TRANSPORT ENGINEERING RESEARCH NEW ZEALAND LIMITED

Development of a Road Safety Engineering Modelling Tool

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Te Whare Wānanga o Waikato

Background

The work described in this report is part of a research programme aimed at developing methods of identifying and improving high-risk interactions between vehicles, roading situations, and drivers. To date this has involved the use of high-resolution video analysis, computer simulation, and full scale field testing. The research objectives guiding this work employ a systems approach to understanding and improving our road transport system; addressing vehicle performance (stability, tracking etc), road configurations (signage, geometry etc) and driver behaviour collectively. Part of this approach has been directed at analysis of the driver's perception-decision-action cycle in responding to various driving situations. As it has been hypothesised that driver attentiveness is a key variable affecting the time course of the perception-decision-action cycle (Neisser, 1976; White & Thakur, 1995), our work has included analysis of driver attentiveness in terms of: 1) a driver's momentary level of cognitive workload (overall demands on cognitive resources), and 2) the proportion of those resources dedicated to the driving task (as reflected in the driver's momentary situation awareness).

Within this context, our previous research examined drivers' reactions to road hazards, maintenance of speed and following distances, and the differential properties of explicit (attentional) and implicit (perceptual) features of road safety engineering solutions across a range of traffic and road situations (Charlton & Baas, 1998; Charlton, Mueller, & Baas, 1999; Charlton, 2000; Charlton, Alley, Baas, & Newman, 2002; Charlton, 2003). Some traffic control devices and road safety treatments are designed to provide information to drivers by means of an explicit alerting function. For example, speed limit signs and many hazard warning signs are designed to direct drivers' attention to road or traffic conditions and undertake recommended or required driving behaviours; the information is explicit as it relies on a driver consciously attending, comprehending, and responding to the information. In contrast, some treatments are designed to work at an implicit, or perceptual level, by affecting drivers' perception of their speed without conveying an explicit or specific message. For example, transverse road markings and lateral edge line treatments have been implemented at many locations overseas to reduce vehicle speeds by modifying the visual information used to perceive speed subconsciously (Fildes & Jarvis, 1994). The desirability of road safety treatments based on implicit perceptual cues lies in their unobtrusiveness; they do not place any additional processing demands, distractions, or frustrations on the driver, they do not involve introducing any additional hazards on the roads, and in some cases they may be the only way to influence drivers who refuse to obey the law.

For any given treatment, however, it is an open question whether the effectiveness (or lack thereof) is the result of explicit alerting characteristics or implicit perceptual cues. In the case of transverse line treatments in particular, they appear to exhibit both alerting effects and speed perception influences (Godley, Fildes, Triggs, & Brown, 1999). Conversely, it has been shown that oversized explicit speed control signs placed at urban thresholds may have a perceptual quality, forming a “gateway” and slowing drivers’ speeds, even without any speed restriction information on the signs (Charlton, Alley, Baas, & Newman, 2002). It has also been suggested that the effectiveness of perceptual treatments may be dependent on drivers’ perceptions of safety in a particular situation. Fildes & Jarvis (1994) reported that when perceptions of risk were low, modifying the environment may change drivers’ speed estimation but was less likely to be translated into slower vehicle speeds.

The goal of the present experiment was to develop and demonstrate an analysis tool that would allow road safety professionals to compare the effectiveness of a range of road safety engineering treatments, including treatments with implicit and explicit features, as they related to a specific road with a known pattern of crashes. This work involved two distinct phases of enquiry: first, selection of a road with a well-documented history of crashes and analysis of specific sections of the road as regards their amenability to various road safety treatments; second, a comparison of the treatments’ effectiveness by means of an accurate 3-D re-creation of the road in a driving simulator and a representative sample of drivers.

Phase 1: Crash analysis and treatment identification

Methodology.

The road selected for the study was a 25km stretch of State Highway 2 (SH2) from Katikati Township to Bethlehem in Transit New Zealand's Region 4. SH2 is the main north south route along the Bay of Plenty East Coast and is the northern access route for the port of Tauranga. It is also the key logging route between forestry in the northern Bay of Plenty, Coromandel, South Auckland and beyond to the port at Mount Maunganui and central north island processing facilities. Along the length of the route studied there are numerous commercial orchards and vineyards, and thus the route contains many intersections (37) and a significant number of access points (sealed and unsealed) used by vehicles servicing the agricultural operations. SH2 is also a scenic drive (posted as the Pacific Coast Highway from SH1 south of Auckland) and is heavily trafficked by tourists and holiday makers. The traffic volumes calculated for the study route range between 12,000 and 16,000 vehicles per day with an 11% component of heavy vehicles.

The route has been the subject of several Transit New Zealand crash reduction studies in the past including: Athenree to Wairoa Intersection Upgrading Strategy (March 1995); Selected Blackspot Sites (November 1998); Urgent Site Study SH2 Apata (August 1999); Strategic Length 1 Athenree to Te Maunga (June 2000); and Special Crash Reduction Study SH2 Athenree to Bethelehem (October 2000). Many of the recommendations made by these studies were implemented, including the upgrading of many intersections to include right and left turn bays. Although the route possesses a generally high standard of roadmarking and signage, this has not been enough to prevent a high number of crashes. In the five years from 1995 through 1999 there were a total of 237 reported crashes over the 25km study route, for a rate of 9.48 crashes per km, as compared to a national average crash rate for rural state highways of 3.35 during the same period. The severity of crashes along the study route have also been higher then the national average, with 7% of reported crashes involving a fatality (as compared to 3% nationally), 11% involving serious injury (9% nationally), and 32% involving minor injury (25% nationally). More recently, in the three years from 2000 through 2002 there were 170 reported crashes along the 25km study route; a 19% annualised increase in crash rates at a time when comparable crashes decreased nationally (LTSA, 2003).

Following review and analysis of the available crash data from the Land Transport Safety Authority's (LTSA) Crash Analysis System (CAS) and the subsequent examination of individual Traffic Crash Reports (TCR's), high-resolution digital video of the aforementioned stretch of SH2 was created, "filming" the road in both directions under conditions of clear visibility at mid-day, by means of a vehicle equipped with two stable-mounted digital video cameras. The road was also recreated in a 3-D simulation using road geometry from Transit New Zealand's Road Geometry Data Acquisition System (RGDAS) database and road markings, road signs, and clear sight angles reproduced by consulting local Geographical Information Systems (GIS) data, road surveys, and the digital video. The 3-D simulation allowed the road features to be viewed from any perspective (including drivers' eye-level and top-down aerial views) using cursor controls, or "driven" by means of steering wheel and foot pedals and a simulated vehicle dynamics model. These resources were then presented to a group of expert road safety engineers empanelled to discuss and assess potential road safety treatments that could be applied to this stretch of SH2.

<u>Participants</u>.

Seven experts from the local road safety engineering community were recruited from the Land Transport Safety Authority, Transit New Zealand, and Opus International Consultants. All but one of the participants were male and their years of experience in the transport engineering/road safety sector averaged 21.57 years (ranging from 2 to 45 years). Three members of the expert panel rated their knowledge with the subject stretch of SH2 as "Very familiar – driven and thought about frequently", two of the panel rated their knowledge as "Moderately familiar – driven occasionally, some discussion", and the remaining two rated their knowledge as "Slightly familiar – have driven and are aware some problems exist".

<u>Materials</u>.

The panel of experts were provided with an "Expert Panel Workbook" (shown at Appendix A). The workbook contained: a background section asking several demographic questions; five crash analysis sections containing historical crash data diagrams and questions regarding each of five pre-selected segments of the study road; and a summary section asking questions about the usability and value of the expert panel exercise. The digital video of the study road was presented on a 48.26 cm (19 in) colour monitor displaying 1280 x 1024 pixels. The study road could be displayed travelling in either direction (north or south), travelling at normal speed (approx 80km/h), or advanced frame by frame. The 3-D simulation of the study road was presented on a desktop driving simulation tool using measured 3-dimensional road geometry (from the Transit RGDAS database) to specify the roadway geometry. The road markings, road signs, traffic, and sight angles were modelled as 3-dimensional objects and placed along the roadway using data from GIS and road surveys and the digital video. The simulated scenes were presented in panorama across three display screens: one 53.34 cm (21 in) and two 43.18 cm (17 in) CRTs, affording approximately 130 degrees effective field of view at a frame rate of 150 frames per sec (see Figure 1). Navigation through the simulation was by means of either cursor controls or steering wheel and foot pedal controls. When navigation was effected through the steering wheel and foot pedals, movement through the simulation was governed by an interactive non-linear multi-body vehicle dynamics model.

Figure 1. An example of the 130° field of view from the driving simulator apparatus.

<u>Procedure</u>.

The expert panels were convened in two separate sessions (one group of two participants and one group of five) in March of 2003. Each panel began with a description of the purposes of the study and an overview of the workbooks and the procedure. After completing the demographic questions, the participants progressed through the five predefined segments of the study road. Each segment was first discussed in terms of its crash history and then viewed from both directions using the high-resolution video. The high-resolution video was used to allow the participants to safely assess the road, signage, and traffic characteristics of each segment. Discussion of possible treatments for each section was further aided by wide field-of-view simulation to help visualise how a specific treatment or roading change would appear *in situ*. After discussing each segment as a group, the participants individually rated the driving difficulty of the segment, the mental workload required of drivers for that segment, and noted the specific aspects of the road segment they felt to be unsafe and the road features they would most like to change. The discussion of each of the five segments lasted for between 15 to 45 minutes (average duration of 25 min) and the entire procedure lasted for 2 hrs 45 min for the first panel and 3 hr 35 min for the second panel.

Results.

During the course of the discussions about the five road segments, several noteworthy road safety engineering problems were identified by the participants. The most frequently mentioned problems were: very limited sight distances afforded by the numerous vertical curves (often coinciding with intersection locations); difficulties overtaking and a lack of overtaking lanes; the presence of many narrow bridges; narrow (& variable) shoulder widths; and inconsistent and excessive signage. Of the five road segments discussed, the median rating on the seven-point driving difficulty scale for three of the segments was a 4, “somewhat difficult -- challenging” or worse. The remaining two road segments were rated less severely by the participants, with a median rating of 3, “moderately difficult.” The mental workload ratings for the road segments mirrored the driving difficulty ratings, with three of the road segments having higher median ratings (4 – “challenging but manageable”, and 5 – “demanding to manage”) than the other two (3 – “easily managed”). The driving difficulty and mental workload ratings for each of the five road segments are shown in Figure 2.

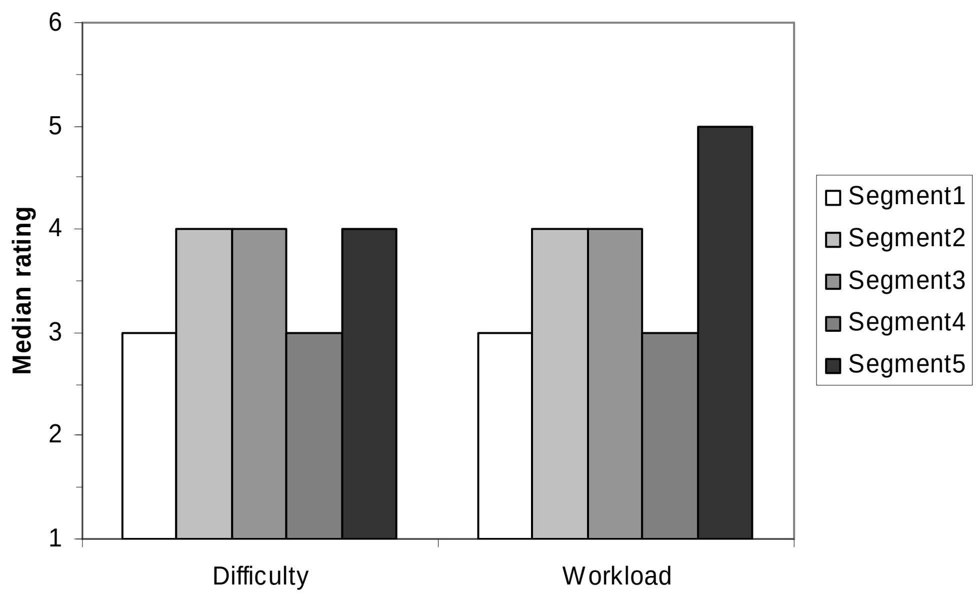

Figure 2. Median driving difficulty and mental workload ratings for the 5 road segments.

