Turn left onto Ruakura Rd

1.6 km

17. At the roundabout, take the 2nd exit onto Knighton Rd

900 m

Drive to your destination

2 min (550 m)

18. Turn left

450 m

19. Slight right

110 m

Unnamed Road

Hillcrest, Hamilton 3216

Appendix F: Interview Analysis

Passengers increase driver situation awareness, acting as a second pair of eyes

Almost all pairs of participants in this study identified that the passenger assisted the driver by expanding the driver's awareness of the situation, acting as a 'second pair of eyes'. Passengers can watch the road and surrounding environment along with the driver, and their positioning can allow them to see things that the driver might not. Passengers with high situation awareness can help by pointing out things that the driver has not seen, including hazards or potential hazards as well as parking spaces or speed limits. Some participants identified that this was particularly useful at times when the driver had low visibility *"like in the rain or at night"* (Driver 5), or in complex driving environments.

> *D9: They can be, they can help with keeping, keeping the driver focused maybe, by pointing out things definitely.*
> *P9: Yep, speed and*
> *D9: Speed signs and uh, and anything happening, happening to, maybe out of that peripheral view of the driver. They can help with that if they feel the driver doesn't see it so.*
> *P9: The same with traffic again ay, watching for hazards I guess.*

As the driver was expected to focus on the road, passengers were seen as more free to look around the surrounding environment and identify features that the driver could have missed. This might include looking down long driveways or keeping an eye on moving hazards "*like people and cars and animals"* (Passenger 18).

One example alluded to by almost half of the participants was the passenger looking out for traffic at a busy intersection. The exact ways that this played out differed over the driver/passenger pairs. In some partnerships, the driver would explicitly task the passenger with keeping watch over one direction of the road, which allowed the driver to focus in the other direction.

> *D1: And it is easier, definitely having a passenger in here to check that way *gestures left* because you had people coming this way, people coming that way, people turning in, someone on a verge on the other side trying to come out into traffic like, we sat there for, it wasn't a ridiculous amount of time but for a good amount of time*

and to have the passenger like <passenger> to be able to say you're good on my side then I only had to worry about what was over here
P1: Yeah
D1: And I would have been able to get out myself but it just would have been a lot trickier

Participants emphasized that despite the passenger keeping lookout, it was ultimately the driver's responsibility to ensure that they avoided accidents; the driver was still expected to check both directions even if a passenger was watching one. However, even in these cases it was still helpful to have someone looking out as this allowed them to perform a "*quick check*" (Driver 2) instead of needing more time and cognitive resources processing whether there was a gap or not.

Even when the driver does not ask assistance or task the passenger with looking out to one side, participants mentioned that the passenger would automatically keep lookout and warn the driver in case of a lapse, error or something the driver didn't see.

P10: I mean, as we were driving around today I was certainly checking. Um, but I never said anything because, I guess I had, I had trust in your own judgements for gap selection. But if I saw a car that was coming up at speed I might have said something.

This behaviour of keeping lookout for hazards was often attributed to the passenger also being a driver. Participants suggested that they had picked up the habit of looking out for hazards and monitoring the surrounding environment from their own driving experiences, and these were automatically translated into keeping lookout when travelling as a passenger. However, the one passenger in this study that had no driving license did mention watching for traffic at intersections, suggesting that this form of assistance occurs to some degree with passenger both with and without driving licenses.

While participants acknowledged that passengers helping drivers' situation awareness can be useful, they were also very clear that speaking up too much was detrimental. In the case of hazards, passengers pointing out things the driver had already spotted was seen as annoying or "*patronizing"* (Driver 12). Passengers who overreacted to hazards, or continually assumed the driver had not seen a hazard were perceived as distracting rather than helpful. Pairs where the driver and passenger had different driving styles were particularly at risk; journeys where each pair member had a similar style allowed

the passenger to better predict when the driver was already reacting to a hazard and when it was appropriate to warn the driver.

