MONASH University
Accident Research Centre

A centre within the Monash University Injury Research Institute

REPEAT SPEEDERS TRIAL

Final Evaluation Report

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21 November 2013

Final Report

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Acknowledgements

This project was funded, designed and coordinated by VicRoads. We thank Dr Nick Duck for his input to this report and earlier project phases. We would also like to acknowledge the input and support of the other project partners: Colmar Brunton (Your Source), Caraniche, and Smart Car Technologies.

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EXECUTIVE SUMMARY

In 2010 VicRoads commenced a trial, known as the Repeat Speeders Trial (RST), to test and evaluate two interventions to assist Victorian recidivist speeders to reduce speeding. The first intervention is an advisory Intelligent Speed Adaptation (ISA) system, while the second involves drivers attending a two-part behavioural intervention program. The Monash University Accident Research Centre's (MUARC's) main role in the project, and the focus of this report, is to evaluate the outcomes of the ISA and Behavioural Intervention (BI) sub-trials.

Behavioural Intervention Sub-Trial Method and Results

The BI sub-trial aimed to evaluate the effectiveness of completing a speed behaviour program, which consisted of a two-part BI course coupled with demerit point removal. The program was designed to assist drivers to develop strategies and plans to reduce their speeding behaviour. A total of 237 BI Program participants completed the program during the trial. In addition, 221 BI Survey participants, who did not complete the program, acted as a comparison group. All participants involved in the BI sub-trial completed pre- and post-intervention surveys designed to measure self-reported speeding behaviour and attitudes, and the outcomes of these surveys were used as the main method of assessing program effectiveness.

The results of the BI surveys provide evidence that, at least in the short-term, completing the speed behaviour program increased repeat speeders' knowledge of the dangers of speeding, improved their attitudes towards speeding and other driving behaviours in general, and led to improvements in their self-reported speeding behaviour. Although numbers are low, there is also some evidence that completion of the program decreased the number of self-reported crashes the Program participants were involved in during the four weeks after attending the course, with only one crash reported by the Program group and eight reported by the Survey group. Future work should focus on examining if these observed improvements in self-reported behaviour are maintained over a longer period of time, through the examination of crash or traffic infringement data.

ISA Sub-Trial Method and Results

The ISA sub-trial aimed to evaluate the effectiveness of an alerting ISA system in reducing speeding. A total of 39 drivers in the Speed Alert (treatment) group completed the trial. Participants in this group were exposed to an advisory ISA system for a period of 12 weeks and then monitored for a further eight weeks. The Speed Data group, who were not exposed to ISA and acted as a control group, comprised 46 drivers who successfully completed the trial. Approximately half of the participants in the ISA treatment and control groups had three demerits points from their last speeding offence removed from their record if they successfully completed the trial in order to assess any effects, combined or otherwise, of demerit point removal and ISA on speed behaviour. All ISA sub-trial participants completed two surveys of self-reported speeding behaviour and attitudes towards speeding specifically or driving in general: one in the period prior to the ISA being active and the second in the period after ISA was removed.

The logged driving results suggest that, while active, ISA is effective in reducing mean speed, 85th percentile speed, the time spent exceeding the speed limit, and the time taken to return to the speed limit and to the ISA auditory warning threshold after being exceeded. When ISA was active, the Speed Alert (treatment) group had a statistically significant reduction in mean speeds, 85th percentile speed, and the time taken to return to the speed limit and auditory threshold compared to the Speed Data (control) group who did not experience ISA warnings. Drivers in the Speed Alert group also spent a statistically significant lower proportion of time travelling at any speed above the limit, or >5 km/h and >10 km/h over the speed limit when ISA was active. These results are promising

given that this is the first study known to the authors to demonstrate the effectiveness of ISA in a sample of recidivist speeders.

While ISA was effective for all recidivist drivers in this study, the results suggest that some driver characteristics do impact on the effectiveness of ISA in reducing speeding, but only in some of the lower speed zones. In particular, ISA was found to be particularly effective for older drivers aged 50 and above, for female drivers, and for drivers with a greater propensity for angry driving. In contrast, being classified as a high- or a low-level speeder had no significant impact on the effectiveness of ISA. There was no evidence that drivers' subjective experience with the ISA device had any impact on its effectiveness in reducing speeding.

Beyond improvements to recidivist speeders' speed behaviour, the use of ISA is expected to yield significant crash saving benefits with this group of drivers. Across all speed zones combined, a 12.2% reduction in crash risk was found for drivers using ISA compared to those drivers who did not. The use of ISA was found to be particularly effective at reducing crash risk in the lower speed zones, with an expected reduction in crash risk of 40.5% in 40 km/h zones for drivers who use ISA. No significant reduction in crash risk was found for 80 and 100 km/h zones while ISA was active, most likely due to the lower levels of speeding found in these zones compared to the lower speed zones.

The aggregate casualty crash reductions that would be expected to occur over a five year period if offending drivers (Victorian repeat speeders who meet the trial inclusion criteria) were to have ISA installed in their cars continuously were also estimated. A total of 6588 Victorian drivers were assessed as eligible for recruitment in the RST over approximately a six month period. Licence numbers were available for 4710 (71.5%) of these drivers. Based on the RST sample obtained, it is expected that 14,738 drivers across the whole of Victoria would meet the criteria for inclusion in the ISA intervention program in any 12 month period. Results of the analysis revealed that, on average, based on the number of casualty crashes the drivers eligible for recruitment into the RST were involved in between 2006 to 2011, the crash reductions estimated from repeat speeders' use of ISA was 7.22 casualty crashes per year. With approximately 14,738 repeat speeders entering the program each year, a total cumulative reduction of approximately 180 casualty crashes is expected over the first 5 years of ISA being placed in all eligible repeat speeders' vehicles.

Once ISA was removed, there were no significant reductions in expected crash risk found for drivers who used ISA for any of the speed zones examined. This suggests that once ISA is removed, its effectiveness in reducing crash risk is not maintained. The removal of demerit points, on its own or in combination with ISA, was found to have no statistically significant effect on relative crash risk in any speed zone or on any of the speed-related outcomes.

The results of the surveys, however, suggest that using ISA or having demerit points removed had little influence on repeat speeders' self-reported speeding behaviour and attitudes towards speeding specifically, or driving in general. Taken together, the logged driving and survey results suggest that ISA, while effective at supporting drivers to perform the immediate tactical and operational aspects of driving (i.e. maintaining the legal speed limit), simply did not bring about a lasting attitudinal or behavioural change. It may be the case that in-vehicle systems, such as ISA, that support drivers at the tactical and operational levels of driving are less able to have an appreciable effect on drivers' attitudes or bring about lasting behaviour change that is sustained when the system is no longer active. Rather, tactical and operational behaviours, such as speed control, may need constant and sustained support from an in-vehicle system.

Methodological Considerations

The RST contained a number of methodological and technical issues that may affect the interpretation and generalisability of the results. These included the ISA digital map containing a

small number of inaccurate speed zones; significant delays to the recruitment of participants, particularly to the BI sub-trial; and significant delays in some participants completing Survey 2.

The design of the RST meant that baseline speed data were not collected. Rather, conclusions regarding ISA effectiveness are made by comparing the treatment and control groups' speeds. Baseline data were not collected because participants for the RST were recruited immediately after they received a traffic infringement notice (TIN) for speeding (the trigger TIN) which may have affected their speed behaviour in any baseline recording period. This meant that any baseline (pre-ISA) data collected may have been affected by the receipt of the TIN and, thus, would not be a true reflection of participants' baseline speeding behaviour. Also, the design of the ISA intervention, as it would be implemented by VicRoads in reality, meant that the ISA device was required to be installed as soon as possible after recruitment and receipt of the trigger TIN. It is important to note, however, that the design of the ISA sub-trial does impact the types of conclusions that can be drawn regarding the effectiveness of ISA and, particularly, the effects of ISA after the system was removed from the vehicle. As there are no baseline speed data, it cannot be determined if the observed increase in drivers' speed after the ISA was removed represents a return to baseline speed levels or just an increase towards baseline levels. Likewise, it is difficult to know the absolute magnitude of the speed reduction affected by the use of ISA for the Speed Alert group, only the relative reduction compared to the control group. If the randomisation worked appropriately, the difference between the Speed Alert (ISA) and Speed Data groups is the absolute effectiveness of ISA.

Conclusions and Recommendations from the Repeat Speeders Trial

Behavioural Intervention Sub-Trial

- The results of the surveys suggest that the speed behaviour program had a positive influence on repeat speeders' self-reported speeding behaviour as well as their attitudes towards speeding specifically and driving more generally.
- The observed improvements in driver attitudes and self-reported behaviour do not appear to be moderated by driver characteristics such as age, gender, driving experience, social desirability, propensity for angry driving and course knowledge retention.
- It is important to note that driver attitudes and self-reported behaviour was only measured short-term (approximately five weeks after course completion). It is therefore not possible to determine from the current study if the observed improvements will be sustained longer-term.
- The effectiveness of the speed behaviour program was evaluated in terms of self-reported attitudes and behaviour. It is not clear if the benefits of completing the program would extend to actual behaviour as measured through, for example, crash involvement and the receipt of speeding offences in the months after program completion.
- While the short-term effects of the speed behaviour program look promising, it is recommended that the longer-term benefits of the program on actual driving behaviour, including crashes and speed offence rates, be established before an investment is made to implement the program in the community on a wider-scale.

ISA Sub-Trial

- Alerting ISA is effective in reducing speeding and, in particular, higher end speeds (e.g., speed over the speed limit) in a sample of repeat speeders. Specifically, the use of ISA significantly reduced mean speed, 85th percentile speed, the time spent exceeding the speed limit, and the time taken to return to the speed limit and to the ISA auditory warning threshold after being exceeded.

- A robust finding of the current study, which is also supported by previous research, is that the speed reducing effects of ISA do not appear to remain once the device has been removed from the vehicle.
- A number of usability issues were reported with the system, such as the ISA speed map not being accurate in all areas, drivers becoming over-reliant on the system to warn them of speeding episodes and the visual display being too bright, particularly at night.
- Based on the survey results it appears that the use of ISA has little effect on improving driver attitudes towards speeding.
- Taken together, the study findings indicate that ISA affects speed changes by means of tactical and operational speed support. It does not bring about an attitudinal change in drivers, nor does it sustain behaviour change after it has been removed. As such, ISA needs to remain active in order to confer its safety benefits.
- Overall, the alerting ISA device appears to be effective in reducing speeding by recidivist speeders. However, if implemented as part of a repeat speeders intervention, ISA would need to remain in the vehicle as it does not change driver attitudes or behaviour long-term.
- It is important that, prior to wider-scale implementation, the usability issues observed with the ISA system be addressed, as these could lead to problems with system acceptability, increased workload and distraction, and, ultimately, undermine the effectiveness of the system.
- The addition of demerit point removal did not further improve speed behaviour over and above that of the ISA system for any of the measures examined. Demerit point removal also did not appear to have any benefits in regard to improving drivers' attitudes towards speeding or their attitudes towards the ISA system in general. As such, demerit point removal does not appear to be an effective addition to a repeat speeder intervention program.
- Although the ISA and BI sub-trials were run separately and no formal comparisons were made across the two, based on the results from both trials it is possible that combining ISA use and the speed behaviour course may bring about greater effects on driver attitudes and behaviour than either of the interventions alone. This is particularly the case with ISA use, which was not found to influence drivers' attitudes towards speeding and only benefited driver behaviour while it was active. It is possible that attending the speed behaviour program in conjunction with ISA use may bring about more sustained behaviour and attitudinal change in repeat speeders. Further research is required to examine if combining the interventions would indeed have the benefits suggested. The ideal trial design to investigate the effectiveness of both interventions combined on behaviour and attitude change is to include four study groups as follows: Group 1: ISA Only, Group 2, Speed Behaviour Program Only, Group 3: Both ISA and Speed Behaviour Program, Group 4: Control group receiving neither intervention.

1 INTRODUCTION

1.1 BACKGROUND

Excessive or inappropriate speed remains one of the most common factors contributing to road crashes. In 2011, 1,291 people in Australia died as a result of road crashes (Bureau of Infrastructure, Transport, Regional Economics, 2011). Excessive and inappropriate travel speeds are estimated to account for at least 30 per cent of deaths on Victoria's roads each year (VicRoads, 2008). Statistics from other countries tell a similar story. Speeding was a causal factor in 31 percent of all fatal road crashes in the United States during 2009, accounting for 11,591 lives lost (NHTSA, 2011). The economic cost of speed-related serious crashes in Victoria was estimated to be in excess of $1 billion in the year 2000 (Transport Accident Commission, 2011).Taken together, these statistics indicate that speeding imposes a substantial burden on society and represents a serious road safety issue worldwide.

The reasons why drivers speed are many and varied. The literature distinguishes between unintentional and deliberate speed violations. For some, speeding is unintentional, brought about by a lack of awareness of the current speed limit and/or vehicle speed, or because it is a habitual behaviour. For others, speeding is intentional; drivers speed for the thrill of it, because of peer-pressure, or because it holds some intrinsic value such as saving time (Forward, 2006; McKenna, 2005; Rothengatter, 1991).

A range of measures have been developed to manage speeding behaviour. Traditional measures to reduce vehicle speeds include those aimed at drivers (e.g., police and automated enforcement and public awareness campaigns) and modifications to road infrastructure (e.g., reduced speed limits, perceptual speed countermeasures, speed humps, street narrowing). These measures, however, have had varied success in improving speed compliance (e.g., Holland & Conner, 1996; Mountain et al., 2005).

More recently, in-vehicle technology, namely Intelligent Speed Adaptation (ISA), has been widely acknowledged as a promising means of significantly reducing excessive and inappropriate speeds and, ultimately, speed-related crashes (Young & Lenné, 2010). However, the effectiveness of ISA in improving the speed behaviour of recidivist or repeat speeders has not been examined to date. The use of behavioural interventions in the form of group discussion/educational meetings has also been shown to yield a reduction in crashes and speed violations (Masten & Peck, 2004). Styles, Imberger and Cairney (2009) propose that recidivist speeders be defined as 'drivers who are detected at least twice for speeding within a three year period, with at least one of these offences being a high speed offence, possibly defined in terms of its attracting four or more demerit points'. Information regarding the effectiveness of behavioural interventions in changing the speed behaviour of high-level recidivist speeders is also limited (Styles, Imberger & Cairney, 2009).

In response to the speed-related crashes in Victoria, in 2010 VicRoads commenced a trial, known as the Repeat Speeders Trial (RST), to test and evaluate two interventions to assist recidivist speeders to reduce speeding. The first intervention is an advisory ISA system, while the second involves drivers attending a two-part behavioural intervention program. The RST was designed and coordinated by VicRoads and involved input from a number of projects partners. MUARC's main role in the project was to evaluate the outcomes of the ISA and Behavioural Intervention sub-trials. The scope of the project did not include a formal statistical comparison of the ISA and BI sub-trials.

This report constitutes the final evaluation of the RST. The RST comprised two sub-trials: the Behavioural Intervention (BI) sub-trial and the Intelligent Speed Adaptation (ISA) sub-trial. An overview of the RST design is provided in Figure 1. The methodology and results of the BI and ISA sub-trials are discussed in chapters 2 and 3, respectively, followed by a general discussion of the outcomes of the two sub-trials in Chapter 4.

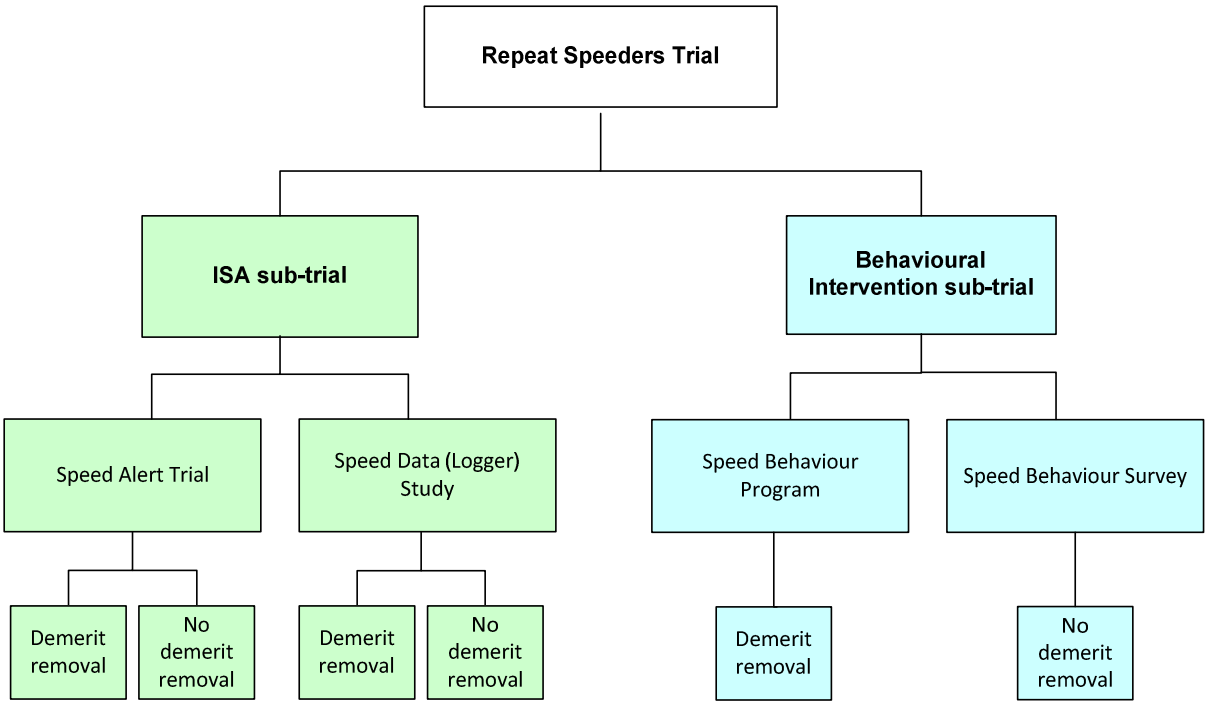


Figure 1.1 Design of the Repeat Speeders Trial

1.2 SELECTION OF RST PARTICIPANTS AND ALLOCATION ACROSS SUB-TRIALS

Potential RST candidates who met the eligibility criteria for the RST (see Sections 2.1.1 and 3.1.1) were identified by VicRoads using the VicRoads Driver Licensing System (DLS). Once identified, potential participants were randomly allocated by the recruitment provider Colmar Brunton (Your Source) into one of the two BI sub-trial groups or one of the four ISA sub-trial groups. A recruitment telephone interview was then conducted to determine whether potential participants were eligible for the sub-trial to which they had been allocated and, if so, to invite them to participate.

2 BEHAVIOURAL INTERVENTION SUB-TRIAL

The BI sub-trial aimed to evaluate the effectiveness of completing a speed behaviour program, which consisted of a two-part behavioural intervention course coupled with demerit point removal. Effectiveness of the program was measured by changes in drivers' speed behaviour and attitudes, as assessed using self-report measures. The program was designed by a consultant to VicRoads and aimed to assist drivers to develop strategies and plans to reduce their speeding behaviour. A minimum of 250 drivers were required to complete the program. In addition, it was expected that a minimum of 250 drivers, who did not complete the program, would act as a comparison group. All participants involved in the BI sub-trial completed pre-intervention (Survey 1) and post-intervention (Survey 2) surveys designed to measure self-reported speeding behaviour and attitudes.

Prior to the main data collection phase, all procedures and materials for the BI sub-trial were piloted with a small sample of 16 participants. Refinements to improve the study materials and procedures were made based on the pilot results.

2.1 BI SUB-TRIAL METHOD

2.1.1 Participants

A total of 3,730 participants were contacted to participate in the BI sub-trial to allow for refusals and participants who might withdraw from the trial before completion. Of these, half were randomly assigned to the Speed Behaviour Program and half to the Speed Behaviour Survey (See Section 2.2 for more details on the BI sub-trial recruitment). Final participant demographics can be found in Section 2.3.2.

Participants were eligible for an invitation to participate in the RST if they held a full current Victorian car licence, and had recently received a three-point Traffic Infringement Notice (TIN) for speeding and that this took the driver to an eight to eleven point demerit point level. In Victoria, when drivers reach 12 points, they are sent an 'Option Notice', which allows the driver to choose between a suspended licence or a 12 month bond where they are not allowed to accrue any additional demerit points. Thus, the drivers in this trial were considered to be at 'high risk' of losing their licence, and the intervention was developed to help them improve their speeding behaviour to avoid this outcome.

In addition to receiving the recent speeding TIN, at least one of the previous TINs received by the driver was required to be for a three point speeding offence or two one point speeding offences to ensure that participants could be considered a repeat speeder. It should be noted that when a driver receives demerit points, they can nominate another driver to take these points. This can be assigned legally, if the other driver did indeed accrue these points, or illegally, if the other driver takes the points when they did not accrue them. It is not possible to detect drivers who had illegally taken points from another driver but candidates were instructed that they could not volunteer for the study if this had occurred.

Other eligibility criteria for trial participation were that participants must:

- be aged over 21 years
- hold a full Victorian driver licence
- have no previous or current suspensions/cancellations/disqualifications on their licence and have never reached 12 or more demerit points, or received an Option Notice before or during the trial
- have no criminal convictions or pending charges showing up in police checks
- reside within a 150 km radius of the Melbourne CBD
- be available in Victoria during the trial to complete the required trial activities.

Participants who successfully completed the BI sub-trial received a $200 gift card to cover their time and travel expenses. Additionally, participants assigned to the Speed Behaviour Program had three demerit points removed from their current driver demerit history if they successfully completed all trial requirements.

2.1.2 Design

The BI sub-trial comprised two groups: a Speed Behaviour Program and a Speed Behaviour Survey (Table 2.1). Half of the participants in this sub-trial were randomly allocated to each group prior to recruitment. To avoid any participation bias, participants were not informed of their assigned trial group before verbally agreeing to participate. They could, however, withdraw upon being informed as to which group they were assigned. Also, each participant was only made aware of the details that pertained to their specific trial group. They were not made explicitly aware of the other group, or the overall aim and design of the study. They were aware, however, of the activities that were being conducted in general (e.g. program, surveys, etc.).

The participants in the Speed Behaviour Program attended a speed intervention course based on best-practice methods of behaviour change, and they had their trigger offence demerit points removed upon completion of the trial. Program participants completed Survey 1 before (pre-intervention) and Survey 2 after (post-intervention) the program. Participants in the Speed Behaviour Survey served as a control group and did not attend the course or have their demerit points removed; however, they did complete Surveys 1 and 2.

Table 2.1 Design of the Behavioural Intervention sub-trial

Program	Survey
Target: ~ 250 participants	Target: ~ 250 participants
• Pre- and Post-Intervention Surveys • Two part Intervention Course • Demerit Point Removal • $200 gift card	• Pre- and Post-Intervention Surveys • $200 gift card

2.1.3 Materials

2.1.3.a Speed Behaviour Program – Course Content

The program materials were developed by an experienced road safety psychologist contracted by VicRoads and reviewed by a panel of experienced psychologists comprising experts in behaviour change and road user behaviour. MUARC was not involved in the design of the speed behaviour program.

The course aimed to reduce speeding recidivism. The first session provided a general overview of the program, factual information on speeding and the risks it poses, encouraged participants to think about where, when and why they speed, challenged myths and common beliefs that support speeding behaviour, summarised how people can change their behaviour and guided participants towards thinking about ways in which they could reduce their speeding behaviour. Session 2 summarised material from Session 1, including the consequences of speeding for them and others, and culminated in participants developing personal plans to change their speed behaviour and cope with lapses and slips (see Appendix A for a list of content covered by the speed behaviour program course).

The course comprised two group sessions, each of two hours duration conducted approximately one week apart. Between the first and second session, participants were required to complete a homework assignment, which required participants to review the information from Session 1 using a series of

true/false questions and to reflect on how they could modify their speeding behaviour. The sessions were conducted in a classroom or meeting room led by a single facilitator. Approximately 10 participants attended each session.

2.1.3.b Participant Pack

Candidates who provided a verbal agreement to participate during the recruitment phone call were sent a participant pack. This pack contained a plain language statement detailing the participant's and VicRoads' responsibilities during the trial, a participant agreement detailing what activities they were required to complete to receive demerit removal and the gift card, and a copy of Survey 1. If candidates submitted a signed consent form and at least one survey they were considered participants in the trial. Each pack was branded and colour coded differently for each trial group to ensure that each group received the correct pack and did not have the details of the other trial group disclosed to them. Participants were instructed in the participant agreement and plain language statement that they would not have their three demerit points removed and/or receive the $200 gift card if they did not complete all required trial activities.

2.1.3.c Pre- and Post-Intervention Surveys

The two surveys for the Behavioural Intervention sub-trial each comprised four parts made up of a combination of existing standardised and non-standardised scales. The full surveys are contained in Appendix B. Below is a brief description of each survey section and a summary of how Survey 1 (pre-intervention) differed from Survey 2 (post-intervention).

Part A: Driving experience, travel patterns and driving record

Part A of Survey 1 was designed to measure basic demographic information that was not captured during the recruitment process, as well as to generate estimates of exposure for different driving patterns, including average kilometres travelled, time-of-day that the majority of driving is done, road type most often travelled and passenger carriage in the vehicle.

Part A of Survey 1, with the exception of questions on crash involvement, was not repeated for Survey 2.

Part B: Perception of road safety issues

Part B was designed to measure any changes in drivers' perception of speed-related and other road safety issues that were predicted to occur as a result of participants completing the speed behaviour program. Items in this section were selected from a Preliminary Questionnaire that was administered as part of the TAC SafeCar project, an on-road demonstration trial of ISA and other driver support technologies conducted by MUARC from 1999 to 2006 (Regan et al., 2006). Items were included on topics such as 'Awareness of road safety issues', 'Effect of driver behaviours on safety', 'Driver perception of what constitutes speeding' and 'Perceived likelihood of being caught by the police'.

Part B was re-administered as part of Survey 2.