The participants identified drivers' reducing speed and lateral deviation as the behaviours most needing change in order to improve safety across the five driving segments. In their comments, the participants pinpointed several locations of particular concern and identified specific treatments that could be used to achieve these changes in driver behaviour, including: rumble strips, lane colours, herringbones, and explicit speed restrictions. In their ratings of the usability of the road safety modelling procedure they had just used, the participants' average SUS score was 71.8 (median score of 72.5) on the 10-item SUS scale. The SUS produces scores ranging from 0 to 100, with scores greater than 50 indicating the system being rated possesses a good level of usability (Brooke, 1996). The participants' written comments on the procedure included the following statements:

> "Would provide a useful analysis tool"; "Able to get a lot more people to view and comment on a site than at a physical location"; "I found the whole approach very interesting"; "I liked the way it integrated the various aspects of analysing the routes"; "Lots of potential".

Phase 2: Simulator testing

Methodology.

The second phase of the study consisted of a comparison test of two road safety engineering treatments suggested by the expert panel participants. The comparison test was conducted using the simulation of SH2 and a representative sample of licenced drivers. The test was conducted at Waikato University throughout May and June of 2003 and was structured as a within-participants design such that all participants were exposed to every treatment type, with the order of presentation counterbalanced across participants.

<u>Participants</u>.

Thirty-five volunteers with a full New Zealand Class B Driving licence were recruited from flyers and notices posted in the local area. Four of the participants withdrew before completing the experiment, citing other time commitments, eyestrain, or feelings of dizziness while driving the simulator. Of the thirty-one participants completing the experiment, 17 were female and 14 were male, they ranged in age between 17 and 72 years (average of 32 years, std. dev. of 14.74). The testing protocols were reviewed and approved by the University of Waikato's Psychology Research and Ethics Review Committee prior to testing.

<u>Apparatus</u>.

The primary experimental apparatus was the driving simulator described for the previous research phase. Participants drove the simulated road using the steering wheel and foot pedal controls. The vehicle dynamics of the simulated vehicle represented a passenger car with a 2 litre engine and an automatic transmission. The simulated road surface was high friction corresponding to dry asphalt and scene visibility corresponded to clear daytime conditions. Three driving scenarios were created: an "as-is" or standard representation of the 25 km study road; a scenario with perceptual countermeasures added; a scenario with explicit (attentional) speed restrictions added. Each of these three scenarios contained representative traffic densities (approximately 14,000 vehicles per day) modelled using information from traffic counts and video recordings of the study road. In addition, a 7 km practice scenario with reduced traffic levels was created from a short section of the "as-is" scenario to allow the participants to familiarise themselves with the simulator.

Of particular interest were four locations along the road identified by the expert panel members in Phase 1 of the study (selected from road segments 2 through 5). These locations included a concealed left/right intersection, an intersection on the drivers' right, an intersection on the drivers' left, and a left/right intersection with a stop sign (which also served as the end of the driving scenarios). The perceptual countermeasures scenario featured "herringbone" road markings placed at the approach to each of the four intersections as shown in Figure 3. The herringbone road markings extended 1.5 m from the left and right edge lines with a 3 m repeat interval and were placed at the four locations shown in Table 1. The explicit attentional scenario included speed reduction signs instead of the herringbone markings at three of the locations indicated in Table 1, with signs indicating a return to open road speeds after the intersections. At location 4, which already contained a speed reduction sign for all conditions, the attentional scenario introduced a warning sign prior to the intersection stop.

Table 1

Scenario	Location 1	Location 2	Location 3	Location 4
Standard	300m downhill curve approach to concealed left/right intersection, followed by 400m downhill straight leading to narrow bridge.	600m downhill approach with “s” curves to intersection on right with flush median and right-hand turn bay beginning 110 m prior.	400m straight downhill approach to gentle curve with intersection on left, left-hand turn bay beginning 50 m prior.	300 m uphill to 60 kph speed reduction sign and flush median treatment, 420 m straight downhill to intersection with stop sign.
Perceptual	150m herringbone placed 270 m before intersection (ending 120 m prior) and 300m herringbone placed 100 m after intersection, ending at bridge.	300 m herringbone placed 410 prior to intersection (ending 110 prior).	300 m herringbone placed 410 prior to intersection (ending 110 prior).	280 m herringbone placed 418 prior to intersection (2 0 m after speed change sign) ending 138 m prior to intersection.
Attentional	80 kph speed sign placed 270 m before intersection, 100 kph speed sign placed 500 m after intersection (end of bridge).	80 kph speed sign placed 410 m before intersection, 100 kph speed sign placed 25 m after intersection	80 kph speed sign placed 410 m before intersection, 100 kph speed sign placed 25 m after intersection.	“Stop ahead” warning sign placed 230 prior to intersection.

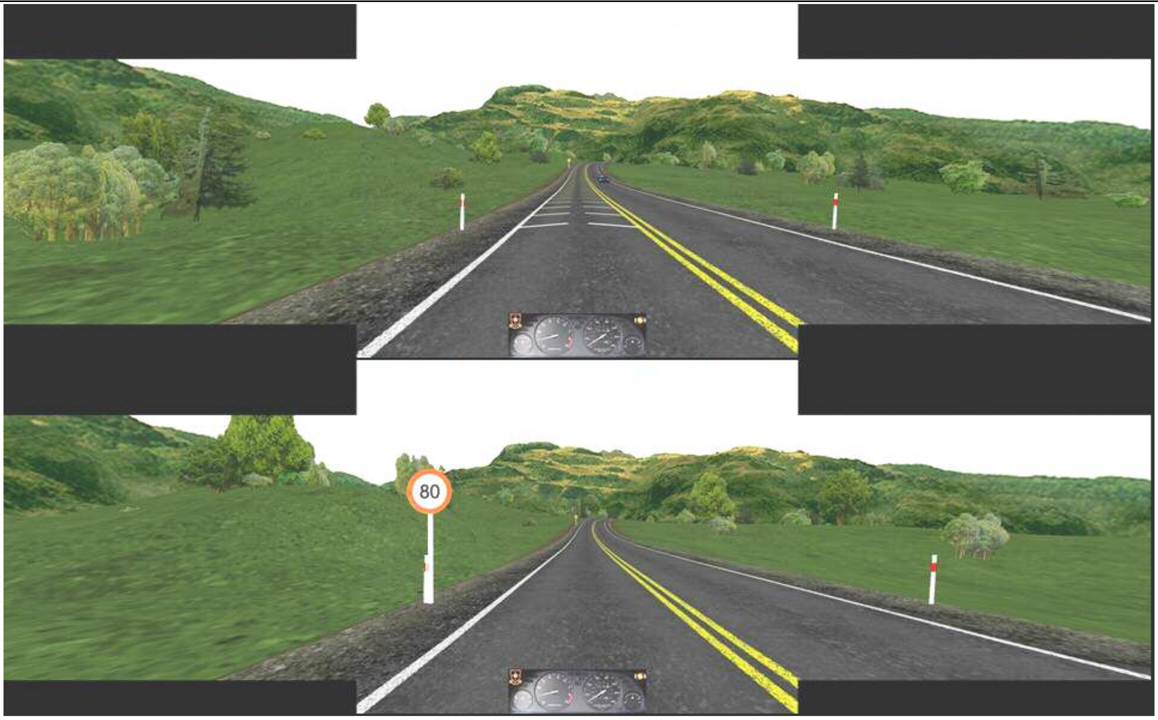

Figure 3. Approach to location 1 as depicted in the perceptual scenario (top panel) and attentional scenario (bottom panel).

<u>Procedure</u>.

In the within-subjects experimental design employed, each participant drove the three driving scenarios across two 1-hr experimental sessions. During the first session each participant was asked to complete a brief questionnaire containing demographic questions (age, gender, etc.) and 28 questions about their driving habits. The 28-item survey, known as the Manchester Driver Behaviour Questionnaire (DBQ), categorises driver behaviour in terms of errors, lapses, and violations and has been found to be a good predictor of crash involvement (Reason, et. al., 1990; Parker, Reason, Manstead, & Stradling 1995). The questionnaire booklet completed by the participants is shown in Appendix B. Participants were also asked whether they required corrective lenses to drive, and if so, to wear them during the experiment. Then the participants were given instructions about the driving task and allowed to drive the practice scenario. After driving the practice scenario, the participants drove one of the three comparison scenarios, and during the second session (between 1 and 7 days later) drove the remaining two scenarios.

Results.

Shown in Figure 4 are the average speeds for the standard (as-is), perceptual (herringbone road markings), and attentional (speed restriction signs) scenarios. As can be seen, both the herringbone road markings and the explicit speed restriction signs reduced the participants' speeds at the approach to the concealed left/right intersection (location 1), as compared to the as-is scenario. In contrast, the attentional scenario also produced reduced speeds at the right intersection (location 2) and left intersection (location 3), while the average speeds under the perceptual scenario were only slightly lower than the as-is scenario. At the stop intersection (location 4), the average approach speeds appeared more or less equivalent for the three scenarios.

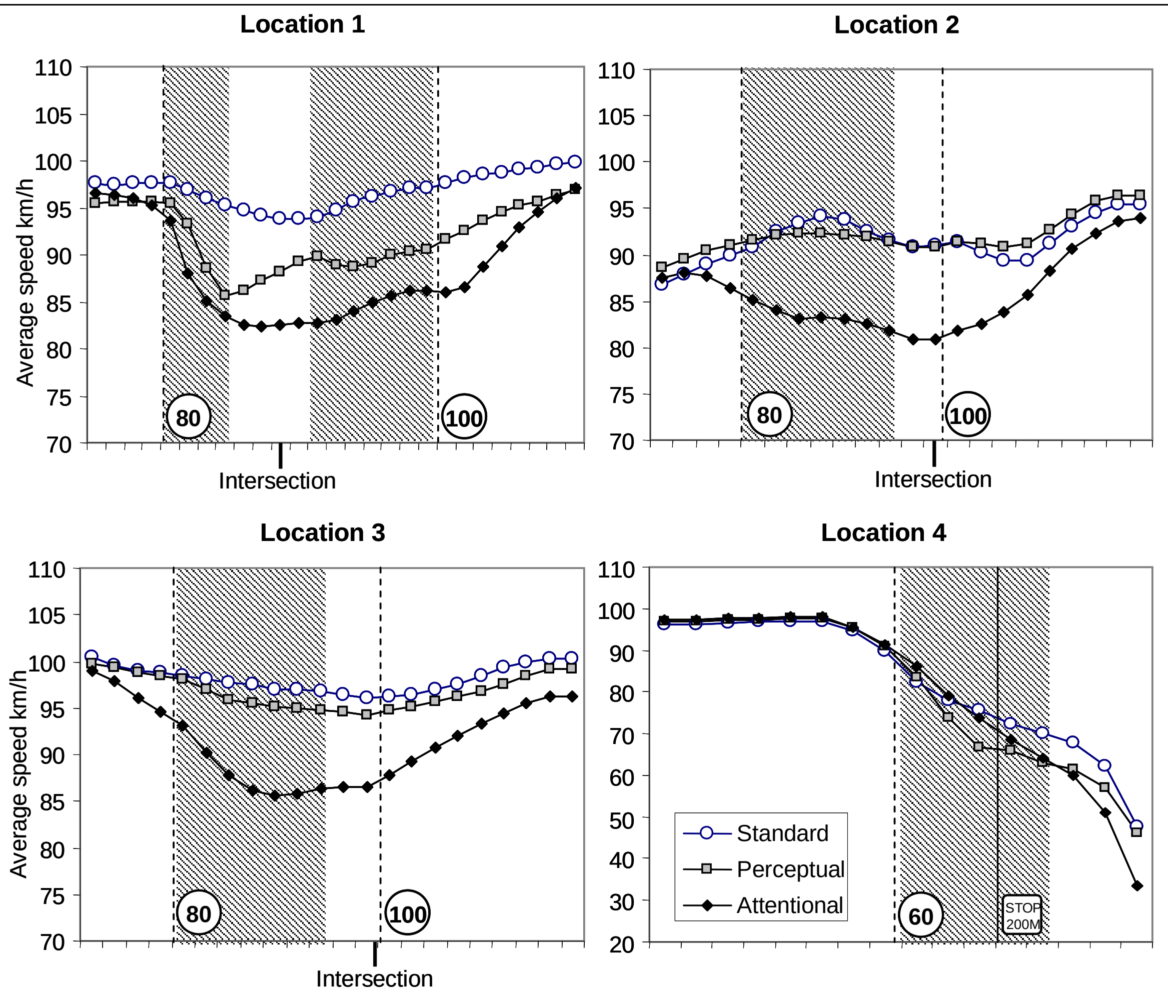

Figure 4. Average speeds for the four locations in the standard (as-is), perceptual (herringbone), and attentional (speed signs) scenarios.
(Note: placement of herringbone markings are indicated by shaded areas, speed signs by dashed lines, and the warning sign at location 4 indicated by the solid line.)

