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Familiarity and Recollection in Everyday Driving

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Abstract

Driving a car is one of the most common activities that we take part in everyday, however previous research has indicated that there is a gap in our current knowledge about how familiarity affects our everyday driving behaviour. Many of the studies that examine everyday driving behaviours are conducted off-road through the use of driving simulators and self-report questionnaires. The objective of this present study was therefore to investigate the role of familiarity on everyday driving behaviours during on-road drives. Additionally, this thesis sought to examine the relationship between familiarity and driver perceptions such as anxiety and risk. The relationship between familiarity and speed choices was also observed and finally, the impact of familiarity on a driver's ability to recall important information about a drive was investigated. Data was collected through the use of video and self-report questionnaires. In total, 30 participants took part in two on-road drives; one which they were familiar with and another that they found unfamiliar. Results indicated that speed choices were affected by how familiar a driver was with the environment, however no relationship was found between familiarity and driver perceptions of anxiety and risk, or recollection. Further research that builds on the present findings could prove to be beneficial for future approaches towards specific interventions aimed at reducing serious vehicle accidents.

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1. Literature Review

1.1 Introduction

Everyday driving is a complex and interesting area for the study of behaviour, due to its prevalence and frequency in modern society. Driver behaviour does not only refer to their ability to aim the vehicle in a direction and accelerate, but encompasses a wide variety of different behaviours (Östlund, Nilsson, Törnros & Forsman, 2006). Driver behaviour is said to be what the driver does after considering their limitations, needs and motivations that can be achieved through a driving task (Shinar, 2008). It can therefore be said that driver behaviour not only includes their observed behaviour (e.g. foot pressing on the accelerator) but also includes the driver's internal functioning (e.g. conscious/unconscious processes) where the driver's rely on learned behaviours to react to different driving situations.

Driving a familiar route is generally considered to be an example where learned behaviours can become proceduralised or automated with continued practice over time. Research on this topic has found that repeated exposure to a driving environment can often lead to the phenomenon known as driving without awareness, where individuals experience a feeling of travelling from one place to another without being able to recall how they got there, colloquially known as 'going on autopilot' (Charlton & Starkey, 2013). This type of experience can often occur when an individual becomes accustomed to their environment and begins to perform tasks and behaviours subconsciously, or without being entirely aware of their actions (Yanko & Spalek, 2013). The driver's attention may

then return to the driving task with the feeling that there is a time gap in their memory where they are unable to recall information about their behaviours during the drive or the drive itself (Charlton & Starkey, 2013). It was found that changes in what drivers reported noticing suggested that participants were experiencing inattention blindness, and declining ratings of mental demand which suggested participants were driving without awareness (Charlton & Starkey, 2013). However, a contradictory finding showed that extended practice of driving routes was also found to create an increased sensitivity for detecting changes to road features as well as improved performance with vehicle detection tasks, where participants were required to detect a certain type of vehicle (Charlton & Starkey, 2013). Although this feeling of 'going on autopilot' is commonplace, there has been little research into how familiarity with a driving route can affect an individual's perception of the environment they are in, which may ultimately have an effect on their overall driving behaviour.

The following review will investigate the current existing research that is related to driver perceptions of anxiety and risk, as well as other driver behaviours such as speed choices as they relate to everyday driving. Studies that observe how familiarity and attention play roles in everyday driving behaviours will also be described. Finally, studies that discuss driver memory recollection about driving events will be considered. It is hoped that the findings from this thesis will contribute to the growing knowledge that currently exists about everyday driving behaviours in an attempt to provide overall safer driving conditions.

1.2 Familiarity and Attention in Everyday Driving

Driving without awareness is a familiar experience for many drivers where they are unable to recall information about a drive they have just completed, usually the last few minutes of driving by the time the drive becomes aware of the phenomenon (Charlton & Starkey, 2011). Charlton and Starkey (2011) researched the development of proceduralised driving (driving without awareness) in a driving simulator, where participants drove a simulated road regularly over 12 weeks. During each session, participants would take part in two “trips” down a simulated road; sometimes completing a “to” and “from” journey on one half of the road, or completing the entire road in one direction (Charlton & Starkey, 2011). A range of measures were observed, including overall driving performance, vehicle detection, speed regulation and hazard reactions (Charlton & Starkey, 2011). Results showed that drivers developed driving patterns and changes in object detection abilities (active attention) that were indicative of proceduralised driving (Charlton & Starkey, 2011). Active attention is defined as the deliberate concentration of awareness on some phenomenon and the exclusion of other stimuli (Charlton & Starkey, 2011). Speed and lane position variability decreased with practice, as well as the participants’ active attention and subjective experiences of driving difficulty (Charlton & Starkey, 2011). It could therefore be said that familiarity with a driving route lowers a driver’s perception of difficulty and therefore lowers their focus for active attention, resulting in significant changes to driver behaviour.

When driving a vehicle, a driver’s active attention has been shown

to be divided between the driving task, monitoring the environment and sorting out relevant from irrelevant stimuli (Chapman & Groeger, 2004). It is generally considered that inexperience with a driving route can lead to an increase in a driver's perceived level of risk and an increase in crash rates on account of the number of unexpected environmental and otherwise relevant stimuli a driver is required to divide their active attention between (Chapman & Groeger, 2004). However, other studies have stated that over-familiarity and experience with a driving route can also lead to an increase in crash rates (Chapman & Groeger, 2004). Given that a driver's active attention while driving a familiar route would be less likely to be spread as widely as during an unfamiliar route, this brings into question how much of a role driver active attention and divided attentiveness actually has in circumstances where a crash has occurred.

Charlton and Starkey (2013) proposed that familiarity with the visual features of a road was most closely related to an individual's general feelings of familiarity while carrying out everyday driving tasks. Participants drove a simulated road regularly over a time period of three months and completed 20 driving sessions (Charlton & Starkey, 2013). Participants reported fewer stimuli attracting their attention as their familiarity with the visual features associated with a driving route increased, while the stimuli that did continue to attract their attention was more generalised and focused more on other vehicles instead of road signs, buildings or landscapes (Charlton & Starkey, 2013). These results showed that changes in what drivers reported noticing were indicative of inattention blindness, a lack of attention resulting in an individual failure to

recognise an unexpected stimulus that is right in front of them (Charlton & Starkey, 2013). Because of these findings, Charlton and Starkey (2013) suggest that this may explain why drivers are more likely to crash at locations close to their home, due to the lack of attention to stimuli in a familiar and well-practiced location.

These findings support the results that were found in a study conducted by Martens and Fox (2007) which showed that the duration of eye fixations would decrease after being exposed to the same road and its visual features multiple times, and that over-familiarity on driving routes would cause inattention and worse performance during every day driving tasks. Half of the participants were randomly assigned to an on-road driving condition where the participants were taking down a two lane road that traveled through both rural and urban areas (Martens & Fox, 2007). Participants were required to drive from the start point to the end point, make a u-turn and return back to the starting point (Martens & Fox, 2007). The other half of the participants were randomly assigned to a video condition, where they watched the same route on a video, from the viewpoint of the driver (Martens & Fox, 2007). This indicates a potential link between a reduction in the amount of active attention given to specific elements in a driving environment and the familiarity of the route to the driver.

Although individuals who are familiar with their driving route may be driving without awareness, they are not always blind to all the changes in their driving environment (Charlton & Starkey, 2013). The extended practice of driving the same route can also result in a heightened level of

sensitivity for detecting changes to features on the road that are associated with vehicle guidance, as well as resulting in improved driver performance when looking for stimuli that the driver is expecting (Charlton & Starkey, 2013). The placement of important cues in locations that are more likely to be visually scanned by the driver may subsequently aid in developing stronger hazard detection abilities (Charlton & Starkey, 2013).

Yanko and Spalek (2013) conducted an on-road study where participants were required to follow a vehicle along a route that they were either familiar or unfamiliar with. During these driving sessions, the lead vehicle would break and random locations, forcing the participant who was following behind to brake to avoid a collision (Yanko & Spalek, 2013). Participants were also required to press a button to signify that they had noticed pedestrians heading towards the road from a sidewalk (Yanko & Spalek, 2013). Results showed that drivers travelling in a familiar location were more likely to follow the vehicle in front of them more closely and were slower to notice approaching pedestrians than drivers travelling in unfamiliar locations (Yanko & Spalek, 2013). Reaction times to central or peripheral events that occurred during the drives were found to be longer for drivers in familiar routes than those in unfamiliar routes suggesting a degree of mind-wandering may have been occurring in familiar locations where participants were not made to focus on the driving task (Yanko & Spalek, 2013). This suggests that familiarity during everyday driving can play a role in traffic accidents due to the mind wandering that often occurs while drivers are travelling along familiar routes, where the driver continues to perform the driving task while experiencing some level of

inattention blindness to the surrounding pedestrians or traffic. Inattention blindness may be the result of attention lapses, a common occurrence where an individual becomes bored of the situation they are in and their attention appears to wander away from the task at hand (Carriere & Smilek, 2006).

In a study of traffic accidents conducted by Herslund and Jorgenson (2002), inattention blindness was further highlighted by the discovery of the “looked-but-failed-to-see” phenomenon. This phenomenon describes the behaviour exhibited when a driver who is supposed to give way to another party fails to do so and instead collides with the other party, but maintains that they did not see them until immediately before the collision (Herslund & Jorgenson, 2002). Participants in this study were required to report on their experiences of near accidents (Herslund & Jorgenson, 2002). Drivers involved in those accidents often stated that they were feeling very surprised and shocked at the collision, having no memory of the other vehicle or cyclist being as close as they were when the driver started to move from their position (Herslund & Jorgenson, 2002). It would appear that while the drivers involved in those accidents had actually looked in the direction where the other parties were, they did not perceive that the other party was actually where they were (Herslund & Jorgenson, 2002). Findings suggest that this may occur due to a failure on the part of the drivers’ visual scan of the environment during which the driver tries to assess the various risks in the environment, where the driver may not have appropriately perceived the colliding party as a risk before they started moving (Herslund & Jorgenson,

2002).

The visual scanning of an environment is thought to be controlled by the monitoring process, a process which is considered to be responsible for the subconscious detection of important stimuli that guides driver behaviour, even when a driver's attention may be focused elsewhere (Charlton & Starkey, 2011). Charlton and Starkey (2011) believe that two of these processing states work together in tandem to enforce and govern driver behaviour; the operating process, a "conscious" and "intentional level of task engagement", and this monitoring process, an "unconscious error monitoring system" that requires little cognitive effort until an error is discovered (Charlton & Starkey, 2011).

It is therefore valuable to consider what drivers perceive as being familiar during every day driving tasks which may otherwise be more likely to result in a lack of attention, possibly resulting in poor driving performance. The overall perception of driver anxiety and risk in a driving environment may also be worth considering when looking at the relationship between familiarity and attention - links which may as yet not have been identified. Factors such as the straightness of the road, the time of day and how many other vehicles and pedestrians are around at the time may play a more important role than what is currently known.

1.3 Anxiety Perception

Driving anxiety up until now has generally been studied in the context of the relationship between psychological issues and driver fear, and how they have an effect on driver anxiety. Most of the studies relating to

anxiety and fear in driving situations maintain a strong focus on participants who struggle with a range of pre-existing psychological problems, including post-traumatic stress disorder and depression (Taylor, Alpass, Stephens & Towers, 2010). These forms of anxiety can range from mild levels of anxiety in relation to a particular driving situation, to wider forms of fear such as panic disorders and phobias (Taylor et al., 2010). In the study conducted by Taylor et al. (2010), participants completed questionnaires where they answered general questions about their mental and physical health, as well as their driving behaviours and perceptions of anxiety and fear towards driving in general. Results showed that 70% of participants indicated that they experienced no anxiety or fear, 4% felt mild anxiety and fear, and 6% experienced moderate feelings of anxiety and fear (Taylor et al., 2010). These results suggest that there is an overall low level of anxiety and fear being experienced by adults living in New Zealand while driving (Taylor et al., 2010). It is hard to identify the role that anxiety may or may not have on road safety and vehicle accidents as individuals with high levels of driving fear have a tendency to avoid those situations (Taylor et al., 2010). Despite the evidence of driver fear not always having a role in vehicle accidents, the overall effect of anxiety in non-clinical samples remains relatively unknown (Taylor et al., 2010).