> *P10: I mean it can be annoying sometimes when you have a passenger who reacts to a hazard which you are very well aware of. And, particularly when they react quite strongly as a driver, well as a younger driver you get the sense of they don't really trust my skills here*
>
> *…*
>
> *D10: ...Sometimes it's appropriate and sometimes that's just annoying. You know, I've already got that sorted in my head thank you but, and it's the eighth time you've told me about something that I've already got sorted*
>
> *P10: So as a passenger I think you're playing that game where you're trying to get an understanding of what hazards the driver will get and what hazards have you spotted that you think maybe they aren't aware of*

This balance between being helpful and distracting was also mentioned in terms of other forms of passenger assistance such as providing feedback on driver behaviour. Overall, the degree of passenger assistance in enhancing driver awareness that was seen as useful varied between drivers; some emphasized the utility of a passenger and others focused on passengers who had been distracting or annoying or that situation awareness was the driver's responsibility.

Passengers perform tasks on behalf of the driver, acting as a second pair of hands

Most participants in this studied identified that the passenger can and does make driving easier by performing secondary tasks for the driver; that is, tasks that are unrelated to the operation of the vehicle. By doing so, the driver does not have to take their attention away from driving to perform these tasks, theoretically making the drive both easier and safer.

By far the most common method identified was that the passenger assisted the driver by helping to direct or navigate. Although participants identified that most of the time they were driving familiar routes to familiar places with little to no navigation required, passengers were seen as useful in unfamiliar environments, or in places where the passenger had more local knowledge than the driver.

> *"P11: Yeah, when we've done like trips to Australia and had a rental car, um, I tend to do most of the driving and <driver> will navigate. Cause yeah as a driver I find it's a lot to both be driving and navigating in a foreign context so having a passenger helps with that immensely.*
>
> *D11: Definitely, yeah, navigate. Definitely rely on google for a lot of that but trying to figure out what lane you need to be in and those sorts of things is useful."*

With navigation technology being broadly available, many participants mentioned their reliance on tools such as Google Maps to plan their routes and navigate to new destinations. At times, this meant that the passenger was perceived as not involved with navigation. In other situations, the passenger's role instead became to operate the GPS technology on behalf of the driver.

> *"P4: And I usually ask you to pass me the GPS to hold for you*
> *D4: Yeah*
> *P4: Yeah, because I'm worried about your driving if you just watching at your phone you know*
> *D4: Yeah*
> *P4: So I usually ask him to pass me the GPS thing"*
>
> *"D12: Yeah, navigation. The number of times that you'll look up something on your phone and we'll figure out how to get somewhere*
> *P12: Especially if it's like a longer trip or something, you start to get hungry you're like is there any fast food joints along this road"*

By operating the GPS system, passengers prevent the necessity for the driver to either pull over to the side of the road or operate the technology themselves while driving, which could prove to be a dangerous distraction. Passengers also were able to provide

more information to the driver than the navigation software, for example, mentioning what lane the driver should take to be ready for the next turn off.

The next most common form of assistance with secondary actions involved manipulating the car's settings, such as the windscreen wipers, air conditioning or the radio. Whether this was seen as useful varied across pairs. In some pairs, operating settings such as car temperature or the music was done by the passenger for the passenger's own comfort. Operating the technology in these instances could potentially be distracting, especially if the driver disagreed with the passenger's choice.

> *P4: He usually plays some music that I don't like so um, I'm OK for the first couple of musics and after that I try to um, you know*
>
> *D4: Again argue*
>
> *P4: Yeah argue and start nagging and starting playing my own music but today we didn't, we didn't listen to any music yeah.*

In other pairs, drivers indicated that it was useful, or even that it was the passenger's role to manage things like the air conditioner or radio while on the road, especially on long trips. The need for this role was reduced if the driver was able to control the radio via controls installed into the steering wheel.

> *P15: I get my passengers to like sort out the radio and stuff because I can't concentrate and I'm not well practised at driving enough to be able to like, change my concentration like that so I'm just like, bro like, sort out the air-con, sort out the music and also here's my phone I just got a text*

Passengers were also mentioned as assisting the driver by manipulating the environment within the car. This included retrieving objects from storage to pass it to the driver or picking up items that the driver had dropped and would otherwise have to scramble to retrieve. It could also involve performing more intricate tasks such as rolling cigarettes for the driver, which the driver might otherwise be tempted to do themselves.