Interestingly, the effect of the perceptual scenario was different for the men and women participants. As shown in Figure 5, the herringbone road markings appeared to produce a greater reduction in the men's speeds than it did for the women's speeds at locations 1, 2, and 3. At location 1, the speed reduction signs in the attentional scenario produced roughly equivalent reductions in men's and women's speeds, while the herringbone markings produced an initial reduction in the men's speeds, to even a slower speed than that of the women, even though the men's average speed was higher at the approach point during that scenario. While the men drove at generally higher speeds than the women during the standard scenario, as shown at locations 2 and 3, their speeds under the speed restrictions of the attentional scenario were approximately equal. Of particular interest, however, was the finding that the herringbone road markings of the perceptual scenario produced reductions in the men's speeds (particularly at location 3) when they had no apparent effect on the women's speeds. While this could be attributed to the fact that the women were already driving slower through the curves on the approach to the intersection in location 2, at location 3 the herringbone treatment resulted in men's average speeds being slower than the women's even though their approach speeds were equivalent.

As can be seen in Figures 6a and 6b, the participants' ages also influenced their speeds and the magnitude of the perceptual and attentional treatments' effects. The eight drivers aged 17 to 20 tended to drive faster through all three scenarios than the other drivers, particularly compared to the four drivers aged 65 or older who showed the slowest average speeds throughout all three scenarios. Of note though is the finding that the herringbone markings at location 1 slowed the older drivers' speeds to a magnitude equivalent to the speed reduction signs at that location. It can also be seen that those older drivers also reduced their speeds at that location under the as-is scenario, although not to the degree afforded by the perceptual or attentional scenarios. At location 2, the herringbone markings had little or no differential effect on drivers of different ages, but at location 3, the herringbone markings once again produced the greatest reduction for the older drivers. At location 4, the older drivers tended to drive more slowly under the perceptual and attentional scenarios than the as-is scenario, through the approach as well as the treatment areas.

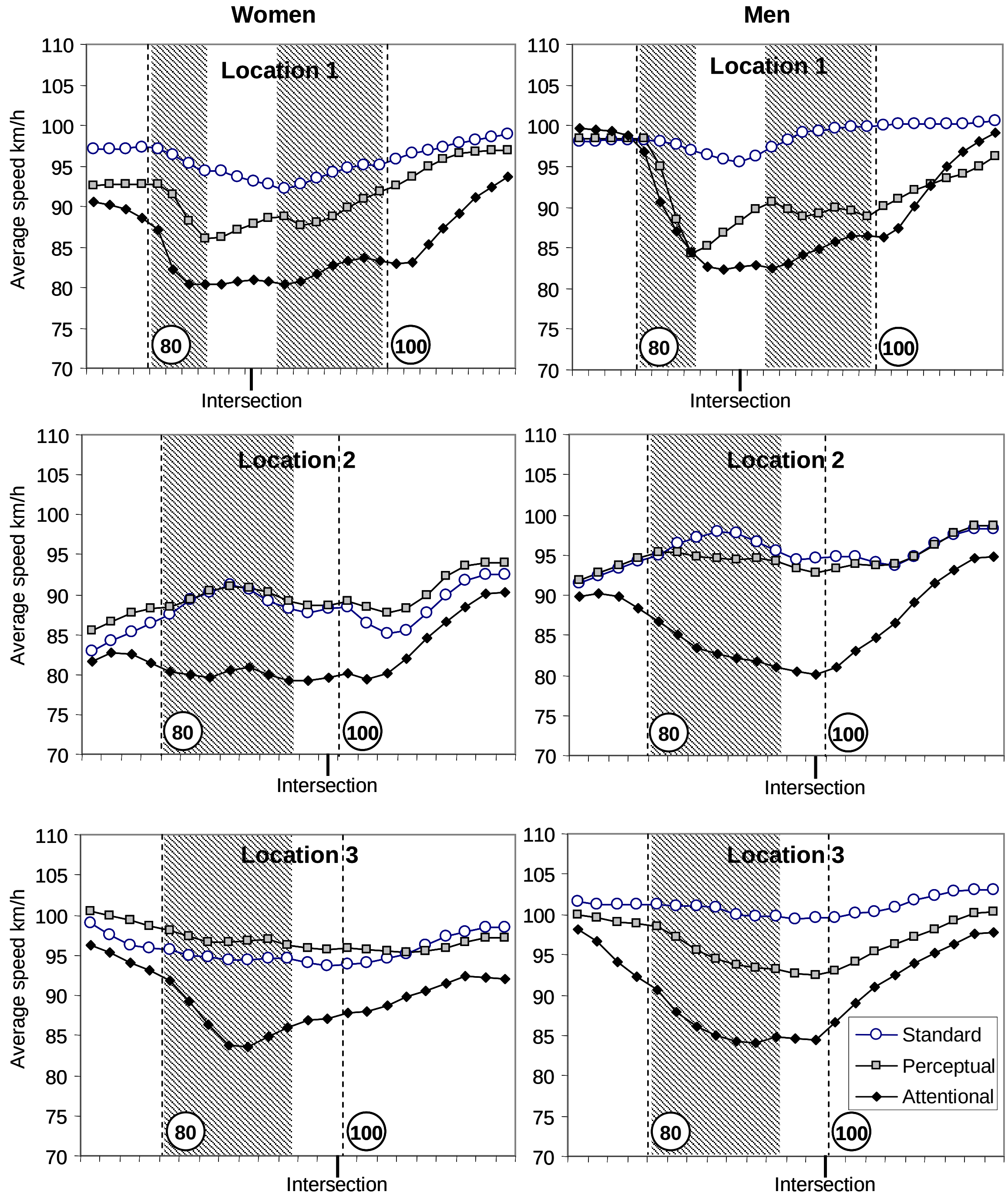

Figure 5. Average speeds for the men and women participants in the three driving scenarios.

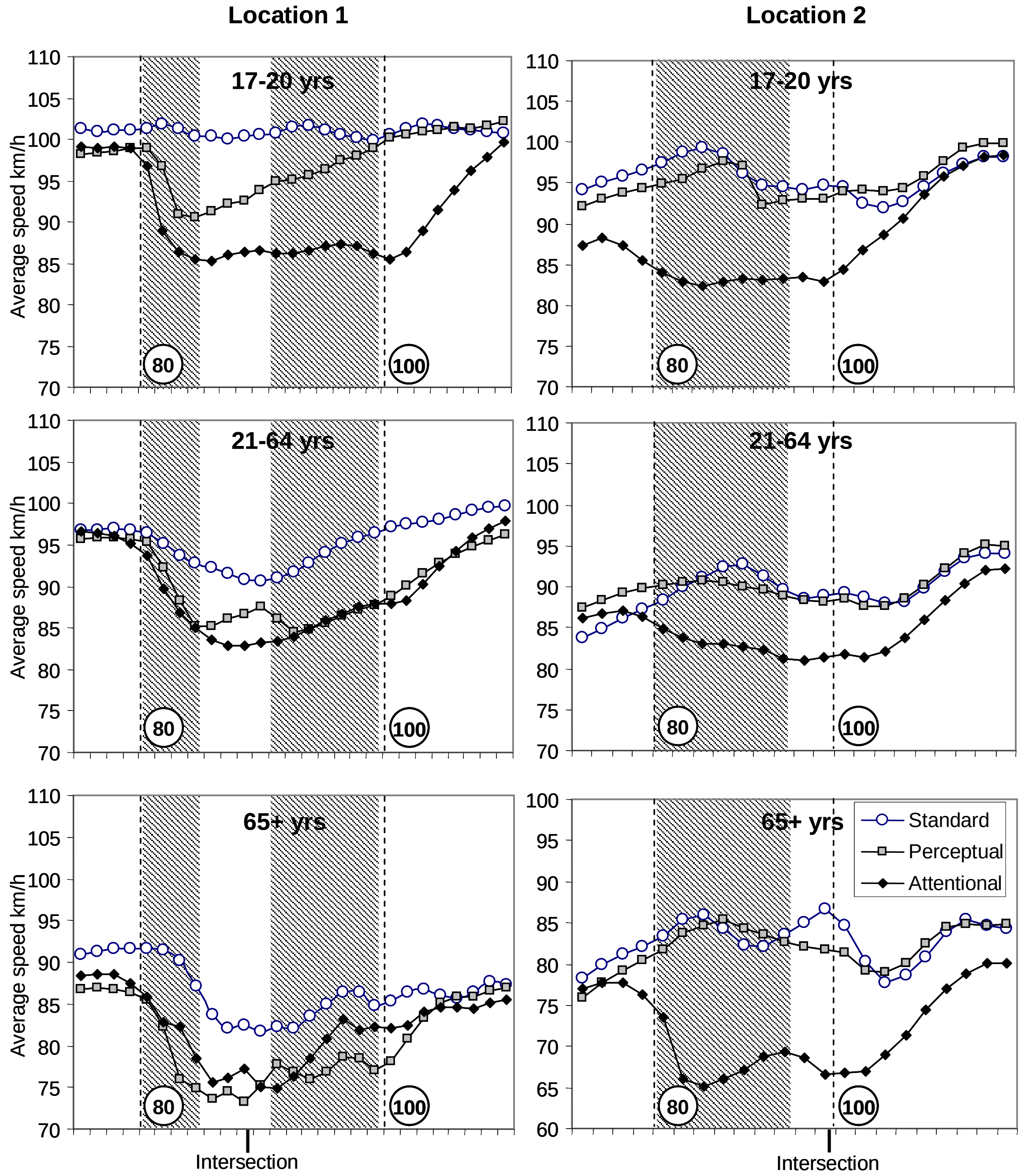

Figure 6a. Average speeds at locations 1 and 2 shown for participants of different ages.