Another questionnaire based study conducted by Taylor and Paki (2008), using a general community sample (mean age = 38.80, $SD = 15.28$, $n = 100$), found a small but significant group of participants (7-8%) reported moderate to extreme feelings of anxiety throughout the course of

a driving exercise (Taylor & Paki, 2008). It was found that within this sample, participants were less anxious about driving in general, but when anxiety did occur, that it was related to different driving situations where the activity was considered risky to the driver (Taylor & Paki, 2008). The behaviour of other drivers (e.g. over-taking, tailgating), travelling in poor weather conditions or travelling in heavy traffic were considered high anxiety-provoking events, as drivers were concerned about the risk of vehicle accidents occurring (Taylor & Paki, 2008). This suggests that links between risk perception, anxiety and driving environments do exist, but raises questions as to what impact familiarity may have on these perceptions given that in this study the anxiety-provoking environmental factors were dynamic in nature.

1.4 Risk Perception

Driver risk perception has been considered for a long time to play an important role in everyday driver behaviour (e.g. speed choice) and can be generally characterised by the focusing of attention onto various dangers in a specific driving situation (Chapman & Groeger, 2004). A number of studies looking at everyday driver behaviour have found that drivers increase their driving speed in relation to how familiar or comfortable they are with the route, as they are less worried and more comfortable about associated risks in the environment (Colonna, Intini, Berloco & Ranieri 2015). In a study conducted by Colonna et al. (2015), participants took part in six on-road drives carried out on a two lane rural road over six days. Results showed that driver speed choice was found to generally

increase with good visibility conditions, but for drivers who are familiar with the route, travelling speed was likely to increase even in poor visibility conditions (Colonna et al., 2015). From these results, it could be suggested that drivers who are more familiar with their driving route are more likely to engage in riskier behaviour, and are subsequently more likely to be involved in car accidents or other traffic violations due to their lower risk perceptions.

The ability for a driver to focus on the road as well as perceive risky environmental situations has been identified as an extremely complicated cognitive process, which involves the driver being able to identify hazards at any given moment, often unexpectedly, and then thinking about ways to appropriately deal with the hazard in order to avoid an accident (Borowsky & Oron-Gilad, 2013). Participants in the study conducted by Borowsky & Oron-Gilad (2013) were asked to observe 10 short movies of real world driving situations. While watching these videos, participants were asked to press a button each time they identified a hazardous situation, organise those hazards into similar groups, and finally to rate each movies level of hazardousness (Borowsky & Oron-Gilad, 2013). Results found that the more time that a driver spent on the road (e.g. taxi drivers) that they were more sensitive to hidden hazards than those who spent less time and had less experience with driving (Borowsky & Oron-Gilad, 2013). First, the driver must be aware of the existence of danger in their environment and then, once the risky stimuli has been observed and is perceived as a potential risk, the driver needs to subjectively evaluate how well they think they are able to handle the risky situation and then act accordingly

(Borowsky & Oron-Gilad, 2013). Since the perception of risks in an everyday driving situation can largely be considered a visual search and may not necessarily require an individual to have prior driving experience, it could be said that risk perception while driving is strongly reliant on previously learnt behaviour obtained by recalling information about past situations.

Furthermore, some literature focused on driver risk perception suggests that there may also be some differences in perceived risk levels based on socio-economic factors such as gender (Machado-Leon et al., 2015). In a study conducted by Machado-Leon et al., (2015) participants were presented with a survey that discussed a driving situation in an inter-city, two-way road context. Participants were presented scenarios in the driving environment that were defined by the drivers behaviour (Machado-Leon et al., 2015). Results found that women in general have higher levels of perceived risk than men due to certain risky driving behaviours being considered more dangerous by women than men (Machado-Leon et al., 2015). This suggests that certain risky situations could be perceived differently by drivers, dependent on their gender and therefore result in different driving behaviours to deal with potential risk.

There has been very little research conducted on how familiarity affects driver risk and anxiety perceptions, which may mean there are some gaps in our currently held knowledge.

Martens and Fox (2007) found that drivers focus less on the stimuli around them while travelling a familiar route due to continual exposure to the same environment. Couple this with the finding that drivers will

generally only attend to the most apparent or immediate source of danger and we can infer that drivers familiar with their environment are less likely to pay attention to other less obvious sources of risk around them (Chapman & Groeger, 2004). This can result in drivers who are less focused on the driving task, slower to react to unexpected changes in the route, and more likely to engage in riskier behaviours such as travelling at faster speeds (Martens & Fox, 2007). It was suggested that this change in behaviour may be due to the degree of comfort that many driver's feel with the environment (Martens & Fox, 2007). Conversely, a similar conclusion has also been drawn by other studies which have found that inexperience or unfamiliarity in a driving route can also increase the level of perceived risk and an increase in crash rates despite the implied level of focus on environmental stimuli (Glisky, 2007).

1.5 Familiarity and Memory Recollection

It is generally assumed that drivers will remember previous driving situations that they have encountered and then use this experience to help shape or change their future behaviours (Chapman & Groeger, 2004). Chapman and Groeger (2004) conducted two experiments that had participants view different driving situations using video films of the view through a car windscreen while driving through various junctions. Results from the first experiment showed no relationship between risk and recollection performance, but instead showed good recollection of dangerous situations and poor recollection of safe ones, with overall memory recollection being generally poor (Chapman & Groeger, 2004).

While memory is obviously an important factor in a number of everyday tasks, there are distinctions between which forms of memory are involved with different levels of consciousness with respect to driving exercises (Schott et al., 2005). Implicit memory is often referred to as automatic memory that uses past experiences or schemata to remember things without intentionally thinking about them (Schott et al., 2005). This differs from explicit memory which is the conscious recollection of previous experiences and information (Schott et al., 2005). Explicit memory includes things such as remembering a driving lesson or some other specific driving experience, whereas the gradual improvement of one's driving skill over time is a demonstration of implicit memory recollection. It could subsequently be inferred that the feeling or perception of environmental familiarity on a specific driving route may be the result of implicit memory recollection. This process is more often than not a subconscious experience derived from previous schemata and does not require an individual to consciously remember previous events to base their actions or behaviours on (Chapman & Groeger, 2004). Implicit schemata may help us understand everyday driving behaviour since it has been suggested that driving behaviour may also be intrinsically controlled by constantly developing schemata (Chapman & Groeger, 2004).

In relation to memory, schema theories describe the encoding and retrieval of information that is guided by pre-existing knowledge, and allows individuals to react to a situation based on past experiences (Alba & Hasher, 1983). Schemata in relation to driving behaviour have been shown to help drivers to monitor all of the different pieces of information in

a driving environment such as speed, road signs and other vehicles, which places high demand on both perceptual attention and memory (Blalock et al., 2014). Schemata when applied to a driving context may allow drivers to react more quickly and efficiently when dealing with road hazards such as losing control of their vehicle or keeping a safe distance from a driver who is exhibiting unusual driving behaviour.

Blalock, Sawyer, Kiken, Gutzwiller, McGill and Clegg (2014) conducted a study where participants were required to drive through two different scenarios on a driving simulator. During pauses in the drive, participants were asked to recall information about both moving and stationary elements in the environment; these items were rated on how important they were to focus on while driving (Blalock et al., 2014). Participants were asked these questions under either a load, or no load condition, where load was induced by getting participants to count and repeat numbers out loud backwards by sevens from a random number that was generated on a screen every 30 seconds (Blalock et al., 2014). Results showed that drivers were more accurate in recalling information about stationary elements in an environment than moving ones while driving under cognitive load and that both were remembered equally when under no cognitive load (Blalock et al., 2014). This may suggest that drivers are not deliberately directing their attention away from different elements based on their priority, but rather that their attention is focused on different aspects of the environment depending on its safety relevance.

There has been very little research conducted which investigates the effect of familiarity on driver recall ability. Chapman and Groeger

(2004) argue that predictability may enhance an individual's ability to recall important information that they did not pay attention to originally. Using memory tests about previously viewed driving situations, Chapman and Groeger (2004) found that when a driver is being tested on what they can remember about a particular driving experience, predictability granted the driver a higher chance at being able to guess the information correctly (Chapman and Groeger, 2004). This may however mean that overall individual memory performance may actually be worse than what has otherwise been represented (Chapman and Groeger, 2004). It does however indicate that schemata play an important role in an individual's ability to recall important information about different driving situations, and particularly when driving a route that they are familiar with (Chapman & Groeger, 2004). With this in mind, it could be suggested that memory is important to consider when looking at everyday driving behaviours, as memory is an integral part of creating schema and therefore familiarity with a driving environment.

1.6 Travelling Speed Selection and Everyday Driving

Driver speed selection is an important behaviour which can significantly contribute towards the severity of a vehicular accident. It is common knowledge that the faster you go, the bigger the mess. In the 2015 New Zealand calendar year, speeding played a role in 93 fatal crashes, 410 serious injury crashes and 1,286 minor injury crashes (Ministry of Transport, 2016). Despite this, drivers continue to travel at speeds they consider comfortable, often flouting the law regardless of the speed limit

(Ahie, Charlton & Starkey, 2015). An equation known as the Power Model (Nilsson, 2004; Elvik, 2013) mathematically demonstrated that as the overall speed increases, so does the severity and probability of crashes. The relationship between high speed and high risk is considered obvious, as drivers who are traveling at high speeds travel a longer distance over a shorter time period while having slower reaction times with respect to perceiving their environment or taking action against potential risks or hazards (Navon, 2003).

Variability in speed limits has been found to be paradoxical however, as even though high speed limit areas are considered to be at high risk of vehicle accidents occurring, lower speed limit areas have their own associated risk related to the variability of speeds that drivers are travelling in those areas (Navon, 2003). The large speed discrepancies between those who comply with the speed limit and those who violate it cultivate driving environments rich with risk which raises the question, why do so many drivers risk speeding?

The Zero-Risk Theory (Naatanen & Summala, 1974) and the Risk Homeostasis Theory (Wilde, 1986) suggest that risk perception plays an important role on influencing speed choices. The Zero-Risk theory suggests that the drivers' previous experience of risk influences their speed choices, as the driver would not travel faster than they would feel safe doing because their feelings of risk would moderate their speed choice (Naatanen & Summala, 1974). This theory suggests that speeding occurs when the driver is motivated to do so (e.g. faster travel time) but that most of the time the driver does not feel at risk while carrying out the

behaviour (Naatanen & Summala, 1974). The Risk Homeostasis theory suggests a different cause for risky behaviour, largely that drivers will increase their speed to meet a personal preferred level of risk (Wilde, 1986). In this theory, driver risk perception is seen to regulate driving speeds to maintain the optimal level of risk accepted by drivers, where there is a perceived positive trade-off between the costs and benefits (Wilde, 1986).

1.7 Aims for this study and research questions

Many of the reviewed studies which focused on the topic of driver familiarity were conducted using questionnaires, driving simulators and videos to simulate the experience of an everyday driving environment. These studies would often repeat the same travel route without investigating any unfamiliar driving routes for comparison purposes. These studies not only have very little on-road data, but also do not include the familiarity effect of a driver being in a familiar vehicle that they driver regularly. A comparison that observes the differences between both familiar and unfamiliar on-road routes may be beneficial to understand the relationship between familiarity and attention, though little research presently covers this topic.

In response to the review of familiarity, how it may affect attention and recollection, driver perceptions such as anxiety and risk, and speed choices, it seems important to understand how familiarity can affect driver behaviours in everyday situations in real traffic. It is hoped that by gaining a deeper understanding into how drivers behave in familiar and unfamiliar

environments, one might better understand everyday driver behaviours and therefore contribute towards the search for effective solutions to provide a safer overall driving environment.

The main aim of this research project is to explore the concept of familiarity, and how it affects a driver's perceptions that influence driver behaviours such as speed choice. This research additionally seeks to explore whether there is a relationship between familiarity and recollection.

In order to explore these relationships, the following research questions will be addressed:

1. Does familiarity affect driver perceptions of anxiety and risk?
2. Is driver speed choice influenced by their perceptions of familiarity, anxiety and risk?
3. How is recollection influenced by familiarity, anxiety and risk?