> *D13: If there is something that happens like, something, like my phone thing falls off every so often all that sort of stuff. So if there's anything that actually happens in the car that requires your attention, you've got someone else in the car to take care of it*.

Having child passengers in the car presents an additional distraction to drivers. Child passengers can passively distract drivers with noise, kicking the chair or other activities. They can also actively distract drivers, demanding their attention. Some participants indicated that having an adult passenger could help manage the distraction that children provided, at least to some extent.

> *P18: Dealing with our kid if he's in the car and he's having a tanty or something, or needs something. They're not really safe for the driver to have to deal with that. Although it's probably slightly distracting if the passenger is doing stuff with the kid anyway and you're driving.*
> *D18: Yep. You've got to be wary*
> *P18: Just don't drive with children, it's distracting!*

Some participants recognized the danger of driving while operating a mobile phone, and indicated that depending on how much the driver trusted their passenger they would request that the passenger handle external communications; answering phones, informing the driver of the caller or answering text messages on behalf of the driver. This removed the temptation for a driver to operate the phone themselves despite being aware of the danger, or the illegal nature of the behaviour.

> *D1: No so yeah, if they're a good passenger they could kind of take all those things away from what the driver would maybe be distracted by, even right down to if you had your phone sitting in here and the phone went, which is, we talked about that although you know we know we're not meant to we probably still do look at our phones, a passenger can, if you don't mind them reading your messages they can open your phone and they can read it to you and it's done*
> *P1: Yeah*
> *D1: I think all those things now in today's world with technology and how busy we are and that, that's important you know*

Passengers help keep the driver awake, alert and focused

Almost every pair of participants referred to the passenger helping keep the driver alert or entertained while driving. Drivers mentioned that having a passenger made driving more enjoyable, some suggesting that the passenger's role was to provide good conversation and keep the driver company along the road. At times, this conversation was mentioned as something that distracted the driver, drawing their attention away from the road.

> *D10: With a good conversation going on you can get distracted. Um, you know the driver can become in their automatic mode. You know there have been times that I've got to Rotorua and gone "oh, we're in Rotorua now". You know, we're just there so all of the driving was in the automatic part of the brain. And the actual here and now bit was the interaction with the person beside you. So yeah. They can do that as well*

However, other drivers found conversation to be something that increased their focus and attention to the road. For these drivers, having a passenger prevented them from getting bored and drifting off or "*zoning out*" (Driver 20). Some mentioned that without passengers present, they tended to rely on other forms of entertainment such as music or audiobooks.

> *D9: And yeah keeping me, basically keeping me awake with his concentration because I do, I can daydream a lot. I find if I'm by myself a lot I have points where I kind of, oh yeah, how did I get through that part without crashing! I get, it's not, you know it's that drift, driver drift*
> *P9: Oh, so you go into the monitoring process*
> *D9: Yeah yeah yeah if I'm alone, if someone's not keeping me, constantly talking to me so, so yeah I can, I call it driver drift, it's the same drive so I do it automatically. So I can basically lose focus. So yeah I find a passenger will, can keep me focused, attentive for, well not all of the time but most of the time, let's say that.*

The benefits of keeping the driver alert and focused were often mentioned as particularly valuable on longer drives, or when the driver was otherwise fatigued. In

these instances, the driver may ask the passenger to engage their mind with conversation to help them focus.

> *P2: It's the company too sometimes when you've said to me, oh just keep talking to me like if it's a been on a long trip and, you know, you've had a break and that but just that company and that just to keep your mind*
> *D2: Yeah, more focused, yep.*

Beyond that, participants spoke of the passenger having a roll in monitoring the driver, watching them to see when they were getting tired, stressed or emotional. In those situations, the passenger could assist in managing the driver's emotions, talking with them to keep them alert or calm, or suggesting that they pull over to rest. In some partnerships, the passenger would also rotate with the driver in intense situations to give them a break and keep them fresh.