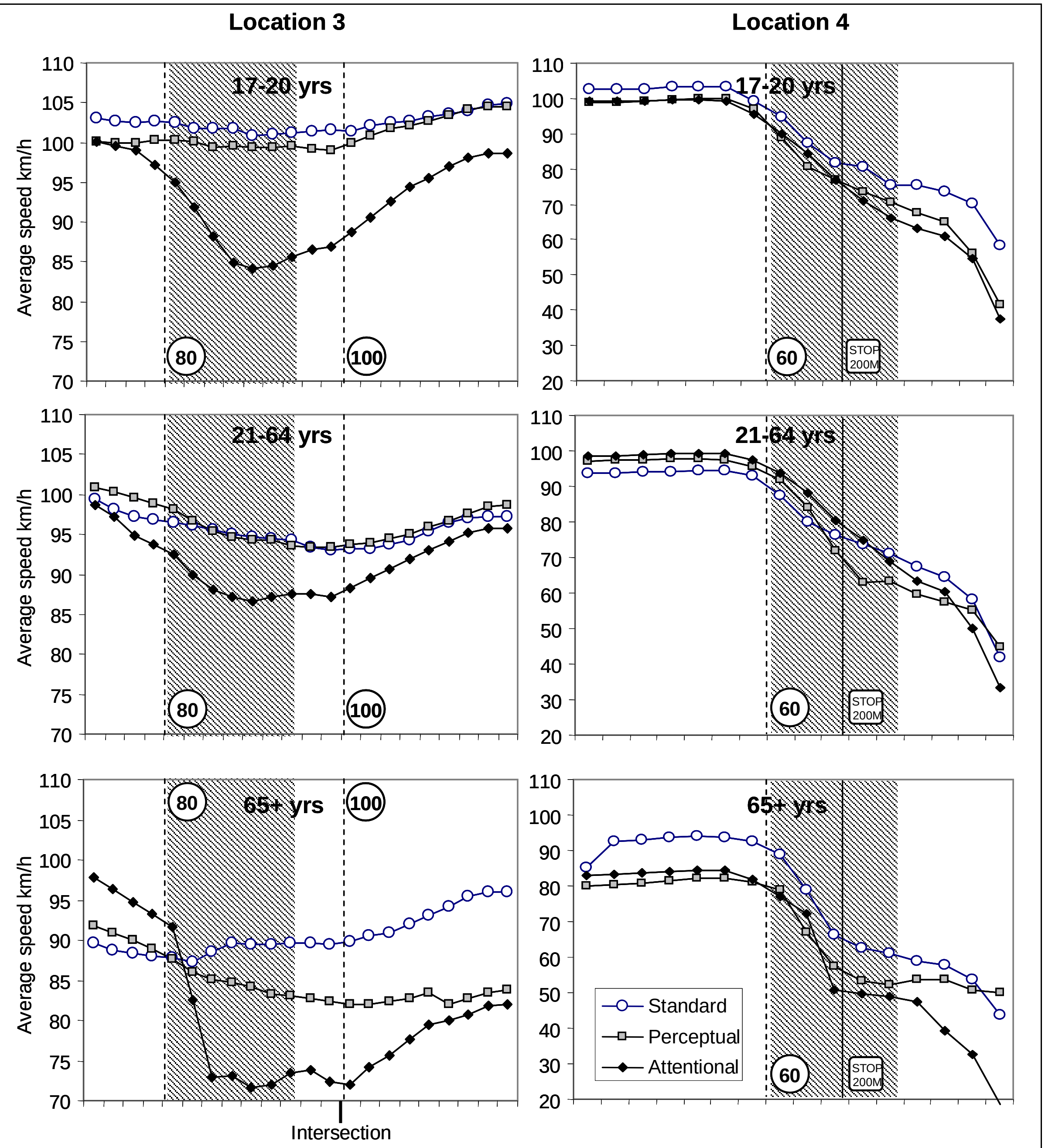

Figure 6b. Average speeds at locations 3 and 4 shown for participants of different ages.

Statistical analysis of the participants' reduction in speed across the three scenarios using a repeated-measures analysis of variance revealed a significant main effect of treatment type $F_{(2, 28)} = 32.117$, $p < .001$, and a significant treatment by gender interaction $F_{(2, 28)} = 3.557$, $p < .05$. The analysis also showed a significant effect of location on the participants' reduction in speed $F_{(2, 28)} = 24.158$, $p < .001$, but did not indicate any significant higher-order interactions of location with treatment or gender. Pearson correlations computed on the data indicated a significant negative correlation between participants' age and their speed in the driving simulator ($r = -.492$, $p < .01$) indicating that driving speeds declined with age. The analysis also indicated that the participants' reported number of crashes in the past year was positively correlated with their reported kilometres driven per week ($r = .594$, $p < .001$). Analysis of the participants' responses to the DBQ showed significant correlations between their reported crashes and their violations score ($r = .542$, $p < .01$), error score ($r= .484$, $p< .01$), lapse score ($r = .466$, $p< .01$) and aggressive violation score ($r=3.75$, $p <.05$). Analysis of variance indicated significant differences between the men and women participants' DBQ error scores, $F_{(1,29)} = 6.776$, $p < .01$, and lapse scores, $F_{(1, 29)} = 4.567$, $p < .05$), with the women reporting more errors and lapses than the men.

Discussion

The principal aim of this research programme was to explore methods of identifying and modelling high-risk interactions between vehicles, roading situations, and drivers, culminating in the development of a modelling tool for road safety professionals. The work described in this paper represents the final phase of that programme, the use of high-resolution video analysis and computer simulation techniques to assess issues of vehicle performance, road configurations, and driver behaviour. As demonstrated in Phase 1 of the report, the programme has been successful in producing a modelling technique with which road transport solutions can be assessed safely and economically. The modelling tool was successfully implemented and tested with a panel of experienced road safety professionals exploring the issues and treatment alternatives associated with a specific section of the state highway system. The feedback from the panel of experts was uniformly positive as regards the tool's capabilities, usability, and potential.

In the second phase of work described in the paper, candidate treatments identified by the expert panel were introduced into a simulation of the road and tested with a representative sample of drivers. The results of that test identified which treatment alternatives may produce the greatest road safety benefits at specific locations. More specifically, speed reduction signage was found to produce significantly reduced vehicle speeds at intersections known to have a history of crashes. Further, the testing demonstrated that, at two of the locations, herringbone road markings also produced reductions in drivers' average speeds. The comparison of these two treatment types, road markings designed to work at an implicit perceptual level and explicit speed reduction signage, was of particular current interest due to the hypothesised costs and benefits of the two types of approach.

The results of the testing also provided further information with which to understand and gauge the potential benefits of the approaches. For example, the relationship between the effectiveness of implicit perceptual and drivers' perceptions of safety in a particular situation can be explicitly compared by examining the age differences observed for the perceptual driving scenarios. Older drivers, known to perceive the risk in driving situations as being greater than do other road user segments (Charlton, Newman, & Baas, 2003) showed the greatest caution in approaching intersections in the as-is scenario and also displayed the greatest effects of the perceptual treatments. On the other hand, the finding that the perceptual treatment had a greater effect on male drivers than female drivers (of all ages) is difficult to reconcile with males' generally higher tolerance to driving risk. This latter finding is the first time this relationship has been reported and opens avenues for further research on the mechanisms behind perceptual countermeasures' effectiveness. Finally, the differential effectiveness of the perceptual countermeasures at the four sites tested in this study also sets the stage for further research into the road characteristics and situations most appropriate for perceptual treatments.

As regards the specific road examined in the paper, the results provide some relatively clear-cut information regarding the potential effectiveness of two treatment options. These findings will be transmitted to the road safety agencies currently considering options for this road as well as made available to other road safety professionals who may be facing similar situations elsewhere. The modelling tool and methodology will also be made available for use in assessing other situations and potential treatments in New Zealand.

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Appendix A

Phase 1 Expert Panel Workbook

Expert Panel Workbook

Welcome to the

Driver-Vehicle Interaction Study

The purpose of the study is to develop a planning and evaluation tool for road safety and engineering professionals in NZ.

We are asking our expert panel of advisors to:

1) Try out the tool by using it to assess an actual road in the NZ state highway network,
2) Answer several multi-choice questions about the road and possible remedial treatments, and
3) Provide a short assessment of the usefulness and potential effectiveness of the tool.

Treatments recommended by the expert panel will be incorporated into the tool and a representative sample of drivers will be asked to "drive" the road in the simulator to gauge the effectiveness of the remedial treatments

All information you provide will be treated in the strictest confidence and if you have any questions feel free to ask us. You can withdraw from the study at any time.

Thank you in advance for your participation.

Dr. Samuel G. Charlton, Project Supervisor

Background Demographics

How many years of experience do you have in the transport engineering or road safety sector?
__________ yrs

How many kilometres do you drive in an average week? (approximately) _________________ km

What is your job title ? ____

What is your gender? M F (circle one)

Road familiarity question.

Please rate your familiarity with this section of road
(SH2 between Katikati & Bethlehem).

1 – Very, very familiar; driven and thought about frequently.
2 -- Moderately familiar; drive road occasionally, some discussion.
3 – Slightly familiar; have driven and aware some problems exist.
4 – Somewhat unfamiliar; may have driven road, no discussion.
5 – Completely unfamiliar; never driven nor discussed this road.

Answer: _______________

Now we will try out the planning and engineering tool on five sections of the road.

You will be shown a video of each section of the road,
the available crash data for each section, and be allowed drive and explore each section using a digital simulation.

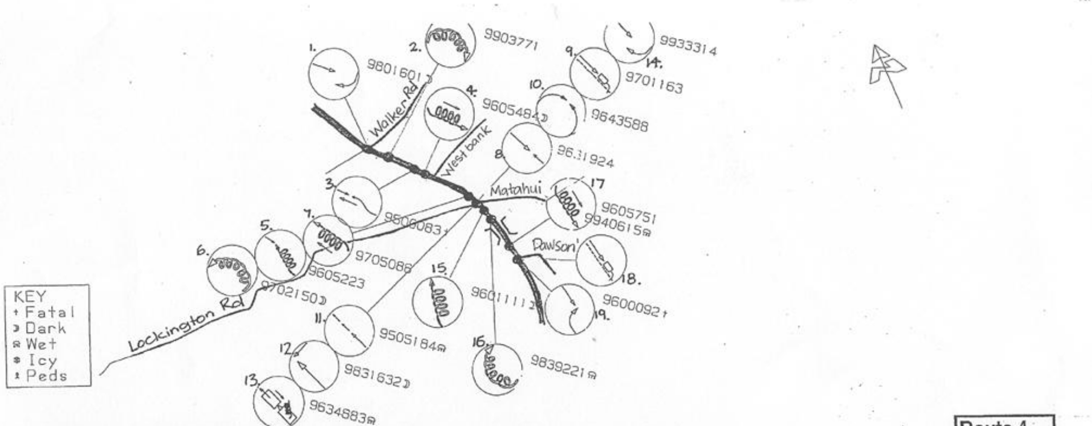
After you have explored each section of the road we will ask you several questions about the characteristics of the road and what might be done to improve it.

Section 1: Walker Road to Dawson Road

5 Year crash history

19 reported crashes:

4 loss of control (1 S, 2 M, 1 NI)
4 overtaking (1 F, 3 M)
3 head-on (1 M, 2 NI)
2 turning vs same direction (1 S, 1 NI)
2 crossing turning (1 M, 1 NI)
1 right turn against (F)
1 rear-end (M)
1 crossing (NI)
1 load lost/object in roadway (NI)