Part C: Attitudes toward driving

Part C was designed to measure self-reported attitudes relating to speed and speed behaviour. This section comprised five questions that were made up of a range of standardised and non-standardised scales. Question 1 of Part C used a portion of speed-related 'Attitudes towards driving behaviours' items from the Preliminary Questionnaire from the TAC SafeCar project (Regan et al., 2006). Also included were nine 'stages-of-change' items, which were originally designed for a driving under the influence (DUI) intervention program (Wells-Parker et al., 2000; Wells-Parker et al., 1998). These items were modified to assess the extent to which participants were considering changing their speed behaviour.

The second set of questions comprised the Speeding Attitude Scale (SAS; Whissell & Bigelow, 2003), a 14-item scale that uses a 7-point Likert scale to assess respondents' behaviours and beliefs about driving. The third set of questions came from the Driver Behaviour Questionnaire (DBQ) that was adapted by Åberg &

Rimmö (1998). The fourth set of questions used a 'last-ten-trips' scenario to assess self-reported speeding behaviour. The fifth set of questions included a portion of the speed-related 'Attitudes towards road safety measures' items from the Preliminary Questionnaire used in the TAC SafeCar project (Regan et al., 2006).

Part C was re-administered as part of Survey 2.

Part D: Interests and personal style

Part D was designed to measure any differences among participants' stable personality characteristics that have a demonstrated relationship with the likelihood to engage in speeding behaviour. This helps to determine if there are certain types of drivers for whom the intervention may be more or less effective. For the first set of questions, items used were a combination of the 10-item 'Thrill and Adventure Seeking (TAS)' sub-scale of Zuckerman's (1994) Sensation-Seeking Scale (Version V), interspersed with the 8-item short form of the Marlowe-Crowne social desirability scale (developed originally by Greenwald & Satow, 1970).

The second set of questions contained 25 items used to assess participants' retention of the speed behaviour program course content. The third set of questions contained the Australian version of the Propensity for Angry Driving Scale (Aus-PADS) used to evaluate driver trait aggression.

Sections 1 and 2 from Part D were re-administered as part of Survey 2. Section3 was excluded from Survey 2. An additional open-ended question was included in Survey 2 requesting participants to note down their experiences of participating in the trial.

Items from Parts A and B and Questions 1, 4 and 5 of Part C were each analysed and reported individually. The existing standardised scales contained in Parts C (Stages-of-change, SAS, DBQ) and D (Sensation-Seeking Scale, Marlowe-Crowne, Aus-PADS) were analysed based on their aggregated scale (and where relevant sub-scale) scores.

2.1.3.d Behavioural Intervention Course Evaluation Forms

The speed behaviour program course evaluation form consisted of 8 multi-choice and three open-ended questions asking participants their views of the course. Topics covered included if participants felt that their speed knowledge had improved by attending the course, if the venue and facilitator were acceptable, if they found the content useful and interesting and if they had any suggested improvements.

2.1.4 Procedure

Sub-trial candidates with relevant TIN information for the RST were first identified by VicRoads through the VicRoads Driver Licensing System (DLS). These candidates were sent a letter outlining that they had been identified as a potential participant for the RST and that they may receive a phone call inviting them to participate in the trial. Participants were then contacted by phone by the recruitment provider Colmar Brunton (Your Source) and a recruitment telephone interview was conducted to determine whether they were eligible and, if so, to invite them to participate.

All candidates were informed that they would complete either the program and/or a set of surveys, but were not told which group they were in before agreeing to take part in the trial to avoid a systematic selection bias at the telephone agreement stage. If the candidate agreed to participate they were provided with details of the trial group (including details of demerit point removal if undertaking the speed behaviour program), to which they were previously randomly assigned. Participants in the Program group were then booked into the speed behaviour program and all participants were sent the participant pack.

The BI sub-trial was designed to be completed over a nine week period. An overview of the timing of trial activities for individual participants in the BI sub-trial is contained in Figure 2.1. Participants were first required to complete Survey 1 and the participant agreement and return them to the recruitment provider, Your Source. Participants were able to withdraw from the trial at any stage (both before and after signing

the participant agreement) by doing so in writing. Approximately one week after returning their consent form and Survey 1, participants in the Program group attended their first course session. Participants were sent reminder cards prior to the session to remind them of their session details.

The course was run over two, 2-hour sessions, which were conducted one week apart. Each session typically contained between 6 and 10 participants. Participants completed a homework assignment between the sessions. At the end of the second session, participants completed the course evaluation survey. Approximately four weeks after completing the second course session, participants were sent Survey 2 to allow participants sufficient time to drive after completing the sessions and to allow time for the recency effects of the program to diminish.

If Program participants successfully completed all trial components, they then received their participant payment and had the trigger speeding offence and associated three demerit points removed from their record. This occurred approximately 2-3 weeks after receipt of their completed Survey 2.

The trial procedure for the Speed Behaviour Survey (control) group was the same as for the Program group, although this group did not attend the speed behaviour program course, complete the homework assignment and did not have their trigger offence demerit points removed at the end of the trial. Participants in the Survey group completed Surveys 1 and 2 at approximately the same time points as the Program group (see bottom of Figure 2.1).

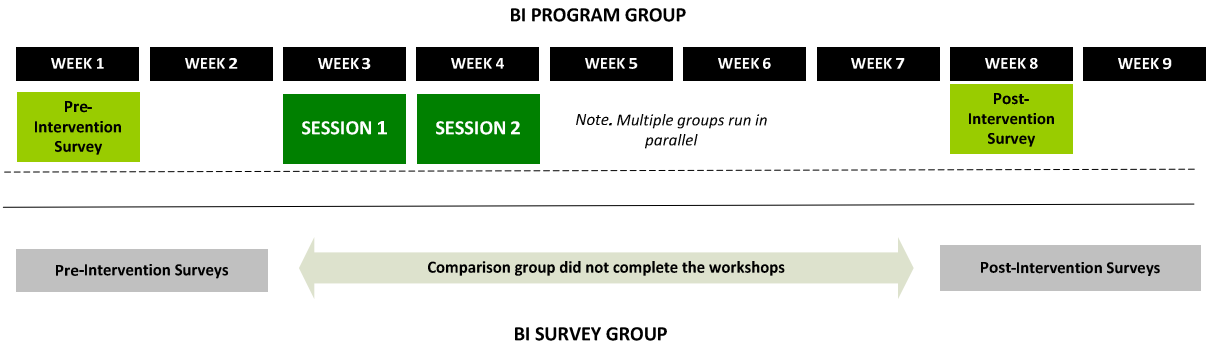


Figure 2.1 BI sub-trial activities and timelines for the Program (top row) and Survey (bottom row) participants

The BI sub-trial ran from October 2010 to June 2012. The timing of various activities throughout the trial for the BI Program and Survey groups are contained in Table 2.2.

Table 2.2 Timing of trial activities for the BI sub-trial groups

BI group	First participant recruited	Last participant recruited	First date Survey 1	Last date Survey 1	First date course completed	Last date course completed	First date Survey 2	Last date Survey 2
Program	7/10/2010	1/12/2011	21/01/2010	20/02/2012	3/11/2010	27/02/2012	20/12/2010	7/05/2012
Survey	7/10/2010	23/01/2012	12/10/2010	5/02/2012	NA	NA	9/01/2011	24/06/2012

2.2 BI SUB-TRIAL RECRUITMENT DATA & BIAS

2.2.1 Selection Bias

Recruitment data were analysed to determine if any selection bias existed in terms of the demographic details of participants who were recruited into the BI sub-trial versus the entire RST sample list (used for the BI and ISA sub-trials). Table 2.3 displays the age and gender details of the entire trial sample list and those participants who were recruited into the BI sub-trial group. Participants were considered to have been recruited into the sub-trial if they provided a signed consent form and returned at least one completed survey.

Differences in age across the participants recruited into the BI sub-trial and the entire RST sample were examined using a t-test. A significant[1] difference in participant age was found ($t(6508)=2.82$, $p=0.005$), with the participants recruited into the trial being an average of two years older than the entire RST sample. Differences in the number of days to recruitment/refusal from TIN issue date and the date the TIN was entered into the VicRoads DLS were also examined using a Mann-Whitney U test (data were not normally distributed). Significant differences were found between participants recruited into the BI sub-trial and the entire RST sample for both the number of days from the TIN being issued to recruitment/refusal ($p<.001$) and the number of days from TIN DSL entry and recruitment/refusal ($p<.001$). In both cases, participants who were recruited into the BI trial had fewer days from TIN issue and DLS entry to recruitment, compared to the RST sample overall. The impact of these differences on the outcomes of the trial are difficult to establish given that there is no clear association between receiving a TIN and behaviour, especially after the amount of time that had lapsed between the TIN and recruitment (up to 23 weeks). However, these differences should be considered when generalising the effectiveness of the BI program beyond the current sample, as the participants recruited may have been more affected by the trigger TIN.

Differences in gender and years of driving experience could not be examined because gender and driving experience were not provided for the entire RST list.

Table 2.3 Demographic details of the entire RST sample list and broken down across the BI sub-trial groups

	n	Mean (SD) age	Gender	Driving experience
Participants recruited into BI sub-trial	555	43.3 (14.6)	F 280 (50.5%) M 275 (49.5%)	24.0 (14.3)
Total RST Sample	**6588**	**41.4 (13.9)**	**N/A**	**N/A**

For those on the entire RST sample list with whom a contact attempt was made, selection bias analyses were also conducted to examine if there was any bias across those participants recruited into the BI-sub trial and those not recruited. Contact attempts were made with 3,730 candidates from the RST sample list for the BI sub-trial. Table 2.3 displays the number of participants recruited into the trial and the number who were not recruited for various reasons. The recruitment data were classified as follows:

- **Recruited:** Participants who provided a signed consent form and completed at least one survey.
- **Not Recruited:** Participants who refused to participate in the trial, those who failed the introductory screener due to language barrier or not meeting eligibility criteria and those who could not be reached (e.g. answering machine, engaged, no answer after two attempts).

[1] Throughout the report, use of the term 'significant' is used in relation to statistical significance.

Selection bias across the 'Recruited' and 'Not Recruited' groups was examined using a t-test (age) and Fisher's exact test[2] (gender).

Significant differences in participant age were found (t(3728) = 3.39, p=.001), with the participants recruited into the trial being an average of 2 years older than those contacted, but not recruited into the trial (See Table 2.4). In practice, this age difference is likely to have a negligible effect on program outcomes. In terms of the gender analyses, no significant differences in gender were found across participants recruited into the trial and those who were not recruited (Fisher's exact, p=0.854).

Apart from the BI participants being slightly older than the RST sample, there does not appear to have been a systematic selection bias occurring for recruitment into the BI trial.

Table 2.4 Demographics of participants recruited and not recruited into the two BI sub-trial groups from contact attempts made

	n	Mean (SD) age	Gender
Recruited	555	43.3 (14.6)	F 280 (50.5%) M 275 (49.5%)
Not recruited	3175	41.1 (13.8)	F 1601 (50.4%) M 1545 (48.7%) 29 Unknown (0.9%)

2.2.2 Randomisation Bias

To examine if there was any bias in the randomisation of BI participants into the Program and Survey groups, age, gender, driving experience and days to recruitment from TIN issue date and date the TIN was entered into the VicRoads DLS were examined across the two groups.

No significant differences in participant age were found across the BI Program and BI Survey (t(553) = 0.44, p=.663) groups (Table2.5). Likewise, there was no significant difference in years of driving experience across the groups (t(554) = 0.188, p = .893), nor differences in the days from TIN issue/DLS entry to recruitment (Mann-Whitney U, both p > .05). No significant difference in gender was found across participants in the Program and Survey groups (Fisher's exact, *p* = .051).

Table 2.5 Mean (SD) age and gender of participants recruited into the BI Program and Survey groups

BI group	n	Mean (SD) age	Gender	Driving experience
Program	283	43.0 (14.6)	131 F 152 M	23.9 (14.4)
Survey	272	43.6 (14.5)	149 F 123 M	24.1(14.3)

[2] Fisher's exact test is a test of statistical significance useful in the analysis of categorical data. It is typically used when sample sizes are small or when cell counts in contingency tables are less than 5.

2.2.3 Attrition Bias

A final examination of bias involved examining if there were any differences in the demographic characteristics of participants who withdrew or were disqualified at any point during the BI trial or who were excluded from the analyses because they did not complete Survey 2 in a timely manner (within 4 months) compared to those who completed all trial activities successfully. Table 2.6 provides details of the number of participants recruited into the BI sub-trial, the drop-out rate and the number of participants who completed all sub-trial activities. Attrition bias across those participants who completed and those who dropped out was examined for the Program and Survey groups using a binary logistic regression, using age, gender, driving experience and BI group as predictor variables.

Results revealed no significant differences in age, driving experience and gender across those Program ($p>0.05$) and Survey participants ($p>0.05$) who completed the trial and those who dropped out. Taken together, these results suggest that there was no age, driving experience and gender bias in terms of participant drop-out during the BI trial.

Table 2.6 Age and gender of BI Sub-trial participants who dropped-out or completed trial

BI group	N (%)	Mean (SD) age	Gender	Driving experience
Program				
Dropped-out*	46 (16.3%)	41.6 (14.7)	21 F; 25 M	22.2 (13.8)
Completed trial	237 (83.7%)	43.2 (14.5)	110 F; 127 M	24.4 (14.4)
Survey				
Dropped-out*	51 (18.8%))	42.1 (14.1)	28 F; 23 M	23.8 (14.3)
Completed trial	221 (81.2%)	43.9 (14.7)	121 F; 100 M	24.4 (14.4)

* Includes participants who withdrew or were disqualified from trial, who did not complete both surveys, or who did not complete Survey 2 within 4 months

2.3 BI SUB-TRIAL RESULTS

2.3.1 Data Screening

A total of 283 BI program and 272 BI Survey participants returned at least one survey during the trial. Of these, 46 from the Program group and 51 from the Survey group were removed from the analyses. A breakdown of the number of participants removed from each group and the reasons for removal is included below in Table 2.7. After removal, a total of 237 Program participants and 221 Survey participants were included in the BI Survey analyses.

Table 2.7 Number of participants removed from analyses across the BI groups

Removal reason	Program	Survey
Did not return Survey 1	-	8
Did not return Survey 2*	37	12
Took longer than 4 months (120 days) to complete Survey 2	9	31

*Also includes those disqualified or who withdrew from trial

The days taken to send and complete Surveys 1 and 2 are displayed in Table 2.8 for the BI program and Survey groups. There were a number of errors in the data provided, including data not provided for some participants (Program group n= 6; Survey group n= 43), missing dates (2 cases for Survey 1 and 4 for Survey 2), incorrect dates (e.g., date completed listed as earlier than date sent;(2 cases for Survey 1 and 26 for Survey 2), and data where the days to complete equalled zero (3 cases for Survey 2). These data were excluded from the survey completion time analyses.

T-tests were conducted to examine if the differences in time taken to complete the surveys differed across the Program and Survey groups. Before conducting the t-tests, a number of outliers were removed from the Survey 1 data for both the Program and Survey groups to ensure that the assumptions required of the statistical tests were met. For the Program group, eight extreme outliers were removed for the Survey 1 data (172 – 237 days to complete) and eight removed for the Survey 2 data (131 – 426 days to complete). For the Survey group, three extreme outliers were removed for Survey 1 (31 – 41 days to complete) and 24 were removed for Survey 2 (236 – 481 days to complete).

The t-tests revealed a significant difference in the time taken to complete Survey 1 across the Program and Survey groups, with the Program group taking an average of 23 days longer to complete than the Survey group ($t(250.18)=8.09$, $p=0.0000$). However, the Survey group took significantly longer to complete Survey 2 than the Program group (mean difference 37 days; $t(311.47)=-4.71$, $p=0.0000$). These analyses, and the high within group variability, suggest that Survey completion time should be addressed before the final BI survey analysis.

In particular, the high number of days taken to complete Survey 2 by some BI participants was of concern. To address the issue, data for nine Program participants and 31 Survey participants were excluded from the survey analysis because they took longer than 4 months (120 days) to complete Survey 2.

Table 2.8 Time to send (from recruitment/course completion date) and complete (from sent date) Surveys 1 (pre) and 2 (post) for the BI sub-trial (before outliers removed)

BI group		Days to send Survey 1	Days to complete Survey 1	Days to send Survey 2*	Days to complete Survey 2
Program		*(n = 241)*	*(n = 241)*	*(n = 231)*	*(n = 241)*
	Mean	1.02	33.16	28.52	33.98
	SD	0.14	44.07	3.25	53.21
	Range	1-2	1-237	13-47	2-426
Survey		*(n = 216)*	*(n =216)*	*(n = 216)*	*(n = 216)*
	Mean	1.0	9.94	62.66	71.19
	SD	0.07	6.08	14.78	104.50
	Range	1-2	1-41	31-169	1-481

*Days to send Survey 2 was calculated from the course completion date for the Program Group and from the recruitment date for the Survey group (Survey 2 should have been sent to the Survey group in week 8 (day 56) of the trial)

2.3.2 Participant Sample Demographics

The demographic details of participants who completed both Surveys for the BI sub-trial (N = 458) were examined to explore any differences across the Program and Survey groups. Table 2.9 displays the key demographic, driving history and travel patterns and personality measure details of participants in the two BI sub-trial groups (a full descriptive list of all demographic variables collected for the BI sub-trial can be

found in Appendix C). Each of the demographic details were compared across the two BI groups using t-tests (for normally distributed data), Wilcoxon-Mann Whitney tests (for non-normal ordinal data) and Fisher's exact tests (for categorical data) to determine if any significant differences in key demographics exist across BI groups that need to be used as covariates in the analysis or taken into account when interpreting findings of the BI survey data.

The right column in Table 2.9 provides the results of these statistical tests. No significant differences were found across the two BI groups for any of the variables examined, except for the Marlowe-Crowne social desirability scale. While the difference was statistically different, practically the differences are small, with the median social desirability being the same in both groups (5.0), and the Program group having a marginally higher mean social desirability score (5.0 compared to 4.6). Furthermore, participants in both groups scored moderate on social desirability, suggesting that they are likely to have answered the survey items with little social desirability bias. Therefore, the difference in social desirability scores is unlikely to influence survey responses and was not included as a covariate in the survey analysis. Overall, the lack of significant differences across groups on the key demographic variables suggests that the randomisation process was successful.

Table 2.9 BI sub-trial participant demographics

	Program	Survey	p
n	237	221	
Mean (SD) age	43.3 (14.5)	43.9 (14.8)	z=-0.17, p=0.87
Gender	110 F; 127 M	121 F; 100 M	Fisher's exact, p=0.078
Driving history &travel patterns			
Driving experience (Mean years licence held)	24.4 (14.4)	24.4 (14.4)	z=0.11, p=0.91
Kms in last week (% participants)	< 200km – 21.2% 200-400km – 37.3% >400km – 41.5%	< 200km – 26.3% 200-400km – 34.13% >400km – 39.6%	Fisher's exact, p=0.441
% time driving in city	10.5 (18.5)	8.2 (15.2)	z=1.43, p=0.15
% time driving in urban areas	53.1 (32.2)	50.8 (32.8)	z=0.81, p=0.42
% time driving in rural areas	10.1 (17.5)	16.3 (27.1)	z=-1.24, p=0.22
% time driving on freeways	26.3 (24.9)	24.9 (24.7)	z=0.68, p=0.49
% time travelling *to* work	46.3 (32.3)	44.4 (34.3)	z=0.45, p=0.66
% time travelling *for* work	15.2 (25.4)	14.3 (25.8)	z=1.27, p=0.20
% time travelling for private purposes	38.5 (31.2)	41.3 (32.9)	z=-0.81, p=0.42
No. crashes last 3 years	0 crashes – 169 drivers 1 crash – 53 drivers 2 crashes – 13 drivers 3 crashes - 2 drivers	0 crashes – 164 drivers 1 crash – 42 drivers 2 crashes – 11 drivers 3 crashes – 3 drivers 4 crashes – 1 driver	z=-0.66, p=0.51
Personality measures			
Sensation Seeking (max score=10)	4.3 (2.8)	3.9 (2.8)	z=-1.37, p=0.17

	Program	Survey	p
Propensity for Angry Driving (PADS) (max score=86.05)	35.5 (6.7)	35.4 (6.9)	z=-0.49, p=0.62
Marlowe-Crowne Social Desirability (max score=8)	5.0 (1.9)	4.6 (2.2)	**z=-2.21, p=0.027**

Means with standard deviation in parentheses

2.3.3 BI Survey Results Summary

This section summarises the key results from the BI surveys. The full survey results can be found in Appendix D. The key findings for each survey section are discussed separately.

Generalised Estimating Equations (GEE) were used to examine all survey items unless otherwise stated. This analysis aimed to determine if survey responses differed significantly across the two BI groups and if survey responses changed over time, in order to establish the effectiveness of the speed behaviour program on improving drivers' speeding knowledge and attitudes. GEE is used to analyse correlated data from longitudinal and repeated-measures trials, which is applicable for the survey data from this trial as there is a correlation between attitudes and self-reported behaviour of the same participant taken over time. Participant identifier (number) was used to identify individuals, and survey time was a repeated-measures factor. Statistical significance is represented by p values below 0.05. Results that approach significance (p values greater than 0.051 and <0.10) are discussed as trends.

2.3.3.a Perception of Road Safety Issues – Part B

2.3.3.a.1 Part B Q1 – Factors Contributing to Road Crashes

Question 1 of Part B of the questionnaire (Appendix B) asked respondents to indicate how often they thought a range of factors and behaviours (e.g., poor road design or drink driving) contributed to road crashes. Responses were provided on a 5-point scale ranging from 'Never' to 'Very often'. The logistic GEE models were specified with a logit link function and unstructured correlation matrix.

For the two factors specifically addressed in the speed behaviour program course, speeding and drink driving, a significant two-way interaction was found. Prior to the program, there was no difference between groups in terms of the odds of indicating that speeding or drink driving 'often' or 'very often' contribute to road crashes. However, after completing the program, the odds of the Program group indicating that speeding or drink driving 'often' or 'very often' contributes to crashes were 2.4 and 2.5 times, respectively, the odds of the Survey group indicating so. It was also found that the odds of the Program group indicating that disregard of the road rules 'often' or 'very often' contribute to crashes was 1.5 times the odds of the Survey group indicating so at Survey 2.

For the factors carelessness/negligent driving, poor road design/signs, disregard of road rules and being young, it was found that the odds of the Program group indicating that these factors 'often' or 'very often' contribute to road crashes increased significantly from Survey 1 to Survey 2 while there was no change over time for the Survey group.

For a number of factors (ignorance of road rules, distraction, road congestion and hoons showing off) a significant main effect of time was found. The odds of both groups responding that these factors 'often' or 'very often' contributed to road crashes was significantly higher at Survey 2 than at Survey 1, however there was no difference between groups.

No significant differences were found across groups or survey times for how often the participants thought the following factors contributed to road crashes: inattention/lack of concentration, lack of driver training, and weather conditions.

2.3.3.a.2 Part B Q2 – How dangerous is it to Travel Above Speed Limit

Questions 2a to 2i of Part B of the questionnaire asked participants how dangerous it was to travel at various speeds above the speed limit in 50, 60 and 100 km/h zones. Responses were categorised as Dangerous (Very Dangerous/Dangerous/A Bit Dangerous) or Safe (Safe/Very Safe). Three full factorial GEEs (binomial error distribution, logit link and unstructured correlation matrix) were conducted to determine if the odds of believing that it was safe to travel 5 km/h, 10 km/h or 20 km/h above the speed limit were changed as a result of the program, and if this effectiveness differed according to speed limit.

The program was effective in changing respondents' opinions over time in terms of how dangerous it is to travel 5 km/h over the speed limit and this did not differ according to speed zone. At Survey 1, the BI groups did not differ in terms of how likely they were to report that it was dangerous to travel 5 km/h over the speed limit. At Survey 2, however, the odds of the Program group reporting that this behaviour was dangerous were more than three times the odds of the Survey group doing so ($p<0.001$). The opinions of the Survey group did not differ over time. In contrast, after they completed the program, the odds of the Program group believing it was dangerous to drive 5 km/h over the speed limit were more than three times the odds of them believing so prior to going through the program ($p<0.001$).

The program was also effective in changing respondents' opinions over time in terms of how dangerous it is to travel 10 km/h over the speed limit and this also this did not differ according to speed zone. At time 1, the groups did not differ in terms of how likely they were to report that it was dangerous to travel 10 km/h over the speed limit. At time 2, however, the odds of the Program group reporting that this behaviour was dangerous were almost two and a half times the odds of the Survey group doing so. The opinions of the Survey group differed over time; the odds of them reporting that travelling 10 km/h over the speed limit was dangerous increased by 79% at time 2 compared to time 1 ($p<0.001$). The opinions of the Program group also changed; after they went through the program, the odds of the Program group believing it was dangerous to drive 10 km/h over the speed limit were 3.2 times the odds of them believing so prior to going through the program, which is equivalent to a 220% increase at time 2 compared to time 1 ($p<0.001$).

The program did not work to change participants' attitudes about whether or not travelling 20 km/h over the speed limit was dangerous, with no significant 3-way group by time by speed zone interaction, nor a group by time interaction significant. This may be due to the fact that the proportion of respondents who thought this activity was dangerous or very dangerous was already high at Survey 1 (71% of Program and 76% of Survey participants), thus there was probably little opportunity for the program to further improve drivers' knowledge.

Significant main effects of speed zone were also found for travelling 5, 10 and 20 km/h over the speed limit (all $p<0.05$). Respondents, regardless of BI group or survey time, were more likely to believe that travelling 5, 10 and 20 km/h over the speed limit was more dangerous in 50 km/h zones and 60 km/h zones, compared to 100 km/h zones.

2.3.3.a.3 Part B Q3 – Q5 – At How Many Kilometres Over Limit are Drivers Speeding?

Questions 3 to 5 of Part B of the questionnaire asked respondents to indicate, for 50, 60 and 100 km/h zones, how many km/h over the limit a driver has to be travelling before they are speeding. Nine response options were provided ranging from 1 to 5 km/h over the limit to more than 30 km/h over the limit, with a 'don't know' option also provided. The data were recoded into binary form where a correct answer equals anything over the speed limit, and an incorrect answer equals any other response. GEE analyses were conducted to determine if the odds of answering correctly were different for the BI groups over time. The logistic GEE models were specified with a logit link function and unstructured correlation matrix.