2 Methodology

2.1 Participants

Participants were recruited by the use of flyers posted on notice boards around the University of Waikato and local community centres, shops and cafés around Hamilton. Electronic advertisements were also placed on the psychology research participation forum located on Moodle, and on Facebook.

A total of 30 participants (16 Males, 14 Females) were asked to participate in two on-road drives. The participants' ages ranged from 20 to 59 years old; and the mean age of the participants was 33 years old ($SD = 15.56$). Participants drove 6.5 days a week on average, with the majority of these drives occurring in urban areas. When asked about how fast participants travel in relation to the speed limit, 13 participants said that they generally drove at a speed just over the speed limit, 16 said that they stuck to the speed limit and one participant said they would rather not say.

Of the 30 participants, 11 said that they had been in at least one car accident in the past five years, with the total number of accidents occurring between all participants totalling at 12. Of those 12 accidents, 10 of them involved other drivers on the road, with six of those incidents being either a rear end or front on collision.

Of the 30 participants, 15 participants said they had received at least one infringement notice in the past five years. Between those 15 participants, there were at least 28 infringement notices; 20 were for speeding, five were for parking violations, one was for failing to stop at

traffic lights and one was for violating the conditions of their restricted license.

All of the participants were required to possess a current New Zealand full driver licence and were asked to wear any corrective lenses if they are required to do so as a condition of their driver licence. In recognition of their participation in the study, participants received their choice of either 2% course credit, or a \$15 fuel voucher to compensate for their time.

The questionnaires and data collection protocols were reviewed and approved by the School of Psychology Research and Ethics Committee.

2.2 Research Design

To answer the research questions, data were collected in two ways; from on-road drives that were video recorded and from the pre-drive questionnaire (see Appendix C), the familiar route questionnaire (see Appendix D), the on-road questionnaire (see Appendix E) and the post-drive questionnaire (see Appendix F). There were four primary measures of interest in this study; 1) speed choice, 2) driver recollection, 3) risk perception and 4) anxiety perception. The first variable, *speed choice*, was defined as the driver's actual travelling speed and was measured in km/h at five locations during the drive. The second variable, *drive recollection*, was a self-report measure, collected from participants using the post-drive questionnaire (see Appendix F). To obtain the second variable, participants were asked to recall information about the location of

pedestrians and other vehicles. The remaining two variables, *risk perception* and *anxiety perception*, were obtained from self-report answers from the on-road questionnaire (see Appendix E).

2.3 Materials

2.3.1 The GoPro Camera

The camera used in this study to record on-road drives was a GoPro Hero 4 camera. The camera which is depicted in Figure 1, was equipped with an extra rechargeable battery, and was attached to the front windscreen of the car using a windscreen mount.



Figure 1. GoPro Hero 4 Silver Camera (GoPro, Inc., 2016)

The camera was set to video mode and was set to record at 720p resolution so that the videos could be accurately observed post-drive for recollection comparisons.

2.3.2 The Questionnaires

Before the drive, participants were asked to fill out a demographic and driver history questionnaire (see Appendix C) so that the resulting demographic data could be divided and organised into various data groups for later analysis.

The pre-drive questionnaire (see Appendix C) contained fifteen questions that sought some basic demographic information from the participant such as their age, gender, ethnicity, and how long the participant had been living in the country. It also included questions about the participant's driver's license, the type of vehicle they regularly drove, and any past driving history that may have involved car accidents or resulted in any infringement notices. The last part of the questionnaire discussed the participants driving behaviours in relation to regularly travelled routes, such as how many hours they regularly drove each week, the areas they most frequently travelled, and how many times a week they would travel their most familiar route in any given week (e.g. the number of times they would travel to work or school).

Participants were required to complete a driving routes questionnaire (see Appendix D), where they rated how familiar they were with six pre-selected driving routes on an ordinal scale of 1-10, where 1 represented extremely unfamiliar, and 10 was extremely familiar. The six pre-planned routes were decided in advance of running any participants through the experiment, and were designed to have the same or very similar travel time, as well as maintain similarities to the nominated familiar route (e.g. similar mix of speed zones) for comparison purposes.

The post-drive questionnaire (see Appendix F) contained 10 pre-determined questions for three of the five sampling locations during the drive. Participants were required to answer questions about the first, third and fifth sampling locations. The questionnaire asked participants to describe all they could recollect about the location and whether they felt there was anything unusual happening such as road works or any car accidents. They were also asked questions about their surroundings at each location such as whether there were any other cars around them or on any side roads, as well as whether there were any pedestrians and where those pedestrians might have been. Participants were asked about their speed choice with respect to the speed limit and finally, to recall the subjective ratings they previously gave at each location to which described their feelings of risk, anxiety and familiarity during their driving task.

2.3.3 The Roads

On-road drive data was collected with the GoPro camera for 30 participants who each took part in two on-road drives. The speeds ranged from 50km/h to 100km/h. The routes which are depicted in Figures 2 through to 7, were designed to take the participant approximately 20 minutes to complete and had an average distance of 12km. Each route required the participant to demonstrate a series of behaviours that they would usually conduct in an everyday drive. This included making left and right turns, entering and leaving a roundabout, traveling through intersections, and moving through different speed zones.



Figure 2. Map of Route One, Hamilton East. (14km)



Figure 3. Map of Route Two, Te Rapa (13km)

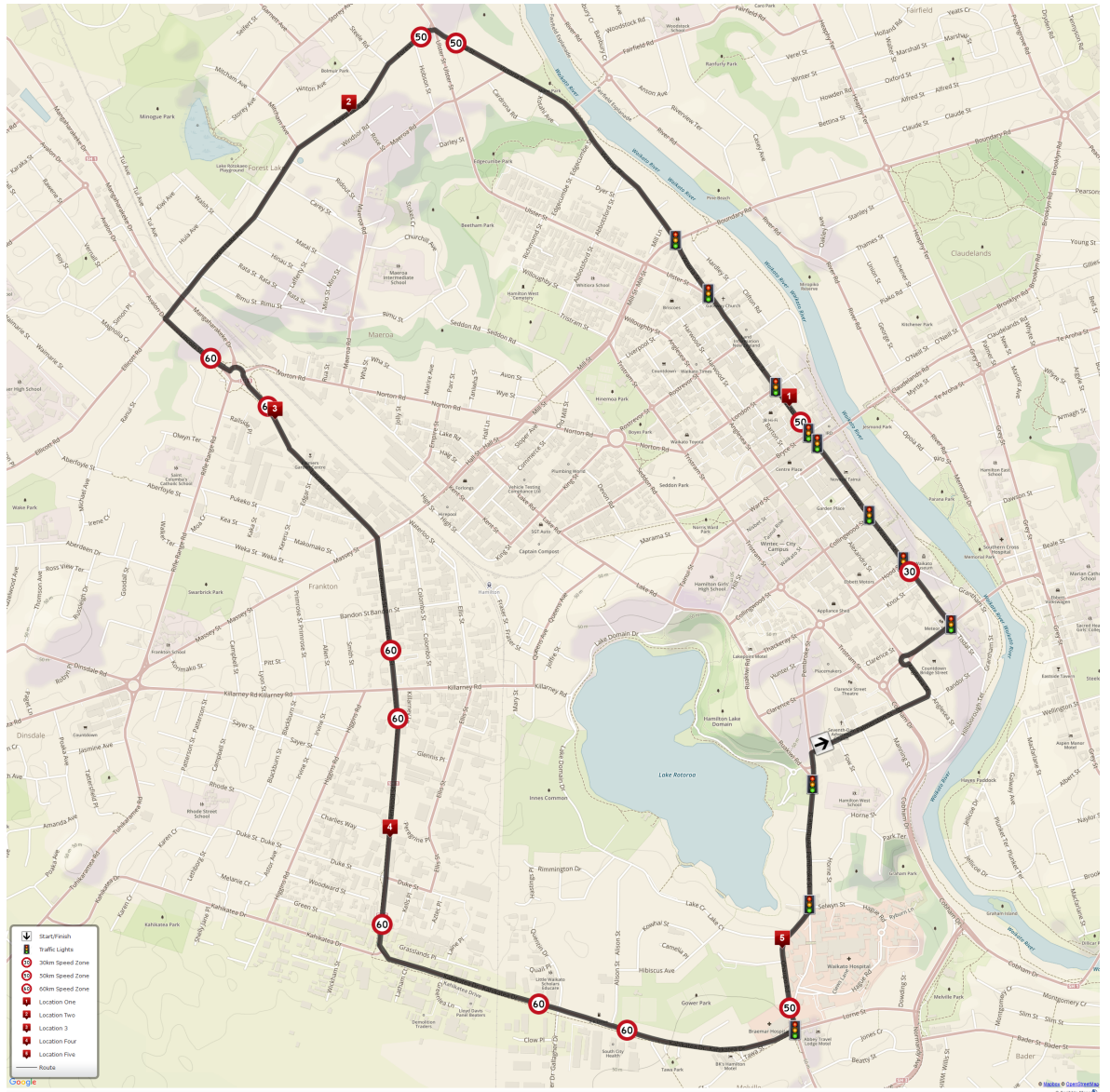


Figure 4. Map of Route Three, Hamilton Central (13km)



Figure 5. Map of Route Four, Ngaruawahia (11km)

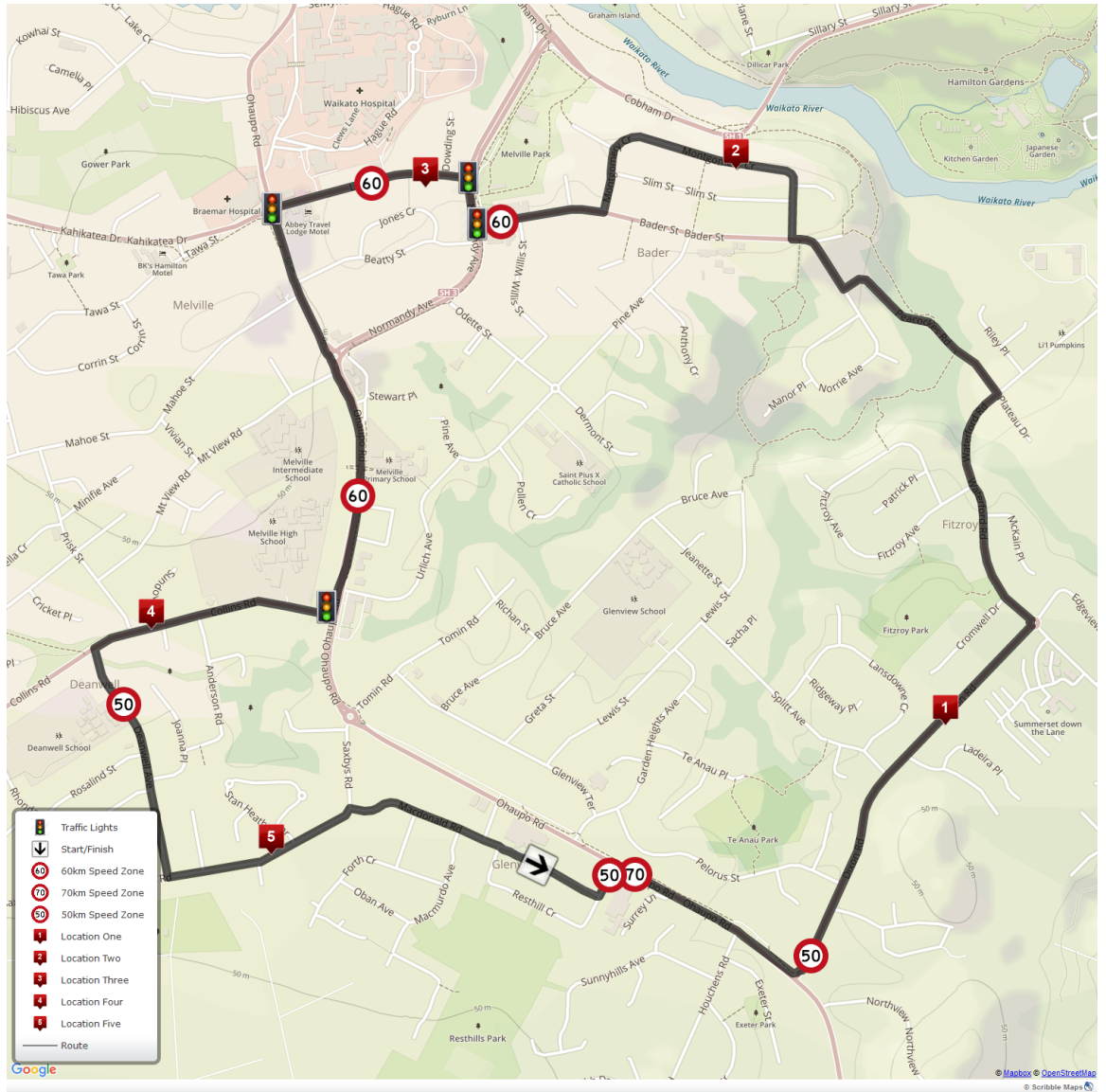


Figure 6. Map of Route Five, Glenview (10km)



Figure 7. Map of Route Six, Nawton (11km)

2.4 Procedure

Each data collection consisted of three phases; the pre-drive data collection phase, the driving phase, and the post-drive recognition/recollection phase. The pre-drive phase was the initial data collection phase where participants filled out a driving route questionnaire (see Appendix D), as well as a demographic and driving history questionnaire (see Appendix E) to build up an audience profile. The second phase contained two separate on-road drives, where the participant's anxiety, risk and familiarity ratings were noted at sampling locations during the drive. Driver speed choice was also noted at these locations. The third phase was the post-drive recognition/recollection phase where participants were asked to report on specific events from the second phase as well as the risk/anxiety ratings they previously provided at each sampling location. The order in which participants completed their familiar and unfamiliar route was balanced so that half the participants started with their familiar route first, and the other half started with their unfamiliar route. Participants conducted their second drive at a minimum of one day to a maximum of one week apart from the completion of their first drive.