Walker Road East to Dawson Road : RP 116/8.92 to 10.75

Route 4

No.	1st Road	dist	dir	2nd Road	Ax #	date	day	time	movement description	causes	wet	light	weather	junction	control	fatal	ser	min
1	2/116/9.034			WALKER ROAD EAST	9801601	27/03/98	Fri	1750	MOTOR CYCLE1 SBD on SH 2 hit CAR2 turning right onto SH 2 from the left	CAR2 failed to give way at stop sign	Dry	Twilight	Fine	T Type Junc	Stop Sign	0	0	2
2	2/116/9.236	200	E	WALKER ROAD EAST	9903771	2/08/99	Thu	1530	CAR1 EBD on SH 2 lost control turning right, hit Cliff Bank	CAR1 alcohol test result unknown, medical illness (not sudden eg flu)	Dry	Bright Sun	Fine	Unknown	Nil	0	0	1
3	2/116/9.495	200	N	WESTBANK DRIVE	9500083	15/05/95	Mon	1620	CAR1 NBD on SH 2 overtaking hit TRUCK2 head on	CAR1 overtaking line of traffic or queue, overtaking deliberately in the face of oncoming traffic	Dry	Overcast	Fine	Unknown	Nil	2	0	0
4	2/116/9.595	100	N	WESTBANK DRIVE	9605484	6/12/96	Fri	2045	CAR1 SBD on SH 2 lost control while overtaking	CAR1 overtaking deliberately in the face of oncoming traffic, overtaking at no passing line	Dry	Dark	Fine	Unknown	Nil	0	0	1
5	2/116/10.054	100	N	LOCKINGTON ROAD	9605223	27/11/96	Wed	1755	CAR1 NBD on SH 2 lost control on straight and hit TRUCK2 head on	collision	Dry	Overcast	Fine	Unknown	Nil	0	0	1
6	2/116/10.054	100	N	LOCKINGTON ROAD	9702150	10/05/97	Sat	200	VAN1 NBD on SH 2 lost control turning left, hit Cliff Bank, Traffic Sign	VAN1 alcohol suspected	Dry	Dark	Fine	Unknown	Nil	0	0	1
7	2/116/10.054	100	N	MATAHUI ROAD	9705086	20/12/97	Sat	1000	CAR1 NBD on SH 2 lost control while overtaking, went Over Bank, Fence, Tree	CAR1 overtaking ENV: road slippery (loose material on seal)	Dry	Overcast	Fine	Unknown	Nil	0	0	1
8	2/116/10.154			LOCKINGTON ROAD	9631924	17/03/96	Sun	1130	CAR1 SBD on SH 2 hit CAR2 headon on straight		Dry	Bright Sun	Fine	T Type Junc	Nil	0	0	0
9	2/116/10.154			LOCKINGTON ROAD	9701163	18/01/97	Sat	1548	CAR1 SBD on SH 2 hit rear of CAR2 turning right from centre line	CAR1 inattentive	Dry	Bright Sun	Fine	X Type Junc	Stop Sign	0	2	2
10	2/116/10.154			LOCKINGTON ROAD	9643588	17/03/96	Sun	1130	CAR1 SBD on SH 2 cutting corner hit CAR2 head on		Dry	Bright Sun	Fine	X Type Junc	Unknown	0	0	0
11	2/116/10.154			MATAHUI ROAD	9505184	10/10/95	Tue	900	CAR1 NBD on SH 2 hit rear end of CAR2 stop/slow for queue	CAR1 inattentive	Wet	Overcast	Light Rain	X Type Junc	Unknown	0	0	2
12	2/116/10.154			MATAHUI ROAD	9831632	13/01/98	Tue	2030	CAR1 NBD on SH 2 hit CAR2 crossing at right angle from right		Dry	Twilight	Fine	X Type Junc	Stop Sign	0	0	0
13	2/116/10.154			MATAHUI ROAD	9634883	25/05/96	Sat	830	load or trailer from VAN1 NBD on SH 2 hit CAR2 hit Obj thrown/dropped	ENV: object deliberately thrown at or dropped on vehicle / shot at	Wet	Overcast	Fine	X Type Junc	Stop Sign	0	0	0
14	2/116/10.154			MATAHUI ROAD	9933314	9/05/99	Sun	1640	MOTOR CYCLE1 SBD on SH 2 hit CAR2 turning right onto SH 2 from the left		Dry	Overcast	Fine	X Type Junc	Stop Sign	0	0	0
15	2/116/10.254	100	S	LOCKINGTON ROAD	9601111	1/01/96	Mon		CAR1 NBD on SH 2 lost control; went off road to right	CAR1 fatigue (drowsy, tired, fell asleep)	Dry	Dark	Fine	Unknown	Nil	0	1	0
16	2/116/10.354	200	S	MATAHUI ROAD	9839221	27/09/98	Sun	1200	CAR1 NBD on SH 2 lost control turning right		Wet	Overcast	Light Rain	Unknown	Nil	0	0	0
17	2/116/10.654	500	S	MATAHUI ROAD	9605751	23/12/96	Mon	1315	TRUCK1 SBD on SH 2 lost control while overtaking	TRUCK1 too fast on straight, following too closely	Dry	Bright Sun	Fine	Unknown	Nil	0	0	1
18	2/116/10.802	20	N	DAWSON ROAD	9940615	28/10/99	Thu	1230	CAR1 SBD on SH 2 hit rear of CAR2 turning right from centre line	ENV: entering or leaving specialised liquor outlet	Wet	Overcast	Light Rain	Driveway	Nil	0	0	0
19	2/116/10.825	600	N	WRIGHT ROAD	[illegible]	[illegible]	Tue	1500	TRUCK2 turning right hit by oncoming MOTOR CYCLE1 SBD on SH 2	MOTOR CYCLE1 new driver showed inexperience ENV: visibility limited by temporary obstruction, entering or leaving other commercial	Dry	Overcast	Fine	Driveway	Nil	1	0	0

Section 1: Walker Road to Dawson Road

Driving difficulty question.
Please rate the difficulty of driving this road (for a typical driver).

1 -- Easy; No difficulty at all.
2 -- Slightly difficult; No problems.
3 -- Moderately difficult; Easy to do.
4 -- Somewhat difficult; Challenging.
5 -- Very difficult; Hard to do.
6 -- Extremely difficult; Potentially hazardous.
7 -- Nearly impossible; Unsafe.

Answer: ____________

Mental workload question
Please rate the mental workload associated with this drive (for a typical driver).

1 -- No workload; Not demanding.
2 -- Little workload; Minimal demands.
3 -- Moderate workload; Easily managed.
4 -- Busy; Challenging but manageable.
5 -- Very busy; Demanding to manage.
6 -- Extremely busy; Very difficult to manage.
7 -- Overloaded; Unmanageable; Unsafe.

Answer: ____________

What are the most difficult (or unsafe) aspects of driving this section of road?

1. ____
2. ____
3. ____

What specific aspects or features of the road would you change?

1. ____
2. ____
3. ____

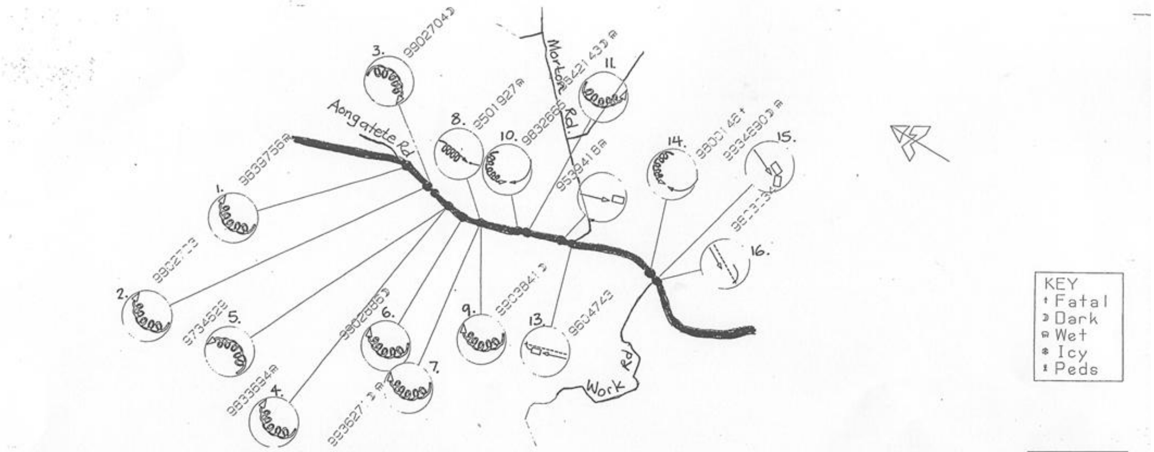
(Continue on the back of the page if necessary)

Section 2: Aongetete to south of Works Road

5 Year crash history

16 reported crashes:

9 loss of control (4 M, 5 NI)
3 head-on (1 F, 1S, 1 NI)
2 turning vs same direction (1 S, 1 M)
2 hit parked vehicle (2 NI)



Aongatete Road to Works Road : RP 116/11.92 to 13.50

Route 6

No.	1st Road	dist	dir	2nd Road	Ax #	date	day	time	movement description	causes	wet	light	weather	junction	control	fatal	ser	min
1	2/116/12.079	1000	N	MORTON ROAD	9839756	4/11/98	Wed	810	CAR1 NBD on SH 2 lost control turning right, hit Ditch	ENV: road slippery (rain)	Wet	Overcast	Light Rain	Unknown	Nil	0	0	0
2	2/116/12.227	150	S	AONGATETE ROAD	9902703	19/06/99	Sat	1545	CAR1 NBD on SH 2 lost control turning right, hit Cliff Bank	CAR1 too fast entering corner, lost control due to road conditions ENV: road surface deep loose metal	Dry	Bright Sun	Fine	Unknown	Nil	0	0	1
3	2/116/12.277	200	S	AONGATETE ROAD	9902704	19/06/99	Sat	2000	CAR1 SBD on SH 2 lost control turning right, hit Cliff Bank	CAR1 too fast entering corner, lost control due to road conditions, failed to notice roadworks signs, attention diverted by driver dazzled by sun/lights ENV: road surface deep loose metal	Dry	Dark	Fine	Unknown	Nil	0	0	1
4	2/116/12.377	300	S	AONGATETE ROAD	9833694	10/03/98	Tue	835	CAR1 NBD on SH 2 lost control turning right		Wet	Overcast	Light Rain	Unknown	Nil	0	0	0
5	2/116/12.379	700	N	MORTON ROAD	9734629	4/06/97	Wed	1115	CAR1 NBD on SH 2 lost control turning left, hit Cliff Bank		Dry	Bright Sun	Fine	Unknown	Nil	0	0	0
6	2/116/12.479	600	N	MORTON ROAD	9902886	21/06/99	Mon	1900	CAR1 NBD on SH 2 lost control turning right, hit Fence, Tree	CAR1 too fast at temporary speed limit	Dry	Dark	Fine	Unknown	Nil	0	0	1
7	2/116/12.577	500	S	AONGATETE ROAD	9936271	26/06/99	Sat	1735	CAR1 NBD on SH 2 lost control turning right, hit Other		Wet	Dark	Light Rain	Unknown	Nil	0	0	0
8	2/116/12.579	500	N	MORTON ROAD	9501927	10/02/95	Fri	810	CAR1 SBD on SH 2 lost control on straight and hit VAN2 head on	CAR1 unconverted old codes lost control - head on collision	Wet	Overcast	Fine	Unknown	Nil	0	1	2
9	2/116/12.581	500	N	MORTON ROAD	9903841	28/09/99	Tue	1810	CAR1 NBD on SH 2 lost control turning right, hit Fence, Tree	CAR1 too fast entering corner ENV: signs / signals badly located	Dry	Dark	Fine	Unknown	Nil	0	0	1
10	2/116/12.779	300	N	MORTON ROAD	9832665	9/03/98	Mon	1105	CAR1 SBD on SH 2 lost control on curve and hit CAR2 head on, hit Fence		Dry	Bright Sun	Fine	Unknown	Nil	0	0	0
11	2/116/12.829	250	N	MORTON ROAD	9842143	20/01/98	Tue	2100	CAR1 SBD on SH 2 lost control turning left, hit Ditch	ENV: road slippery (rain)	Wet	Dark	Light Rain	Unknown	Nil	0	0	0
12	2/116/13.019	60	N	MORTON ROAD	9539418	19/09/95	Tue	925	CAR1 SBD on SH 2 hit parked veh, hit Vehicle		Wet	Overcast	Light Rain	Unknown	Nil	0	0	0
13	2/116/13.079			MORTON ROAD	9604743	23/10/96	Wed	804	CAR1 NBD on SH 2 hit rear of CAR2 turning right from centre line	CAR1 overtaking line of traffic or queue	Dry	Bright Sun	Fine	T Type Junctio	Stop Sign	0	0	1
14	2/116/13.531	50	N	WORK ROAD	9800146	17/08/98	Mon	1815	CAR1 SBD on SH 2 lost control on curve and hit VAN2 head on	CAR1 too far left/right, lost control while returning to seal from unsealed shoulder	Dry	Bright Sun	Fine	Unknown	Nil	5	1	3
15	2/116/13.579	500	S	MORTON ROAD	9934690	5/06/99	Sat	2130	CAR1 SBD on SH 2 hit accident or broke down CAR2 hit Vehicle		Wet	Dark	Light Rain	Unknown	Nil	0	0	0
16	2/116/13.581			WORK ROAD	9803034	3/09/98	Thu	1530	MOTOR CYCLE1 SBD on SH 2 overtaking hit CAR2 turning right	MOTOR CYCLE1 overtaking at no passing line, overtaking vehicle signaling right turn	Dry	Bright Sun	Fine	T Type Junctio	Nil	0	1	0

Section 2: Aongetete to south of Works Road

Driving difficulty question.
Please rate the difficulty of driving this road (for a typical driver).