For 50 km/h zones, there was a significant group by time interaction ($p<0.001$). At time 1, there was no difference between the Program and Survey groups in terms of the proportion who thought that anything over 50 km/h was speeding in a 50 km/h zone. At time 2, the odds of the Program group knowing this was almost three times the odds of the Survey group ($p<0.001$). Over time, there was no change in the proportion correct for the Survey group, however, the odds of the Program group being correct after

completing the speed behaviour program, was 2.3 times the odds of them being correct prior to the program ($p<0.001$).

For 60 km/h zones, there was a significant BI group by time interaction ($p<0.001$). At time 1, there was no difference between the Program and Survey groups in terms of the proportion who thought that anything over 60 km/h was speeding in a 60 km/h zone. At time 2, the odds of the Program group knowing this was 2.75 times the odds for the Survey group ($p<0.001$). Over time, there was no change in the proportion correct for the Survey group, however, the odds of the Program group being correct after completing the speed behaviour program, was 2.4 times the odds of them being correct prior to the program ($p<0.001$).

For 100 km/h zones, there was a significant group by time interaction ($p<0.001$). At time 1, there was no difference between the Program and Survey groups in terms of the proportion who thought that anything over 100 km/h was speeding in a 100 km/h zone. At time 2, the odds of the Program group knowing this was 2.79 times the odds for the Survey group ($p<0.001$). Over time, there was no change in the proportion correct for the Survey group, however, the odds of the Program group being correct after the completing the speed behaviour program, was 2.59 times the odds of them being correct prior to the program ($p<0.001$).

2.3.3.a.4 Part B Q6 – Factors Influencing Speeding

Questions 6a and 6b of the questionnaire asked participants to tick the top three factors that influence whether they speed and the top three factors that stop them from speeding. For the factors that influence whether drivers speed, the most common response was 'losing track of my own speed', followed by 'the speed of other traffic', 'unaware of speed limit' and 'how much of a hurry I am in'. Responding patterns were consistent across the two groups and across the two survey time points.

In terms of the factors that stop drivers from speeding, the most common response was 'the road and weather conditions', followed by 'the speed limit', 'my chances of having a crash' and 'the volume of traffic on the particular road'. Again, response patterns were consistent across BI groups and did not change appreciably across the two survey time points.

2.3.3.a.5 Part B Q7 & Q8 – Likelihood of Being Caught by Police

In Question 7 of Part B of the questionnaire, respondents were asked by how much they can exceed the speed limit before being booked by police. A Fisher's exact test was conducted to examine if there were differences in responses across groups and survey time points. At time 1, there were no significant differences in the responses of the Program or Survey groups ($p=0.387$); however, at time 2, there was some evidence for a difference across groups, although it did not reach statistical significance ($p=0.065$), with a greater proportion of the survey group responding 'don't know'.

Participants were also asked to specify if they thought there was another amount that drivers could exceed the limit by before being booked by police. Responses to this question in both groups were mixed and there was little consistency in responding across the two survey points. Responses ranged from 0 km/h over to 15-20 km/h over, or 5% to 15% over and also included answers such as 'depends on circumstances and speed limits' and that it is up to the 'discretion of police'. Based on the varied responses provided, it is clear that drivers do not know what the speed tolerance is.

The final question of Part B, Question 8 of the questionnaire, asked respondents what the likelihood was of being caught by the police for travelling 5, 10 and 20 km/h above the speed limit. Responses were provided on a 5-point scale ranging from 'Very unlikely' to 'Very likely'. For analysis, the response of interest was whether participants thought being caught was probable; thus, the data were recoded into two categories, with Neither Unlikely or Likely/Very Unlikely and Unlikely forming one category, and Very Likely and Likely forming the other. Generalised Estimating Equations (GEE) were used to see how responses changed in each BI group over time. The logistic GEE models were specified with a logit link function and unstructured correlation matrix.

For the likelihood of being caught travelling 5 km/h above the speed limit, there was a significant group by time interaction (p=0.001). There was no difference between the proportion of Program and Survey groups that believed it was likely they would be caught by the police for travelling 5 km/h over the speed limit at either time. Over time for the Survey group, there was no change in the proportion who believed it was likely they would be caught; however, after the program, the odds of the Program group thinking it was likely they would be caught was 1.8 times the odds of them believing that prior to the program (p<0.001).

For the likelihood of being caught travelling 10 km/h above the speed limit, there was marginal evidence for an interaction between BI group and time (p=0.099). There was no difference between the proportion of Program and Survey groups that believed it was likely they would be caught by the police for travelling 10 km/h over the speed limit at either time. Over time, there was no change in the proportion who believed it was likely they would be caught for the Survey group, however, after the program, the odds of the Program group thinking it was likely they would be caught was 1.7 times the odds of them believing that prior to the program (p=0.008).

There was no group by time interaction and no overall difference between groups in terms of the proportion that believed it was likely they would be caught by police for travelling 20 km/h over the speed limit. However, there was a significant main effect of time, with the odds at time 2 of replying it is likely/very likely they would be caught by police for travelling 20 km/h over the speed limit being 55% higher (p=0.023) than at time 1 (pooled over the Program and Survey groups).

2.3.3.b Attitudes toward Driving and Speeding – Part C

2.3.3.b.1 Part C Q1 – Attitudes Towards Speeding

Question 1 of Part C of the questionnaire asked respondents to indicate if they agreed or disagreed with 14 statements regarding speeding. Responses were provided on a 5-point scale ranging from 'Strongly disagree' to 'Strongly agree'. For analysis the data were recoded into two categories, with Strongly Disagree and Disagree forming one category, and Strongly Agree and Agree forming the other. A Generalised Estimating Equation (GEE) was used to examine how responses changed in each BI group over time. The logistic GEE models were specified with a logit link function and unstructured correlation matrix.

For the following positively worded statements, a significant group by time interaction was found (all p<.05): 'Speeding is always wrong' and 'you are much more likely to be involved in a crash if you increase driving speed by 5 km/h'. At time 1, there was no difference between the groups in terms of the proportion who agreed with these statements; however, at time 2, the odds of the Program group agreeing with the statements was between two and four times the odds of the Survey group believing so. There was no change in opinion over time for the Survey group, however, the odds of the Program group agreeing with the statements after completing the speed behaviour program were significantly higher than the odds of agreeing prior to the program.

A significant group by time interaction was also found (p<.05) for the positively worded statement: 'people who exceed speed limits are major contributors to crashes'. For this statements, there was no difference in the Program and Survey groups at either time and there was no change over time in the opinion of the Survey group; however, there was a change of opinion for the Program group, whereby the odds of the Program group agreeing or strongly agreeing at time 2 was 2.7 times the odds of them agreeing or strongly agreeing at time 1.

For the following negatively worded statements, a significant group by time interaction was found (all p<.05): 'It makes sense to exceed speed limits to get ahead of slower drivers'; 'it is OK to drive at 100 km/h in an 80 km/h zone if the road conditions are good and there is no-one else around'; 'speeding enforcement is more for revenue raising than for safety'; 'speed limits are too low – it is usually safe to drive faster than the speed limit'; and 'it is safe to speed on roads I am familiar with'. At time 1, there was no difference between the groups in terms of the proportion who agreed with the statements; however, at time 2, the odds of the Program group agreeing with the statements was significantly lower than the odds

of the Survey group agreeing. There was no change in opinion over time for the Survey group, however, the odds of the Program group agreeing with the statements after completing the speed behaviour program were significantly lower than the odds of them agreeing prior to the program.

A significant group by time interaction was also found ($p<.05$) for the negatively worded statement: 'it is OK to drive a little faster than the speed limit if you are a good driver'. For this statements, there was no difference in the Program and Survey groups at either time and there was no change over time in the opinion of the Survey group; however, there was a change of opinion for the Program group, whereby there was a 36% reduction in the odds of agreeing or strongly agreeing with the statement after completing the program.

For the statements 'it is OK to exceed the speed limit if you are driving safely' and 'it doesn't bother me if other people speed' there was a main effect of group ($p<0.05$), in that across both time points, the odds of participants in the Program group agreeing or strongly agreeing with these statements were 41% and 35% lower respectively, than for the Survey group.

For the statements 'it is OK to exceed the speed limit if you are driving safely' and 'I will ride as a passenger with a driver who speeds if other passengers are also in the car' there was a main effect of time ($p<0.05$), in that the odds of participants agreeing were 36% and 40% lower respectively, at Survey 2 than Survey 1, pooled across groups.

2.3.3.b.2 Stages-of-change

The Stages-of-change items are based on behaviour change models and are designed to examine respondents' motivation to change their behaviour, or their 'stage-of change' across three levels from Pre-contemplation to Contemplation to Action. The Stages-of-change items were scored on a five-point scale from 1 (strongly disagree) to 5 (strongly agree). Scores at each stage can indicate if the speed behaviour program has been effective in bringing about positive behaviour change. If effective, scores on the Pre-contemplation scales would be expected to decrease, while scores on the Contemplation and, particularly, the Action scales would be expected to increase from Survey 1 to Survey 2. Generalised Estimating Equations (GEE) were used to examine how responses at each level changed across each BI group over time. The GEE models were specified with a normal error distribution, an identity link function and unstructured correlation matrix.

For the Pre-contemplation score, there was a significant group by time interaction. At Survey 1, the Program and Survey groups did not differ in their pre-contemplation scores. At Survey 2, however, the mean Pre-contemplation score was significantly lower (by 0.28 of a point on a 5-point scale) in the Program group than the Survey group. The mean score for the Survey group did not differ significantly over time; however, the Program groups' mean score decreased significantly by 0.22 of a point over time.

For the Contemplation score, no significant differences were revealed across groups or time.

For the Action score, there was a significant group by time interaction. At Survey 1, the Program and Survey groups did not differ in their mean Action scores. At Survey 2, the Program group had a significantly higher mean Action score (0.42 of a point on a five-point scale) than the Survey group. The mean score for the Survey group did not differ significantly over time; however, the Program groups' mean Action score increased significantly by 0.41 of a point over time.

In summary, there was a significant reduction in the Pre-contemplation score and a significant increase in the Action score for the Program group over time (no change in the Contemplation score). However, there was no significant difference in any of the Stages-of-change scores for the Survey group over time. These results suggest that completing the speed behaviour program led Program drivers to shift from not even thinking about changing their speed behaviour (Pre-contemplation) to reportedly actively taking steps to speed less (Action).

2.3.3.b.3 Part C Q2 – Speeding Attitudes Scale (SAS)

Question 2 of Part C of the questionnaire comprised the Speeding Attitudes Scale (SAS) and asked respondents to indicate if they agreed or disagreed with a range of statements regarding speeding. This scale was used to assess changes in drivers' attitudes toward speeding as a result of completing the program. Responses were provided on a 7-point scale ranging from 'Strongly disagree' (1) to 'Strongly agree' (7). Higher scores indicate less positive and safe attitudes towards speeding. A Generalised Estimating Equation (GEE) was used to see how responses changed in each BI group over time. The GEE model was specified with a normal error distribution, an identity link function and unstructured correlation matrix.

Results revealed a significant group by time interaction. At Survey 1, there was no difference in the mean scores for the Speeding Attitude Scale between the Program and Survey groups. At Survey 2, the Program groups' mean score was significantly lower (by 0.23 points on a 7 point scale) than the Survey group, suggesting that completing the program improved drivers' attitudes towards speeding. Looking at changes over time in each group separately, the Survey groups' mean score increased significantly (by 0.14 points) between Survey 1 and Survey 2. In contrast, the Program group's mean Speeding Attitude Scale score decreased significantly (by 0.16 points) after the Program, again suggesting that completion of the program improved drivers' attitudes towards speeding.

2.3.3.b.4 Part C Q3 – Driver Behaviour Questionnaire (DBQ)

Question 3 of the questionnaire comprised the Driver Behaviour Questionnaire (DBQ). The DBQ is a well-researched instrument designed to assess driver experiences with, and reactions to, a range of situations encountered in everyday driving. As well as a total score, the DBQ provides scores on four sub-scales: *violations, mistakes, lapses due to inattention* and *lapses due to inexperience*. Respondents were asked to indicate how often various driving situations happened to them in the preceding four weeks. Responses were provided on a 6-point scale ranging from 'Never' (1) to 'Very often' (6). Generalised Estimating Equations (GEE) were used to examine how responses changed in each BI group over time. The GEE models were specified with a normal error distribution, an identity link function and unstructured correlation matrix. The total DBQ scores and sub-scales were analysed, however, only the results of the total DBQ score are summarised here.

For the total DBQ score, there was a significant BI group by time interaction ($p<0.001$), whereby there was no difference between the Program and Survey groups in the mean total DBQ score at Survey 1; however, at Survey 2, the Program groups' mean score was significantly lower (by 0.25 points) than the Survey group. Both groups showed a significant reduction in mean DBQ scores over time, however, the magnitude of the reduction was larger for the Program group (-0.24) than the Survey group (-0.06). These results suggest that both groups reported experiencing fewer violations, mistakes, and lapses due to inattention and inexperience over the course of the trial, and the reduction in these behaviours was greater for the Program group.

2.3.3.b.5 Part C Q4 – Speeding Behaviour During Last 10 Trips

Question 4 of the questionnaire asked respondents in their last ten driving trips, how often they engaged in a range of eight different speeding behaviours. Respondents answered from 0 trips up to 10 trips. A Generalised Estimating Equation (GEE) was conducted on each of the speeding behaviours to see how responses changed in each BI group over time. The GEE model was specified with a negative binomial error distribution and an unstructured correlation matrix.

For the items about accidental speeding, intentional speeding and being in a hurry and driving over the speed limit to get to their destination, there was a significant interaction between BI group and time (all $p<0.05$). There was no significant difference between the Program and Survey groups in terms of engaging in these behaviours at Survey 1. However, at Survey 2 the probability of engaging in these behaviours was 30% less in the Program group compared to the Survey group. There was also no difference over time for

the Survey group, but for the Program group, the risk of engaging in these behaviours was less at Survey 2 compared to Survey 1.

For the item 'drove well over the speed limit but didn't realise', there was a main effect of group, whereby the probability of the Program group driving well over the speed limit and not realising it was 46% lower than the Survey group (pooled over time; $p<0.001$). There was also a significant main effect of time, where the risk of driving well over speed limit but not realising it was 33% lower at time 2 compared to time 1, pooled over the BI groups ($p<0.001$).

For the items 'kept at a safe speed even though people were driving faster' and 'made a real effort to look out for speed signs ', there was a significant main effect of time, where the probability of engaging in these behaviours was significantly higher at Survey 2 than at Survey 1, pooled over the BI groups.

2.3.3.b.6 Part C Q5 – Perceived Effectiveness of Road Safety Measures

The final question in Part C, Question 5 of the questionnaire, asked respondents to indicate how effective they thought a range of 10 road safety measures are in helping drivers to keep to the speed limit. Respondents answered on a 5 point scale ranging from 'Very ineffective' (1) to 'Very effective' (5). A Generalised Estimating Equation (GEE) was conducted on each of the speeding behaviours to see how responses changed in each BI group over time. Here, the response of interest was whether participants thought the measures to be effective; thus, the GEE analysis determined if the odds of answering Effective/Very effective (compared to Very ineffective/ineffective/neither effective nor ineffective) were different for the BI groups over time. The logistic GEE models were specified with a logit link function and unstructured correlation matrix.

Results revealed that the speed behaviour program was effective in improving drivers' perceived effectiveness of a range of road safety measures. After completing the program, the Program participants were more likely than Survey participants to indicate that speed cameras, speed signs, road safety advertising, in-car technology and speed guns are all effective in helping drivers keep to the speed limit. The program did not, however, appear effective in improving the perceived effectiveness of speed humps, roundabouts or police car presence.

2.3.3.c Interests and Personality Style– Part D

2.3.3.c.1 Sensation Seeking

Items on sensation seeking were a combination of the 10-item 'Thrill and Adventure Seeking (TAS)' sub-scale of Zuckerman's (1994) Sensation-Seeking Scale (Version V). According to Zuckerman (1994), items on the TAS express "a desire to engage in sports or other physically risky activities that provide unusual sensations of speed or defiance of gravity". Significant relationships between driving speed and sensation seeking have been reported in a number of studies and may moderate the effectiveness of the speed behaviour program. The maximum score is 10, with higher scores indicating higher sensation seeking. Both groups displayed low to moderate levels of sensation seeking.

A Generalised Estimating Equation (GEE) was used to examine how sensation seeking changed in each BI group over time. The GEE model was specified with a normal error distribution, an identity link function and unstructured correlation matrix. There was a significant group by time interaction, whereby there was no difference in sensation seeking scores for the Program and Survey groups at either time point. There was no change over time for the Survey group; however, for the Program group, there was some evidence for a small reduction in sensation seeking over time (8.5% reduction, $p=0.05$).

2.3.3.c.2 Marlowe-Crowne Social Desirability Scale

The 8-item short form of the Marlowe-Crowne social desirability scale (developed originally by Greenwald & Satow, 1970) was used to measure participants' level of social desirability. Social desirability concerns the propensity for participants to answer survey items in an overly positive or socially desirable manner, rather

than in a manner that reflects their true feelings or behaviour. The short-form has a maximum score of 8, with higher scores indicating a greater level of social desirability and that participants may have been answering survey items in an overly positive way. Participants in both groups scored low on social desirability at both survey time points, suggesting that participants are likely to have answered the survey items with little social desirability bias.

A Generalised Estimating Equation (GEE) was used to examine how social desirability changed in each BI group over time. The GEE model was specified with a normal error distribution, an identity link function and unstructured correlation matrix. There was no significant group by time interaction, nor a significant main effect for time. However, there was a significant main effect for BI group, whereby the Program group scored higher on social desirability at both survey time points than the Survey group. However, as stated above, the Program group still scored moderate on social desirability and the difference in mean scores between the two groups was small (less than 0.5 on a 8 point scale). Thus, the impact of these differences on survey responses is likely to be negligible.

2.3.3.d Course Material Retention Items

Twenty-four true/false items were included in the BI surveys to assess participants' retention of the speed behaviour program course materials. Eighteen of the 24 items assessed participants' knowledge of program content, while the other six did not. Examples of items addressing course content include: 'Speeding is about as risky as drink-driving' and 'Speed limits are set randomly'. All BI participants were administered these questions in the pre- and post-intervention surveys. One of the questions was dropped from the analysis due to it inadvertently not being asked in Survey 2.

The mean number of correct responses (out of 24) on the retention items was examined across the Program and Survey groups and across the two survey time points in a 2 x 2 ANOVA. There was a significant interaction between BI group and survey time ($F(1,455) = 25.13$, $p<.005$, eta squared = .046). Post-hoc tests revealed that the Program group answered a significantly higher number of retention items correctly in Survey 2 (after completing the speed behaviour program) compared to Survey 1 ($p<.05$). For the Survey group, in contrast, the number of items answered correctly did not differ significantly across the two survey points. These results suggest that the BI Program participants had retained, an average of five weeks later, information learnt at the speed behaviour program course.

2.3.3.e Factors Moderating BI Program Effectiveness

A series of GEE models were fitted to determine if a number of driver-based factors moderate the effectiveness of the speed behaviour program, as measured by the Stages-of-change Pre-contemplation, Contemplation and Action scores and the course knowledge retention items (only items relevant to course content were included). The potentially moderating factors examined included participant age, gender, social desirability Survey 1 scores (Marlowe-Crowne), scores on the Australian Propensity for Angry Driving Scale (Aus-PADS) from Survey 1, and course retention items total score from Survey 2 (for the analyses where success was measured by Stages-of-change scores).

For the Pre-contemplation and Contemplation scores, none of the variables (age, gender, driving experience, Marlowe-Crowne total score, Aus-PADS score, total retention score) formed a significant three-way interaction with BI Group and Time, which indicates that none of these factors moderated the effectiveness of the speed behaviour program in reducing participants' mean Pre-contemplation score.

For the Action scores, age, driving experience, Marlowe-Crowne total score, Aus-PADS score, or total retention score all had no significant effect on the effectiveness of the BI program in increasing participants' mean Action score. However, there was some evidence of an effect of gender ($p=0.057$). Both the male and female Program participants were actively taking steps to change their speeding behaviour after completing the program. There was evidence that Action scores increased slightly more for females in the Program group than males; however, this finding might be partly driven by the fact that females in the Survey group actually had a reduction in Action scores.

With respect to the course retention item scores, analyses were performed to determine if the effectiveness of the program in increasing retention of course-related knowledge was modified by age, gender, driving experience, Marlowe-Crowne score or Aus-PADS score. Age, gender, driving experience, or Marlowe Crowne total score were not found to impact the effectiveness of the program in increasing awareness. However, there was a significant three-way interaction between Group, survey time and the Aus-PADS score (p=0.015), indicating that the propensity for angry driving did modify the effectiveness of the BI program. At the first survey, there was no effect of Aus-PADS score on their knowledge. However, at the second survey, the retention item score increased significantly by 0.04 points (95%CI 0.01 to 0.07, p=0.013) for every unit increase in Aus-PADS score, suggesting that drivers with a greater propensity for angry driving retained more knowledge from the BI course. There was no effect of Aus-PADS score or survey time (or interaction between the two) on knowledge retention for the Survey group.

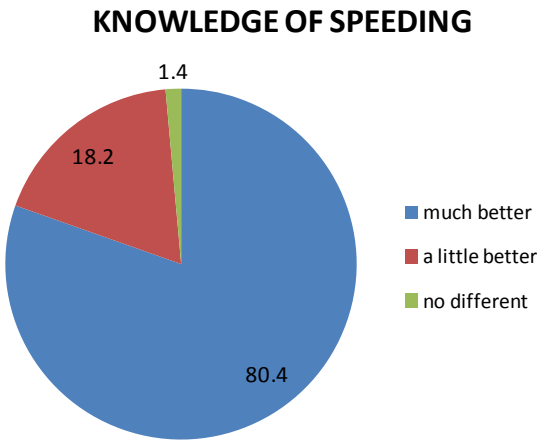
2.3.3.f BI Course Evaluation Survey Data

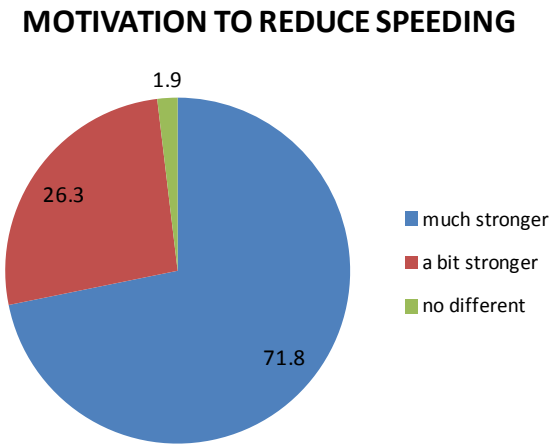
The speed behaviour program course evaluation data was examined for the 209 (of 247) BI Program participants who completed the BI course evaluation form. The purpose of the analysis was to establish if there is a clear division across participants in terms of whether they rated the course favourably or unfavourably. A clear division in course ratings may indicate the need to take this into account when analysing the survey data.

The pie charts below show the percentage of participants who responded to the various response categories for the forced-choice questions in the course evaluation survey. No major issues or rating divisions were identified, with the majority of participants indicating that the course had a positive influence on their speed knowledge, motivation to reduce speeding and was relevant to their driving behaviour. The majority of participants also reported that the facilitator was knowledgeable, the materials were useful and the venue/catering were satisfactory to excellent. In the overall course rating, over 92% of participants reported that the course met or exceeded their expectations.

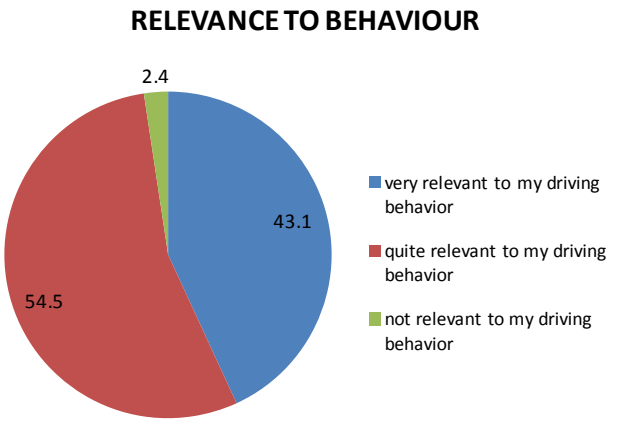
The top five responses to the open-ended questions on the most useful course content and asking for suggestions for improvement are listed in Table 2.93. The most useful course content reported by participants was the information on crash statistics, particularly when presented graphically, the opportunity to share their speed experiences with others as part of the group discussion and the comparison of the risks associated speeding compared to drink driving. Participants suggested a range of improvements including using more visual aids in the sessions such as photos or videos, particularly those that provide 'shock' value, and the need to update the statistics presented and to supplement these with real-life case studies.