> *D10: I think in long distance driving or evening driving actually monitoring the driver. Are they yawning, I was yawning this afternoon as we drive, it wasn't, didn't get anywhere. But are they yawning, is there head bobbing I mean those, is the vehicle starting to weave, you know, weave to left or right. I think monitoring the driver is a really important thing to do. And then being honest about hey, I think it's time to pull over*

It was also seen as important for passengers to monitor how much the driver needed to concentrate on the current situation. This necessitates maintaining awareness of both the external environment and how the driver is managing to handle the driving task. Done successfully, the passenger would then be able to manage their own distracting influence on the driver through altering their conversation, slowing it down and keeping quiet during difficult situations before picking it up again once the challenge had been passed. Passengers who did not maintain awareness of the situation, or moderate their own conversation were noted as distracting, requiring the driver to tune them out and making the drive more difficult overall

> *D8: I think, I think it's when people like, when we're going somewhere together we um, well at least when you're the passenger which is most of the time, um. When there are those moments that, that the*

person driving needs to have more attention to what they're doing like at a roundabout or those kinds of situations then the conversation, it kind of changes to allow for that. So if we're discussing something then we might kind of pause while I get through this busy intersection and then like, restart on the other side. I find that when I have a passenger who's not like that, it's a bit trickier

Alternately, passengers that were more situation aware could reduce their impact on a driver's field of view at busy intersections, pulling back to allow the driver an unobstructed look through the left side of the vehicle.

Overall, passengers were seen as able to affect the driver's focus and attention both positively and negatively. Helpful passengers kept the driver entertained and focused on the road, managing their own distractive influence in complex situations. Helpful passengers could also monitor the driver's condition, actively assisting more when the driver was taxed or making suggestions to help the driver behave more safely; for example, switching out with the driver or suggesting they pull the car off the road to rest. In contrast, unhelpful passengers did not maintain an awareness of the situation or the driver's condition, resulting in them not tailoring their own behaviour to the needs of the driver and therefore acting as a distracting, frustrating and potentially dangerous distraction.

Passenger presence and feedback influences drivers' safe and unsafe driving behaviour

Participants viewed passengers as able to affect the driver's behaviour on the road, both positively and negatively. Through both active intervention (such as providing feedback, suggestions or encouragement) and their passive presence in the vehicle, passengers could influence drivers to behave both more and less safely.

Passenger feedback can be both helpful and unhelpful

Almost every pair referenced the passenger providing some form of feedback or criticism to the driver, usually providing examples of times that they had either received or given feedback. Feedback was a contentious topic, at times seen as a useful and important responsibility of the passenger and at other times seen as distracting, annoying and unhelpful.

Both passengers and drivers recognized that feedback could serve to refocus the driver's attention on the road, pointing out potentially unsafe behaviours or conditions that the driver may not have noticed or paid attention to. Examples included drawing attention to the driver's speed, following distance, lane positioning or a need to adjust behaviour for road or weather conditions.

> *D1: Passengers sometimes, you know sometimes things like that you know maybe if someone's going a bit quick you might say hey mate, or, just watch your speed here or remind them that, cause that's something that you can easily do*

Feedback could also be used to confront drivers about unsafe driving behaviour when the passenger felt uncomfortable or unsafe with the driver's behaviour on the road. Though it was recognized that ultimately the driver was responsible for behaving responsibly on the road, the passenger's safety was also put at risk with dangerous driving decisions. In such situations, the passenger could take ownership of their own safety by confronting the driver about behaviour that made them uncomfortable or asking the driver to let them out of the vehicle.

> *P15: There have been times when I've said to people like I'm not comfortable with you using your phone while you're driving like when they're sitting there on their phone*
> *D15: Yeah yeah*
> *P15: Yeah, I do that if I'm not comfortable with it then I say I'm not comfortable with it*

Some drivers suggested that feedback from passengers could be something that was both helpful and increased their likelihood to behave more safely on the road. However, feedback was also framed as something that could be distracting, annoying or frustrating. Passengers that overreacted to potential hazards or unsafe behaviours, or who were overly controlling and critical of the driver's choices were seen as unhelpful, making the drive more difficult and less safe.