1 -- Easy; No difficulty at all.
2 -- Slightly difficult; No problems.
3 -- Moderately difficult; Easy to do.
4 -- Somewhat difficult; Challenging.
5 -- Very difficult; Hard to do.
6 -- Extremely difficult; Potentially hazardous.
7 -- Nearly impossible; Unsafe.

Answer: ____________

Mental workload question
Please rate the mental workload associated with this drive (for a typical driver).

1 -- No workload; Not demanding.
2 -- Little workload; Minimal demands.
3 -- Moderate workload; Easily managed.
4 -- Busy; Challenging but manageable.
5 -- Very busy; Demanding to manage.
6 -- Extremely busy; Very difficult to manage.
7 -- Overloaded; Unmanageable; Unsafe.

Answer: ____________

What are the most difficult (or unsafe) aspects of driving this section of road?

1. ____
2. ____
3. ____

What specific aspects or features of the road would you change?

1. ____
2. ____
3. ____

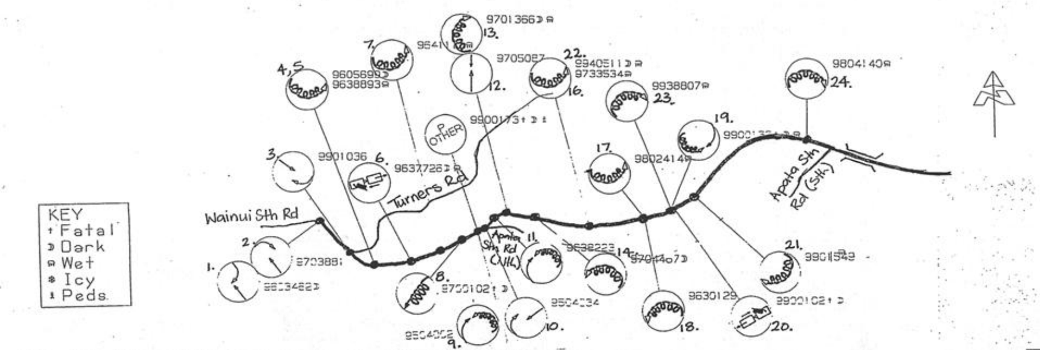
(Continue on the back of the page if necessary)

Section 3: Wainui South Road to south of Apata Station South

5 Year crash history

24 reported crashes:

13 loss of control (1F, 1 S, 5 M, 6 NI)
4 head-on (1 F, 2 S, 1 NI)
3 crossing turning (2 S, 1 M)
1 right turn against (S)
2 load lost/object in roadway (1F, 1 M)
1 pedestrian (F)



Wainui South Road to Apata Station Road (South) : RP 130/1.75 to 3.93 — Route 8

No.	1st Road	dist	dir	2nd Road	Ax #	date	day	time	movement description	causes	wet	light	weather	junction	control	fat	ser	min
1	2/130/1.43			WAINUI SOUTH ROAD	9603462	25/06/96	Tue	1924	CAR2 turning right hit by oncoming CAR1 NBD on SH 2 hit Ditch	CAR2 failed to give way when turning to non-turning traffic, impared ability due to old age	Dry	Dark	Fine	T Type Junc	Nil	0	1	1
2	2/130/1.43			WAINUI SOUTH ROAD	9703881	9/08/97	Sat	1640	MOTOR CYCLE1 NBD on SH 2 hit VAN2 turning right onto SH 2 from the left	VAN2 failed to give way at stop sign	Dry	Overcast	Fine	T Type Junc	Stop Sign	0	0	2
3	2/130/1.589			STEWART ROAD	9901036	7/01/99	Thu	1345	MOTOR CYCLE1 SBD on SH 2 hit CAR2 turning right onto SH 2 from the left	CAR2 failed to give way at stop sign	Dry	Bright Sun	Fine	T Type Junc	Stop Sign	0	1	0
4	2/130/1.689	100	E	STEWART ROAD	9605699	27/11/96	Wed	2249	CAR1 EBD on SH 2 lost control turning left, hit Fence	inadequate	Dry	Dark	Fine	Unknown	Nil	0	0	1
5	2/130/1.689	100	E	STEWART ROAD	9638893	2/09/96	Mon	1225	CAR1 EBD on SH 2 lost control turning left, hit Cliff Bank	ENV: road slippery (oil/diesel/fuel)	Wet	Unknown	Light Rain	Unknown	Nil	0	0	0
6	2/130/1.821	300	W	APATA STATION ROAD W	9637726	2/08/96	Fri	2225	load or trailer from 1 EBD on SH 2 hit VEHB		Wet	Dark	Light Rain	Unknown	Nil	0	0	0
7	2/130/1.939	350	E	STEWART ROAD	9641111	13/10/96	Sun	1343	CAR1 EBD on SH 2 lost control turning left		Wet	Overcast	Light Rain	Unknown	Nil	0	0	0
8	2/130/2.03	600	S	WAINUI SOUTH ROAD	9700102	9/05/97	Fri	2050	VAN1 SBD on SH 2 lost control; went off road to left, hit Bridge	VAN1 unconverted old codes defective vision or illness (not sudden)	Dry	Dark	Fine	Unknown	Nil	1	0	0
9	2/130/2.089	500	S	STEWART ROAD	9504002	2/06/95	Fri	1430	VAN1 SBD on SH 2 lost control on curve and hit CAR2 head on, hit Cliff Bank	collision	Dry	Bright Sun	Fine	Unknown	Nil	0	1	1
10	2/130/2.121			APATA STATION ROAD W	9504034	21/06/95	Wed	1110	CAR1 WBD on SH 2 hit CAR2 turning right onto SH 2 from the left	CAR2 failed to give way at stop sign	Dry	Bright Sun	Fine	T Type Junc	Stop Sign	0	0	3
11	2/130/2.171	50	N	APATA STATION ROAD W	9638223	22/08/96	Thu	1720	CAR1 SBD on SH 2 lost control on curve and hit CAR2 head on		Dry	Bright Sun	Fine	Unknown	Nil	0	0	0
12	2/130/2.221	100	E	APATA STATION ROAD	9705087	9/12/97	Tue	1630	CAR1 NBD on SH 2 hit CAR2 headon on straight	CAR1 alcohol suspected, failed to keep left on straight	Dry	Overcast	Fine	Unknown	Nil	0	2	0
13	2/130/2.221	100	N	APATA STATION ROAD	9701366	2/03/97	Sun	1925	CAR1 NBD on SH 2 lost control turning right, hit Cliff Bank	CAR1 Inattentive	Wet	Twilight	Fine	Unknown	Nil	0	0	2
14	2/130/2.321	200	E	APATA STATION ROAD	9704467	15/11/97	Sat	430	VAN1 WBD on SH 2 lost control turning left, hit Cliff Bank, Fence	VAN1 fatigue due to lack of sleep	Dry	Dark	Fine	Unknown	Nil	0	0	1
15	2/130/2.515	500	S	TURNER ROAD	9900173	15/09/99	Wed	1845	TRUCK1 NBD on SH 2 hit PEDESTRIAN2 (Age 37), hit Parked Vehicle	PEDESTRIAN2 pedestrian playing on road or unnecessarily on road	Dry	Dark	Fine	Unknown	Nil	1	0	0
16	2/130/2.521	400	E	APATA STATION ROAD	9733534	25/05/97	Sun	800	CAR1 NBD on SH 2 lost control turning left		Wet	Overcast	Fine	Unknown	Nil	0	0	0
17	2/130/2.721	600	E	APATA STATION ROAD	9802414	7/06/98	Sun	1345	CAR1 EBD on SH 2 lost control turning left, hit Cliff Bank	CAR1 too fast entering corner, lost control when turning	Wet	Overcast	Light Rain	Unknown	Nil	0	1	0
18	2/130/2.721	600	E	APATA STATION ROAD W	9630129	2/01/96	Tue	1710	CAR1 SBD on SH 2 lost control turning left, hit Post Or Pole		Dry	Bright Sun	Fine	Unknown	Unknown	0	0	0
19	2/130/2.817	700	W	APATA STATION ROAD	9900132	19/07/99	Mon	1830	CAR1 EBD on SH 2 lost control on curve and hit CAR2 head on	CAR1 lost control due to road conditions ENV: road slippery (oil/diesel/fuel)	Wet	Twilight	Light Rain	Unknown	Nil	1	1	1
20	2/130/2.831	710	N	APATA STATION ROAD	9900102	25/05/99	Tue	1730	load or trailer from TRUCK1 SBD on SH 2 hit CAR2	TRUCK1 too fast entering corner	Dry	Twilight	Fine	Unknown	Nil	4	1	3
21	2/130/2.917	600	W	APATA STATION ROAD	9901549	15/01/99	Fri	1305	CAR1 WBD on SH 2 lost control turning right, hit Cliff Bank, Fence, Ditch	CAR1 attention diverted by cigarette	Dry	Bright Sun	Fine	Unknown	Nil	0	0	2
22	2/130/2.946	400	E	APATA STATION ROAD	9940511	9/11/99	Tue	1900	CAR1 EBD on SH 2 lost control turning left, hit Cliff Bank		Wet	Twilight	Heavy Rain	Unknown	Nil	0	0	0
23	2/130/3.246	700	N	APATA STATION ROAD	9938807	19/09/99	Sun	1230	VAN1 NBD on SH 2 lost control turning right, went Over Bank, Ditch	ENV: road slippery (rain)	Wet	Overcast	Light Rain	Unknown	Nil	0	0	0
24	2/130/3.417	100	W	APATA STATION ROAD	9804140	2/04/98	Thu	1500	CAR1 EBD on SH 2 lost control turning right, hit Cliff Bank	CAR1 lost control due to road conditions ENV: road slippery (rain)	Wet	Overcast	Heavy Rain	Unknown	Nil	0	0	1

Section 3: Wainui South Road to south of Apata Station South

Driving difficulty question. Please rate the difficulty of driving this road (for a typical driver). 1 -- Easy; No difficulty at all. 2 -- Slightly difficult; No problems. 3 -- Moderately difficult; Easy to do. 4 -- Somewhat difficult; Challenging. 5 -- Very difficult; Hard to do. 6 -- Extremely difficult; Potentially hazardous. 7 -- Nearly impossible; Unsafe. Answer: ____________

Mental workload question Please rate the mental workload associated with this drive (for a typical driver). 1 -- No workload; Not demanding. 2 -- Little workload; Minimal demands. 3 -- Moderate workload; Easily managed. 4 -- Busy; Challenging but manageable. 5 -- Very busy; Demanding to manage. 6 -- Extremely busy; Very difficult to manage. 7 -- Overloaded; Unmanageable; Unsafe. Answer: ____________

What are the most difficult (or unsafe) aspects of driving this section of road?

1. ____
2. ____
3. ____

What specific aspects or features of the road would you change?