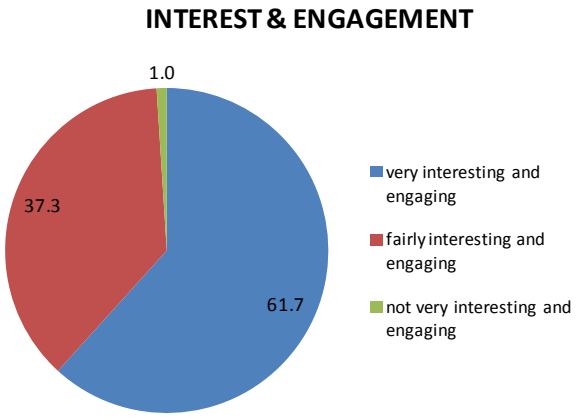
2.3.3.f.1 Speed Knowledge and Behaviour



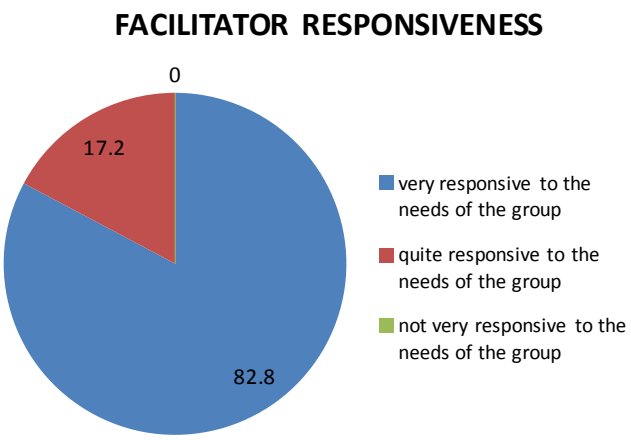


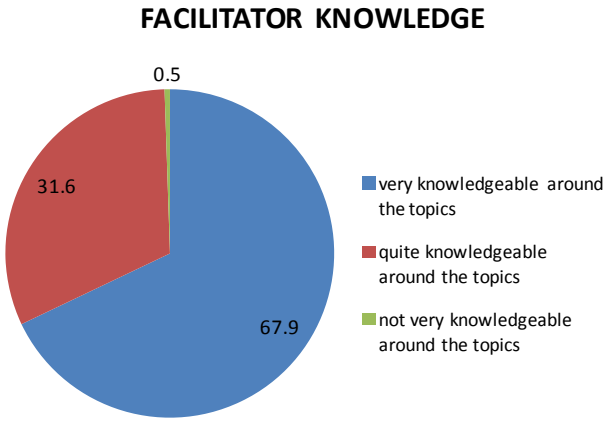
2.3.3.f.2 Course Relevance and Interest

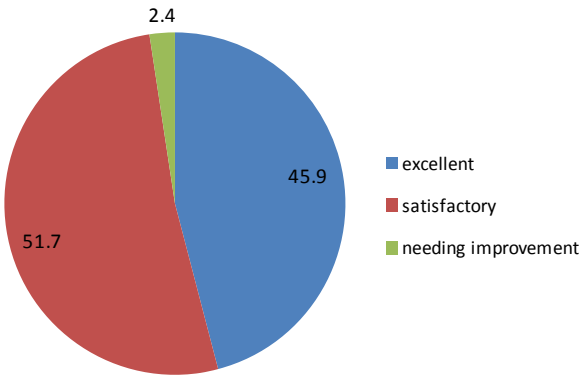




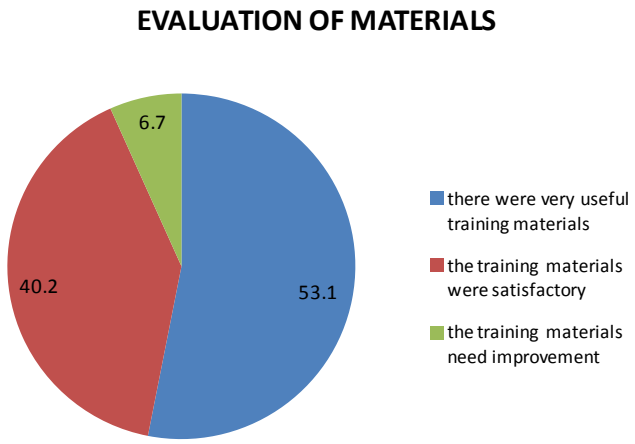
2.3.3.f.3 Facilitator and Venue



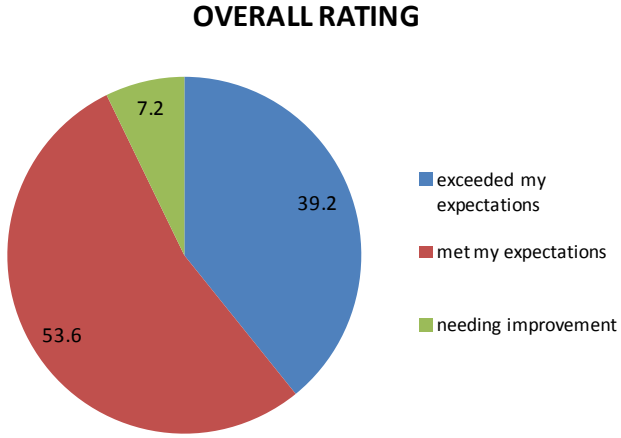




2.3.3.f.4 Session Materials



2.3.3.f.5 Overall Rating



2.3.3.f.6 Open-ended Questions

Table 2.10 Top 5 responses to questions on 'most useful course content' and 'suggested improvements'

Most useful course content	No. of participants	Most common suggested improvements	No. of participants
Speed statistics/graphs	78	No improvement needed	43
Sharing experiences with others	35	More recent speed data	18
Comparison between speeding and other risk behaviours	25	Include photos/videos (shock value)	17
Learning about speed triggers	18	Include real case studies	10
Speed behaviour change plan	11	Venue closer to home/more venue options	8

Note: participants may have stated more than one option

3 ISA SUB-TRIAL

The ISA sub-trial aimed to evaluate the effectiveness of an alerting ISA system in reducing drivers' speeding. Drivers in the ISA treatment group used an advisory ISA system for a period of 12 weeks. A control group, who were not exposed to ISA, acted as a comparison group. Approximately half of the participants in the ISA treatment and control groups had their last speeding offence and associated three demerit points removed from their record if they successfully completed the trial to assess any effects, combined or otherwise, of demerit point removal on speeding behaviour.

Prior to the main data collection phase, all procedures and materials for the ISA sub-trial were piloted with four participants. Refinements to improve the study materials and procedures were made based on the pilot results.

3.1 ISA SUB-TRIAL METHOD

3.1.1 Participants

A minimum of 60 participants were required for the ISA sub-trial, 15 in each of the four sub-trial groups. Final participant demographics for each group can be found in Section 3.3.1.

The eligibility criteria for participation in the ISA sub-trial were the same as those for the BI sub-trial, with the addition of six criteria that stated that participants must:

- either own a Victorian registered vehicle (registered under their name) or have access to a Victorian registered vehicle
- drive a Standard Vehicle (excludes taxis, fleet vehicles, motorcycles and large vehicles over 4 tonnes)
- not be planning on being away from home for an extended period of time during the trial
- drive their vehicle for at least 2000 kilometres over the duration of the study
- confirm that their primary vehicle is not a taxi or part of a fleet
- agree to disable any non-trial ISA device or GPS (satellite navigation) system in their current vehicle during the trial.

Participants who successfully completed the ISA sub-trial received a $300 gift card to cover their time and travel expenses. Additionally, half of the participants assigned to the Speed Alert Study and half of the participants assigned to the Speed Data Study had three demerit points removed from their current driver demerit history if they successfully completed all trial requirements.

3.1.2 Design

The ISA sub-trial was designed by VicRoads and comprised four groups—a Speed Alert group and a Speed Data (Logger) group—each contained demerit removal and no demerit removal sub-groups (Table 3.1). The participants in this sub-trial were randomly allocated to one of the four groups. Participants were provided with general information about the ISA sub-trial and the activities they might be required to complete prior to providing verbal consent to participate during the recruitment phone call. To avoid potential bias in participation and trial completion rates, each participant was only made aware of the project details that pertained to their specific trial group. They were not informed of any details that related to the treatments or incentives provided to other trial groups. Participants in the Speed Alert groups had an advisory ISA system fitted to their vehicle for a period of 12 weeks. A data logger was also fitted and remained in place for the full 20 week trial period to assess the effects of the ISA system and if these effects persisted after removal of the ISA system. A control group comprising approximately 50 participants also had their vehicles equipped with the data logger for a period of 20 weeks, but did not have an ISA system equipped.

Table 3.1 Design of the ISA sub-trial

Speed Alert Trial		Speed Data Trial	
Demerits removed	**No demerits removed**	**Demerits removed**	**No demerits removed**
~ 15 participants	~ 15 participants	~ 15 participants	~ 21 participants
• Pre- and Post-Intervention Surveys • Data logger and Speed Alert System fitted to vehicle • ISA Experience Interview • Demerit Point Removal • $300 gift card	• Pre- and Post-Intervention Surveys • Data logger and Speed Alert System fitted to vehicle • ISA Experience Interview • $300 gift card	• Pre- and Post-Intervention Surveys • Data logger only fitted to vehicle • Demerit Point Removal • $300 gift card	• Pre- and Post-Intervention Surveys • Data logger only fitted to vehicle • $300 gift card

3.1.3 Materials

3.1.3.a ISA Device, Data Logger, & Speed Zone Map

The ISA system, a Global Positioning System (GPS)-based device, 'SpeedAlert' supplied by Smart Car Technologies, is an advisory speed system, designed to warn the driver when he or she is travelling, intentionally or inadvertently, over the posted speed limit. Information regarding the location of the trial vehicles and the local speed limit is determined by comparing the vehicle's location coordinates (obtained from the GPS) with an on-board speed zone map of the Victorian road network, mapped and provided by VicRoads. The device determines the vehicle's location and speed using GPS, and issues warnings when the speed exceeds the posted speed limit. The ISA device is designed to start issuing warnings 1-2 km/h above the posted speed limit.

The ISA system had a three-stage warning sequence consisting of visual and auditory alerts. First, when the posted speed limit was exceeded by 1-2 km/h, the visual speed limit icon denoting the posted limit filled with red. This visual warning remained in place until vehicle speed was reduced below the stage 1 threshold. In the second warning phase, in addition to the visual icon remaining red, the driver received a single auditory tone (beep) when vehicle speed reached 2-4 km/h over the speed limit. In the third warning stage, the system issued a continuous, rapid triple beep auditory warning when vehicle speed reached more than 4 km/h above the speed limit and continued until the vehicle's speed returned to below the warning threshold. In addition to the speed warnings, the ISA device also issued a soft tone when entering a new speed zone to alert the driver of the speed zone change. The ISA device was capable of detecting variable speed changes, such as school zones, which it indicated using a yellow ring around the speed limit icon, or shopping zones, which used a blue ring. The device did not detect variable speed zones on freeways (e.g. Melbourne Westgate Bridge) or speed changes due to road works.

Drivers had the ability to temporarily disable the ISA auditory warnings for one minute by pressing the mute button located on the touch screen display unit. This function automatically reset to prevent participants from muting the device, intentionally or unintentionally, for entire trips. Drivers also had the option of disabling the ISA unit and its warnings for an entire trip by using a screen on/off switch. This switch was designed for use by non-trial participants so that they could still drive the vehicle without being exposed to the system warnings. The switch was also designed to reduce the amount of non-participant data being recorded during the trial. Participants were instructed to inform any non-participants using their vehicle to deactivate the ISA device by using this switch. In addition, drivers were provided with a key ring with a prompt to remind non-participant drivers to switch off the device before driving the vehicle.

The ISA device was not calibrated to each vehicle's speedometer due to the large range of vehicles that were used in the trial. Rather, the device was calibrated in the same way for all participants. The stage 1 warning threshold for the ISA warnings was set 1-2 km/h above the posted speed limit as determined by GPS speed in order to minimise the occurrence of false warnings. It should be noted that this means that some participants received warnings earlier or later than other participants depending on how their vehicle speedometer was calibrated.

The accuracy of speed and position records generated by two ISA device units was tested and certified by Transport Certification Australia prior to the commencement of the trial. Both devices were found to meet the accuracy criteria for >98% of the records sampled. That is, the records showed that the vehicle was within 2 kms of the true vehicle speed for between 99.17 – 99.36% of the time and within a radius of 10 meters for between 98.02 – 99.77% of the time across a variety of driving contexts. Drivers were told at the start of the study that the speed alert (ISA device) was not 100% accurate and may lose reception in some areas.

There are, however, some limitations with the device. First, it does not work in tunnels or under significant cover (e.g. built-up areas). Second, the Speed Zone Map is not 100% accurate; meaning that the devices may display the incorrect limit for a road or may not always detect a change in the speed limit. This issue was partly addressed by having a feedback mechanism where participants could call a project hotline to log discrepancies. Participants in the Speed Alert group were also given the opportunity to provide information about inaccuracies with the speed map during the ISA Experience interview. Map updates were then periodically provided automatically over the internet. Third, the device has limitations common to all GPS devices. The device can sometimes take a long time to boot and the signal can stray to the wrong roads. For example, the device can have difficulty distinguishing between two roads running closely in parallel.

Each sub-trial vehicle is also fitted with a data logging system. The data logging system enables automatic collection of a wide range of vehicle data, such as vehicle speed, time, date, location, screen status and alert status. The data were recorded at a rate of 1 Hz and were transferred wirelessly over the internet to the Smart Car Technologies monitoring server.

3.1.3.b Pre- and Post-Intervention Surveys

The pre- and post-intervention surveys (Surveys 1 and 2) for the ISA sub-trial were identical to the surveys used for the BI sub-trial, with two exceptions. First, the ISA sub-trial surveys did not contain the behavioural intervention course retention questions in Part D. Second, the ISA sub-trial Survey 2 had two additional questions in Part D asking participants if having the data logger fitted to their vehicle changed their speed behaviour and if they forgot that the logger was in the car (See Appendix B).

Items from Parts A and B and Questions 1, 4 and 5 of Part C were each analysed and reported individually. The existing standardised scales contained in Parts C (Stages-of-change, SAS, DBQ) and D (Sensation-Seeking Scale, Marlowe-Crowne, Aus-PADS) were analysed based on their aggregated scale (and where relevant sub-scale) scores.

3.1.3.c Participant Pack

The participant packs were identical to those provided in the BI sub-trial, but contained details relevant to the ISA group to which the participant had been assigned. Each pack was branded and colour coded differently for each trial group to ensure that each group received the correct pack and did not have the details of the other trial group disclosed to them.

3.1.3.d ISA Experience Interview

The ISA experience interview was a telephone-based semi-structured interview conducted with participants from the Speed Alert group within one week of the ISA device being removed from their vehicle. The interview took approximately 45 minutes to complete and contained a range of questions designed to elicit more detailed information from participants about their experiences with using the ISA device. Specific

topics covered in the interview included the perceived effects of the ISA and data-logging devices on drivers' speed and other driving behaviour, the usability of the system, issues with system errors and drivers becoming over-reliant on the device, the effects of the ISA device on mental workload and distraction, and any suggested improvements to the operation of the ISA system.

3.1.4 Procedure

Potential ISA sub-trial participants were first identified by VicRoads through the DLS as per the BI sub-trial. Each week a new batch of participants who met the trial criteria were identified. These potential participants were randomly assigned to one of the four ISA groups prior to being contacted. The sample list from which recruitment was conducted was split each week into separate lists for each ISA group. The sample list was typically split evenly across ISA groups; however, if recruitment was lagging in one group, then the split of the sample list was weighted in that group's favour until recruitment numbers were roughly equivalent across groups. The weighted split was conducted so that participants were recruited into the different ISA groups at roughly the same rate.

Once they were assigned to a group, potential participants were sent a letter of intent, outlining that they had been identified as a potential participant for the RST and that they may receive a phone call inviting them to participate in the trial. Participants were then contacted by phone by the recruitment provider Colmar Brunton (Your Source) and a recruitment interview was conducted to check their eligibility and invite them to participate.

Participants were not told which trial group they were in before agreeing to take part in the trial to avoid a systematic selection bias at the telephone agreement stage. Once the participant verbally agreed to participate they were provided with details of their trial group (including details of demerit point removal if relevant), to which they were previously randomly assigned. Participants were then sent a participant pack containing a plain language statement detailing the participant's and VicRoads' responsibilities during the trial, a participant agreement and a copy of Survey 1. Participants were required to complete the survey and participant agreement, which detailed the activities they were required to complete to receive demerit removal and the monetary incentive ($300 for each participant), and return them to the recruitment provider. Participants were able to withdraw from the trial at any stage (both before and after signing the participant agreement) by doing so in writing.

The ISA sub-trial took approximately 21 weeks for each participant to complete. An overview of the timing of trial activities for individual participants in the ISA sub-trial is contained in Figure 3.1. After returning their consent form, participants in the Speed Alert group had their vehicle fitted with the ISA device and data logging system. Participants received a reminder card detailing their installation session time and location. The ISA device remained in their vehicle for 12 weeks, after which it was removed. This 12 week period is referred to as the *'ISA Active'* period. Within one week of the ISA device being removed, participants completed the ISA experience interview and, four weeks after ISA removal, completed Survey 2. The second survey was sent four weeks after ISA device removal to allow participants sufficient time to drive without the ISA device and to allow time for any recency effects of the device warnings to diminish. The data logger remained in the Speed Alert group's vehicles for the entire 20 week trial. The 8 weeks of the trial where only the data logger was present is referred to as the *'After ISA'* period. During the entire period that the data logger was fitted, each participant's logged driving data was checked on a weekly basis for any instances of Sustained Dangerous Driving. For the purposes of the RST, two criteria of Sustained Dangerous Driving were developed:

1. 10% or more of the time spent driving 15 km/h over the speed limit on two or more days during a week
2. Exceeding the posted speed limit for at least 15 seconds by 25 km/h or more on three or more occasions during a week.

If participants were found to meet either criterion for Sustained Dangerous Driving they were disqualified from the trial. Participants were aware of these criteria prior to consenting to the trial.

The Speed Data group had their own vehicles fitted with the data logging device only, which remained in place for 20 weeks. For the purposes of comparing this group with the Speed Alert group in the analyses, the Speed Data groups' trial was split into the equivalent 12 week *'ISA Active'* period and an 8 week *'After ISA'* period. Approximately 16 weeks after installation of the data logger, the Speed Data participants completed Survey 2 (i.e. at the equivalent point in the trial that the Speed Alert group completed their Survey 2).

If ISA sub-trial participants successfully completed all trial components, they received their participant payment. In addition, half of the participants in the Speed Alert and Speed Data groups had their trigger offence with the associated three demerit points removed from their record. The other half of these groups did not receive any demerit point removal.

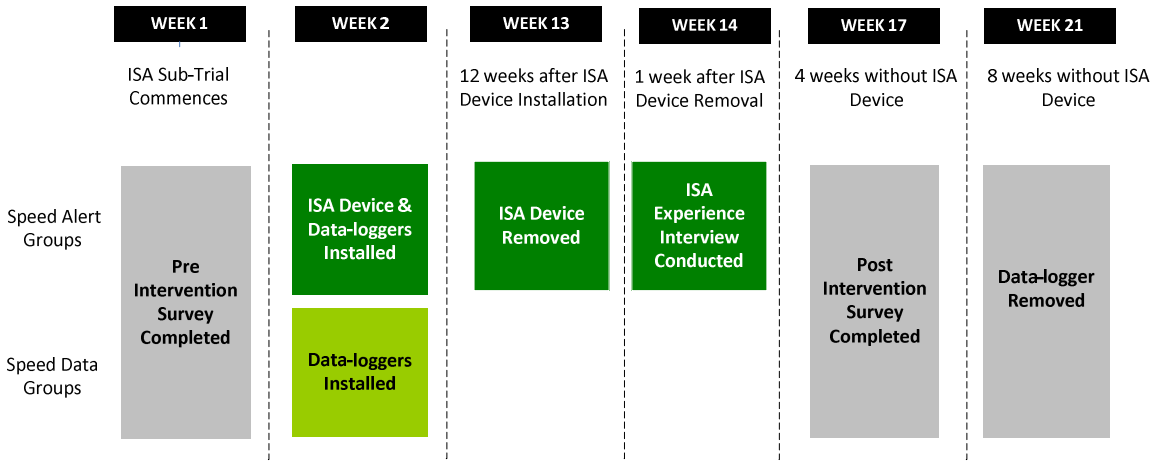


Figure 3.1 ISA sub-trial activities and timelines for the Speed Alert and Speed Data participants

The ISA sub-trial ran from October 2010 to March 2012. The timing of various activities throughout the trial for the ISA groups is contained in Table 3.2.

Table 3.2 Timing of trial activities for the ISA sub-trial groups

Group	First participant recruited	Last participant recruited	First date Survey 1	Last date Survey 1	First date ISA and/or logger in car	Last date ISA and/or logger removed	First date Survey 2	Last date Survey 2
Speed Alert (No Demerit Points Removed)	16/01/2011	2/05/2011	20/01/2011	16/05/2011	25/01/2011	2/06/2011	27/07/2011	13/03/2012
Speed Alert (Demerit Points Removed)	5/02/2011	4/05/2011	15/02/2011	2/06/2011	24/02/2011	8/06/2011	27/07/2011	22/10/2011
Speed Data (No Demerit Points Removed)	19/01/2011	3/05/2011	28/01/2011	15/05/2011	4/02/2011	31/05/2011	27/07/2011	19/10/2011
Speed Data (Demerit Points Removed)	16/01/2011	20/02/2011	19/01/2011	18/03/2011	27/01/2011	12/04/2011	27/07/2011	19/10/2011

3.1.5 ISA Map Updates and Loss of Satellite Coverage

Analysis of data and logged issues during the trial confirmed the Speed Alert device was not 100% accurate in terms of being consistent with the posted speed limit and the device would sometimes lose satellite coverage, during which time drivers did not receive warnings.

On occasion, the ISA system would display a speed limit that was different (lower or higher) to the posted speed limit for a segment or entire length of road. The system would also in some cases change through various different speed limits within a short distance, without any changes in the posted speed limit actually occurring. The inaccuracies in the ISA map database occurred across metropolitan Melbourne as well as in semi-rural areas and major Victorian freeways (e.g. Hume Freeway).

Across the entire ISA sub-trial (including device piloting), a total of 61 cases of ISA inaccuracies were observed and reported. Most of these were discovered during the piloting of the Speed Alert device or through examination of the logged data as part of the weekly Sustained Dangerous Driving checks. Of these 61 cases, 26 were caused by errors in the ISA map, six by errors with the device (including GPS stray and the system detecting limits on parallel roads such as service roads), four by drivers' excessive speeding (which were flagged initially as potential map inaccuracies). For the remaining 25 flagged cases, the cause was unknown due to a lack of information, or because a map and site check failed to reveal the cause of the error. Many of these unknown cases are likely to have been due to GPS stray, however, there was insufficient evidence to record this as the cause of the inaccuracy.

The cases where the inaccuracies were due to a map or device error were addressed by updating the map database periodically throughout the trial to reflect the correct speed limit or to update the software to improve GPS accuracy. Any documented cases of GPS inaccuracies were removed from the data set before

analysis, as the incorrectly displayed speed and false warnings may have affected behaviour differently to accurate speed warnings.

In terms of loss of satellite coverage, the mean (SD) proportion of driving time that the ISA device lost satellite coverage is listed in Table 3.3 for each ISA group. As displayed, loss of satellite coverage during the trial varied considerably within groups and also to a lesser extent across groups. Both Speed Alert groups had no coverage for a similar amount of their driving time (about 9 – 10%), while the control Speed Data groups also spent a similar amount of time with coverage (6%).

Table 3.3 Mean (SD) proportion of driving time without satellite coverage for the ISA device

	Speed Alert (No Demerit Points Removed)	Speed Alert (Demerit Points Removed)	Speed Data (No Demerit Points Removed)	Speed Data (Demerit Points Removed)
Mean (SD) % of time	10.02 (6.34)	8.99 (11.93)	5.82 (6.40)	5.94 (3.62)
Range	4.04 -23.57	2.71 – 61.11	1.67 – 30.65	2.23 – 16.97

3.2 ISA SUB-TRIAL RECRUITMENT DATA & BIAS

3.2.1 Selection Bias

Recruitment data were analysed to determine if any selection bias exists in terms of the demographic details of participants who were recruited into the ISA sub-trial versus the entire RST sample list (used for the BI and ISA sub-trials). Table 3.4 displays the age and gender details of the entire trial sample list and those participants who were recruited into the ISA sub-trial group. Participants were considered to have been recruited into the sub-trial if they provided a signed consent form and returned at least one completed survey.

Differences in age across the participants recruited into the ISA sub-trial and the entire RST sample were examined using a t-test. No significant difference in participant age was found between the participants recruited into the trial and the entire RST sample ($t(6691) = 1.02$, $p = 0.31$). Differences in the number of days to recruitment/refusal from TIN issue date and date the TIN was entered into the VicRoads DLS were also examined using a Mann-Whitney U test (data were not normally distributed). No significant difference was found between recruited participants and the entire RST sample in the number of days from TIN DSL entry and recruitment/refusal ($p=.466$).

However, a significant difference was found between participants recruited into the ISA sub-trial and the entire RST sample for the number of days from the TIN being issued to recruitment/refusal ($p=.001$). Participants who were recruited into the ISA trial had fewer days from TIN issue to recruitment, compared to the RST sample overall. As with the BI sub-trial, the impact of these differences on the outcomes of the ISA trial are difficult to establish given that there is no clear association between receiving a TIN and behaviour, especially after the amount of time that had lapsed between the TIN and recruitment (up to 23 weeks). However, these differences should be considered in the interpretation of the effectiveness of the ISA program as the participants recruited into the trial may have been more affected by the trigger TIN.

Differences in gender and years of driving experience could not be examined because gender and driving experience were not provided for the entire RST list.

Table 3.4 Demographic details of the entire RST sample list and broken down across the ISA sub-trial groups

	n	Mean (SD) age	Gender	Driving experience (years)	Mean (SD) days to recruitment from TIN
Participants recruited into ISA sub-trial	105	42.8 (14.2)	F 56 (53.3%) M 49 (46.7%)	23.4 (13.8)	From TIN issue: 119.1 (45.0) From DLS entry: 62.4 (31.7)
Total RST sample	**6588**	**41.4 (13.9)**	**N/A**	**N/A**	From TIN issue: 157.4 (95.1) From DLS entry: 92.7 (86.4)

For those on the entire RST sample list with whom a contact attempt was made, selection bias analyses were also conducted to examine if there was any bias across those participants recruited into the ISA sub-trial and those not recruited. Contact attempts were made with 1,096 candidates from the RST sample list for the ISA sub-trial. Table 3.3 displays the number of participants recruited into the trial and the number who were not recruited for various reasons. The recruitment data were classified as follows:

- **Recruited:** Participants who provided a signed consent form and completed at least one survey.
- **Not Recruited:** Participants who refused to participate in the trial, those who failed the introductory screener due to language barrier or not meeting eligibility criteria and those who could not be reached (e.g. answering machine, engaged, no answer after 2 attempts).