2.4.1 Pre-drive

Volunteers were recruited to participate in the study through the use of flyers (see Appendix G) which contained instructions on how to contact the researcher to express their interest in taking part. Upon receiving an expression of interest, the researcher contacted the volunteer to arrange a

meeting time and place in order to explain the purpose of the research, what would occur during experimental sessions, how long the experimental sessions would take, and to detail that participants would be required to provide a vehicle that they are familiar with for the driving tasks. After being presented with this information both in writing (see Appendix B) and verbally, potential volunteers were given an opportunity to ask questions about the experiment and give their informed consent to participate by signing the provided consent form (see Appendix A).

Participants then filled out the driving routes questionnaire (see Appendix D) and the demographic and driver history questionnaire (see Appendix C). The participants were informed that there was another questionnaire (see Appendix E) to be answered at the conclusion of each driving task. A photographed copy of each participant's full drivers licence was taken for our records to confirm they had a full drivers licence. At this time the researcher nominated and discussed with the participant which routes were to be driven as the participants' familiar and unfamiliar routes. A time and meeting place to conduct the driving tasks was also organised at this time.

2.4.2 Drive

Before both drives, the participants were accompanied to their vehicle and the camera was mounted to the centre of the participant's car windscreen, between the driver and front passenger. It was set around head height, and faced the road with a clear view of the surroundings so that the drive could be accurately reviewed post-drive.

Participants were informed that the use of the camera was to record the drive for later analysis and to ensure the accuracy and integrity of the data collection was maintained.

Before the drive began, the researcher informed the participant that they had the opportunity to practice answering questions that the researcher was going to ask during the drive. The participant had the option to continue to practice answering the questions until they were comfortable and confident in answering the questions appropriately.

The participants were instructed to drive how they would normally as if there were no one else in the car with them. The researcher avoided conversation so as not to distract the driver, but directed the driver where to go with regard to which roads and turns they needed to take. These instructions were given in advance so that the driver had enough time to safely complete the driving behaviours without putting themselves or others at imminent risk of harm.

Participants were asked what they were thinking about, and to give their subjective ratings of their feelings of anxiety, risk and familiarity at five sampling locations during the drive.

Driver speed choice may have been an indicator of how familiar the driver was with the route they were driving, so the researcher observed and noted down the driver's speed choice at each location. This observation was attempted to be done discretely without the participant's awareness, but in some cases the driver was needed to be asked what speed they were travelling when the researcher was unable to see the speedometer. The participant was asked to provide information about

what they were thinking about at sample locations. These answers were encouraged to be kept brief, between one word and a short sentence.

The ratings for anxiety and risk were on a ten-point ordinal scale where one meant 'I have low feelings of risk/anxiety' and ten meant 'I have high feelings of risk/anxiety'. Ratings of route familiarity were also on a ten-point scale where one means 'I am not familiar at all at this location' and ten means 'I am very familiar with this location.'

2.4.3 Post-drive

In the post-drive phase following the driver task, the participant was asked questions about the drive they had recently completed. The questionnaire (see Appendix F) was completed at the end of each driving task.

Participants were asked to recall as much information as they could about each location such as whether there were any pedestrians or cars around them, and whether anything unusual (e.g. road works, vehicle accidents or strange behaviours) was happening at three of the five locations. Those locations were the first, middle and last locations during the drive, and were asked in a random order, by the use of a random number generator to avoid memory bias. Participants were also asked to recall their driving speed, the speed limit, and their perception ratings for risk, anxiety and familiarity at each sampling location.

2.5 Statistical Analysis

To examine the role of familiarity on drivers' choice of speed and their ratings of risk and anxiety, a series of correlations and within subject ANOVAs were conducted.

Using the outlier labelling rule, defined as multiplying the interquartile range (IQR) by a factor of 1.5, outliers were identified. Extreme outliers were identified in the participants driving speeds for location one of the Ngaruawahia route, and so all data for that location was removed from the analysis to avoid skewing the data. All other outliers were not considered to be extreme outliers or errors in the data and were included in the analysis. Greenhouse-Geisser corrections were applied where appropriate.

Driver recollection was scored on a nominal scale of correct positive, false positive, correct negative or false negative. Participants were given a score of one for getting the answer correct (correct positive, correct negative) and were given a score of zero for incorrect answers (false positive, false negative). Participants' percentage scores were based on the 30 questions from the post-drive questionnaire (Appendix F). Only three out of five locations were used from the drive to avoid potential systematic bias in memory, so that participants would not simply recall information in the order that they experienced it in.

3 Results

This study aimed primarily to explore the effect of route familiarity on driver perceptions of anxiety and risk. Driver speed choice and recollection were also of interest.

3.1 Route Familiarity

Figure 8 shows the participants' on-road ratings of familiarity for the two routes (familiar and unfamiliar).

As can be seen in Figure 8, the ratings provided by the participants during the drive confirmed that they were less familiar with the route they had chosen as unfamiliar prior to the drive.

Average familiar ratings at familiar locations were 9.32 ($SD=1.16$, $n=30$), with average ratings at unfamiliar locations being 3.16 ($SD=2.97$, $n=30$). Participants rated the two routes as being significantly different from each other in terms of familiarity which means that the familiar manipulation of routes worked.

Statistical analysis with a 2 (route type) x 5 (location) repeated measures ANOVA indicated that the mean ratings were significantly different for the two route types, $F(1,11) = 221.83$, $p < .001$, $\eta_p^2 = .953$. There was also a significant main effect on the type of location that the participant was driving on their familiarity rating, $F(1.86, 20.45) = 9.14$, $p = .002$, $\eta_p^2 = .454$, (Greenhouse-Geisser corrected) This means that if the ratings differed across the locations regardless of whether it was a familiar or unfamiliar route, that participants were more familiar with some places on the routes than others. There was no significant interaction between

route familiarity and the location, $F(2.16, 23.75) = 3.19$, $p = .056$, $\eta_p^2 = .225$, (Greenhouse-Geisser corrected).

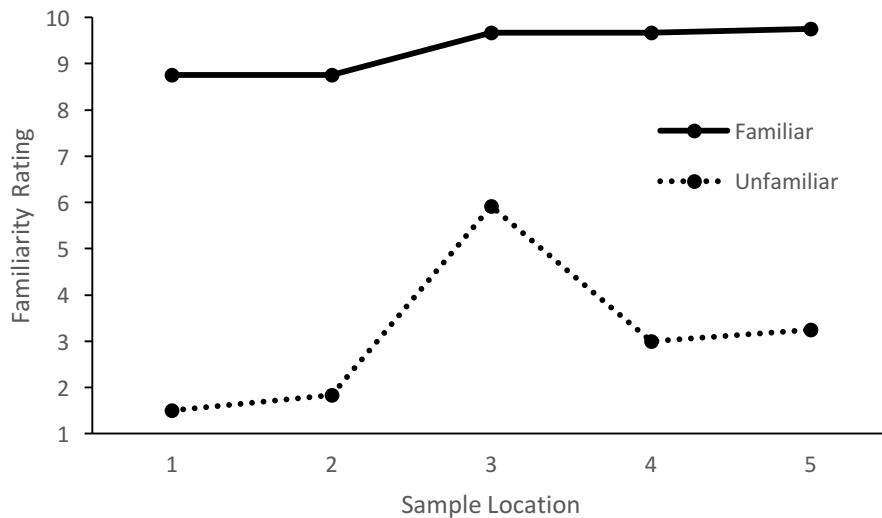


Figure 8. Mean familiarity ratings across sampling locations for familiar and unfamiliar routes.

Figure 9 shows the participants' on-road ratings of perceived risk for the two routes (familiar and unfamiliar). Risk ratings at each of the locations as shown on Figure 9 were generally low with all ratings being below the mid-way point. Both familiar and unfamiliar routes were rated as having similar levels of risk across the locations, with an average rating of 2.35 ($SD=1.506$, $n=30$) at familiar locations, and an average of 2.11 ($SD= 1.358$, $n=30$) at unfamiliar locations.

Statistical analysis with a 2 (route type) x 5 (location) repeated measures ANOVA confirmed that the mean ratings were not significantly different for the two route types, $F(1,11) = .85$, $p= .38$ $\eta_p^2 = .072$. However, there was a significant main effect on driver risk perception based on the

location they were in, $F(4,44) = 2.59$, $p = .05$ $\eta_p^2 = .191$. There was no significant interaction between how familiar a participant was and the location they were driving with their perceived ratings of risk, $F(2.40,26.38) = 2.67$, $p = .20$ $\eta_p^2 = .196$, (Greenhouse-Geisser corrected).

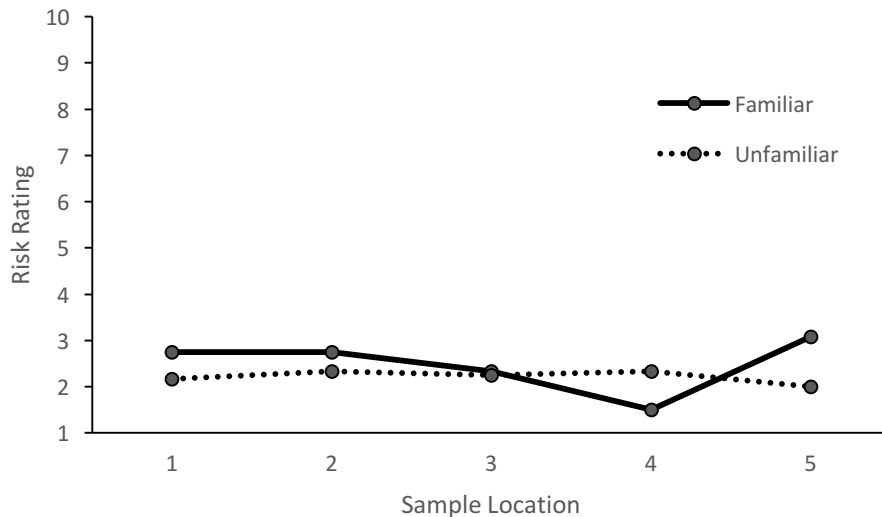


Figure 9. Mean risk ratings across sampling locations for familiar and unfamiliar routes.

Figure 10 shows the participants' on-road ratings of anxiety for the two route types (familiar and unfamiliar). Anxiety ratings at sample locations can be seen on the figure as being generally low, with all ratings being below the mid-way point. Perceptions of anxiety were rated fairly similarly at each location regardless of how familiar the driver was with the location. Participant anxiety had an average rating of 2 ($SD=1.23$, $n=30$) at familiar locations and an average rating of 2.02 ($SD=1.155$, $n=30$) at unfamiliar locations.