> *P12: I don't want to speak negatively of anyone necessarily but driving with my ex was very much a pain at times. Um, because I think in part she knew I was new to driving in that country. But I think I was a pretty decent driver she was just overly paranoid all of the*

time about how I was driving. To a point where it made it difficult for me to drive properly. Um, and she was picky about everything even like how fast I accelerated, how far over in the lane I was, a lot of stuff that I was doing a fine job… It got to the point where I did not want to drive when I was in the car with her

Participants suggested that passengers who gave too much feedback showed a lack of trust in their driver's abilities. This could cause the driver to become annoyed or frustrated with the passenger – *"You wanna drive? Well then, shut up!"* (Passenger 20). Passenger's feedback could also cause the driver to become more anxious should they overreact to potential dangers. Alternately, it could just prove to be a distraction that the driver needed to tune out so they could focus on the road.

Similar to hazard identification, whether passenger feedback was perceived as being helpful or unhelpful was affected by several factors. The relationship between driver and passenger, whether the passenger was an experienced driver, the difference between driver and passenger driving styles, the frequency of passenger feedback, and individual differences in drivers and passengers could all impact how feedback would be received by the driver.

Passenger presence in the car affects the way drivers behave

Passengers providing feedback or suggestions was seen as one way that passenger influenced driver behaviour. However, participants also stated that passenger just being present could be enough to alter the way that a driver behaved in the car. Several pairs of participants referred to passengers as having a moderating effect on the way that the driver drove, reducing extreme or risky behaviour. Some participants suggested that this was due to not wanting to be judged or criticised for their driving; this may have been influenced by feedback or criticism that they had received in the past.

D20: To a certain degree I probably drive a little bit more
P20: Cautiously?
D20: Yeah, more cautiously
P20: Do you?
D20: A little bit. Um, or I feel like, oh maybe they're just judging my driving. So I drive with maybe two hands on the wheel.

For other drivers, carrying a passenger resulted in an increased sense of responsibility. These drivers recognized that their decisions would put the other people in their vehicle at risk, which resulted in them being more conscious of their own behaviour and decisions on the road. Commonly, participants mentioned being particularly conscious when carrying child passengers. Beyond concern for their safety, drivers also stated that they wanted their passengers to feel comfortable in the car and would adjust their driving accordingly.

> *P2: But yes I think there is a sense of, I mean I know when I've had passengers in my car I have said to myself you know, you've got to make these people feel comfortable being in your car because you're holding their lives in your hands really. And for them to get out of the car and feel very anxious and upset is not what I want to happen under my care.*

In contrast, some drivers stated that they did not change their driving while passengers were in the car as they were always concerned about driving safely. Only one participant pointed out that even without passengers, their driving could impact the safety of other road users, meaning they had a responsibility to drive safely even when alone in the vehicle.

In addition to engendering a sense of a responsibility in the driver, and a concern that their driving was being judged passengers were also viewed as acting as a calming and moderating influence in the car. Some drivers indicated that carrying a passenger changed the nature of a car trip from pure commute to something that could be enjoyed for its own sake. As such, these drivers were less eager to reach the end of the drive when they travelled with a passenger compared to driving alone with corresponding effects on their driving decisions and safety.

> *D3: I feel like I might try and get to the destination faster if I'm alone? Cause I don't maybe enjoy driving? Like listening to radio is fine, but, I think it just, it just become you know, the way of transport.*
> *P3: Mm*
> *D3: So you just want to go there. Whereas if you're driving with a passenger you might not be too bad because you've got someone to talk to so it might be more*

P3: Mm, it's almost like a little trip sort of thing

D3: Yeah, it might be more laid back and then not going like

P3: Then just driving by yourself it's just like I just want to like, get where I'm going

Complex or stressful driving environments provided another way for passengers to assist the driver by helping them to remain calm or relaxed. For some participants, this took the form of the passenger providing a sense of reassurance. By having another person potentially able to share in decision making, or to confirm a driver's decisions or perceptions of a situation a passenger could allow the driver to feel more comfortable and relaxed behind the wheel.

D16: Makes me feel like we're in it together. Not just one person trying to make the decision.

Passengers may also actively calm their drivers down through giving feedback or suggestions when the driver starts to get frustrated or annoyed at the environment. Here, the passenger could help to reduce instances of road rage or other dangerous behaviour, resulting in lower risks of the driver making a dangerous lapse or violation leading to an accident.