1. ____
2. ____
3. ____

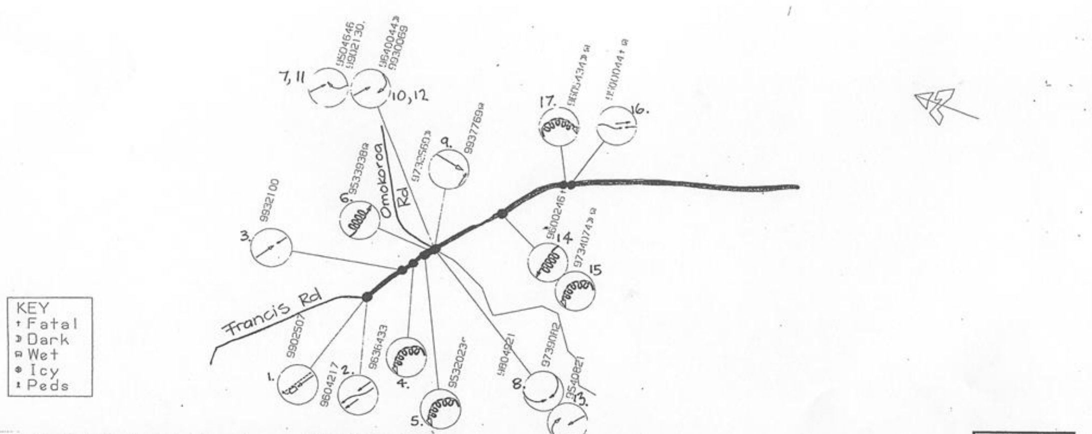
(Continue on the back of the page if necessary)

Section 4: Francis Road to South of Omokoroa

5 Year crash history

17 reported crashes:

6 loss of control (1 F, 2 S. 2 M, 1 ni)
2 overtaking (1 F, 1 M)
2 head-on (2 NI)
1 turning vs same direction (S)
3 crossing turning (3 NI)
2 right turn against (2 S)
1 crossing (NI)



Francis Road 2.2km South of Omokoroa: RP 130/6.83 to 9.25

Route 10

No.	1st Road	dist	dir	2nd Road	Ax #	date	day	time	movement description	causes	wet	light	weather	junction	control	fatal	ser	min
1	2/130/6.42	15	S	FRANCIS ROAD	9902507	31/05/99	Mon	1730	CAR1 NBD on SH 2 hit rear of CAR2 turning right from centre line	CAR1 fatigue due to lack of sleep	Dry	Bright Sun	Fine	T Type Junc	Stop Sign	0	1	1
2	2/130/6.425	20	S	FRANCIS ROAD	9604217	17/06/96	Mon	1630	CAR1 NBD on SH 2 changing lanes/overtaking to right hit CAR2 hit Vehicle	CAR1 alcohol suspected	Dry	Bright Sun	Fine	Unknown	Nil	0	0	1
3	2/130/6.654	200	N	OMOKOROA ROAD	9932100	2/03/99	Tue	1530	CAR1 SBD on SH 2 hit OTHER2 headon on straight		Dry	Bright Sun	Fine	Unknown	Nil	0	0	0
4	2/130/6.724	130	N	OMOKOROA ROAD	9636433	1/07/96	Mon	1250	CAR1 NBD on SH 2 lost control turning left		Dry	Bright Sun	Fine	Unknown	Nil	0	0	0
5	2/130/6.794	60	N	YOUNGSON ROAD	9532023	13/01/95	Fri	600	CAR1 NBD on SH 2 lost control turning left		Wet	Overcast	Light Rain	Unknown	Nil	0	0	0
6	2/130/6.834	20	N	YOUNGSON ROAD	9533938	10/06/95	Sat	840	CAR1 SBD on SH 2 lost control; went off road to left, hit Parked Vehicle		Wet	Bright Sun	Fine	T Type Junc	Nil	0	0	0
7	2/130/6.854			OMOKOROA ROAD	9504646	10/02/95	Fri	1235	CAR2 turning right hit by oncoming CAR1 SBD on SH 2	ENV: visibility limited by crest CAR2 alcohol suspected, failed to give way when turning to non-turning traffic	Dry	Bright Sun	Fine	T Type Junc	Stop Sign	0	0	1
8	2/130/6.854			OMOKOROA ROAD	9739082	3/10/97	Fri	1620	CAR1 NBD on SH 2 cutting corner hit CAR2 head on	ENV: stolen vehicle	Dry	Bright Sun	Fine	T Type Junc	Stop Sign	0	0	0
9	2/130/6.854			OMOKOROA ROAD	9732569	13/04/97	Sun	1905	CAR1 WBD on OMOKOROA ROAD hit CAR2 crossing at right angle from right		Dry	Twilight	Fine	Multi Rd Joi	Give Way	0	0	0
10	2/130/6.854			OMOKOROA ROAD	9640044	30/08/96	Fri	1900	CAR1 SBD on SH 2 hit CAR2 turning right onto SH 2 from the left		Dry	Dark	Fine	T Type Junc	Stop Sign	0	0	0
11	2/130/6.854			OMOKOROA ROAD	9902130	1/05/99	Sat	1920	CAR2 turning right hit by oncoming CAR1 SBD on SH 2	CAR1 didn't signal in time incorrect signal CAR2 alcohol suspected, failed to give way when turning to non-turning traffic, misjudged intentions of other party	Wet	Dark	Light Rain	T Type Junc	Nil	0	0	2
12	2/130/6.854			OMOKOROA ROAD	9930069	11/01/99	Mon	1630	CAR1 SBD on SH 2 hit CAR2 turning right onto SH 2 from the left		Dry	Overcast	Fine	T Type Junc	Stop Sign	0	0	0
13	2/130/6.854			YOUNGSON ROAD	9540821	19/11/95	Sun	1120	CAR1 WBD on SH 2 hit CAR2 turning right onto SH 2 from the left		Dry	Bright Sun	Fine	T Type Junc	Stop Sign	0	0	0
14	2/130/7.254	400	S	YOUNGSON ROAD	9600246	31/12/96	Tue	735	CAR1 NBD on SH 2 lost control; went off road to left, hit Cliff Bank	CAR1 fatigue due to lack of sleep	Dry	Overcast	Fine	Unknown	Nil	1	2	3
15	2/130/7.254	400	S	YOUNGSON ROAD	9734074	2/06/97	Mon	1940	CAR1 WBD on SH 2 lost control turning left, hit Post Or Pole		Wet	Dark	Light Rain	Unknown	Nil	0	0	0
16	2/130/7.654	800	S	OMOKOROA ROAD	9500044	11/03/95	Sat	1200	CAR1 SBD on SH 2 overtaking hit TRUCK2 head on	caught fire	Wet	Overcast	Light Rain	Unknown	Nil	1	1	2
17	2/130/8.055	1200	N	OMOKOROA STATION ROA	9605434	13/12/96	Fri	2155	CAR1 SBD on SH 2 lost control turning right, hit Cliff Bank	CAR1 alcohol suspected	Wet	Dark	Light Rain	Unknown	Nil	0	0	1

Section 4: Francis Road to South of Omokoroa

Driving difficulty question.
Please rate the difficulty of driving this road (for a typical driver).

1 -- Easy; No difficulty at all.
2 -- Slightly difficult; No problems.
3 -- Moderately difficult; Easy to do.
4 -- Somewhat difficult; Challenging.
5 -- Very difficult; Hard to do.
6 -- Extremely difficult; Potentially hazardous.
7 -- Nearly impossible; Unsafe.

Answer: ____________

Mental workload question
Please rate the mental workload associated with this drive (for a typical driver).

1 -- No workload; Not demanding.
2 -- Little workload; Minimal demands.
3 -- Moderate workload; Easily managed.
4 -- Busy; Challenging but manageable.
5 -- Very busy; Demanding to manage.
6 -- Extremely busy; Very difficult to manage.
7 -- Overloaded; Unmanageable; Unsafe.

Answer: ____________

What are the most difficult (or unsafe) aspects of driving this section of road?

1. ____
2. ____
3. ____

What specific aspects or features of the road would you change?

1. ____
2. ____
3. ____

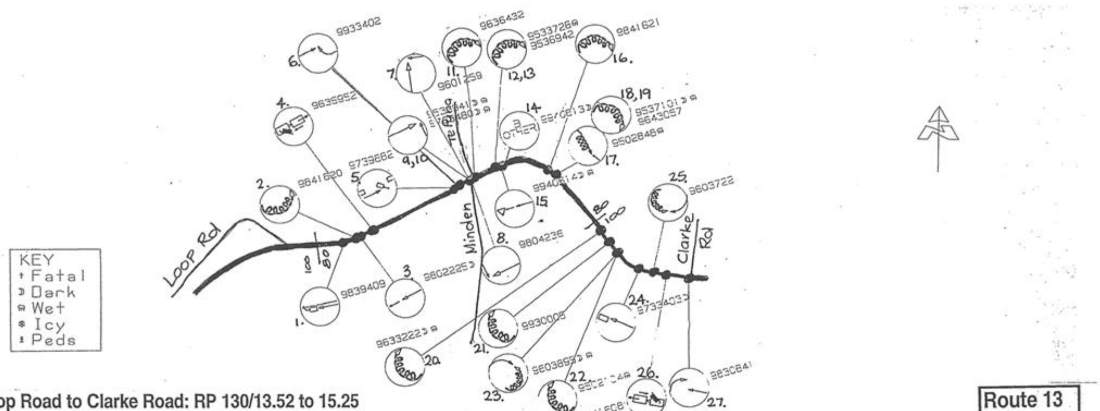
(Continue on the back of the page if necessary)

Section 5: Loop Road to Clarke Road

5 Year crash history

27 reported crashes:

10 loss of control (1 M, 9 NI)
4 head-on (2 S, 1 M, 1 NI)
1 turning vs same direction (NI)
2 right turn against (2 NI)
2 rear-end (1 S, 1 NI)
4 crossing (1 S, 2 M, 1 NI)
2 load lost/object in roadway (2 NI)
1 manoeuvring (NI)
1 collision with obstruction (NI)