Statistical analysis with a 2 (route type) x 5 (location) repeated measures ANOVA indicated that the mean ratings were not significantly different for the two route types, $F(1, 11) = .02, p = .89 \eta_p^2 = .002$. This means that familiarity did not affect feelings of anxiety. There was also no significant main effect on the location that the participant was driving on their anxiety rating, $F(2.19, 20.45) = 2.05, p = .15 \eta_p^2 = .191$, (Greenhouse-Geisser corrected). There was no significant interaction effect between route familiarity and the location that the participant was driving in on the rating of anxiety that the participants gave, $F(1.85, 20.39) = .80, p = .46 \eta_p^2 = .196$, (Greenhouse-Geisser corrected).

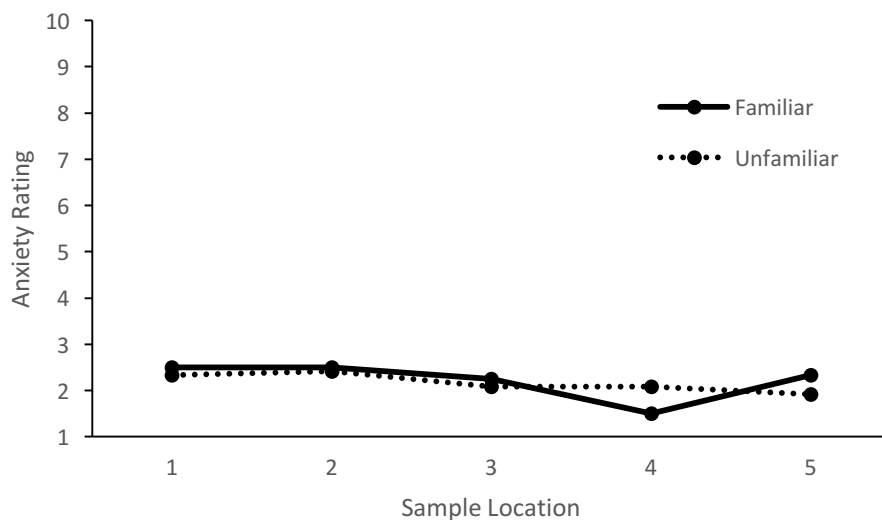


Figure 10. Mean anxiety ratings across sampling locations for familiar and unfamiliar routes.

3.2 Speed Choice

Figure 11 shows the participants' travel speed at the sampling locations for the two routes (familiar and unfamiliar).

As can be seen in the figure, drivers travelled at faster speeds on familiar routes ($M= 56.76$, $SD= 4.49$) than they did on unfamiliar routes ($M= 53$, $SD= 6.72$). None of the sampling locations were taken at traffic lights where participants were required to stop. There was one instance where speed was collected at a location where the participant had come to a complete stop due to traffic and was excluded from the data set. The average speed limit on familiar routes ($M= 57.52$, $SD= 7.20$) was higher than the speed limit at unfamiliar routes ($M= 48.52$, $SD= 8.84$).

Statistical analysis with a 2 (route type) x 5 (location) repeated measures ANOVA indicated that the mean ratings were significantly different for the two route types, $F(1, 11) = 8.13$, $p = .02$ $\eta_p^2 = .425$. There was no significant main effect on location that the participant was driving with the speed they were travelling, $F(2.13, 23.42) = 1.19$, $p = .32$ $\eta_p^2 = .098$, (Greenhouse-Geisser corrected). There was also no significant interaction effect between the location that the participant was driving, on their speed ratings $F(1.92, 21.11) = 1.47$, $p = .25$ $\eta_p^2 = .118$, (Greenhouse-Geisser corrected).

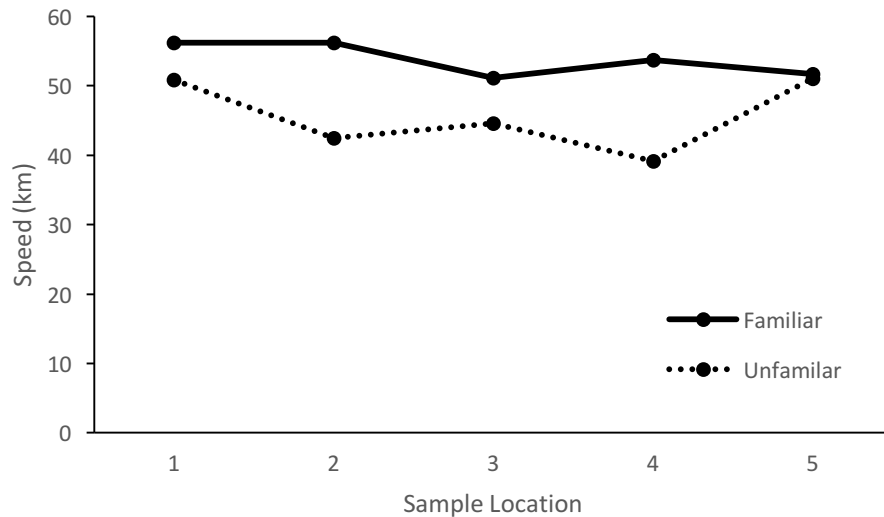


Figure 11. Mean speed choices across sampling locations for familiar and unfamiliar routes.

In summary, familiarity with a driving location did not have a strong effect on the drivers' perceptions of anxiety and risk. Other than the effect of familiarity on speed choices, no other significant differences in the ratings were found. Participants reported similar feelings of anxiety and risk for both the locations that they were not familiar with, and the locations that they would travel through everyday. Familiarity did have a strong effect on driver speed choices which was on average slower in unfamiliar locations than the speed choices made in familiar locations.

3.3 The Effect of Familiarity on Driver Recall

Participants were asked to recall information about the locations of other cars and pedestrians, as well as their travelling speed and perception ratings. Only three of the five sampling locations were used in the analysis

to avoid potential systematic bias in memory, so that participants would not simply recall information in the order that they experienced it in.

Figure 12 shows the participants' percentage correct on the post-drive questionnaire by route type and location. Driver recollection was strongest at the beginning of the drive where participants were more likely to get answers correct, than when they were questions about locations from the middle and end of the drive. Participant correct answer scores were higher for recalling familiar routes ($M= 21.15$, $SD= 3.15$) than for unfamiliar routes ($M= 20.48$, $SD= 3.83$). On average, percentage correct was 70.5% for familiar routes, and 68.27% for unfamiliar routes.

Statistical analysis with a 2 (route type) x 3 (location) repeated measures ANOVA indicated that the mean ratings were not significantly different for the two route types, $F(2, 58) = 1.41$, $p = .25$, $\eta_p^2 = 8.97$. There was also no significant main effect of location that the participant was driving with their ability to recall information, $F(1,29) = .77$, $p = .39$, $\eta_p^2 = 1.61$. Additionally, there was no significant interaction effect between how familiar the driver was, and the type of location that the driver was travelling, on their ability to recall information, $F(2,58) = 1.41$, $p = .25$, $\eta_p^2 = 8.27$.

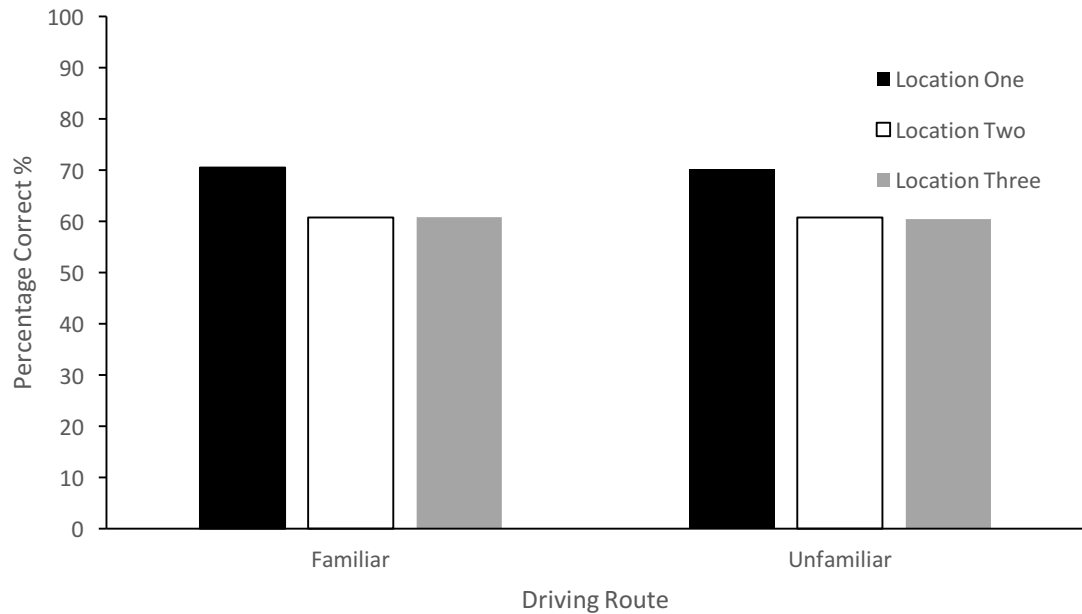


Figure 12. Average percentages of memory accuracy across three locations for familiar and unfamiliar driving routes.

In summary, while the percentage scores between familiar and unfamiliar locations are minimally different, familiarity appeared to have no significant effect on the drivers' ability to recall information. While participant percentage scores were generally higher when asked about the beginning of the drive, overall recollection was generally low with most participants scoring between 50-70%.

3.4 The Effect of Age and Gender

An independent-samples t-test was conducted to compare driver perceptions with gender (male/female). There was a significant difference in the risk ratings for female ($M= 1.77$, $SD= .75$) and male ($M= 2.70$, $SD= 1.18$) at familiar locations; $t(28)= -2.57$, $p= 0.02$. These results suggest that gender does have an effect on driver perceptions of risk, specifically

that men had higher perceptions of risk than women while driving in a familiar area.

There was also a significant difference in memory recall scores for females ($M= 22.54$, $SD= 2.64$) and males ($M= 19.94$, $SD= 3.12$) at familiar locations; $t(28)= 2.44$, $p=0.02$. Female participants had a higher percentage correct (68.27%) than male participants (66.47%). These results suggest that gender does have an effect on a driver's ability to recall information about a drive from a familiar location, with female participants having scored higher on average than male participants.

No other conditions were found to have a significant difference in ratings compared with gender for familiar locations. No significant differences in perception ratings compared with gender conditions at unfamiliar locations were found.

A Pearson's correlation was also conducted to see if there was a relationship between age and driver perceptions, however results show that age had no correlation with any other measures.

In summary, significant differences between gender scores were only found at familiar locations. Male participants gave slightly higher anxiety ratings on average than female participants at familiar locations, although the difference between the average ratings is very small. Female participants were found to score higher percentages on their recollection tests than male participants at familiar locations. No other significant differences between gender scores were found, and no significant correlations between age were found with any measures.

4 Discussion

4.1 Research Findings

The first research question asked: Does familiarity affect driver perceptions of anxiety and risk? The results from this study indicate that the answer is no. While familiarity was clearly different for unfamiliar and familiar driving routes, there was no strong influence found on the participants' ratings of anxiety and risk. Although the participants' ratings were slightly higher in familiar areas than unfamiliar areas, this difference was not significant enough to suggest that familiarity was the cause.

For the second research question: Is driver speed choice influenced by their perceptions of familiarity, anxiety and risk? The results from this study suggest that the answer is yes. Findings from this study show that driver speed choice may be influenced by perceptions of familiarity and that the level of comfort involved in the driving task helps drivers to determine the speed they prefer to drive at. This speed can change depending on environmental conditions, other road-user behaviour, and location that they are in.

The final research question: How is recollection influenced by familiarity, anxiety and risk? Results suggest that there is no significant relationship between driver recall ability and any of the driver perceptions. This may be suggestive of another external influence on a driver's ability to recall information; such as the duration of the drive, or whether there are any abnormal occurrences that stand out to them (e.g. vehicle accident).

4.1.1 The Effect of Familiarity on Driving Routes

It was hypothesized that familiarity with a driving environment would have an effect on driver perceptions about the environment, resulting in changes to driver behaviour. It was expected that participants would experience high familiarity in locations that they travelled regularly, and low familiarity in areas that they travelled rarely.