Selection bias across the 'Recruited' and 'Not Recruited' groups was examined using a t-test (age) and Fisher's exact (gender).

No significant differences in participant age were found between the participants recruited into the trial and the entire RST sample ($t(1094) = 1.12$, $p = 0.26$) (Table 3.5). In terms of the gender analyses, no significant differences in gender were found across participants recruited into the ISA trial and those who were not recruited (Fisher's exact, $p=0.47$). Taken together, these results indicate that there does not appear to have been a systematic selection bias occurring for recruitment into the ISA sub-trial.

Table 3.5 Demographics of participants recruited and not recruited into the ISA sub-trial groups from contact attempts made

	n	Mean (SD) age	Gender
Recruited	105	42.8 (14.2)	F 56 (53.3%) M 49 (46.7%)
Not Recruited	991	41.2 (13.9)	F 481 (49.2%) M 497 (50.8%)

3.2.2 Randomisation Bias

To examine if there was any bias in the randomisation of ISA participants into the four groups, age, gender, driving experience and days to recruitment from TIN issue date and date the TIN was entered into the VicRoads DLS were examined across groups.

A one-way ANOVA revealed no significant differences in participant age across the four ISA groups (F(3,101)) = 0.86, p=0.465) (See Table 3.6). Likewise, there was no significant difference in years of driving experience across the groups (F(3,100) = 0.681, p = .565). In terms of the gender analyses, no significant difference in gender was found across participants in the four ISA groups (Fisher's exact, p=0.354).

Significant differences were found across the four ISA groups for both the number of days from the TIN being issued to recruitment/refusal (Kruskal-Wallis, p=.009) and the number of days from TIN DSL entry and recruitment/refusal (Kruskal-Wallis, p<.001). In both cases, it appears that participants in the Speed Data (Demerit points removed) group had fewer days from TIN issue and DLS entry to recruitment, compared to the other three groups, who were all similar. Again, these differences should be considered in the interpretation of the effectiveness of the ISA program.

Table 3.6 Mean (SD) age, gender and driving experience of participants recruited into the ISA sub-trial groups

ISA group	n	Mean (SD) age	Gender	Driving experience (years)	Mean (SD) days to recruitment from TIN
Speed Alert (No Demerit Points Removed)	26	41.1 (16.7)	11 F 15 M	22.2 (16.6)	From TIN issue: 117.4 (39.8) From DLS entry: 59.8 (25.6)
Speed Alert (Demerit Points Removed)	26	40.1 (11.9)	14 F 12 M	20.8 (11.6)	From TIN issue: 132.1 (31.6) From DLS entry: 73.7 (23.6)
Speed Data (No Demerit Points Removed)	27	44.5 (12.9)	18 F 9 M	24.9 (13.9)	From TIN issue: 124.4 (65.6) From DLS entry: 70.1 (47.9)
Speed Data (Demerit Points Removed)	26	45.4 (14.9)	13 F 13 M	25.5 (12.9)	From TIN issue: 102.5 (29.7) From DLS entry: 45.6 (9.1)

3.2.3 Attrition Bias

A final examination of bias involved examining if there were any differences in the demographic characteristics of participants who withdrew or were disqualified at any point during the ISA trial compared to those who completed all trial activities successfully. This was completed separately for the ISA survey data and the ISA logged driving data given that the drop-out rate was different across these two data sources. Participants who did not complete one of these data sources but successfully completed the other were retained only for the analysis involving the completed data source. Most participants completed both survey and logged data, thus there is a large degree of over-lap in the participants included in each data group.

Table 3.7 provides details of the number of participants recruited into the ISA sub-trial, the drop-out rate across the survey and logged driving data, and the number of participants who completed the survey and logged driving sub-trial activities. Selection bias across those participants who completed and those who dropped out was examined using binary logistic regression, with age, gender, driving experience and ISA group as predictor variables.

For the survey attrition analyses, there was no significant differences in age, driving experience or gender (all p≥0.05) across those ISA group participants who completed the survey component and those who dropped out. Nor was there a statistically significant difference in survey completion and attrition rates across the four ISA groups (p>0.05).

For the logged data analysis, again there were no significant differences in age, driving experience or gender (all p≥0.05) across those ISA group participants who completed the logged driving component and

those who dropped out. Nor was there a statistically significant difference in logged driving completion and attrition rates across the four ISA groups (p>0.05).

Taken together, these results suggest that there was no age, gender, driving experience or group bias in terms of participant drop-out during the ISA trial. However, it is interesting to note that was a non-significant trend for the drop-out rate to be higher for those ISA groups who did not receive demerit point removal. Given that participants dropped out of the trial for various reasons (including being disqualified for dangerous driving), it is difficult to know the extent to which the lack of demerit point removal contributed to the relatively higher drop-out rate.

Table 3.7 Age, gender and driving experience of ISA sub-trial participants who dropped-out and completed the two surveys and logged driving aspects of trial

	Speed Alert (No Demerit Points Removed)	Speed Alert (Demerit Points Removed)	Speed Data (No Demerit Points Removed)	Speed Data (Demerit Points Removed)
Surveys				
Dropped-out*				
n	10	4	10	2
Mean (SD) age	42.1 (17.0)	37.3 (9.2)	41.8 (15.1)	42.5 (16.3)
Gender	4 F; 6 M	2 F; 2 M	8 F; 2 M	1 F; 1 M
Driving experience	19.4 (17.0)	19.5 (8.6)	23.3 (15.0)	20.0 (9.9)
Completed trial				
n	16	22	17	24
Mean (SD) age	39.4 (16.8)	40.6 (12.4)	46.1 (11.8)	45.6 (15.1)
Gender	7 F; 9 M	12 F; 10 M	10 F; 7 M	12 F; 12 M
Driving experience	23.8 (16.7)	21.0 (12.3)	25.9 (13.6)	25.9 (13.2)
Logged driving data				
Dropped-out#				
n	9	3	5	2
Mean (SD) age	37.7 (16.9)	37.0 (11.3)	38.6 (14.2)	42.5 (16.3)
Gender	3 F; 6 M	1 F; 2 M	4 F; 1 M	1 F; 1 M
Driving experience	19.4 (17.0)	20.0 (10.4)	20.4 (13.8)	20.0 (9.9)
Completed trial				
n	17	23	22	24
Mean (SD) age	42.9 (16.8)	40.5 (12.1)	45.8 (12.7)	45.6 (15.1)
Gender	8 F; 9 M	13 F; 10 M	14 F; 8 M	12 F; 12 M
Driving experience	23.8 (16.7)	20.8 (12.0)	26.0 (14.0)	25.9 (13.2)

* Includes participants who withdrew or were disqualified from trial, who did not complete both surveys, or who did not complete Survey 2 within 4 months

Includes participants who withdrew or were disqualified from trial or who did not complete a full set of logged driving data

3.3 ISA SUB-TRIAL RESULTS

3.3.1 Participant Sample Demographics

The demographic details of participants who were included in the ISA survey and/or logged driving analyses were examined to explore any differences across the ISA groups. One participant from the Speed Alert (No demerit removal) group did not return Survey 1 and thus did not have any demographic details available beyond age and gender. Table 3.8 displays the key demographic, driving history and travel patterns and personality measure details of participants in the four ISA sub-trial groups (a full descriptive list of all

demographic variables collected for the ISA sub-trial can be found in Appendix C). Each of the demographic details were compared across the four ISA groups using MANOVA, ANOVA and chi-square test to determine if any significant differences in key demographics exist across ISA groups that need to be used as covariates in the analysis of the ISA survey and logged driving data. The six response categories for the number of kilometres travelled in the last week were collapsed into three categories (< 200km, 200-400km, >400km) so that the expected cell counts met the required minimum to perform chi-square analysis.

The right column in Table 3.6 provides the results of these statistical tests. No significant differences were found across the four ISA groups for any of the variables examined, except for the percentage of driving time spent travelling to get to work, where the Speed Data (No Demerits) group spent less time travelling to work than the Speed Alert groups and Speed Data (Demerit) group. Given that travelling to work is indicative of travelling in higher density peak hour traffic, this might suggest that the Speed Alert (Demerit) and Speed Data (Demerit) groups have less opportunity to speed during these commuter trips. However, given that there are two Speed Data groups used in any comparisons with the Speed Alert groups, the impact of this difference in time travelling to work is expected to be negligible.

The lack of significant differences across groups on the key demographic variables suggests that the randomisation process was successful and that demographic characteristics do not need to be included as covariates in the ISA survey or logged driving analysis.

Table 3.8 ISA sub-trial participant demographics

	Speed Alert (No Demerit Points Removed)	**Speed Alert (Demerit Points Removed)**	**Speed Data (No Demerit Points Removed)**	**Speed Data (Demerit Points Removed)**	**p**
n	16	23	22	24	
Mean (SD) age	42.1 (17.0)	40.5 (12.1)	45.8 (12.7)	45.6 (15.1)	$F(3,81) = 0.78$, $p = .511$
Gender	7 F; 9 M	13 F; 10 M	14 F; 8 M	12 F; 12 M	$\chi^2(3) = 1.71$, $p = .634$
Driving history & travel patterns					
Driving experience (Mean years licence held)	23.1 (16.5)	20.9 (12.0)	26.0 (14.0)	25.9 (13.2)	$F(3,81) = 0.69$, $p = .556$
Kms in last week (% participants)	< 200km – 7.7% 200-400km – 84.6% >400km – 7.7%	< 200km – 26.1% 200-400km – 34.8% >400km – 39.1%	< 200km – 18.2% 200-400km – 31.8% >400km – 50.0%	< 200km – 20.8% 200-400km – 41.7% >400km – 37.5%	$\chi^2(6) = 11.68$, $p = .070$
% time driving in city	8.9 (13.5)	19.0 (27.8)	6.0 (7.3)	18.9 (29.9)	$F(3,81) = 1.94$, $p = .129$
% time driving in urban areas	51.7 (34.2)	46.3 (32.9)	56.1 (31.9)	50.4 (31.2)	$F(3,81) = 0.35$, $p = .787$
% time driving in rural areas	13.8 (22.8)	3.1 (5.3)	18.1 (23.5)	12.4 (22.5)	$F(3,81) = 2.27$, $p = .087$
% time driving on freeways	25.6 (21.4)	31.6 (27.4)	19.8 (19.5)	18.3 (18.4)	$F(3,81) = 1.75$, $p = .163$
% time travelling *to* work	43.1 (26.5)	47.8 (31.2)	23.2 (27.7)	54.6 (30.5)	**$F(3,81) = 4.79$, $p = .004$** Speed data (No demerits) < Speed Alert (Demerits) and Speed Data (Demerits)
% time travelling *for* work	8.1 (19.7)	20.3 (30.0)	27.7 (35.9)	14.8 (25.9)	$F(3,81) = 1.58$, $p = .200$
% time travelling for	48.8 (31.6)	31.9 (21.3)	49.1 (36.2)	30.6 (24.6)	$F(3,81) = 2.68$, $p = .052$

	Speed Alert (No Demerit Points Removed)	Speed Alert (Demerit Points Removed)	Speed Data (No Demerit Points Removed)	Speed Data (Demerit Points Removed)	p
private purposes					
No. crashes last 3 years	0 crashes – 10 drivers 1 crash – 4 drivers 2 crashes – 2 drivers	0 crashes – 14 drivers 1 crash – 6 drivers 2 crashes – 3 drivers	0 crashes – 15 drivers 1 crash – 4 drivers 2 crashes – 3 drivers	0 crashes – 15 drivers 1 crash – 7 drivers 2 crashes – 1 driver	Fisher's exact, p = .909
Personality measures					
Sensation Seeking (max score=10)	5.7 (2.5)	4.3 (3.2)	3.5 (3.0)	4.2 (1.2)	$F(3,78) = 1.66$, $p = .183$
Propensity for Angry Driving (PADS) (max score=86.05)	36.4 (5.1)	37.9 (7.4)	35.9 (6.2)	35.5 (4.9)	$F(3,78) = 0.74$, $p = .534$
Marlowe-Crowne Social Desirability (max score=8)	4.6 (1.4)	5.2 (2.4)	5.3 (2.0)	5.3 (1.9)	$F(3,78) = 0.47$, $p = .708$

Standard deviation in parentheses

3.3.2 ISA Survey Results Summary

This section summarises the key results from the ISA surveys. The full survey results can be found in Appendix E. The key findings for each survey section are discussed separately.

Generalised Estimating Equations (GEE) were used to examine all survey items unless otherwise stated. These analyses aimed to determine if survey responses differed significantly across the four ISA groups and if survey responses changed over time, in order to establish the effectiveness of ISA and/or demerit point removal on improving drivers' speeding knowledge and attitudes (see Section 3.3.3.a for a detailed explanation of the GEE method). Statistical significance is represented by p values below 0.05. Results that approach significance (p values greater than 0.051 and <0.10) are discussed as trends.

3.3.2.a Data Screening

A total of 105 ISA sub-trial participants returned at least one survey during the trial. Of these, 26 were removed from the ISA survey analyses for various reasons. A breakdown of the number of participants removed from each group and the reasons why is included below in Table 3.9. After removal, a total of 79 participants were included in the ISA Survey analyses.

Table 3.9 Number of participants removed from survey analyses across the ISA groups

	Speed Alert (No Demerit Points Removed)	Speed Alert (Demerit Points Removed)	Speed Data (No Demerit Points Removed)	Speed Data (Demerit Points Removed)
Did not return Survey 1	1	-	-	-
Did not return Survey 2*	9	4	10	2

*Also includes those disqualified or who withdrew from trial

The number of days taken to send and complete Survey 1 was also examined for the four ISA groups because completing the survey later may alter the effect of the trial experience on survey responses (Table 3.10).

T-tests were conducted to examine if the differences in time taken to complete the surveys differed across the four ISA sub-trial groups. Before conducting the t-tests, one outlier (29 days to complete) was removed from the Survey 1 data for the Speed Data (No demerits removed) group to ensure that the assumptions required of the statistical tests were met.

A one-way ANOVA revealed a significant difference in the time taken to complete Survey 1 across the ISA groups, $F(3,74) = 5.38$, $p = .002$, $\eta^2 = .18$. Tukey's post-hoc tests revealed that the Speed Alert (No demerits removed) group took significantly longer to complete Survey 1 than both of the two Speed Data groups (both $p < .02$).For Survey 2, a significant difference in the time taken to complete the survey across the ISA groups, $F(3,74) = 4.99$, $p = .003$, $\eta^2 = .17$. Tukey's post-hoc tests revealed that the Speed Alert (Demerits removed) group took significantly less time to complete Survey 2 than the Speed Alert (No demerits removed)and Speed Data (Demerits removed) groups (both $p < .05$).

No action was taken to account for differences in Survey 2 completion time in the ISA survey analysis given that the surveys were almost all completed within 4 months of the sent date.

Table 3.10 Time to send (from recruitment date) and complete (from sent date) Surveys 1 (pre) and 2 (post) for the ISA sub-trial

ISA group	Days to send Survey 1	Days to complete Survey 1	Days to send Survey 2	Days to complete Survey 2
Speed Alert (No Demerit Points Removed)	*(n = 16)*	*(n = 16)*	*(n = 16)*	*(n = 16)*
Mean	1.0	20.31	122.13	86.19
SD	0	15.73	18.63	43.68
Range	-	3-55	93-156	15-211
Speed Alert (Demerit Points Removed)	*(n = 22)*	*(n = 22)*	*(n = 22)*	*(n = 21)*
Mean	1.0	14.33	122.36	60.52
SD	0	8.75	24.02	26.79
Range	-	4-40	98-184	19-110
Speed Data (No Demerit Points Removed)	*(n = 17)*	*(n = 17)*	*(n = 17)*	*(n = 17)*
Mean	1.0	9.24	113.88	84.41
SD	0	6.73	13.21	25.66
Range	-	4-29	95-142	37.13
Speed Data (Demerit Points Removed)	*(n = 24)*	*(n = 24)*	*(n = 24)*	*(n = 24)*
Mean	1.04	10.33	114.87	92.63
SD	0.20	7.25	17.04	19.98
Range	1-2	2-26	94-152	63-128

*Days to send Survey 2 was calculated from the recruitment date for all four groups (Survey 2 should have been sent in week 17 (day 120) of the trial)

3.3.2.b Perception of Road Safety Issues – Part B

3.3.2.b.1 Part B Q1 – Factors Contributing to Road Crashes

Question 1 of Part B of the questionnaire (Appendix B) asked respondents to indicate how often they thought a range of factors and behaviours (e.g., poor road design or drink driving) contributed to road crashes. Responses were provided on a 5-point scale ranging from 'Never' to 'Very often'. The logistic GEE models were specified with a logit link function and unstructured correlation matrix.

For the item asking if speeding 'often' or 'very often' contributes to road crashes, a 3-way interaction was found ($p=0.008$). In the group that did not have demerit points removed, there was a significant change in attitudes for the Speed Data group with the odds of the Speed Data group believing speeding 'often' or 'very often' contributes to road crashes at time 2 being 6.7 times the odds at time 1 ($p=0.021$). There was no such change over time for the Speed Alert group. For the group that did have demerit points removed, there was no significant ISA by time interaction, nor was there any difference between ISA groups, or over time.

For a number of factors (drink driving, ignorance of road rules, poor road design, and road congestion) a significant main effect of time was found. The odds of all four groups responding that these factors 'often' or 'very often' contributed to road crashes was significantly higher at Survey 2 than at Survey 1, however, there was no difference between groups.

For the factor of distraction, there was a main effect of demerit point removal, with participants who had demerit points removed having 60% lower odds of believing that distraction often or very often contributes to crashes compared to those who did not have demerit points removed, however there was no effect of ISA group or time.

For the factor 'hoons showing off', the odds of the Speed Data group thinking that this factor 'often' or 'very often' contributes to road crashes was 100% higher at time 2 compared to time 1 ($p=0.028$). There was no significant change over time for the Speed Alert group.

No significant differences were found across groups or survey times for the remaining seven factors.

3.3.2.b.2 Part B Q2 – How dangerous is it to Travel Above Speed Limit

Questions 2a to 2i of Part B of the questionnaire asked participants how dangerous it was to travel at various speeds above the speed limit in 50, 60 and 100 km/h zones. Responses were categorised as Dangerous (Very Dangerous/Dangerous/A Bit Dangerous) or Safe (Safe/Very Safe). Three full factorial GEEs (binomial error distribution, logit link and unstructured correlation matrix) were conducted to determine if the odds of believing that it was safe to travel 5 km/h, 10 km/h or 20 km/h above the speed limit were changed as a result of the program, and if this effectiveness differed according to speed limit.

The use of ISA or demerit point removal did not change participants' attitudes about whether or not travelling 5, 10 or 20 km/h over the speed limit was dangerous, with no significant interactions of any order. The lack of significant interactions involving ISA group and time indicate that experience of the ISA system did not lead to changes in opinion over time in terms of whether or not it is dangerous to travel more than 5 or 10 km/h over the limit in 50, 60 or 100 km/h speed zones. Demerit point removal was also not found to lead to changed opinions. The lack of effects may be due to the fact that the proportion of respondents who thought these speeding activities were dangerous was already very high, thus there was probably little opportunity for ISA and demerit point removal to further improve drivers' opinions.

Significant main effects of speed zone were also found for travelling 5, 10 and 20 km/h over the speed limit (all $p<0.05$). Respondents, regardless of ISA group or survey time, were more likely to believe that travelling 5, 10 and 20 km/h over the speed limit was dangerous in 50 km/h zones and 60 km/h zones, compared to 100 km/h zones.

3.3.2.b.3 Part B Q3 – Q5 – At How Many Kilometres Over Limit are Drivers Speeding?

Questions 3 to 5 of Part B of the questionnaire asked respondents to indicate, for 50, 60 and 100 km/h zones, how many km/h over the limit a driver has to be travelling before they are speeding. Nine response options were provided ranging from 1 to 5 km/h over the limit to more than 30 km/h over the limit, with a 'don't know' option also provided. The data were recoded into binary form where a correct answer equals anything over the speed limit, and an incorrect answer equals any other response. GEE analyses were conducted to determine if the odds of answering correctly were different for the ISA groups over time. The logistic GEE models were specified with a logit link function and unstructured correlation matrix.

For all three speed zones, there were no significant differences found between groups or across time in terms of the proportion who believed that travelling at any speed over the speed limit is speeding.

3.3.2.b.4 Part B Q6 – Factors Influencing Speeding

Questions 6a and 6b of the questionnaire asked participants to tick the top three factors that influence whether they speed and the top three factors that stop them from speeding. For the factors that influence whether drivers speed, the most common response was 'losing track of my own speed', followed by 'the speed of other traffic', 'unaware of speed limit' and 'how much of a hurry I am in'. Responding patterns were consistent across ISA groups and across the two survey time points.

In terms of the factors that stop drivers from speeding, the most common response was 'the road and weather conditions, followed by 'the speed limit', 'my chances of being caught' and 'the volume of traffic on the particular road'. Again, response patterns were consistent across ISA groups and didn't change appreciably across the two survey time points.

3.3.2.b.5 Part B Q7 & Q8 – Likelihood of Being Caught by Police

In Question 7 of Part B of the questionnaire, respondents were asked by how much they can exceed the speed limit before being booked by police. A Fisher's exact test was conducted to examine if there were differences in responses across ISA groups and survey time points. There was no significant differences in the responses of the ISA groups at time 1 ($p=0.580$) or at time 2 ($p=0.117$).

Participants were also asked to specify if they thought there was another amount that drivers could exceed the limit by before being booked by police. Responses to this question were mixed across groups and there was little consistency in responding across the two survey points. Responses included 0, 5 and 10 km/h over, while one driver from the Speed Data (Demerits removed) group responded that 'Depends on how they are feeling'.

The final question of Part B, Question 8 of the questionnaire, asked respondents what the likelihood was of being caught by the police for travelling 5, 10 and 20 km/h above the speed limit. Responses were provided on a 5-point scale ranging from 'Very unlikely' to 'Very likely'. For analysis, data were recoded into two categories, with Neither Unlikely or Likely/Very Unlikely and Unlikely forming one category, and Very Likely and Likely forming the other. Generalised Estimating Equations (GEE) was used to see how responses changed in each ISA group over time. The logistic GEE models were specified with a logit link function and unstructured correlation matrix.

For the likelihood of being caught travelling 5 or 20 km/h above the speed limit, there were no significant differences between ISA groups or across time.

For the likelihood of being caught travelling 10 km/h above the speed limit, there was a significant 3 way interaction ($p=0.04$), so the analyses of the ISA by time interaction was performed stratifying by demerit point removal groups. The ISA by time interaction was not significant for either demerit point removal group, nor were there any main effects of ISA group or time. Therefore, despite the significant 3 way interaction, it appears that the ISA was not effective in changing opinions over time, either with or without demerit point removal.

3.3.2.c Attitudes toward Driving and Speeding – Part C

3.3.2.c.1 Part C Q1 – Attitudes Towards Speeding

Question 1 of Part C of the questionnaire asked respondents to indicate if they agreed or disagreed with 14 statements regarding speeding. Responses were provided on a 5-point scale ranging from 'Strongly disagree' to 'Strongly agree'. For analysis the data were recoded into two categories, with Strongly disagree and Disagree forming one category, and Strongly agree and Agree forming the other. A Generalised Estimating Equation (GEE) was used to examine how responses changed in each ISA group over time. The logistic GEE models were specified with a logit link function and unstructured correlation matrix.

For the statement ' you are much more likely to be involved in a crash if you increase driving speed by 5 km/h' there was some evidence of a difference in opinion between the Speed Alert group and the Speed Data group (pooled over time and demerit point removal) ($p=0.059$). The odds of the Speed Alert group believing that you are much more likely to be involved in a crash if you increase your driving speed by 5 km/h were just over the double the odds of the Speed Data group believing so.

For all the 13 other statements, there were no significant differences between ISA groups or across time in terms of the proportion who agreed or strongly agreed with the statements.

3.3.2.c.2 Stages-of-change

The Stages-of-change items are based on behaviour change models and are designed to examine respondents' motivation to change their behaviour, or their 'stage-of change' across three levels from Pre-contemplation to Contemplation to Action. The Stages-of-change items were scored on a five-point scale from 1 (strongly disagree) to 5 (strongly agree). Scores at each stage can indicate if the ISA device has been effective in bringing about positive behaviour change. If effective, scores on the Pre-contemplation scales would be expected to decrease, while scores on the Contemplation and, particularly, the Action scales would be expected to increase from Survey 1 to Survey 2. Generalised Estimating Equations (GEE) were used to examine how responses at each level changed across each ISA group over time. The GEE models were specified with a normal error distribution, an identity link function and unstructured correlation matrix.

For the Pre-contemplation score, no significant differences were revealed across groups which indicates that experience of ISA or demerit point removal did not cause a significant change in the participants' pre-contemplation score. There was, however, some evidence of a main effect of time ($p=0.068$), with Pre-contemplation scores being slightly higher (by 0.11 points on a 5 point scale) at Survey 2 compared to Survey 1. This suggests that involvement in the ISA sub-trial did not motivate drivers to start thinking about changing their speeding behaviour.

For the Contemplation score, no significant differences were revealed across groups which indicates that experience of ISA or demerit point removal did not cause a significant change in the participants' Contemplation score. There was, however, some evidence of a main effect of time ($p<0.10$), with scores being slightly lower at time 2 compared to time 1.

For the Action score, there were no significant differences found between groups or across time.

In summary, there was no evidence to suggest that use of ISA or demerit point removal were effective in changing drivers' motivation to speed or their speed behaviour. There was no significant reduction in the Pre-contemplation score, nor a significant increase in the Action score for the Speed Alert group over time, which would have been indicative of ISA having an effect on behaviour change. Indeed, there was a non-significant trend for drivers to increase the Pre-contemplation scores of all four ISA groups over time, suggesting that involvement in the ISA sub-trial had little impact on drivers' unwillingness to change their speed behaviour.