D4: When we get to a maybe kind of hazardous situation, uh, making me more kind of calm and relaxed. Cause you know just hard situation in driving gives me enough stress by itself. Having someone next to me calming me down is much more helpful.

Passengers can act as a negative influence on driving safety

Passenger influence is not always beneficial. Participants recognized that passengers could influence the driver to behave more unsafely in the road. Similar to their positive influences, this could be accomplished directly through giving feedback or suggestions, through affecting the driver's emotional state or by acting as a passive influence in the car.

Participants stated that when driving with some passengers, the passenger would 'egg them on' to behave more riskily on the road. Some drivers indicated that specifically occurred when they were younger and had young friends that would encourage bad

behaviour. Others spoke more generally, referencing situations they faced in everyday life.

> *D1: Um, oh, we're going to miss the first act of the concert, you know, put your foot down, go this way. That sort of stuff you know, depending on what the scenario is I think that they um, probably have, they can be the devil on the shoulder or the angel on the shoulder I guess.*

Several participants discussed times or situations where the passenger could make the drive more stressful by affecting the driver's emotional state. Overreactive passengers, as discussed previously could make driving more frustrating and annoying. But another situation identified by participants involved the passenger having a heated or emotional argument on the road. This was seen as distracting, but also impacted the driver's own emotional state, resulting in worse driving.

> *D15: Like so, if I'm pissed off with my partner and he's in the passenger seat my driving gets a little erratic. Cause I just want to hurry up and get home so he can get out.*

Just as passengers can engender a sense of responsibility in the driver simply by being present, participants identified that some drivers, especially younger drivers used the presence of a passenger as an audience to show off their driving prowess or skill. These drivers would choose higher speeds or take more risks on the road as part of their attempt to "show off" to their passengers.

> *P12: So my brother and I, you know, I'm from a small town, 800 people. He had a Toyota cell, it's a front wheel drive, had a hand brake. And after the first snow in town, we'd go drifting around town at 2AM. We had no cops in town, we'd just drift around, we'd drift the whole city. We had no traffic lights either. But, that's always fun, take more chances than when we're by ourselves. More fun with someone else in the car*

When passenger assistance is appropriate, and how it is received is highly dependent on context

Participants recognized that while passengers could be helpful in certain situations, contextual factors had a large impact not only on whether the assistance would be provided, but also whether it would be helpful and how the driver would react to the passenger offering or providing assistance. The nature and frequency of assistance varied not only across different drivers, but across different driving situations and different passengers.

One common comment across several pairs of participants was the observation that most of the driving they did was in familiar areas, on familiar routes and to familiar destinations. In such situations, assistance with directions and navigation was obviously not required. In unfamiliar areas, conversely, the passenger was seen to have a much greater role; navigating and directing but also acting as a second pair of eyes by keeping more attention on the surrounding environment, looking for cues, roadsigns and other environmental features that the driver should be aware of.

> *D10: If I'm in an unknown city or one that I seldom visit then having a, the passenger has very active roles in terms of helping. Particularly if I'm trying to find some place, very active roles in helping to do that. So Auckland, helping to navigate lanes, being in the right lane coming to the correct intersection, that's a really big role*
> *P10: And that's often, often reading signage properly as well*
> *D10: And knowing the difference between left and right. Get in the left lane, no no, other left lane!*

In areas where the passenger had better familiarity with the driver, they correspondingly were seen to take a larger role in the vehicle; helping to direct the driver and warning them of local hazards or environmental features to be aware of.

> *P14: I'll do it if it's one of those local knowledge situations. Like, say we were driving up the road up north. I'd be able to warn you about dodgy traffic, dodgy corners coming up. But I wouldn't go too far, too far out of my way to*

Even in familiar areas, driving environments that were highly complex and required a large amount of attention from the driver were seen as times where passenger assistance could be more useful. At times the passenger provides reassurance and helps

to calm the driver during these stressful situations. They can take over tasks, reducing the cognitive load on the driver and allowing them to better focus on the road. On the other hand, complex situations were where distracting passengers were seen as being most annoying and dangerous; passengers not recognizing when the driver needed to concentrate and thus not adjusting conversation accordingly leads to the driver either having to ignore the passenger or split attention between tasks.