Results showed that there was a significant difference between the mean ratings for familiar and unfamiliar drives, which supports the route sample selection process. In keeping with predicted outcomes, it was found that participants ($n=30$) experienced high feelings of familiarity in the locations that they travelled regularly, and low feelings of familiarity in locations that they rarely travelled. Participant ratings for familiar locations were consistently on the high end of the scale (10), while ratings for unfamiliar locations never made it to the mid-way point of the scale (5).

4.1.2 Familiarity and Driver Perceptions of Anxiety and Risk

Driver perceptions of anxiety and risk were hypothesised to be lower in familiar areas and higher in unfamiliar areas. This would suggest that the driver would feel like they were more likely to have a car accident and have higher levels of fear at a location they were less familiar with.

Participant ratings of anxiety were all well below mid-way of the scale, and were almost identical at each location regardless of how familiar or unfamiliar they were with the route unless obvious risky driving situations were occurring.

Results did not support the hypothesis that participants would feel more anxious in unfamiliar locations, and suggest that drivers feel a low level of anxiety regardless of the location that are in. Anxiety may instead be caused by external factors such as other road-user behaviour.

These results support the findings found in Taylor and Paki (2008) as well as those found in Taylor et al., (2010). Though both studies were based on self-reported questionnaires, participants reported overall low feelings of anxiety in general about driving, with participants who reported higher levels of anxiety often being identified as having psychological problems relating to driving tasks.

While the main effect of location on risk perception was found to be significant, which may explain the slightly higher ratings of risk at familiar locations, results showed participants giving a similar rating for risk perception across all locations for both familiar and unfamiliar routes. The hypothesis was not supported by the results as the average mean rating of risk across locations for familiar and unfamiliar locations were not significantly different from each other. With all mean ratings being below mid-point, participant risk ratings suggest that feelings of a vehicle crash occurring were unlikely, regardless of how familiar or unfamiliar they were with the route.

The findings from this study support those found in Colonna et al., (2015) who hypothesised that drivers who are familiar with a driving route will be more likely to engage in riskier behaviours. This may be due to the overall level of comfort the driver was feeling in their own vehicle and with the driving environment. Participants made comments about feeling more

anxious and more at risk when presented with other road-user behaviour that they deemed as being unsafe.

These findings support the results found in Taylor and Paki's (2008) study, where the behaviour of other drivers was the main cause of high anxiety ratings in participants. It would appear that drivers remain least anxious and less at risk if they perceive to have a reasonable amount of control of the driving situation.

This perception of comfort is shattered when the driver is confronted with environmental changes (e.g. fog, heavy rain conditions) and behaviours from other people (e.g. pulling out into traffic, sudden breaking) that differ from normal expectations that they have about the environment. This loss of feeling in control of a situation causes spikes in what is otherwise considered a safe and relatively easy task.

4.1.3 Familiarity and Driver Speed Choice

Results supported the hypothesis that drivers will travel at faster speeds in areas that they are familiar with than locations that they are unfamiliar with. It should be noted that the average speed limit was higher on familiar routes than on unfamiliar routes once the 100km zones had been excluded from the analysis. This may have played a role on the speed choices made by participants.

Participants generally stuck to the speed limit, although some participants chose speeds that were faster than the legal speed limit and confessed that this fast speed was slower than what they would normally drive while participating in the experiment. This suggests that there may

have been some other external influences on the speed choices that were being made by the participants, causing them to make riskier or safer speed choices than they otherwise normally would if they were driving on their own.

This supports the findings in the study conducted by Colonna et al., (2004) where drivers were found to increase their driving speed due to a level of comfort and familiarity felt with the driving route or situation. It would seem that there is a fine line between when a driver is willing to risk speeding, and when they feel it is safer to drive to the speed limit, an idea that supports the Zero-Risk theory where the drivers previous experience of risk has an influence on the speed choices that they make.

This could apply not only to environmental concerns for the driver, but also the perceived concerns of their passengers. It is possible that drivers in this study were choosing safer driving speeds, in part due to the fact that a researcher was sitting in the passenger seat. It would seem that an optimal speed was chosen by participants in this study to accommodate a perceived level of comfort for themselves and their passenger.

4.1.4 Recollection

It was hypothesised that drivers would have better recollection about locations that they were familiar with, and would remember less about unfamiliar locations. Results did not support the hypothesis with participants gaining a similar percentage score on their post-drive questionnaire for familiar ($M= 64.05$) and unfamiliar drives ($M=63.82$).

Overall, recollection percentage scores were low with the highest scores on average being $M=70.48$ for familiar drives and $M=70.23$ for unfamiliar drives.

Participants showed a higher percentage correct when asked to recall information about the beginning of the drive, and slightly lower when asked about the middle and end of the drive. To recall information about the drives they had recently driven, participants were required to use explicit memory about the driving experience. It was initially hypothesised that familiarity with the driving route would enhance participants' ability to recall information and that participants would use schemata to aid in their recollection.

It is possible that participants may have recalled less information about the driving environment due to the amount of cognitive load that would be experienced while driving a vehicle on-road. Blalock et al., (2014) suggest that because driver attention is focused on different aspects of an environment, that drivers will focus their attention based on its safety relevance to them as the driver. Because participants were not necessarily experiencing unsafe stimuli during the drive, this may have contributed to lower recollection percentage scores due to a lack of memorable stimuli.

Chapman and Groeger (2004) suggested that the predictability of a driving environment may enhance an individual's ability to recall important information that they did not originally pay attention to, meaning that participants were guessing correctly instead of recalling correctly meaning that participant memory performance may be worse than what their score

represented. It is possible that participants from this study were recalling information about both familiar and unfamiliar routes similarly due to correctly guessing information instead of remembering what actually happened.

4.1.5 Age and Gender

Males had slightly higher risk ratings on average than females. This difference between is very small, but suggests that males on average have higher feelings of fear when driving vehicles than women regardless of how familiar they are with the driving route. This does not support the findings in the study conducted by Machado-Leon et al., (2015) which found that females had higher levels of risk and considered some behaviours more dangerous. These results suggest that further investigation into gender perceptions of risk may be of value.

Female participants were also found to have higher recall percentage scores than males in this study however, as no other conditions were found to have a significant effect on recall ability; it is difficult to see what was influencing the higher recall scores for female participants. Age was found to have no correlation with any other measures in this study; however, because the ages in this participant group was variable with mostly younger participants it is not possible to make a comparison.

4.2 Limitations

Difficulty in recruiting participants meant that an evenly distributed group for age was not possible. As a result, the participant group consisted of participants who were aged between 20-29 years. The sample size was also very small with only 30 participants. I believe that with a larger sample size, the current trends may be more evident and more relationships could have been found.

Participant risk ratings were low across both familiar and unfamiliar driving routes. This may mean that there may be an alternative effect other than familiarity on participant perceptions of risk. The level of experience that a driver has with driving (e.g. years) may have played a role in this study. Because driver experience was not looked at in this study, it may be valuable to include it in future studies observing everyday driving behavior.

Results suggested that anxiety perceptions had no correlation with any effect in this study. This may be due to an internal effect, such as how familiar the driver was with their car, or the general feeling of familiarity from living in a small city. Because this study assumed that anxiety perceptions may be affected by external factors (e.g. other traffic, road conditions) it may be of value to look at other things that may be affecting how anxious the driver is feeling in everyday driving.

The overall financial and time restrictions of this current study meant that participants were limited to driving routes that were local, which while good for being in a familiar environment, made finding an unfamiliar route difficult. The solution to this was to take participants to a nearby town; Ngaruawahia.

While this provided an unfamiliar area for participants to drive, it was noticeably different from the other routes in this study. There was notably less traffic and pedestrians, and speed limits were also different resulting in the removal of one location where the speed was 100km. Because the Ngaruawahia was the most commonly chosen unfamiliar route for participants, this meant that one data point was being excluded for a majority of the participants. Given more time and monetary freedom, taking participants to another city such as Auckland or Tauranga may have yielded better results.

No patterns were found to have an effect on the participant's recall ability. The small sample size may have effected the data in this instance, but also that only three of the five sampling locations were used to assess the driver's ability to recall information. If this study were to be repeated, it would be worthwhile to include all sample locations when testing what participants can remember.

The only correlations in the data set were found in familiar locations. No correlations or relationships were found in unfamiliar locations. While the sample size may contribute to this lack of findings, it may also be due to lack of variability of unfamiliar routes. Because most participants were travelling the same unfamiliar route but had different familiar routes, it may not be a fair representation of what is considered unfamiliar.

4.3 Implications and Suggestions for Further Research

If perceived risk explains part of the reasoning behind driver speed choices, then understanding what makes drivers choose particular speeds would be an important question worth investigating. How do you encourage drivers to make safer speed choices, even while travelling in locations that they are extremely comfortable in?

One approach to controlling driver speed choices could be to re-design driving environments in an attempt to control driver perceptions of safety (Charlton, 2003). Results from Charlton's (2003) study suggest that approach speeds to intersections is lower when it is visually restricted. It could be suggested that if everyday roads were able to be visibly restricted in a safe way, that it may contribute to safer speed choices being made by drivers in busy areas. By creating road environments that subconsciously communicate to drivers what the optimal speed choice would be, this solution could result in a reduction of speed and accidents in everyday traffic that would begin to occur habitually over time due to the frequency at which drivers travel in those locations.

It is possible that the way risk and anxiety was measured in this study was not the best way to gauge what the driver felt while travelling the routes. If this study were to be done again, it may yield better results if participants' levels of fear and anxiety were observed by measuring the participants' biological responses (e.g. heart rate, skin responses, eye movements) to hazards and potentially harmful driving situations.

4.4 Conclusion

Previous findings related to the effect of familiarity on driver perceptions and speed choices suggest that drivers engage in riskier behaviours, and experience a loss of recall ability on familiar routes. Drivers were also thought to engage in safer behaviours, pay more attention to important stimuli and remember more about drives that they were unfamiliar with.

These findings support the idea of familiarity having an impact on driver speed choices, but does not support playing a role in other everyday driving behaviours or perceptions. While this present study found that familiarity had no strong effect on driver perceptions or recall ability, there was a significant effect of familiarity on driver speed choices. Drivers exhibited noticeably riskier behaviours (e.g. overtaking, tail gating) in the locations that they were most familiar with. Participants generally travelled at a speed that they were most comfortable with which was often slightly over the speed limit. In unfamiliar areas, participants travelled slower than the recommended speed limit, and exhibited safer driver behaviours.

Further research is necessary to further establish this link and should target other potential influences of driver speed choice such as their relationship with any passengers, the type of speed zone they are in (e.g. difference between 50km and 100km) and the time of day. Better recognition of what causes drivers to travel faster than the recommended limit will aid in the development of more effective means of specific interventions that reduce the likelihood of serious vehicle accidents to occur.

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Appendices

Appendix A



CONSENT FORM

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

Research Project: Familiarity and Recollection 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 (my choice) 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 agree to have my on-road drives video recorded and understand that they are for analysis purposes only and will not be shown publically.		
9. I wish to receive a copy of the findings		

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: _____

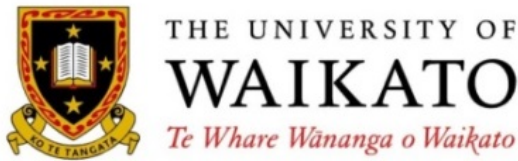
Declaration by member of research team:

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: _____

Appendix B



Study title: **Familiarity and Recollection in Everyday Driving**

Researcher: **Sarah James**

Contact number: **027 527 3475**

Email: extaranz@gmail.com

What is the purpose of this study?

Driving a car is one of the most commonly practiced activities in modern society with many individuals driving cars every day, frequently travelling the same route to get to their destination. Despite this, there has been little research conducted that investigates the effects of repeated exposure to everyday road or traffic situations on drivers. The purpose of this study is to investigate and describe how familiarity affects driver ability to recollect important information about both familiar and unfamiliar driving routes as well as their perception of risk and anxiety while driving. This data is being collected for a Master's thesis. All information collected will remain confidential.

What will my participation in the study involve?