3.3.2.c.3 Part C Q2 – Speeding Attitudes Scale (SAS)

Question 2 of Part C of the questionnaire comprised the Speeding Attitudes Scale (SAS) and asked respondents to indicate if they agreed or disagreed with a range of statements regarding speeding. This scale was used to assess changes in drivers' attitudes toward speeding as a result of completing the program. Responses were provided on a 7-point scale ranging from 'Strongly disagree' (1) to 'Strongly agree' (7). Higher scores indicate less positive and safe attitudes towards speeding. A Generalised Estimating Equation (GEE) was used to see how responses changed in each ISA group over time. The GEE model was specified with a normal error distribution, an identity link function and unstructured correlation matrix.

Results revealed no significant differences between ISA groups or across time in terms of the Speeding Attitude Scale score, suggesting that use of ISA or demerit point removal did not improve drivers' attitudes toward speeding.

3.3.2.c.4 Part C Q3 – Driver Behaviour Questionnaire (DBQ)

Question 3 of the questionnaire comprised the Driver Behaviour Questionnaire (DBQ). The DBQ is a well-researched instrument designed to assess driver experiences with, and reactions to, a range of situations encountered in everyday driving. As well as a total score, the DBQ provides scores on four sub-scales: *violations, mistakes, lapses due to inattention* and *lapses due to inexperience*. Respondents were asked to indicate how often various driving situations happened to them in the preceding four weeks. Responses were provided on a 6-point scale ranging from 'Never' (1) to 'Very often' (6). Generalised Estimating Equations (GEE) were used to examine how responses changed in each group over time. The GEE models were specified with a normal error distribution, an identity link function and unstructured correlation matrix. The total DBQ scores and sub-scales were analysed.

For total DBQ score, there were no significant differences between ISA groups or across time which indicates that experience of ISA or demerit point removal did not cause a significant change in the participants' total DBQ score. There was, however, a significant main effect of time, with scores being slightly lower (by 0.15 points) at Survey 2 compared to Survey 1.

These results suggest that use of ISA or demerit point removal did not result in drivers experiencing fewer violations, mistakes, and lapses due to inattention and inexperience over the course of the trial. While reported DBQ behaviours did decrease over the course of the trial, this was found for all groups and, as such, these improvements were not related to use of ISA or demerit point removal, but may have resulted from drivers' being more cautious in their driving behaviour as a result of being monitored during the trial.

For the Violations and Inattention sub-scales, there was a significant main effect of time, with reported violations and lapses due to inattention being lower at Survey 2 compared to Survey 1. These results suggest that, while reported violations and inattention did decrease over the course of the trial, this was found for all ISA groups and, as such, these improvements may have resulted from drivers' being more cautious in their behaviour as a result of being monitored during the trial.

There were no significant differences between groups or across time in terms of the mean DBQ Mistakes score.

For the lapses due to inexperience sub-scale, there was a significant 3 way interaction between ISA, demerit removal and time, so the results were stratified by Demerit point group. The results of these further analyses suggest that use of ISA may have resulted in drivers in the Speed Alert group experiencing fewer lapses due to inexperience over the course of the trial, but only for the group that did not have demerit points removed. In the group that had demerit points removed, the Speed Alert group did have fewer lapses due to inexperience than the Speed Data group, however this did not change over time.

3.3.2.c.5 Part C Q4 – Speeding Behaviour During Last 10 Trips

Question 4 of the questionnaire asked respondents in their last ten driving trips, how often they engaged in a range of eight different speeding behaviours. Respondents answered from 0 trips up to 10 trips. A Generalised Estimating Equation (GEE) was conducted on each of the speeding behaviours to see how responses changed in each ISA group over time, and whether this differed by demerit point removal. The GEE model was specified with a negative binomial error distribution and an unstructured correlation matrix.

For the item about intentionally driving over the speed limit during their last 10 trips, there was a significant 3 way interaction between ISA, demerit removal and time, so the results were stratified by Demerit point group. In the group that did not have demerit points removed, there was a significant ISA by time interaction. At neither survey time was there a difference between the Speed Alert and Speed Data groups. Looking over time, there was a significant change for the Speed Data group, with the rate of intentional speeding at Survey 2 being 2.25 times higher than at time 1. This result may suggest that drivers in the Speed Data group forgot that they were being monitored as the trial progressed so they increased their speeding behaviour. There was no such change over time in intentional speeding behaviour for the Speed Alert group.

In the group that did have demerit points removed, there was no significant ISA by time interaction, nor was there any difference between ISA groups, or over time.

For the items 'was in a hurry and drove over speed limit to get to my destination' and 'drove well over the speed limit but didn't realise', there was a significant main effect of time, where the probability of engaging in these behaviours was significantly higher at Survey 2 than at Survey 1, pooled over the ISA groups.

For all other statements, there were no significant differences between ISA groups or across time.

3.3.2.c.6 Part C Q5 – Perceived Effectiveness of Road Safety Measures

The final question in Part C, Question 5 of the questionnaire, asked respondents to indicate how effective they thought a range of 10 road safety measures are in helping drivers to keep to the speed limit. Respondents answered on a 5 point scale ranging from 'Very ineffective' (1) to 'Very effective' (5). A Generalised Estimating Equation (GEE) was conducted on each of the speeding behaviours to see how responses changed in each ISA group over time. A GEE analysis was conducted to determine if the odds of answering Effective/Very effective (compared to Very ineffective/Ineffective/Neither effective nor Ineffective) were different for the ISA groups over time. The logistic GEE models were specified with a logit link function and unstructured correlation matrix.

Results revealed no significant differences between ISA groups or across time in drivers' perceived effectiveness of a range of road safety measures.

3.3.2.d Interests and Personality Style– Part D

3.3.2.d.1 Sensation Seeking

Items on sensation seeking were a combination of the 10-item 'Thrill and Adventure Seeking (TAS)' sub-scale of Zuckerman's (1994) Sensation-Seeking Scale (Version V). According to Zuckerman (1994), items on the TAS express "a desire to engage in sports or other physically risky activities that provide unusual sensations of speed or defiance of gravity". Significant relationships between driving speed and sensation seeking have been reported in a number of studies and may moderate the effectiveness of the speed behaviour program. The maximum score is 10, with higher scores indicating higher sensation seeking. All groups displayed moderate levels of sensation seeking.

A Generalised Estimating Equation (GEE) was used to examine how sensation seeking changed in each group over time. The GEE model was specified with a normal error distribution, an identity link function

and unstructured correlation matrix. There were no significant differences between groups or across time in terms of the total sensation seeking score.

3.3.2.d.2 Marlowe-Crowne Social Desirability Scale

The 8-item short form of the Marlowe-Crowne social desirability scale (developed originally by Greenwald & Satow, 1970) was used to measure participants' level of social desirability. Social desirability concerns the propensity for participants to answer survey items in an overly positive or socially desirable manner, rather than in a manner that reflects their true feelings or behaviour. The short-form has a maximum score of 8, with higher scores indicating a greater level of social desirability and that participants may have been answering survey items in an overly positive way. Participants in all groups scored low on social desirability at both survey time points, suggesting that participants are likely to have answered the survey items truthfully.

A Generalised Estimating Equation (GEE) was used to examine how social desirability changed in each group over time. The GEE model was specified with a normal error distribution, an identity link function and unstructured correlation matrix. There were no significant differences between ISA groups or across time.

3.3.2.e Data Logger

Two questions in the ISA sub-trial Survey 2 asked participants whether the presence of the data logger affected their speed behaviour throughout the trial and if they had ever forgotten that the data logger was in their car. The majority of participants in each group indicated that they slowed down in response to the data logger being in their car. A Chi-square test was conducted for each question to examine if there were differences in responses across the Speed Alert and Speed Data groups (responses were pooled into these two groups due to low numbers in some cells). No significant differences were found across groups in response to the question about the data logger affecting speed behaviour ($\chi^2(3)=5.61$, $p = .132$) or to the question about forgetting about the data logger ($\chi^2(4)= 1.44$, $p = .838$).

3.3.3 Logged Driving Data Results

3.3.3.a Data Screening and Analysis

A range of driving performance measures were examined as part of the logged driving data analysis. These dependent measures included: mean speed, proportion of time exceeding the speed limit by any amount or by more than 5 km/h and 10 km/h, mean time taken to return to the speed limit and to the 3 km/h ISA auditory warning threshold once these were exceeded, and the proportion of time spent with the screen off and the mute on.

Three measures in the original proposal were not examined: median and modal speeds and instances of sudden braking. The median and modal speeds were not examined as these measures were likely to yield very similar results to the mean speed analysis. Also, ISA has its greatest effects on speeds higher in the distribution, thus, 85th percentile speed was examined in place of median and modal speeds. Instances of sudden braking could not be examined given that the logged data was only recorded at 1Hz. A higher recording rate (100Hz) is required to reliably examine sudden braking.

The data for ten drivers, who were disqualified from the ISA sub-trial for dangerous speeding or receiving a traffic infringement notice during the trial, were removed from the analysis, as their driving behaviour and attitudes are likely to differ in important ways to the remainder of the participants. The logged driving data for two other participants (one from the Speed Alert - demerit points removed group and one from the Speed Alert – no demerit points removed group) were also excluded from analysis; one participant did not drive their vehicle for long periods during the trial and was removed before completing the required activities and the other participant withdrew from the trial when their ISA system was removed, resulting in no data being recorded for an 'After ISA' period.

All driving performance measures were analysed through application of a Generalised Estimating Equation (GEE). This analysis aimed to determine if there were significant differences in various speed measures (e.g., mean and 85th percentile speed) across the ISA groups, trial periods and speed zones. Essentially the GEE models sought to establish if 1) the use of ISA improved speed behaviour significantly, 2) if demerit point removal had any additional impact on behaviour, 3) if any benefits of ISA remained after it is removed, and 4) if ISA is more effective in certain speed zones.

GEE is used to analyse correlated data from longitudinal and repeated-measures trials, which is applicable for the logged data from this trial as there is a correlation between the speed behaviour of the same participant taken over time and also across different speed zones. Participant identifier (number) was used to identify individuals, and trial period and speed limit were the repeated-measures factors.

Full factorial GEE models were fitted to each driving measure to examine the effectiveness of the ISA device and demerit point removal, across speed zones. The factors included in the models were:

- **ISA Group** (Speed Alert or Speed Data)
- **Trial Group**(Demerit point removal or No demerit point removal)
- **Period** (ISA active or After ISA)
- **Speed Zone** (40, 50, 60, 70, 80, 100 km/h).

Of particular interest was whether or not the ISA system was effective in changing speed behaviour when it was active versus inactive, and whether this effectiveness differed according to speed zone or whether or not demerit points were removed. In addition, the overall effectiveness of demerit point removal and whether this varied by speed zone were of interest and were examined in the models. The four way interaction of ISA group by demerit point removal group by period by speed zone was also included in the models to improve fit, however, the four way interaction was not analysed further because of the lack of power to detect effects. The research questions of particular interest and the model effects that address these are shown in Table 3.11.

Table 3.11 Summary of research questions and ISA effects of interest for the logged data analyses

Research question addressed	**ISA group effects of interest**
Does the ISA have an effect when it is active, and does this vary across speed zone (pooled across Demerit Point removal groups)?	3 way interaction: ISA Group x Period x Speed Limit
Does ISA have an effect when it is active and does this differ according to whether or not demerit points are removed (pooled across speed zones)?	3 way interaction: ISA Group x Period x Trial group
Does the effectiveness of ISA depend on whether it is active (pooled across Demerit Group and Speed Limit)?	2 way interaction: ISA Group x Period
Research question addressed	**Demerit point removal effects of interest**
Is Demerit Point removal more effective in different speed zones (pooled across ISA Group and Period)?	2 way interaction: Demerit point removal group x Speed limit
Is Demerit Point removal effective (pooled across ISA Group, time and speed zone)?	Main effect: Demerit point removal group

The appropriate link function (identity versus logit) and associated model statistical error distribution for the GEE models differed between the different trial outcome measures. The link function and error distribution used for each outcome (dependent) measure are described in Table 3.12.

Table 3.12 Summary of the Link function and error distribution used in the GEE models

Dependent measure	Link function	Error distribution
Mean speed	Identity	Normal
Proportion of time exceeding the speed limit by >0, 5 and 10 km/h	Logit	Binomial
Mean time taken to return to the speed limit and to the 3 km/h ISA warning threshold once these were exceeded	Identity	Normal

An unstructured within-participant correlation matrix was attempted first for each analysis. Where model convergence problems were encountered, which is often the case when using this most general form of the correlation matrix, an exchangeable correlation matrix was considered the most appropriate alternative as it reflects equal inter-correlation of observations within the same distance of each other and proved to allow model convergence in application. It should be noted that the choice of correlation structure does not affect parameter estimates but does change the estimated parameter standard error estimates and hence potentially statistical significance of test results.

Before analysis, the data were filtered using the following parameters:

- Data for 40, 50, 60, 70, 80 & 100 km/h speed zones were analysed. Other speed zones (e.g., 10, 30, 90 km/h) were excluded from the preliminary analysis due to the small number of observations (travel distance) in these zones.
- For the mean speed analysis, the logged data were filtered to include only those observations where the participants' vehicles were travelling 20 km/h or more and were within 30 km/h above the speed limit. This ensured that speed was not constrained by slowing or stopping for traffic lights or turns and that the data were less likely to contain observations where the ISA device map contained an incorrect speed limit. The proportion of data excluded through this filtering was relatively small and the amount did not differ across the four ISA groups.
- Only data that met the following GPS reliability criteria were included in the analyses to ensure that the ISA device had adequate satellite coverage: number of satellites visible is greater than 3 and the HDOP (Horizontal Dilution Of Precision; which gives an indication of horizontal accuracy) value is less than 4.
- Any documented cases of ISA map inaccuracies were removed from the data set before analysis.

Before analysis the data were screened to identify any missing values, outliers, skewness and kurtosis, and to ensure that the data met the assumptions required for statistical testing using the GEE model. Initial data screening revealed that none of the dependent measures contained missing data. Inspection of the histograms and the ratios of skewness and kurtosis to their respective standard errors revealed no strong departures from normality and no extreme outliers for mean speed. The time taken to return to the speed limit and ISA auditory warning threshold data were positively skewed with high kurtosis, however, a logarithmic transformation was insufficient to deal with this, and so the data were analysed using the identity link function.

All data were broken down into the 'ISA Active' (ISA present or equivalent 12 week period for control groups) and the 'After ISA' (ISA removed or equivalent 8 week period for control groups) periods and compared as part of the analysis. For mean speed, data were further broken down into 3 (ISA Active period) and 2 (After ISA period) week intervals to examine if the effects of ISA on speeding behaviour changed over time.

3.3.3.b Driving Exposure by Speed Zone

Table 3.13 displays the mean number of kilometres and hours driven by each ISA group in each speed zone and in total. As shown, ISA participants travelled the greatest time and distance in 60 and 100 km/h zones and the least amount in 40 and 50 km/h zones. Two one-way ANOVAs were conducted to examine if the total number of kilometres and hours driven during the trial differed significantly across ISA groups. No significant differences were found across groups in either the total kilometres ($F(3,85) = 1.381$, $p = .254$) or hours ($F(3,85) = 1.167$, $p = .327$) driven in the trial. The amount of exposure in each speed zone is controlled for as part of the GEE analysis.

Table 3.13 Mean (SD) kilometres and hours driven in each speed zone across the ISA sub-trial

Speed zone (km/h)	ISA Group							
	Speed Alert (No Demerit Points Removed) n=17		Speed Alert (Demerit Points Removed) n=23		Speed Data (No Demerit Points Removed) n=22		Speed Data (Demerit Points Removed) n=24	
	Kms	Hours	Kms	Hours	Kms	Hours	Kms	Hours
40	84.77 (54.06)	4.05 (2.64)	140.57 (138.27)	7.02 (6.82)	106.29 (66.33)	5.50 (4.19)	125.11 (113.13)	5.56 (5.27)
50	484.79 (231.08)	22.02 (10.39)	506.37 (324.15)	23.08 (15.28)	711.89 (495.01)	29.31 (18.78)	653.44 (386.02)	28.18 (15.63)
60	1304.21 (804.46)	37.82 (24.03)	1368.55 (692.78)	43.07 (22.19)	1443.40 (1051.44)	41.88 (28.65)	1556.65 (792.54)	46.48 (26.15)
70	565.24 (309.78)	13.47 (7.35)	669.34 (567.14)	17.52 (16.46)	596.32 (403.21)	14.18 (8.99)	747.71 (669.52)	18.39 (17.38)
80	1017.56 (627.78)	19.53 (12.77)	926.55 (760.63)	19.09 (16.59)	979.21 (860.33)	17.94 (15.93)	1337.40 (1075.74)	26.37 (22.96)
100	1243.07 (1046.74)	14.49 (11.88)	1597.41 (1570.76)	18.57 (17.97)	2967.58 (3404.03)	36.64 (41.72)	1648.98 (1728.38)	19.73 (19.94)
TOTAL	4614.87 (1507.69)	107.34 (37.56)	5068.23 (2714.26)	121.97 (62.54)	6428.63 (4505.14)	136.62 (74.11)	5944.18 (2668.67)	139.15 (53.31)

3.3.3.c Proportion of Time Exceeding the Speed Limit

The proportion of driving time spent exceeding the posted speed limit was examined for three thresholds: any speed above the limit (>0 km/h), more than 5 km/h above and more than 10 km/h above the limit. The proportion of driving time spent exceeding the speed limit at each threshold, across speed zones and ISA groups is displayed in Table 3.14.

For the analyses, the actual number of driving observations (sec) spent above the speed limit were converted to the proportion using the total number of driving observations (sec). These data were then analysed using a full factorial GEE model as described previously. The GEE models were specified with a binomial error function meaning these models examined the relative odds of being over the speed limit thresholds between groups.

Table 3.14 Mean [95% confidence interval] proportion of time spent >0, >5, and >10 km/h above the speed limit across ISA groups, ISA Periods and speed zones

Speed zone (km/h)	ISA Group							
	Speed Alert (No Demerit Points Removed) n=17		Speed Alert (Demerit Points Removed) n=23		Speed Data (No Demerit Points Removed) n=22		Speed Data (Demerit Points Removed) n=24	
	ISA Active	After ISA	ISA Active	After ISA	ISA Active	After ISA	ISA Active	After ISA
>0 km/h above limit								
40	20.7 [14.2-27.1]	26.1 [20.5-31.7]	17.2 [12.7-21.7]	24.1 [17.7-30.6]	29.2 [23.7-34.6]	30.2 [25.4-34.9]	32.3 [27.5-37.1]	33.2 [28.3-38.0]
50	7.2 [3.6-10.7]	9.9 [6.5-13.3]	7.1 [4.5-9.6]	9.9 [6.6-13.2]	11.9 [8.8-15.0]	11.2 [8.6-13.9]	12.7 [9.9-15.5]	13.5 [10.6-16.4]
60	8.4 [5.5-11.3]	13.1 [10.0-16.2]	7.9 [4.8-11.1]	12.1 [8.2-15.9]	13.8 [10.1-17.4]	15.1 [11.2-19.0]	15.3 [11.6-19.0]	16.6 [13.5-19.7]
70	5.4 [3.4-7.4]	7.6 [5.0-10.1]	6.2 [3.7-8.8]	9.8 [6.4-13.1]	10.3 [7.1-13.5]	12.3 [8.1-16.5]	10.9 [8.0-13.7]	11.4 [8.2-14.6]
80	7.8 [3.2-12.5]	12.0 [5.3-18.7]	8.3 [5.3-11.4]	13.7 [8.3-19.2]	13.5 [7.4-19.5]	13.5 [9.2-17.7]	11.7 [8.6-14.9]	11.9 [8.6-15.2]
100	6.0 [2.3-9.8]	10.2 [3.3-17.0]	10.2 [4.0-16.4]	22.7 [13.2-32.3]	11.9 [7.4-16.4]	13.2 [7.5-18.8]	13.0 [6.7-19.2]	16.7 [9.6-23.8]
>5 km/h above limit								
40	9.0 [3.9-14.0]	14.3 [10.2-18.5]	7.9 [4.4-11.3]	13.6 [8.4-18.8]	17.0 [12.7-21.2]	17.2 [13.7-20.8]	19.4 [14.9-23.8]	19.8 [15.2-24.3]
50	2.9 [0.1-5.6]	4.2 [1.9-6.5]	2.7 [1.2-4.2]	4.5 [2.3-6.7]	5.8 [3.7-7.8]	5.0 [3.4-6.6]	5.7 [4.0-7.4]	6.4 [4.6-8.2]
60	2.1 [1.0-3.2]	4.2 [2.6-5.7]	2.6 [0.9-4.4]	4.6 [2.1-7.2]	4.7 [3.0-6.5]	5.7 [3.6-7.7]	5.0 [3.2-6.7]	5.5 [3.9-7.1]
70	1.1 [0.4-1.7]	1.7 [0.7-2.6]	1.7 [0.5-2.9]	2.9 [1.6-4.2]	2.9 [1.4-4.4]	4.3 [1.9-6.7]	3.3 [1.7-5.0]	3.2 [1.6-4.7]
80	3.3 [0.0-6.6]	4.9 [0.3-9.6]	3.8 [1.7-5.9]	7.0 [2.6-11.4]	6.1 [2.3-10.0]	5.5 [3.4-7.7]	4.3 [2.6-6.0]	4.1 [2.7-5.6]
100	0.8 [-0.1-1.66]	1.2 [-0.2-2.6]	3.0 [0.0-6.0]	5.3 [0.9-9.7]	2.4 [0.8-4.0]	2.5 [1.0-4.1]	3.1 [0.4-5.8]	4.1 [1.4-6.7]
>10 km/h above limit								
40	4.6 [1.0-8.1]	7.2 [4.3-10.0]	3.6 [1.5-5.8]	7.4 [3.6-11.2]	8.8 [5.8-11.9]	8.1 [5.9-10.3]	10.9 [7.0-14.7]	10.8 [7.0-14.6]
50	1.3 [-0.3-3.0]	1.5 [0.3-2.7]	1.1 [0.3-1.8]	2.0 [0.7-3.2]	2.6 [1.0-4.2]	2.0 [1.2-2.8]	2.0 [1.1-2.9]	2.4 [1.6-3.2]
60	0.6 [0.3-1.0]	1.2 [0.6-1.8]	1.0 [0.3-1.7]	1.9 [0.5-3.4]	1.5 [0.9-2.1]	1.9 [1.0-2.8]	1.6 [0.8-2.3]	1.8 [1.1-2.4]
70	0.4 [0.1-0.7]	0.4 [0.1-0.7]	0.5 [0.0-1.0]	0.9 [0.3-1.4]	0.8 [0.3-1.4]	1.4 [0.2-2.6]	1.1 [0.3-1.9]	1.0 [0.3-1.7]
80	2.0 [-0.5-4.5]	2.7 [-0.7-6.1]	1.9 [0.9-2.9]	4.3 [0.8-7.8]	3.0 [0.9-5.1]	2.4 [1.3-3.5]	2.0 [1.1-3.0]	1.7 [1.0-2.4]
100	0.1 [-0.0-0.3]	0.2 [-0.1-0.5]	0.7 [-0.3-1.8]	1.5 [-0.1-3.0]	0.4 [0.0-0.8]	0.5 [0.1-0.9]	0.8 [-0.2-1.8]	0.9 [0.2-1.6]

3.3.3.c.1 Proportion of Time 0 km/h Above Speed Limit

The results of the GEE model for the proportion of time travelling any speed over the speed limit for the effects of interest are displayed in Table 3.15.

Table 3.15 Proportion of time spent travelling any speed over the speed limit GEE results for effects of interest

ISA effects of interest			**p-value**
Does the ISA have an effect when it is active, and does this vary across speed zone?	3 way interaction	Period X ISA Group X Speed Limit	0.585
Does ISA have an effect when it is active and does this differ according to whether or not demerit points are removed?	3 way interaction	Period X ISA Group X Trial Group	0.147
Does the effectiveness of ISA depend on whether it is active?	**2 way interaction**	**Period X ISA Group**	**0.000**
Trial group effects of interest			
Is Demerit Point removal more effective in different speed zones?	2 way interaction	Trial Group X Speed Limit	0.121
Is Demerit Point removal effective?	Main effect	Trial Group	0.556

Significant effects in bold

As displayed, there was no significant main effect of Trial Group, meaning that there was no effect of demerit point removal on the proportion of time that participants spent travelling any speed over the speed limit.

There was a significant 2-way ISA Group X Period interaction found. To investigate this further, a simpler GEE model was fitted to see how ISA group and Period affected speeding behaviour, aggregated over Demerit Point removal group and Speed Limit. The simpler model converged using an unstructured correlation matrix. Participants in the Speed Alert (treatment) group spent a significantly smaller proportion of time (an average of 34% less) travelling above the speed limit when ISA was active compared to when it was not (ISA After period) (Odds ratio (OR)[3]=0.54, 95%CI 0.45-0.65, p=0.000). The Speed Data (control) group also spent a significantly lower proportion of time travelling above the speed limit in the ISA Active period compared to the After ISA (an average of 6.4% less) (OR=0.87, 95%CI 0.78-0.97, p=0.014), however the difference was much larger for the Speed Alert group.

Comparing the Speed Alert and Speed Data groups (Figure 3.2), the Speed Alert group spent a significantly lower proportion of travel time speeding when ISA was active than the Speed Data group did during the ISA Active period (OR=0.53, 95%CI 0.37-0.77, p=0.001). However, in the period when ISA was inactive (After ISA), there was no significant difference between the Speed Alert group and the Speed Data group in the proportion of time spent speeding (OR=1.16, 95%CI 0.83-1.63, p=0.375).

[3]The odds ratio for a risk factor is calculated by dividing the odds for that factor among the cases by the odds for that factor among the controls. If a factor is represented equally in both case and control groups then an odds ratio of one is produced. If an odds ratio of greater than one is produced then the factor increases risk, if it is less than one then risk is reduced. A confidence interval (usually at the 95% confidence level) is calculated for the odds ratio to determine if it is statistically significant.