> *P3: I think it depends like what sort of driving you're doing ay? If you're going for a long journey probably yes. If it's just around town perhaps no because there's so much to look out for, it's easy to get distracted but then, I don't know then you've got the other person to look out for you as well so*

Longer journeys which require the driver to be alert for extended periods were also particular situations where the passenger was seen to be useful in keeping the driver awake and entertained, monitoring them and ensuring that they took breaks when they needed to.

> *D4: To be honest, in a long trip yes and the reason being just having someone to just have a chat and not get bored or feel sleepy but in a daily maybe using, I mean driving, I don't think having a passenger would be a help. In my case if I'm wanting to a little bit exaggerate it's more annoying than, you know. Helping.*

Beyond factors related to the driving environment, participants saw passenger assistance as being highly dependent on individual factors related to the driver, passenger and their relationship. Participants identified that drivers who had more defensive personalities were less likely to ask for assistance, or to react well when it was presented. Drivers like this also tend to discourage further attempts from passengers to offer assistance in the future, and some participants stated that there were drivers they would no longer travel with due to their abrasive reactions.

> *D7: Depends on the person too, because someone who gets defensive easily, like I've had this happen when I've been in the car with <name> and he has done something badly, he almost crashed and he got very angry at the other driver. And I said to him, I think that was*

your fault. And he got very angry at me because he was like, no it's not, blah blah blah

Passenger personality, and the way in which they offered assistance was also important. Overreactive passengers who gave frequent feedback the driver saw as unnecessary soon become annoying rather than helpful, as did those who appear not to respect the driver's ability or responsibility over the vehicle. Passengers that are more tactful, or that have a similar driving style to their driver so they are more able to predict what the driver would find useful and unhelpful.

P7: I do that occasionally but we have, we have nearly identical like, limits in terms of proximity and things to cars.
D7: Like following distance and
P7: So, yeah, so basically if I'm like, hmm you should probably back off he's already starting to back off
D7: Slowing down

Almost half of the participants identified the relationship between the driver and passenger as having an important impact on passenger assistance. The exact nature of this impact was more complex. Some participants viewed driving with a passenger they knew well to be both easier and safer than driving with a stranger

P10: I think there's a big difference between driving with someone you're familiar with and driving with a stranger.
D10: Mmhmm
P10: I think if the passenger is a stranger then many of those advantages about making driving easier disappear. And then you've also got that, I don't know that extra concern particularly if you have distrust towards the person. Something like that.

Other participants suggested that they drove better when they didn't know their passenger, behaving more cautiously and being more conscious of their driving. Once they'd gotten to know a passenger and had driven with them several times however, this effect faded and they were able to relax, and correspondingly would not act as safely on the road.

D16: I mean yeah I'll try drive on my best behaviour with someone I've never driven before. Someone that I've only driven with for a little

while. But with you, <name> like the other day, my driving will be a lot more relaxed and dangerous. No, just relaxed.
P16: Yeah, that's true.

The relative ability of the driver and passenger affected both when assistance would be offered, and when it would be received. With some pairs, both participants were aware of areas where the driver or passenger was less comfortable, and thus responsibility for tasks within that area fell to their co-driver.

D11: Depends who's driving! I'm useless at that, cannot use a map!
P11: Yeah, <driver> is really bad at navigating. Like laughably bad. Um, I think
D11: I would get us lost

As mentioned previously, participants identified that particularly with young drivers, passenger presence would often encourage the driver to behave more riskily on the road. Both child and elderly passengers were often seen as more likely to be distracting or dangerous to travel with than helpful, though drivers still mentioned driving more cautiously with them in the car. Participants also identified that having an experienced driver as a passenger affects the way in which assistance is received, as well as the passengers' tendency to keep aware of situations.

P16: Cause I know how to drive that's why I have the nature, things, want to like, check everything. Yeah. But before I didn't know how to drive, I would not do that. Everything's after I be the driver, have the license.