- You will need to hold a full NZ driver's license
- You will need to be under 60 years of age
- You will need to have your own vehicle. You will be asked to complete a demographic and driving history questionnaire and then participate in two drives along a familiar route and an unfamiliar route.
- During the drive we will ask questions about your feelings of risk and driving difficulty. After we will ask you some questions about the roads you have driven.
- You will be required for two separate drives to be spaced out over a maximum of one week.
- You will receive \$15 in the form of a fuel voucher to thank you for participating (or 2% course credit).

Confidentiality

Participants will be guaranteed absolute confidentiality of their responses and the data generated from the experimental session. Participants names will never be associated with their response data as a random number will be used instead. When each participant begins the study, they will be given a unique number. A master sheet will exist that links the names with the numbers and will be retained by the researcher until the study is complete. After this, the information will be destroyed and data will be identified by number only.

What are the possible benefits and risks of this study?

Possible benefits:

There are no specific benefits to you in participating. Your participation may benefit future research by helping researchers understand how familiarity affects driver perceptions of risk and anxiety as well as recollection of important events when travelling both familiar and unfamiliar driving routes.

Possible risks:

Apart from the amount of risk associated with driving on road, there will be no risks from contributing to this study.

Who pays for the study?

There will be a small cost for you as a participant as you will be expected to cover the cost of petrol used during the drives. There will be no payment for taking part in the study; however you will receive a \$15 fuel voucher as a token of recognition for participating.

What if something goes wrong?

If you are injured in this study, which is unlikely, you would be eligible for compensation from ACC. You will have to lodge a claim with ACC, which may take some time to assess. If your claim is accepted, you will receive funding to assist in your recovery.

What are my rights?

Participants have the right to access questionnaire and data information collected from them as part of the study.

If you do agree to take part in this study, you are free to withdraw at any time, without having to give a reason, and will still be able to claim your voucher or course credit. If you withdraw consent at any time questionnaire and data information will be destroyed.

What happens after the study?

Questionnaires and electronically held data will be retained by the experimenter. Paper correspondence will be kept securely in the School of Psychology at the University of Waikato. Electronic data will be stored on a password protected computer. Data will be kept for a minimum of five years as per the university policy. Participants will be identified by ID numbers and the master sheet that contains the names mapping participants to allocated ID numbers will be destroyed once the data analysis is complete.

We aim to have the results of this study published as a Master's research thesis. It will take some time for the results to be completed after you have taken part in the study. If you would like to be informed of the results or any findings, please tick the appropriate box in the consent form.

Who do I contact for more information or if I have concerns?

The study is being supervised by Assoc. Profs Samuel Charlton and Nicola Starkey (School of Psychology), University of Waikato. Ethics approval has been received from the School of Psychology Ethics Committee.

Please feel free to contact Sarah James if you have any questions. (Phone: 027 527 3475, email: extaranz@gmail.com)

If you have any concerns about this study, you may contact the convenor of the Psychology Research and Ethics Committee (Dr Rebecca Sargisson, phone 07 557 8673, email: rebeccas@waikato.ac.nz)

Appendix C

Pre-Drive Questionnaire

Date: _____

Participant ID: _____

1. What is your gender? ☐ Male ☐ Female
2. How old are you? (years) _____
3. How often do you drive? (days a week)

4. What percentages would you say that you drive in urban and rural areas?

Urban _____ %
Rural _____ %
5. How fast do you usually drive in relation to the speed limit? (tick one)

☐ Just over
☐ I keep to the speed limit
☐ Just under
☐ Other (Please specify): _____
6. Have you been involved in any car accidents in the last 5 years? If yes, how many and briefly describe?

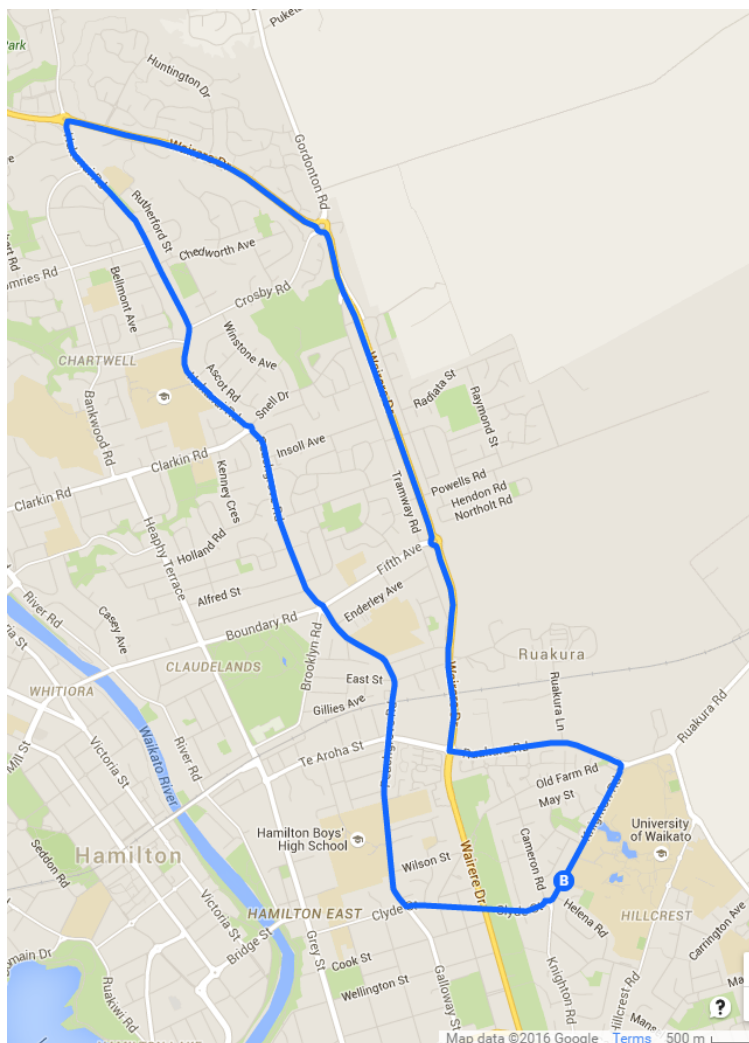
7. Have you had any infringement notices in the last five years? If yes, how many and what were they for?

Appendix D

Familiar Route Questionnaire

Date: _____ Participant ID: _____

Route One



Head northwest toward Knighton Rd

Turn right onto Knighton Rd

At the roundabout, take the 1st exit onto Ruakura Rd

Turn right onto Wairere Dr

At the roundabout, take the 2nd exit and stay on Wairere Dr

At the roundabout, take the 2nd exit and stay on Wairere Dr

At the roundabout, take the 1st exit onto Hukanui Rd

At the roundabout, take the 2nd exit onto Peachgrove Rd

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

Turn left onto Clyde St (signs for Route 10)

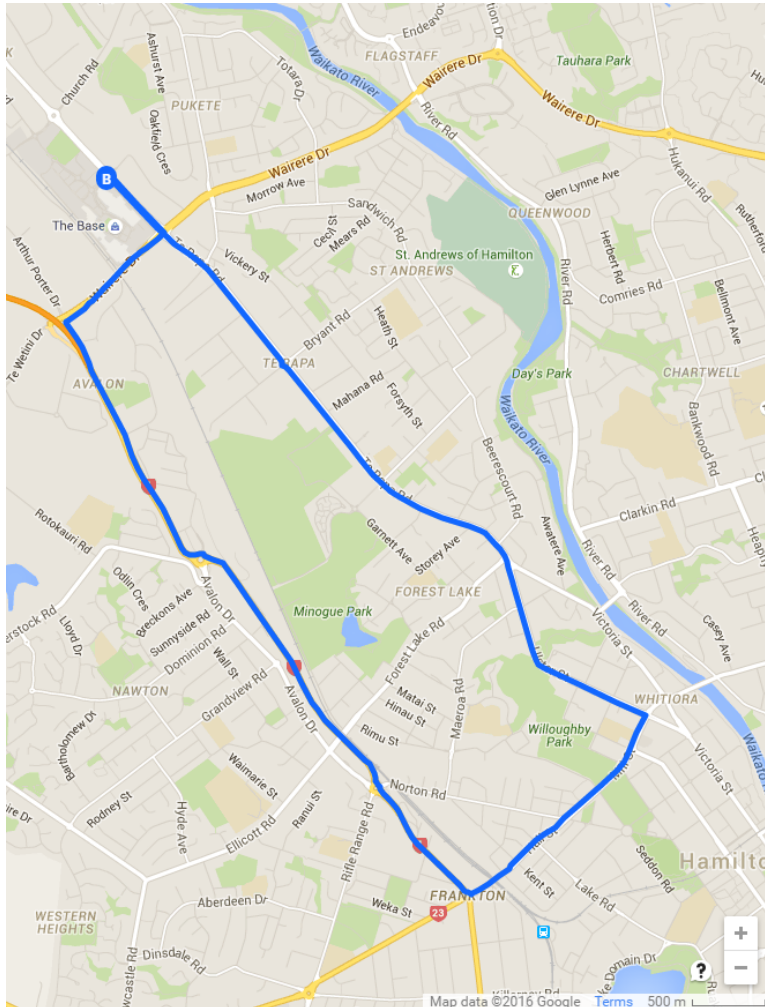
At the roundabout, take the 1st exit onto Knighton Rd

Turn right at 110 Knighton Rd

How familiar are you with this route? (Circle one)

1 2 3 4 5 6 7 8 9 10

Route Two



Head northeast on The Base Parade toward Te Rapa Rd

Turn right at the 1st cross street onto Te Rapa Rd

Turn right onto Wairere Dr

Take the ramp to City Centre Taupo

Continue onto State Highway 1

At the roundabout, take the 2nd exit and stay on State Highway 1

At the roundabout, take the 2nd exit and stay on State Highway 1

Turn left onto Massey Hall Overbridge

Continue onto Hall St

Continue onto Mill St

Turn left onto Ulster St

Continue onto Te Rapa Rd

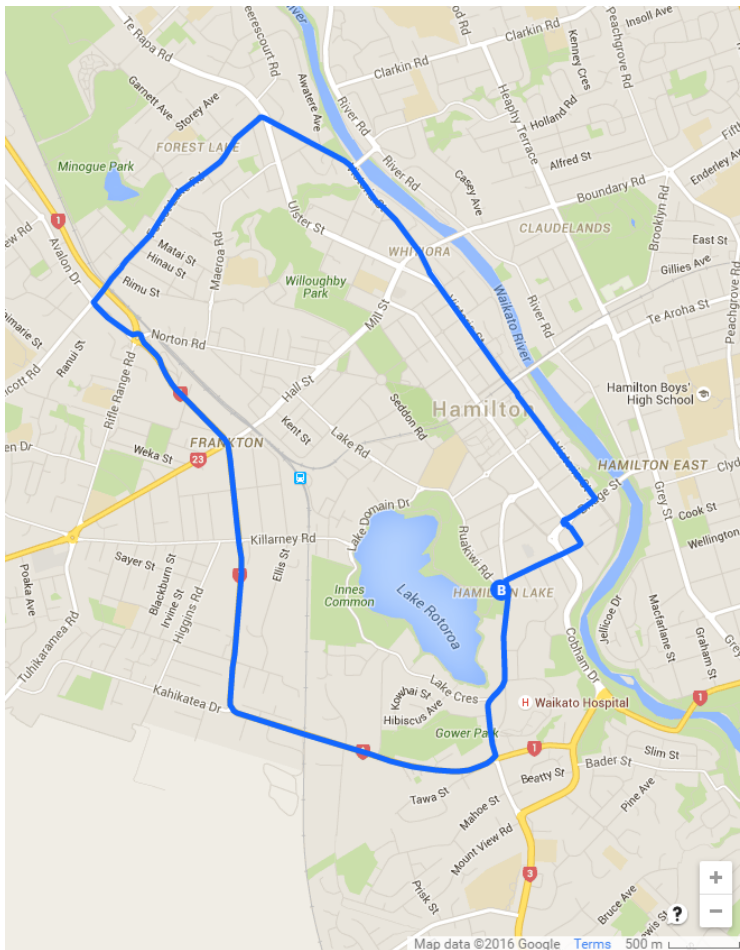
At the roundabout, take the 2nd exit and stay on Te Rapa Rd

Slight left onto 1 The Base Parade

How familiar are you with this route? (Circle one)