Loop Road to Clarke Road: RP 130/13.52 to 15.25

Route 13

No.	1st Road	dist	dir	2nd Road	Ax #	date	day	time	movement description	causes	wet	light	weather	junction	control	fatal	ser	min
1	2/140/3.362	200	E	LOOP ROAD	9839409	30/08/98	Sun	1555	VAN1 NBD on SH 2 hit rear of CAR2 turning right from centre line	ENV: entering or leaving other commercial	Dry	Overcast	Fine	Driveway	Nil	0	0	0
2	2/140/3.412	250	E	LOOP ROAD	9841620	27/12/98	Sun	745	CAR1 EBD on SH 2 lost control turning left		Dry	Overcast	Fine	Unknown	Nil	0	0	0
3	2/140/3.424	450	N	TE PUNA ROAD	9802225	6/06/98	Sat	2240	MOTOR CYCLE1 SBD on SH 2 hit rear end of CAR2 stopped/moving slowly	MOTOR CYCLE1 alcohol suspected, too fast entering corner	Dry	Dark	Fine	Unknown	Nil	0	2	2
4	2/140/3.474	400	W	TE PUNA ROAD	9635952	14/06/96	Fri	1425	load or trailer from VAN1 EBD on SH 2 hit CAR2		Dry	Bright Sun	Fine	Unknown	Nil	0	0	0
5	2/140/3.814	60	W	TE PUNA ROAD	9739682	25/10/97	Sat	1445	VAN1 EBD on SH 2 hit CAR2 parking/unparking		Dry	Bright Sun	Fine	Unknown	Nil	0	0	0
6	2/140/3.824	50	W	MINDEN ROAD	9933402	4/04/99	Sun	1050	CAR2 turning right hit by oncoming CAR1 EBD on SH 2	ENV: entering or leaving private house / farm	Dry	Bright Sun	Fine	Driveway	Nil	0	0	0
7	2/140/3.874			MINDEN ROAD	9601259	31/01/96	Wed	1722	CAR1 NBD on MINDEN ROAD hit MOTOR CYCLE2 crossing at right angle from right		Dry	Bright Sun	Fine	X Type Junc	Stop Sign	0	1	0
8	2/140/3.874			MINDEN ROAD	9804236	15/11/98	Sun	825	MOTOR CYCLE1 WBD on SH 2 hit CAR2 crossing at right angle from right	CAR2 failed to give way at stop sign	Dry	Bright Sun	Fine	X Type Junc	Stop Sign	0	0	1
9	2/140/3.874			TE PUNA ROAD	9533941	30/05/95	Tue	2145	CAR1 EBD on SH 2 hit CAR2 crossing at right angle from right		Wet	Dark	Light Rain	X Type Junc	Stop Sign	0	0	0
10	2/140/3.874			TE PUNA ROAD	9703480	18/06/97	Wed	2245	CAR1 EBD on SH 2 hit CAR2 crossing at right angle from right	CAR2 alcohol test above limit or test refused, did not stop at stop sign	Wet	Dark	Light Rain	X Type Junc	Stop Sign	0	0	4
11	2/140/3.924	50	E	TE PUNA ROAD	9636432	8/06/96	Sat	1125	CAR1 EBD on SH 2 lost control turning right		Dry	Bright Sun	Fine	Unknown	Nil	0	0	0
12	2/140/3.974	100	E	TE PUNA ROAD	9533728	2/02/95	Thu	815	CAR1 EBD on SH 2 lost control turning right, hit Cliff Bank		Wet	Overcast	Light Rain	Unknown	Nil	0	0	0
13	2/140/3.974	100	E	TE PUNA ROAD	9536942	24/02/95	Fri	1415	CAR1 EBD on SH 2 lost control turning right, hit Ditch		Dry	Bright Sun	Fine	Unknown	Nil	0	0	0
14	2/130/14.362	120	E	MINDEN ROAD	9940613	4/11/99	Thu	1940	CAR1 EBD on SH 2 hit CAR2 head on		Wet	Dark	Heavy Rain	Unknown	Nil	0	0	0
15	2/130/14.362	120	E	MINDEN ROAD	9940614	4/11/99	Thu	2035	CAR1 WBD on SH 2 hit rear end of CAR2 stop/slow for obstruction		Wet	Dark	Heavy Rain	Unknown	Nil	0	0	0
16	2/140/4.074	200	E	TE PUNA ROAD	9841621	22/12/98	Tue	1628	CAR1 EBD on SH 2 lost control turning right, hit Cliff Bank, Traffic Sign		Dry	Overcast	Fine	Unknown	Nil	0	0	0
17	2/140/4.174	300	E	TE PUNA ROAD	9502848	5/02/95	Sun	1303	CAR1 SBD on SH 2 lost control on straight and hit CAR2 head on	CAR1 alcohol suspected, too fast entering corner ENV: road slippery (oil/diesel/fuel)	Wet	Overcast	Light Rain	Unknown	Nil	0	2	2
18	2/140/4.174	300	E	TE PUNA ROAD	9643057	25/12/96	Wed	935	CAR1 EBD on SH 2 lost control turning right, hit Cliff Bank, Post Or Pole		Dry	Bright Sun	Fine	Unknown	Nil	0	0	0
19	2/140/4.174	300	E	TE PUNA ROAD	9537101	28/07/95	Fri	10	CAR1 EBD on SH 2 lost control turning right, went Over Bank, Traffic Sign		Wet	Dark	Light Rain	Unknown	Nil	0	0	0
20	2/140/4.474	600	E	TE PUNA ROAD	9633222	31/03/96	Sun	1912	CAR1 NBD on SH 2 lost control turning right, hit Tree		Wet	Dark	Light Rain	Unknown	Nil	0	0	0
21	2/140/4.525	350	W	CLARKE ROAD	9930005	2/01/99	Sat	1340	CAR1 WBD on SH 2 lost control turning right, went Over Bank		Dry	Bright Sun	Fine	Unknown	Nil	0	0	0
22	2/140/4.574	700	E	TE PUNA ROAD	9502104	9/01/95	Mon	1545	CAR1 WBD on SH 2 lost control turning right, hit Tree	CAR1 load	Wet	Overcast	Light Rain	Unknown	Nil	0	0	1
23	2/140/4.575	300	W	CLARKE ROAD	9603895	25/08/96	Sun	1852	VAN1 WBD on SH 2 lost control on curve and hit CAR2 head on, hit Cliff Bank	control - head on collision	Wet	Dark	Light Rain	Unknown	Nil	0	0	1
24	2/140/4.675	200	W	CLARKE ROAD	9733403	11/05/97	Sun	2230	VAN1 WBD on SH 2 hit parked veh, hit Parked Vehicle		Dry	Dark	Fine	Unknown	Nil	0	0	0
25	2/140/4.725	150	W	CLARKE ROAD	9603722	30/06/96	Sun	1400	CAR1 EBD on SH 2 lost control on curve and hit CAR2 head on	CAR1 unconverted old codes lost control - head on collision	Dry	Overcast	Fine	Unknown	Nil	0	2	2
26	2/140/4.775	100	N	CLARKE ROAD	9741608	18/11/97	Tue	1125	load or trailer from CAR1 NBD on SH 2 hit VEHB, hit Cliff Bank, Traffic Sign		Dry	Bright Sun	Fine	Unknown	Nil	0	0	0
27	2/140/4.855	20	W	CLARKE ROAD	9830841	20/01/98	Tue	1720	CAR1 WBD on SH 2 hit CAR2 turning right onto SH 2 from the left	ENV: entering or leaving car parking building / area	Dry	Bright Sun	Fine	Driveway	Nil	0	0	0

Section 5: Loop Road to Clarke Road

Driving difficulty question.

Please rate the difficulty of driving this road (for a typical driver).

1 -- Easy; No difficulty at all.
2 -- Slightly difficult; No problems.
3 -- Moderately difficult; Easy to do.
4 -- Somewhat difficult; Challenging.
5 -- Very difficult; Hard to do.
6 -- Extremely difficult; Potentially hazardous.
7 -- Nearly impossible; Unsafe.

Answer: ____________

Mental workload question

Please rate the mental workload associated with this drive (for a typical driver).

1 -- No workload; Not demanding.
2 -- Little workload; Minimal demands.
3 -- Moderate workload; Easily managed.
4 -- Busy; Challenging but manageable.
5 -- Very busy; Demanding to manage.
6 -- Extremely busy; Very difficult to manage.
7 -- Overloaded; Unmanageable; Unsafe.

Answer: ____________

What are the most difficult (or unsafe) aspects of driving this section of road?

1. ____
2. ____
3. ____

What specific aspects or features of the road would you change?

1. ____
2. ____
3. ____

(Continue on the back of the page if necessary)

Please rate the usability of the planning and evaluation tool you saw today in terms of each of the following areas:

	Strongly disagree				Strongly agree
1. I think that I would like to use this system frequently	1	2	3	4	5
2. I found the system unnecessarily complex	1	2	3	4	5
3. I thought the system was easy to use	1	2	3	4	5
4. I think that I would need the support of a technical person to be able to use this system	1	2	3	4	5
5. I found the various functions in this system were well integrated	1	2	3	4	5
6. I thought there was too much inconsistency in this system	1	2	3	4	5
7. I would imagine that most people would learn to use this system very quickly	1	2	3	4	5
8. I found the system very cumbersome to use	1	2	3	4	5
9. I felt very confident using the system	1	2	3	4	5
10. I needed to learn a lot of things before I could get going with this system	1	2	3	4	5

Finally, please give us any comments or feedback about the tool or the exercise that you are willing to share with us.

That's it. Thank you very much for your help.

Appendix B

Phase 2 Participants' Questionnaire

Welcome to the

Driver-Vehicle Interaction Study

Instructions

The purpose of the study is to find out more about the attitudes and driving habits of road users in NZ. We are asking participants in the study to

1) answer a set of multi-choice questions about your driving habits.
2) drive simulated roads on our driving simulator across three sessions. The roads are based on actual roads in the Waikato and you will be able to practise driving the simulator before you begin.

All information will be treated in the strictest confidence and if you have any questions feel free to ask us. You can withdraw from the experiment at any time.

If you are a first-year Psychology student you will receive participation points for 102 or 103. Otherwise, your club will receive a donation in your name at the end of your participation.

We would like to begin by having you complete an informed consent form and then give us some background information about your driving habits.

Thank you in advance for your participation.

Dr. Samuel G. Charlton, Project Supervisor

What kind of vehicle do you drive most often?

- ❑ Motorbike
- ❑ Compact car
- ❑ Midsize car or wagon
- ❑ Van or ute
- ❑ Taxi
- ❑ Truck
- ❑ Truck & trailer
- ❑ Other ______________

How many kilometres do you drive in an average week? ________________ km

What is your annual income (approximately?)
$ __________________

What is your occupation?

- ❑ Sales
- ❑ Service
- ❑ Clerical
- ❑ Managerial
- ❑ Education
- ❑ Professional/technical
- ❑ Agricultural/fishing
- ❑ Manufacturing/building
- ❑ Transport
- ❑ In school/training
- ❑ Unemployed
- ❑ Retired
- ❑ Work at home
- ❑ Other ______________

In the past year, how many motor vehicle crashes have you been involved in? ________

In the past year, how many driving infringements (including speed camera fines) have you received? _____

What percent of your driving is:

	0%	10-20%	20-30%	40-50%	60-70%	80-90%
To and from work						
Shopping						
Medical						
Education						
Driving as part of job						
Transporting children						
Social and recreation						
Other _____________						

What percent of your driving is between the hours of:

	0%	10-20%	20-30%	40-50%	60-70%	80-90%
6am-10am						
10am-2pm						
2pm-6pm						
6pm-10pm						
10pm-2am						
2am-6am						

What is your age? ________________

Is your household Rural or Urban?
(circle one)

What is your gender? M F (circle one)

This next part of the experiment contains several multi-choice questions about your driving habits

For each question, you are asked to indicate how often a particular driving situation has happened to you, ranging from:

0 = never 1 = hardly ever 2 = occasionally 3 = quite often 4 = frequently 5 = all the time

Base your judgements on what you remember of your driving over, say, the past year.

How often do you do each of the following?

0 = never 1 = hardly ever 2 = occasionally 3 = quite often 4 = frequently 5 = all the time

	never					all the time
please tick the most appropriate column for EACH item	**0**	**1**	**2**	**3**	**4**	**5**
Hit something when reversing that you had not previously seen						
Intending to drive to destination A, you "wake up" to find yourself heading for destination B, maybe because the latter is a more usual destination						
Drive when you suspect you might be over the legal blood alcohol limit						
Get into the wrong lane approaching a roundabout or an intersection						
Queuing to turn left onto a main road, you pay such close attention to the main stream of traffic that you nearly hit the car in front						
Fail to notice that pedestrians are crossing when turning into a side street from a main road						
Sound your horn to indicate your annoyance at another road user						
Fail to check your rear-view mirror before pulling out, changing lanes, etc.						
Brake too quickly on a slippery road, or steer the wrong way in a skid						
Pull out of an intersection so far that the driver with right of way has to stop and let you out						
Disregard the speed limit on a residential road						
Switch on one thing, such as the headlights, when you meant to switch on something else, such as the wipers						
On turning left, nearly hit a cyclist who has come up on your inside						
Miss "Give Way" signs, and narrowly avoid colliding with traffic having right of way						
	0	**1**	**2**	**3**	**4**	**5**

Please continue on to the next page

How often do you do each of the following?

0 = never	1 = hardly ever	2 = occasionally	3 = quite often	4 = frequently	5 = all the time

	never					all the time
please tick the most appropriate column for EACH item	**0**	**1**	**2**	**3**	**4**	**5**
Attempt to drive away from the traffic lights in third gear						
Attempt to overtake someone that you hadn't noticed to be signalling a right turn						
Become angered by another driver and give chase with the intention of giving him/her a piece of your mind						
Stay in a motorway lane that you know will be closed ahead until the last minute before forcing yourself into another lane						
Forget where you left your car in a car park						
Overtake a slow driver on the inside						
Race away from traffic lights with the intention of beating the driver next to you						
Misread the signs and exit from a roundabout on the wrong road						
Drive so close to the car in front that it would be difficult to stop in an emergency						
Cross an intersection knowing that the traffic lights have already turned against you						
Become angered by a certain type of driver and indicate your hostility by whatever means you can						
Realise that you have no clear recollection of the road along which you have just been travelling						
Underestimate the speed of an oncoming vehicle when overtaking						
Disregard the speed limit on the open road						
	0	**1**	**2**	**3**	**4**	**5**

That is the end of the survey – Thank you very much for your answers. Let the researcher know that you are finished and they show you how to begin your practise session on the driving simulator.

Be sure to ask if you have any questions whatsoever!