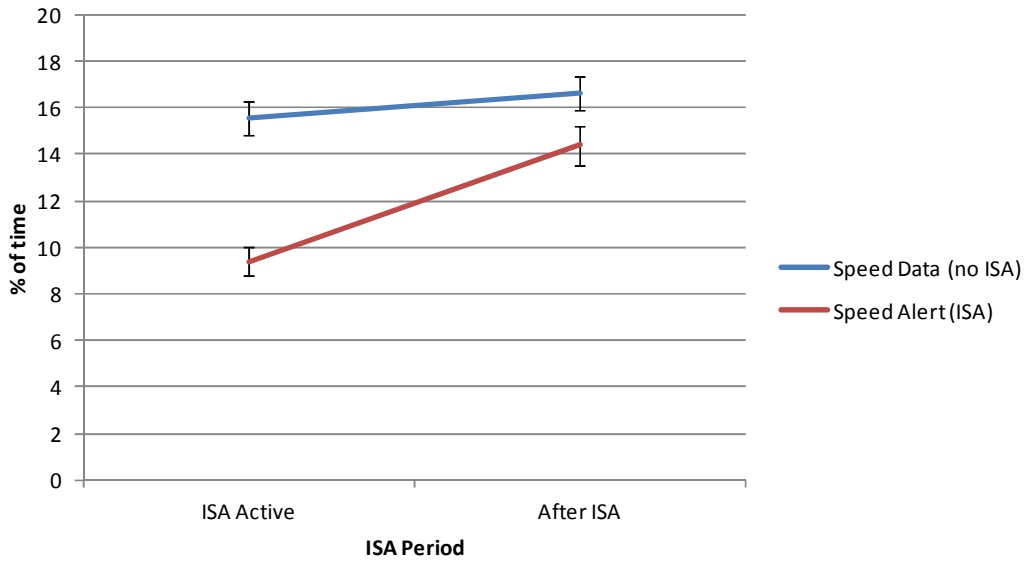


Figure 3.2 Proportion of time spent travelling at any speed over the speed limit as a function of ISA Group and ISA Period (standard error bars[4])

3.3.3.c.2 Proportion of Time More Than 5 km/h Above Speed Limit

The results of the GEE model for the proportion of time travelling more than 5 km/h over the speed limit for the effects of interest are displayed in Table 3.16.

Table 3.16 Proportion of time spent travelling more than 5 km/h above the speed limit GEE results for effects of interest

ISA effects of interest			**p-value**
Does the ISA have an effect when it is active, and does this vary across speed zone?	3 way interaction	Period X ISA Group X Speed Limit	0.891
Does ISA have an effect when it is active and does this differ according to whether or not demerit points are removed?	3 way interaction	Period X ISA Group X Trial Group	0.284
Does the effectiveness of ISA depend on whether it is active?	**2 way interaction**	**Period X ISA Group**	**0.000**
Trial group effects of interest			
Is Demerit Point removal more effective in different speed zones?	**2 way interaction**	**Trial Group X Speed Limit**	**0.054**
Is Demerit Point removal effective?	Main effect	Trial Group	0.882

Significant effects in bold

[4] Standard errors represent graphically the variability of data and provide an estimate of the accuracy of the measurement or how far the true sample mean may be from the reported mean.

A marginally significant Trial Group X Speed Limit interaction was found (p=.054), which indicates that there might be an effect of speed limit on the effectiveness of demerit point removal. Figure 3.3 below shows that the two demerit point removal groups spent a remarkably similar amount of time travelling more than 5 km/h over the speed limit in all speed zones except 100 km/h zones. In 100 km/h zones, those participants who had demerit points removed actually spent more time travelling more than 5 km/h over the limit than those who did not (3.8% vs. 1.8%).

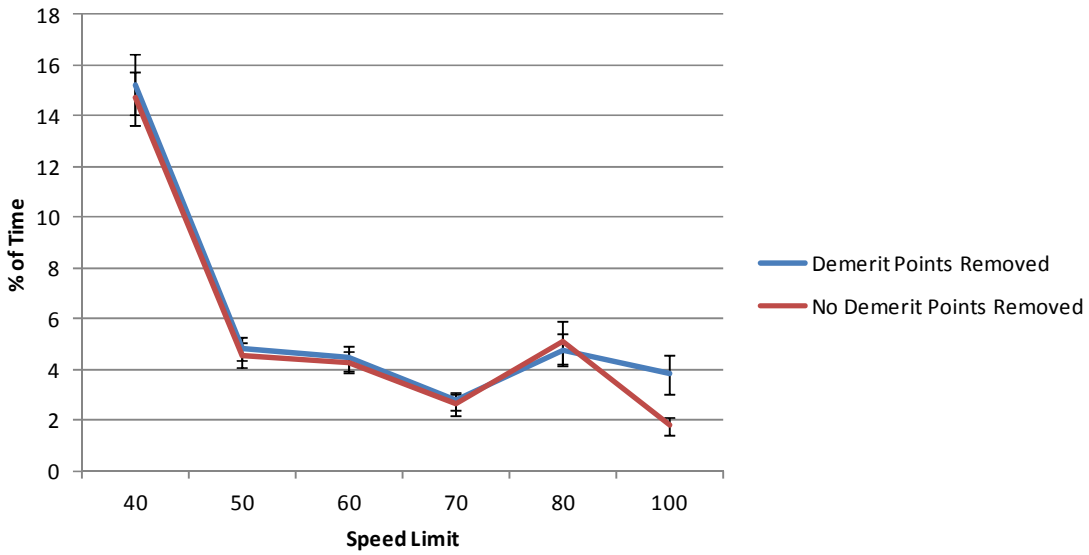


Figure 3.3 Proportion of time spent more than 5 km/h above speed limit as a function of speed limit and demerit point removal (standard error bars)

There was a significant ISA Group X Period interaction (Figure 3.4). To investigate this further, a simpler GEE model was fitted to see how ISA Group and Period affected speeding behaviour, aggregated over Demerit Point removal groups and Speed Limit. The simpler model converged using an unstructured correlation matrix. Speed Alert participants spent a significantly lower proportion of time travelling more than 5 km/h over the speed limit when ISA was active compared to when it was inactive in the After ISA period (OR=0.55, 95%CI 0.47-0.64, p=0.000) and also compared to the Speed Data group in the ISA Active period (OR=0.48, 95%CI 0.29-0.81, p=0.006). There was no significant difference between the proportion of time that the Speed Data group spent travelling more than 5 km/h over the speed limit in the two ISA periods (OR=1.08, 95%CI 0.97-1.21, p=0.172) or between the Speed Data and the Speed Alert groups in the After ISA period (OR=1.22, 95%CI 0.79-1.90, p=0.369).

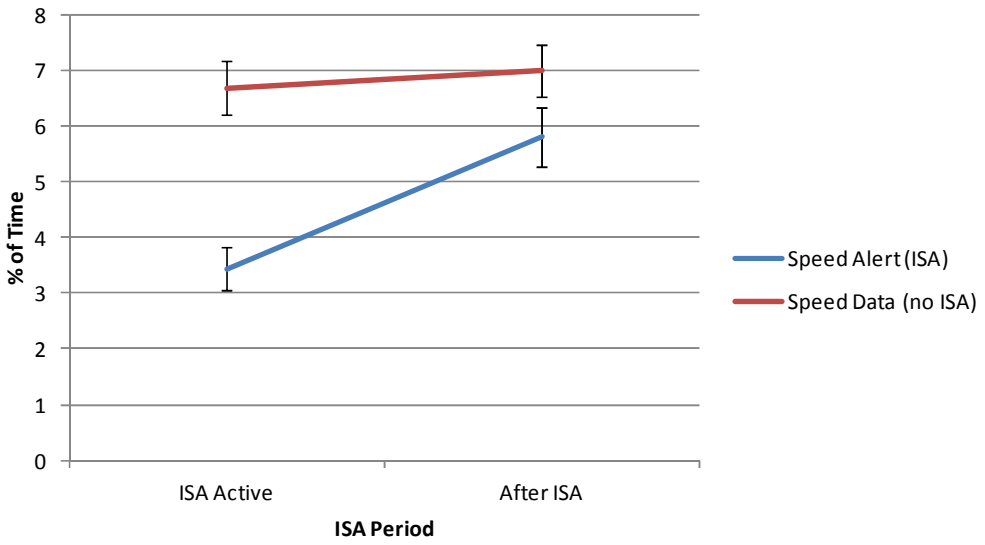


Figure 3.4 Proportion of time spent more than 5 km/h above speed limit as a function of ISA Group and ISA Period (standard error bars)

3.3.3.c.3 Proportion of Time More Than 10 km/h Above Speed Limit

The results of the GEE model for the proportion of time travelling more than 10 km/h over the speed limit for the effects of interest are displayed in Table 3.17.

Table 3.17 Proportion of time spent travelling more than 10 km/h above the speed limit GEE results for effects of interest

ISA effects of interest			**p-value**
Does the ISA have an effect when it is active, and does this vary across speed zone?	3 way interaction	Period X ISA Group X Speed Limit	0.423
Does ISA have an effect when it is active and does this differ according to whether or not demerit points are removed?	3 way interaction	Period X ISA Group X Trial Group	0.115
Does the effectiveness of ISA depend on whether it is active?	**2 way interaction**	**Period X ISA Group**	**0.002**
Trial group effects of interest			
Is Demerit Point removal more effective in different speed zones?	**2 way interaction**	**Trial Group X Speed Limit**	**0.02**
Is Demerit Point removal effective?	Main effect	Trial Group	0.898

Significant effects in bold

There was a significant Trial Group X Speed Limit interaction (p=.002), which indicates an effect of speed limit on the effectiveness of demerit point removal (Figure 3.5). The figure below shows that the two demerit point removal groups spent a remarkably similar amount of time travelling more than 10 km/h over the speed limit in all speed zones except 100 km/h zones. Again, in 100 km/h zones, those participants who were informed they would have their demerit points removed after successful trial completion

actually spent more time speeding more than 10 km/h over the limit than those who did not (0.9% vs. 0.3%).

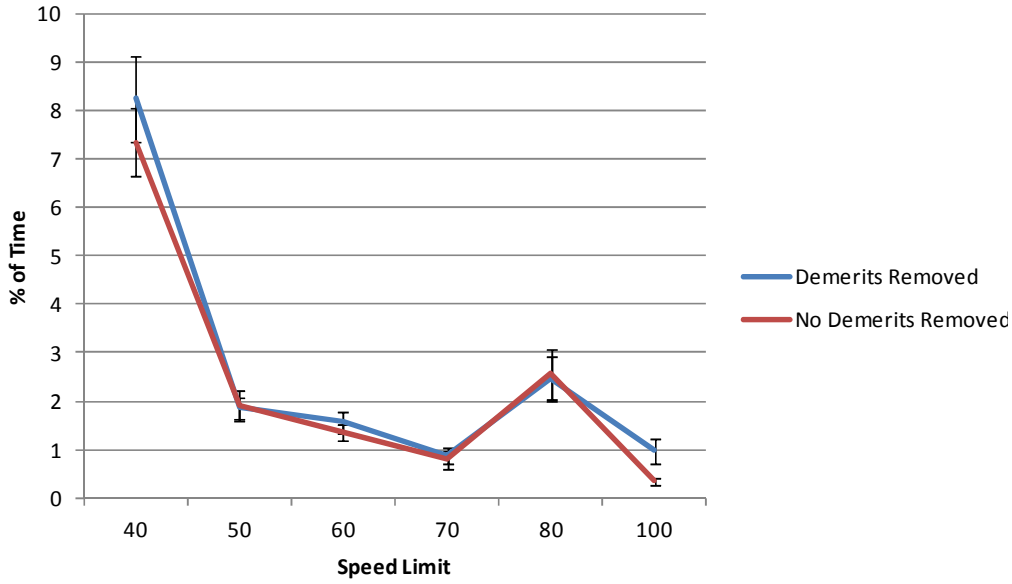


Figure 3.5 Proportion of time spent more than 10 km/h above speed limit as a function of speed limit and demerit point removal (standard error bars)

There was a significant ISA Group X Period interaction (p=.002) (Figure 3.6). To investigate this further, a simpler GEE model was fitted to see how ISA Group and Period affected speeding behaviour, aggregated over Demerit Point removal groups and speed limits. The simpler model converged using an unstructured correlation matrix. Speed Alert group participants spent a significantly lower proportion of time travelling more than 10 km/h over the speed limit when ISA was active compared to when it was inactive in the After ISA period (1.5% vs. 2.7%, OR=0.57, 95%CI 0.49-0.64, p=0.000) and also compared to the Speed Data group in the ISA Active period (1.5% vs. 2.9%, OR=0.52, 95%CI 0.30-0.89, p=0.017).

There was no significant difference between the proportion of time that the Speed Data group spent travelling more than 10 km/h over the speed limit in the two ISA periods (OR=1.00, 95%CI 0.84-1.19, p=0.970) or between the Speed Data group and the Speed Alert group in the After ISA period (OR=1.10, 95%CI 0.69-1.75, p=0.681).

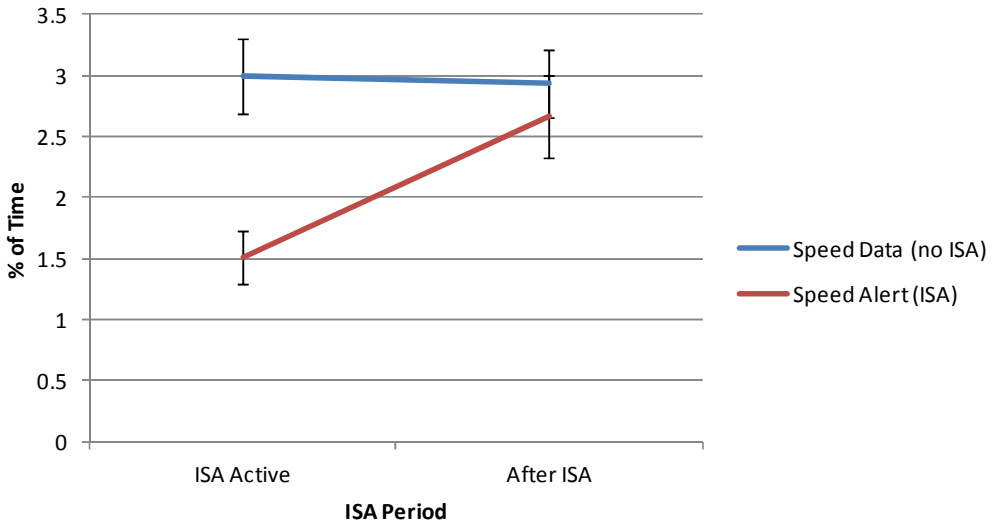


Figure 3.6 Proportion of time spent more than 10 km/h above speed limit as a function of ISA Group and ISA Period (standard error bars)

3.3.3.d Maximum Speed

The maximum speed reached in each speed zone during each period for each participant was measured. The maximum speed data was highly skewed. Transformations to address this were unsuccessful and so the data could not be analysed in raw form. Instead, three variables were derived to determine the proportion of participants who reached a maximum speed more than a certain amount over the speed limit: more than 5 km/h over the speed limit, more than 10 km/h over the speed limit, and more than 25 km/h over the speed limit.

Almost all participants reached maximum speeds of more than 5 km/h over the speed limit (95%) and more than 10 km/h over the speed limit (89%). As there were so few participants who did *not* reach maximum speeds of these magnitudes, analyses of these outcome variables were not possible. Approximately half (46%) of the participants reached speeds of more than 25 km/h over the speed limit. Attempts to conduct GEE analyses with these data were unsuccessful as the models failed to reach convergence regardless of the correlation matrix type specified. Upon reflection, these unsuccessful analyses of the maximum speed data were not felt to be a major concern, as the maximum speed data may only reflect one instance of speeding over a large number of observations. The proportion of driving time spent at various levels over the speed limit was thought to better reflect speeding behaviour and these data were more amenable to analysis (refer to Section 3.3.3.c).

The maximum speed distributions were also graphed for the four ISA groups to gain insight into how the use of ISA (and its subsequent removal) and demerit point removal change the maximum speed distribution. These speed distribution graphs are contained in Appendix F.

3.3.3.e Mean Speed

Mean speed for each ISA group across speed zones and ISA period are displayed in Table 3.18. The effects of ISA system and demerit point removal on mean speeds were examined using the GEE model described previously. Mean speed followed an approximate normal distribution so the appropriate error distribution specified in the GEE was a normal error distribution, an identity link function was used and the correlation matrix was unstructured.

The mean speed distributions were also graphed for the four ISA groups to gain further insight into how the use of ISA (and its subsequent removal) and demerit point removal change the mean speed distribution. These speed distribution graphs are contained in Appendix F.

Table 3.18 Mean [95% Confidence Interval] speed across ISA groups, ISA periods and speed zones

Speed zone (km/h)	ISA Group							
	Speed Alert (No Demerit Points Removed) n=17		Speed Alert (Demerit Points Removed) n=23		Speed Data (No Demerit Points Removed) n=22		Speed Data (Demerit Points Removed)n=24	
	ISA Active	After ISA	ISA Active	After ISA	ISA Active	After ISA	ISA Active	After ISA
40	35.6 [34.0-37.1]	36.5 [35.2-37.8]	34.9 [33.8-36.0]	36.1 [34.5-37.6]	37.2 35.9-38.6]	37.2 [36.1-38.4]	38.1 [36.8-39.4]	38.2 [36.9-39.4]
50	42.2 [41.0-43.4]	42.6 [41.4-43.7]	42.0 [41.1-43.0]	42.5 [41.4-43.7]	43.1 [42.0-44.1]	43.0 [42.1-44.0]	43.5 [42.5-44.4]	43.7 [42.7-44.6]
60	53.4 [52.7-54.1]	54.2 [53.4-54.9]	53.1 [52.1-54.1]	53.8 [52.6-55.0]	54.1 [53.1-55.1]	54.4 [53.3-55.5]	54.6 [53.7-55.4]	54.8 [54.1-55.6]
70	62.2 [61.1-63.2]	62.2 [61.2-63.2]	62.3 [61.3-63.3]	62.8 [61.7-63.9]	63.2 [62.2-64.2]	63.5 [62.3-64.8]	63.3 [62.5-64.2]	63.1 [62.2-64.1]
80	72.7 [70.9-74.4]	73.1 [71.0-75.1]	72.6 [71.6-73.7]	73.9 [71.7-76.1]	73.7 [72.0-75.3]	73.9 [72.6-75.2]	73.3 [72.3-74.2]	73.0 [71.9-74.1]
100	93.0 [91.4-94.6]	93.0 [91.3-94.7]	93.9 [92.5-95.4]	95.6 [93.8-97.3]	94.6 [93.9-95.4]	94.4 [93.2-95.7]	94.0 [92.6-95.5]	94.4 [92.9-95.9]

The results of the GEE model for means speed for the effects of interest are displayed in Table 3.19.

Table 3.19 Mean speed GEE results for effects of interest

ISA effects of interest			**p-value**
Does the ISA have an effect when it is active, and does this vary across speed zone?	3 way interaction	Period X ISA Group X Speed Limit	0.279
Does ISA have an effect when it is active and does this differ according to whether or not demerit points are removed?	3 way interaction	Period X ISA Group X Trial Group	0.154
Does the effectiveness of ISA depend on whether it is active?	**2 way interaction**	**Period X ISA Group**	**0.003**
Trial group effects of interest			
Is Demerit Point removal more effective in different speed zones?	2 way interaction	Trial Group X Speed Limit	0.565
Is Demerit Point removal effective?	Main effect	Trial Group	0.590

Significant effects in bold

As displayed, there was no significant main effect of Trial Group, meaning that there was no effect of demerit point removal on participants' mean speed during the trial.

A significant ISA Group X Period interaction (p=.003) was found. For the Speed Alert group, mean speed was significantly lower, by 0.71 km/h (95%CI 0.41-1.01, p=.000), when the ISA was active compared to when it was not (After ISA period). In contrast, no significant difference in mean speed was found between the ISA Active and After ISA periods for the Speed Data group (0.09 km/h, 95%CI 0.20-0.37, p=.55). Comparing the Speed Data (control) group and the Speed Alert (treatment) group, the Speed Alert group had a significantly lower mean speed when the ISA was active (1.22 km/h, 95%CI 0.39-2.04, p=.004), however there was no significant difference between the Speed Alert group and the Speed Data group in the After ISA period (0.59 km/h, 95%CI -0.27-1.45, p=.18) (Figure 3.7).

Taken together, these results suggest that the ISA system was effective in reducing mean speed while it was active, but that its effects dissipated once it was removed. Further, the effectiveness of ISA did not differ according to whether demerit points were removed or not (3-way Period X ISA Group X Trial Group interaction not significant),nor according to speed limit (3-way Period X ISA Group X Speed Limit interaction not significant).

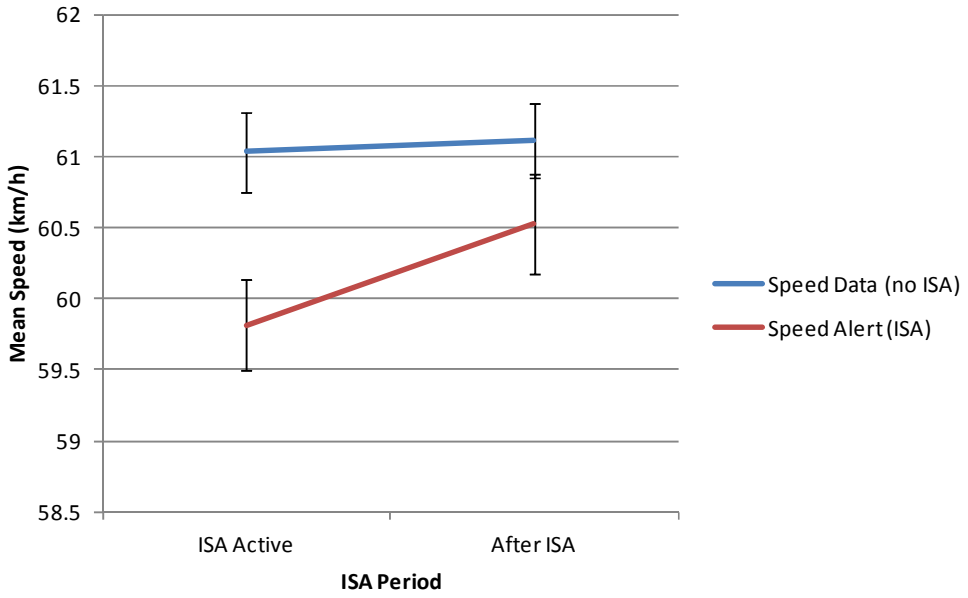


Figure 3.7 Mean speed (marginal means) as a function of ISA Group and ISA Period (standard error bars)

3.3.3.f Changes in Mean Speed Over Time

The ISA Active period (12 weeks) and the After ISA period (8 weeks) were further divided into four sub-periods each to examine if the effectiveness of ISA varied over time, which would indicate whether there was any adaptation to the ISA device when it was first fitted and when it was removed. The mean speed attained in each speed zone during each of the eight sub-periods was calculated for each participant. Eight sub-periods were selected for this analysis because the GEE model required that there be the same number of sub-periods in each of the ISA active and After ISA periods. Also, for some weeks during the trial, there was no logged data recorded for some drivers; thus, combining weeks into 2 or 3 weeks blocks was

necessary. The mean speed across sub-periods for each group at each speed zone is shown in Figures 3.8 to 3.13.