1 2 3 4 5 6 7 8 9 10

Route Three



Head southeast on Ruakiwi Rd toward Pembroke St

Turn left onto Pembroke St

Turn right onto Palmerston St

Continue onto Anglesea St

At the roundabout, take the 3rd exit onto Anzac Parade/Bridge St

Turn left onto Victoria St

Continue straight onto Forest Lake Rd

Turn left onto Lincoln St

At the roundabout, take the 3rd exit onto State Highway 1

Turn left onto Ohaupo Rd

Continue onto Lake Cres

Continue straight onto Pembroke St

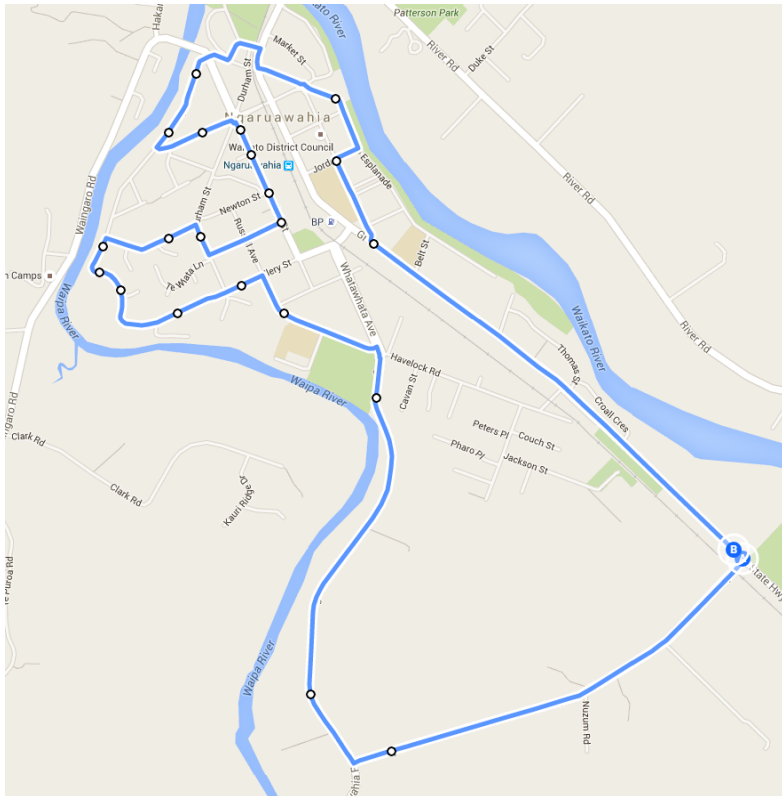
Turn left onto Ruakiwi Rd

Stop at 23 Ruakiwi Rd

How familiar are you with this route? (Circle one)

1 2 3 4 5 6 7 8 9 10

Route Four



Turn left onto Saulbrey Rd

Turn right onto Ngaruawahia Rd

Ngaruawahia Rd turns slightly left and becomes Whatawhata Ave

Turn left onto Havelock Rd

Continue onto Russell Ave

Turn left onto Ellery St

Continue onto Waipa Esplanade

Turn Right onto Newton St

Turn right onto Durham St

Turn left onto Kepler

Turn left onto Herschel St

At the roundabout, take the 2nd exit onto Princess St

Turn right onto Wiapa Esplanade

Turn right onto Waingaro Rd

Turn right onto Great S Rd

Turn left onto Jesmond St

At the roundabout, take the 2nd exit onto Waikato Esplanade

Turn left onto Jordon Street

Turn left at the 1st cross street onto

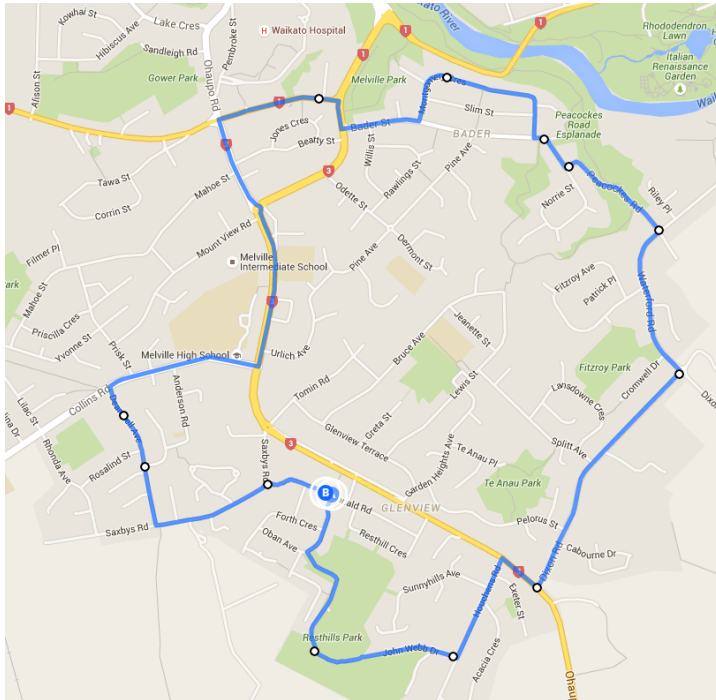
Galileo St

Turn left onto Great S Rd.

How familiar are you with this route? (Circle one)

1 2 3 4 5 6 7 8 9 10

Route Five



Start on McDonald Road,

Turn left onto Resthill

Turn right onto State Highway

Turn left onto Dixon Rd

At the roundabout, take the first exit onto Waterford Rd

Turn left onto Peacockes Rd

Turn right onto Norrie St

Turn right onto Montgomery Cres

Turn right onto Bader St

Turn right onto Normandy (State Highway 1)

Turn left onto Lorne

Turn left onto State Highway 3 (To New Plymouth)

At the roundabout, take the 2nd exit and stay on State Highway 3

Turn right onto Collins Rd

Turn left onto Deanwell Ave

Turn left onto Saxbys Rd

Turn right onto Macdonald Rd

How familiar are you with this route? (Circle one)

1 2 3 4 5 6 7 8 9 10

Route Six



Head south east on Brymer Rd toward Farnborough Dr

Turn right onto Highgrove Rd

At the roundabout take the 1st exit onto Ayrshire Dr

Turn left onto Grandview Rd

At the roundabout, take the 3rd exit onto Newcastle Rd

Turn right to stay on Newcastle Rd

Turn left onto Dinsdale Rd

Turn left onto Aberdeen Dr

Turn left onto Michael Ave

Turn left onto Aberfoyle St

Turn right onto Ellicott Rd

Turn left onto Waimarie St

Turn left onto Livingstone Ave

Turn right onto Holmes St

Turn right onto Grandview Rd

Turn left onto Wall St

Turn left onto Dominion Rd

Turn right onto Lloyd Dr

Turn right onto Crawshaw Dr

Turn left onto Breckons Ave

Turn left onto Odlin Cres

Turn left onto Rotokauri Rd

Continue onto Baverstock Rd

How familiar are you with this route? (Circle one)

1 2 3 4 5 6 7 8 9 10

Appendix E

On-road Questionnaire

Date: _____ Participant ID: _____

Location 1 _____

1. What are you thinking about? _____
2. What is your anxiety rating at this location? (Circle one) **1 2 3 4 5 6 7 8 9 10**
3. What is your risk rating at this location? (Circle one) **1 2 3 4 5 6 7 8 9 10**
4. What is your familiarity rating at this location? (Circle one) **1 2 3 4 5 6 7 8 9 10**
5. Drive speed _____ km
6. Speed limit at this location _____ km

Location 2 _____

1. What are you thinking about? _____
2. What is your anxiety rating at this location? (Circle one) **1 2 3 4 5 6 7 8 9 10**
3. What is your risk rating at this location? (Circle one) **1 2 3 4 5 6 7 8 9 10**
4. What is your familiarity rating at this location? (Circle one) **1 2 3 4 5 6 7 8 9 10**
5. Drive speed _____ km
6. Speed limit at this location _____ km

Location 3 _____

1. What are you thinking about? _____
2. What is your anxiety rating at this location? (Circle one) **1 2 3 4 5 6 7 8 9 10**
3. What is your risk rating at this location? (Circle one) **1 2 3 4 5 6 7 8 9 10**
4. What is your familiarity rating at this location? (Circle one) **1 2 3 4 5 6 7 8 9 10**
5. Drive speed _____ km
6. Speed limit at this location _____ km

Location 4 _____

1. What are you thinking about? _____
2. What is your anxiety rating at this location? (Circle one) **1 2 3 4 5 6 7 8 9 10**
3. What is your risk rating at this location? (Circle one) **1 2 3 4 5 6 7 8 9 10**
4. What is your familiarity rating at this location? (Circle one) **1 2 3 4 5 6 7 8 9 10**
5. Drive speed _____ km
6. Speed limit at this location _____ km

Location 5 _____

1. What are you thinking about? _____
2. What is your anxiety rating at this location? (Circle one) **1 2 3 4 5 6 7 8 9 10**
3. What is your risk rating at this location? (Circle one) **1 2 3 4 5 6 7 8 9 10**
4. What is your familiarity rating at this location? (Circle one) **1 2 3 4 5 6 7 8 9 10**
5. Drive speed _____ km
6. Speed limit at this location _____ km

Appendix F

Post-drive Questionnaire

Date: _____ Participant ID: _____

Location 1 _____

1. Tell me everything you can remember about this location?
2. Was there anything unusual happening? If yes, please describe:
3. Were there any cars in front of you? ☐ Yes ☐ No
4. Were there any cars on the side roads? ☐ Yes ☐ No
5. Were there any pedestrians? If yes, where were they?
6. What was the speed limit at this location? _____ km/h
7. What speed were you traveling? _____ km/h
8. What was your anxiety rating at this location? (Circle one) **1 2**
3 4 5 6 7 8 9 10

9. What was your risk rating at this location? (Circle one) 1 2 3
4 5 6 7 8 9 10

10. What was your familiarity rating at this location? (Circle one) 1 2
3 4 5 6 7 8 9 10

Location 2 _____

1. Tell me everything you can remember about this location?

2. Was there anything unusual happening? If yes, please describe:

3. Were there any cars in front of you? ☐ Yes ☐ No

4. Were there any cars on the side roads? ☐ Yes ☐ No

5. Were there any pedestrians? If yes, where were they?

6. What was the speed limit at this location? _____ km/h

7. What speed were you traveling? _____ km/h

8. What was your anxiety rating at this location? (Circle one) 1 2
3 4 5 6 7 8 9 10

9. What was your risk rating at this location? (Circle one) 1 2 3
4 5 6 7 8 9 10

10. What was your familiarity rating at this location? (Circle one) 1 2
3 4 5 6 7 8 9 10

Location 3_____

1. Tell me everything you can remember about this location?

2. Was there anything unusual happening? If yes, please describe:

3. Were there any cars in front of you? ☐ Yes ☐ No

4. Were there any cars on the side roads? ☐ Yes ☐ No

5. Were there any pedestrians? If yes, where were they?

6. What was the speed limit at this location? _____km/h

7. What speed were you traveling? _____km/h

8. What was your anxiety rating at this location? (Circle one) 1 2
3 4 5 6 7 8 9 10

9. What was your risk rating at this location? (Circle one) 1 2 3
4 5 6 7 8 9 10

10. What was your familiarity rating at this location? (Circle one) 1 2
3 4 5 6 7 8 9 10

Is there anything else you can remember about this drive?

Appendix G



Familiarity and Recollection in Everyday Driving

We are looking for participants to take part in a study to investigate what people remember about the roads they drive

What does the study involve?

- You will need to hold a full NZ drivers licence
- You will need to be under 60 years of age
- You will need to have your own vehicle. You will be asked to complete a demographic and driving history questionnaire and then participate in two drives along a familiar route and an unfamiliar route.
- During the drive we will ask questions about your feelings of familiarity, risk and anxiety. After each drive, we will ask you some questions about the roads you have driven.
- You will be required for two separate drives to be spaced out over a maximum of one week.
- You will receive \$15 in the form of a gift voucher to thank you for participating (or 2% course credit).

Who can I contact to volunteer or to find out more?

Email Sarah to find out more (extaranz@gmail.com), who will be happy to provide you with further information and answer any questions you may have.

The study is being supervised by Assoc. Profs Samuel Charlton and Nicola Starkey (School of Psychology), University of Waikato. Ethics approval has been received from the School of Psychology Ethics Committee. All information collected will remain confidential.