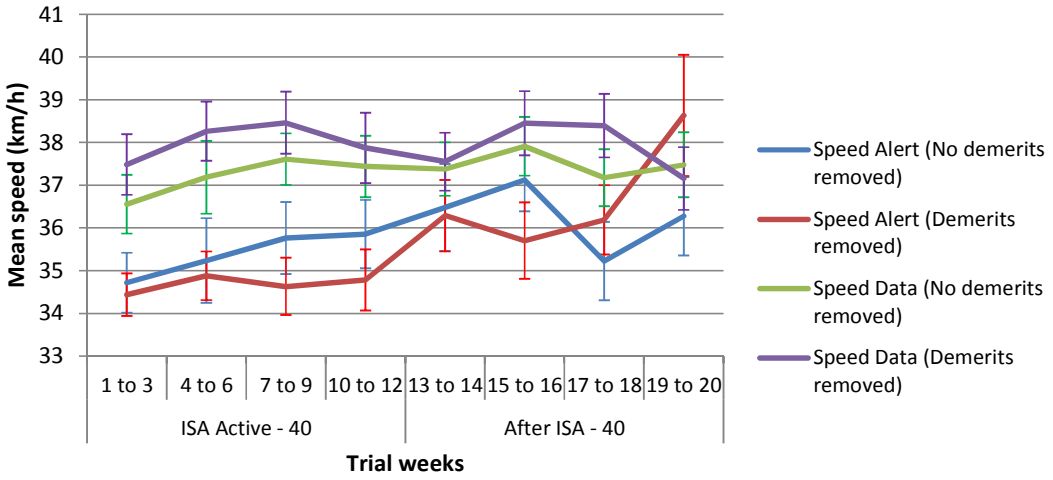


Figure 3.8 Mean speed (marginal means) in 40 km/h zones as a function of ISA Group and ISA sub-period (standard error bars)

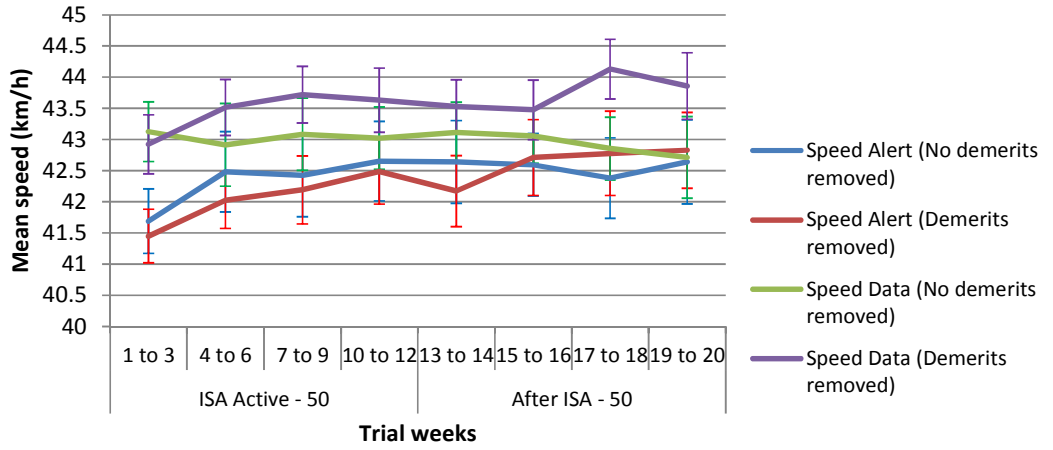


Figure 3.9 Mean speed (marginal means) in 50 km/h zones as a function of ISA Group and ISA sub-period (standard error bars)

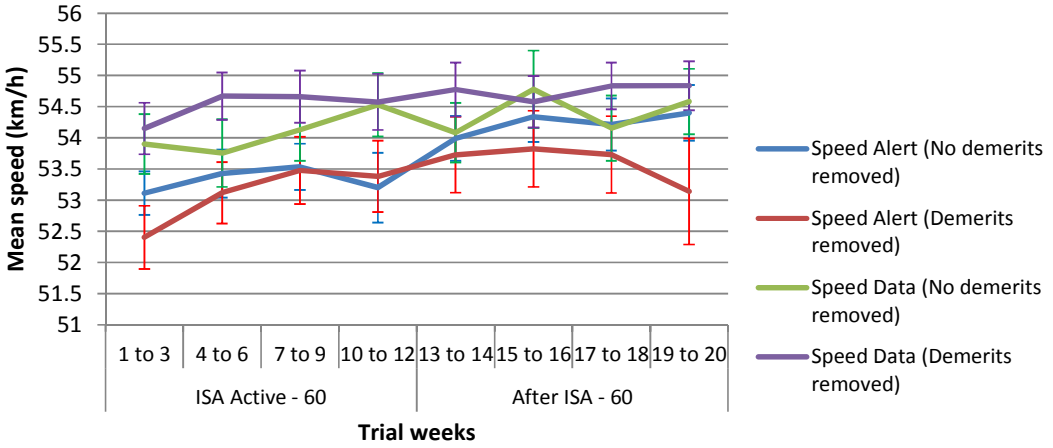


Figure 3.10 Mean speed (marginal means) in 60 km/h zones as a function of ISA Group and ISA sub-period (standard error bars)

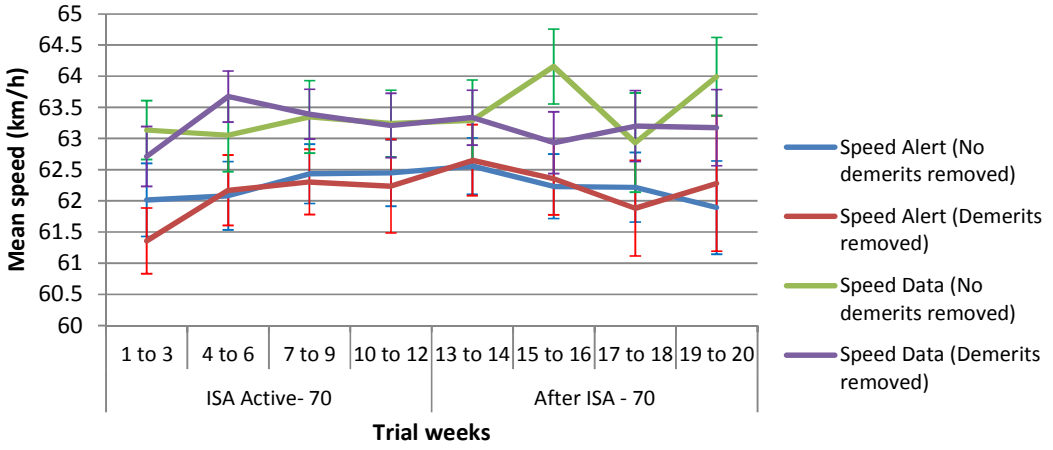


Figure 3.11 Mean speed (marginal means) in 70 km/h zones as a function of ISA Group and ISA sub-period (standard error bars)

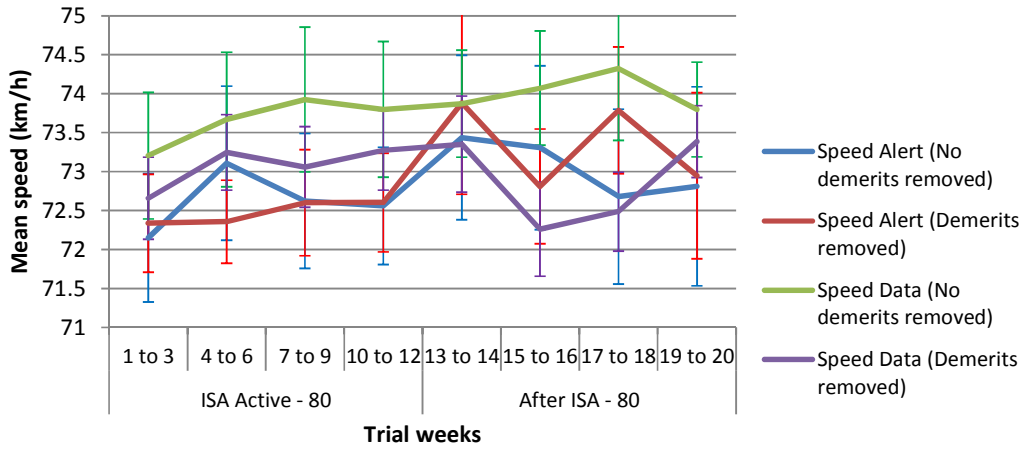


Figure 3.12 Mean speed (marginal means) in 80 km/h zones as a function of ISA Group and ISA sub-period (standard error bars)

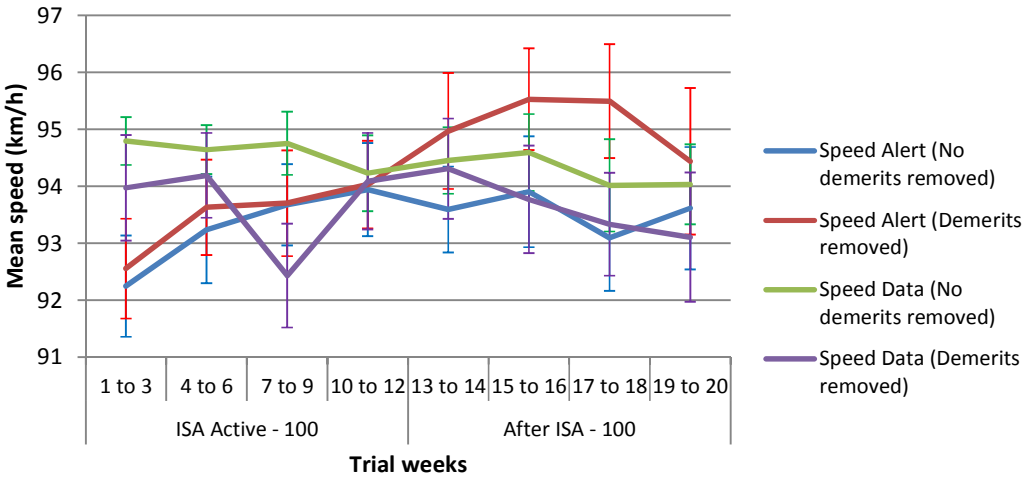


Figure 3.13 Mean speed (marginal means) in 100 km/h zones as a function of ISA Group and ISA sub-period (standard error bars)

First, a full factorial GEE model using the identity link function, the normal error distribution and an unstructured correlation matrix was fitted to the mean speed data to examine the effectiveness of the ISA device and demerit point removal, across speed zones, and if this varied over time within the trial periods. The five factors included in the model were:

- **ISA Group** (Speed Alert or Speed Data)
- **Trial Group** (Demerit point removal or No demerit point removal)
- **Period** (ISA active or After ISA)
- **Speed Zone** (40, 50, 60, 70, 80, 100 km/h)
- **Sub-period** (1 to 4).

Similar to the overall mean speed analysis, demerit point removal was not found to significantly affect mean speed (p=0.86), or to interact significantly with ISA in any of the interactions of interest. Therefore, in

an effort to simplify the analysis, Trial Group was removed from the model and a full factorial GEE model was fitted using the following four factors:

- **ISA Group** (Speed Alert or Speed Data)
- **Period** (ISA active or After ISA)
- **Speed Zone** (40, 50, 60, 70, 80, 100 km/h)
- **Sub-period** (1 to 4).

Table 3.20 displays the results of interest. None of the interactions involving sub-period were significant, which indicates that the effect of ISA did not differ significantly over time while it was active or after it had been removed. Similar to the overall mean speed analysis, the 2-way Period X ISA Group interaction was significant (p=0.015). However, in contrast to the overall mean speed results, the addition of the Sub-Period term lead to the Period X ISA Group X Speed Limit interaction becoming statistically significant (p=0.015). This indicates that, once sub-period is adjusted for, the ISA has an effect when it is active, and that this effect differs over speed zone.

Table 3.20 Mean speed by Sub-Period GEE results for effects of interest

ISA effects of interest			**p-value**
Does the ISA have an effect when it is active, and does this effectiveness vary across speed zone and over time?	4 way interaction	Period X ISA Group X Speed Limit X Sub-Period	0.659
Does the ISA have an effect when it is active, and does this vary across speed zone?	**3 way interaction**	**Period X ISA Group X Speed Limit**	**0.015**
Does ISA have an effect when it is active and does this differ over time?	3 way interaction	Period X ISA Group X Sub-Period	0.614
Does the effectiveness of ISA depend on whether it is active?	**2 way interaction**	**Period X ISA Group**	**0.000**

Significant effects in bold

Table 3.21 displays pairwise comparisons between the estimated marginal means for the Speed Alert group during the ISA Active period compared with the After ISA period; the Speed Alert group during the ISA Active period compared to the Speed Data group during the equivalent ISA Active period; and the Speed Data group during the equivalent ISA Active period and the Speed Data group during the equivalent After ISA period.

Table 3.21 Differences between estimated marginal means for contrasts of interest

Speed limit	**Estimated marginal means**		
	Speed Alert ISA Active – Speed Alert After ISA	**Speed Alert ISA Active – Speed Data ISA Active**	**Speed Data ISA Active – Speed Data After ISA**
40	**-1.41**	**-2.63**	-0.02
50	**-0.48**	**-1.01**	-0.05
60	**-0.63**	**-1.12**	**-0.28**
70	-0.18	**-1.12**	-0.09
80	**-0.75**	-0.72	0.01
100	**-0.92**	-.075	0.28

Significant effects in bold

For the Speed Alert group, mean speed when ISA was active was significantly lower than mean speed when it had been removed in all speed zones except 70 km/h. Additionally, in the ISA Active period, compared to the Speed Data group, mean speed for the Speed Alert group was significantly lower in the lower speed zones, but not in 80 km/h or 100 km/h zones. Looking at how mean speed changed over time in the Speed Data Group, there was no significant difference between the equivalent ISA Active and After ISA periods in any speed zone except 60 km/h, where the mean speed in the equivalent ISA Active period was marginally lower than in the equivalent After ISA period.

3.3.3.g 85th Percentile Speed

The average 85th percentile speed for each ISA group across speed zones and ISA period are displayed in Table 3.22. The effects of ISA system and demerit point removal on average 85th percentile speeds were examined using the GEE model described previously. The error distribution specified in the GEE was a normal error distribution, an identity link function was used and the correlation matrix was unstructured.

The 85th percentile speed distributions were also graphed for the four ISA groups to gain further insight into how the use of ISA (and its subsequent removal) and demerit point removal change the 85th percentile speed distribution. These speed distribution graphs are contained in Appendix F.

Table 3.22 Average 85th percentile [95% Confidence Interval] speed across ISA groups, ISA periods and speed zones

Speed zone (km/h)	ISA Group							
	Speed Alert (No Demerit Points Removed) n=17		Speed Alert (Demerit Points Removed) n=23		Speed Data (No Demerit Points Removed) n=22		Speed Data (Demerit Points Removed)n=24	
	ISA Active	After ISA	ISA Active	After ISA	ISA Active	After ISA	ISA Active	After ISA
40	43.36 [41.14-45.59]	46.36 [44.43-48.29]	43.01 [41.11-44.90]	45.52 [43.19-47.85]	47.57 [45.52-49.63]	47.52 [46.09-48.96]	48.78 [46.85-50.70]	48.72 [46.79-50.64]
50	49.50 [47.65-51.34]	50.65 [48.89-52.42]	49.35 [47.94-50.76]	50.89 [49.02-52.76]	51.82 [50.17-53.47]	51.77 [50.37-53.17]	52.46 [50.99-53.93]	52.92 [51.51-54.33]
60	59.40 [58.47-60.33]	61.05 [59.99-62.12]	59.51 [58.14-60.88]	61.07 [59.26-62.89]	61.20 [59.77-62.63]	61.83 [60.33-63.34]	61.71 [60.61-62.82]	62.15 [61.20-63.10]
70	67.91 [66.85-68.96]	68.56 [67.29-69.84]	68.46 [67.16-69.77]	69.86 [68.30-71.41]	69.91 [68.65-71.17]	70.57 [68.95-72.19]	70.17 [69.00-71.34]	70.04 [68.88-71.20]
80	79.08 [76.47-81.70]	80.00 [77.22-82.79]	79.37 [77.63-81.11]	81.30 [78.56-84.05]	80.84 [78.66-83.02]	81.08 [79.36-82.80]	80.43 [79.05-81.80]	80.02 [78.56-81.48]
100	97.75 [96.34-99.15]	98.06 [96.45-99.66]	99.07 [97.51-100.62]	100.71 [98.86-102.57]	99.98 [98.86-101.09]	99.71 [98.42-101.01]	99.41 [97.76-101.06]	100.24 [98.69-101.78]

The results of the GEE model for average 85th percentile speed for the effects of interest are displayed in Table 3.23.

Table 3.23 Average 85th percentile speed GEE results for effects of interest – 4 factor model including ISA Group, Trial Group, Speed Limit and Period

ISA effects of interest			**p-value**
Does the ISA have an effect when it is active, and does this vary across speed zone?	3 way interaction	Period X ISA Group X Speed Limit	0.052
Does ISA have an effect when it is active and does this differ according to whether or not demerit points are removed?	3 way interaction	Period X ISA Group X Trial Group	0.447
Does the effectiveness of ISA depend on whether it is active?	**2 way interaction**	**Period X ISA Group**	**0.000**
Trial group effects of interest			
Is Demerit Point removal more effective in different speed zones?	2 way interaction	Trial Group X Speed Limit	0.561
Is Demerit Point removal effective?	Main effect	Trial Group	0.471

Significant effects in bold

As displayed, there was no significant main effect of trial group, meaning that there was no effect of demerit point removal on the average 85th percentile speed travelled at during the trial. There were also no interactions involving trial group, so in order to investigate the effect of ISA Group and speed limit in more detail, another GEE was conducted without including trial group as a factor (Table 3.24).

Table 3.24 Average 85th percentile speed GEE results for effects of interest – 3 factor model including ISA Group, Speed Limit and Period

ISA effects of interest			**p-value**
Does the ISA have an effect when it is active, and does this vary across speed zone?	**3 way interaction**	**Period X ISA Group X Speed Limit**	**0.038**
Does the effectiveness of ISA depend on whether it is active?	**2 way interaction**	**Period X ISA Group**	**0.000**

This analysis revealed a significant Period X ISA Group X Speed Limit interaction, which indicates that ISA has an effect when active and that this effect varies across speed zones. To investigate this in more detail, the data were stratified by speed limit, and 2 factor model using ISA Group and Period was conducted for each speed limit separately (Table 3.25).

Table 3.25 Average 85th percentile speed GEE results for effects of interest – 2 factor model including ISA Group and Period

ISA effects of interest			**p-value**
Does the effectiveness of ISA depend on whether it is active?			
40 km/h	**2 way interaction**	**Period X ISA Group**	**0.000**
50 km/h	**2 way interaction**	**Period X ISA Group**	**0.001**
60 km/h	**2 way interaction**	**Period X ISA Group**	**0.001**
70 km/h	**2 way interaction**	**Period X ISA Group**	**0.047**
80 km/h	**2 way interaction**	**Period X ISA Group**	**0.032**
100 km/h	2 way interaction	Period X ISA Group	0.077

The interaction between Period and ISA Group was statistically significant ($p<0.05$) for all speed zones except 100 km/h. For 100 km/h zones, there was some evidence for an interaction ($p<0.08$) which did not reach the level for statistical significance.

The average 85th percentile speed in 40 km/h zones was higher than 40 km/h for both the Speed Alert and Speed Data groups (Figure 3.14). In 40 km/h zones the 85th percentile speed in the Speed Alert group was significantly lower when the ISA was active (43.16 km/h) compared to when it was inactive (45.88 km/h, p=0.000 for difference). Compared to the Speed Data group, the 85th percentile speed in 40 km/h zones was lower for the Speed Alert group both when ISA was active (43.16 cf 48.20 km/h, p=0.000) and inactive (45.88 cf 48.15 km/h, p=0.000).

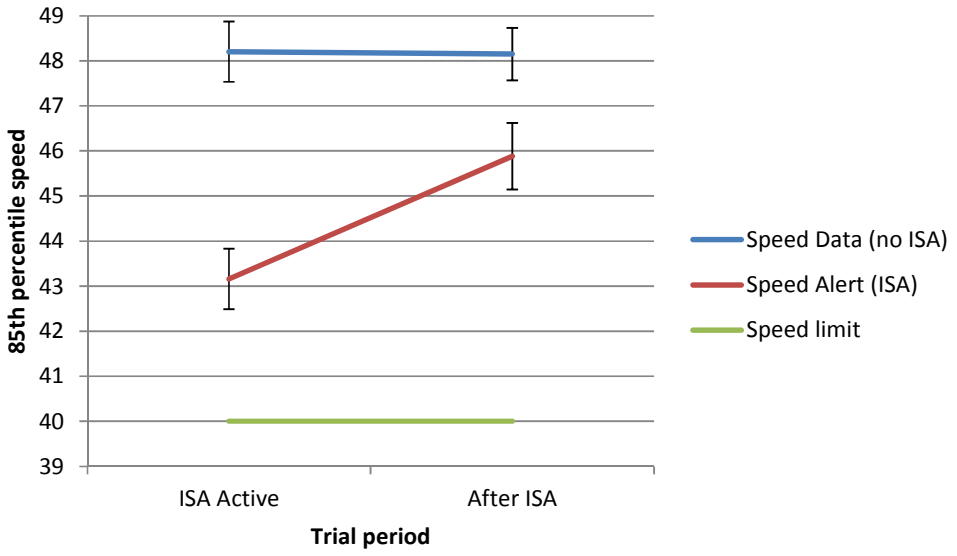


Figure 3.14 Average 85th percentile speeds in 40 km/h speed zones

The only situation where the average 85th percentile speed in 50 km/h zones was less than 50 km/h was for the Speed Alert group when ISA was active (Figure 3.15). In 50 km/h zones, the 85th percentile speed in the Speed Alert group was significantly lower when the ISA was active (49.41 km/h) compared to when it was inactive (50.79 km/h, p=0.000 for difference). Compared to the Speed Data group, the 85th percentile speed in 50 km/h zones was lower for the Speed Alert group both when ISA was active (49.41 cf 52.16 km/h, p=0.000) and inactive (50.79 cf 52.37 km/h, p=0.042).

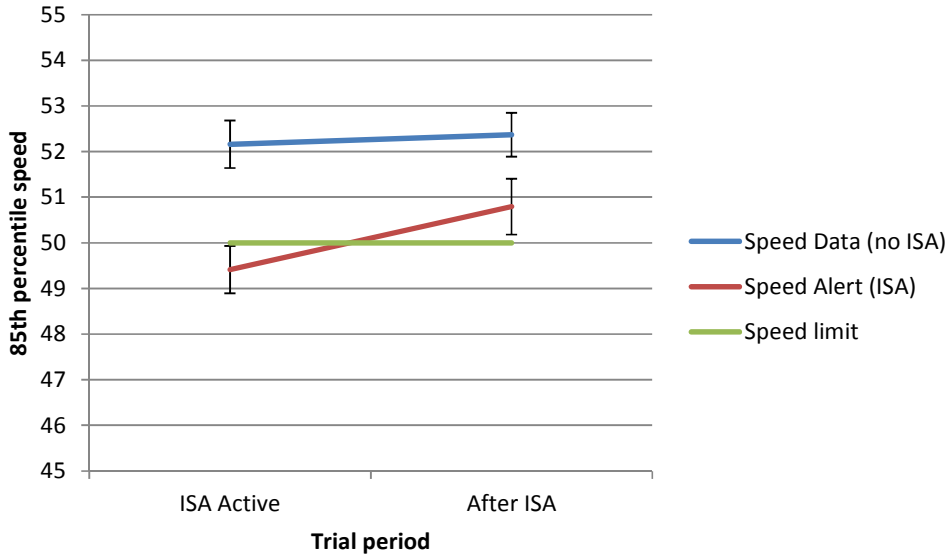


Figure 3.15 Average 85th percentile speeds in 50 km/h speed zones

The only situation where the average 85th percentile speed in 60 km/h zones was less than 60 km/h was for the Speed Alert group when ISA was active (Figure 3.16). In 60 km/h zones, the 85th percentile speed in the speed alert group was significantly lower when the ISA was active (59.46 km/h) compared to when it was inactive (61.06 km/h, p=0.000 for difference). Compared to the Speed Data group, the 85th percentile speed in 60 km/h zones was lower for the Speed Alert group when ISA was active (59.46 cf 61.47 km/h, p=0.001) but not when ISA was inactive (61.06 cf 62.00 km/h, p=0.17).

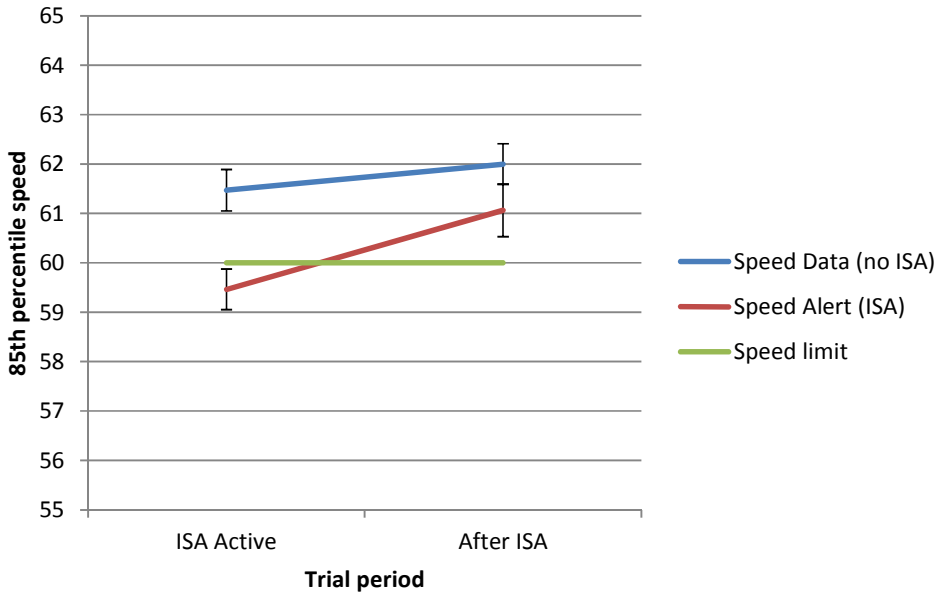


Figure 3.16 Average 85th percentile speeds in 60 km/h speed zones

In 70 km/h zones, the 85th percentile speed in the Speed Alert group was significantly lower when the ISA was active (68.23 km/h) compared to when it was inactive (69.31 km/h, p=0.000 for difference) (Figure 3.17). Compared to the Speed Data group, the 85th percentile speed in 70 km/h zones was lower for the Speed Alert group when ISA was active (68.23 cf 70.05 km/h, p=0.002) but not when ISA was inactive (69.31 cf 70.29 km/h, p=0.149).

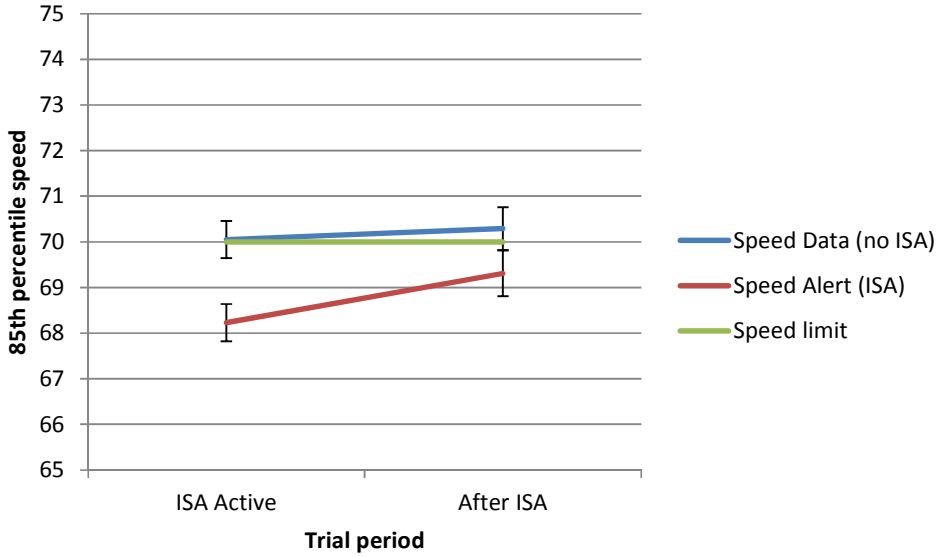


Figure 3.17 Average 85th percentile speeds in 70 km/h speed zones

In 80 km/h zones, the 85th percentile speed in the Speed Alert group was significantly lower when the ISA was active (79.25 km/h) compared to when it was inactive (80.75 km/h, p=0.004 for difference) (Figure 3.18). Compared to the Speed Data group, the 85th percentile speed in 80 km/h zones was not statistically different from the Speed Alert group when ISA was active (79.25 cf 80.62 km/h, p=0.133) nor when ISA was inactive (80.75 cf 80.53 km/h, p=0.834).

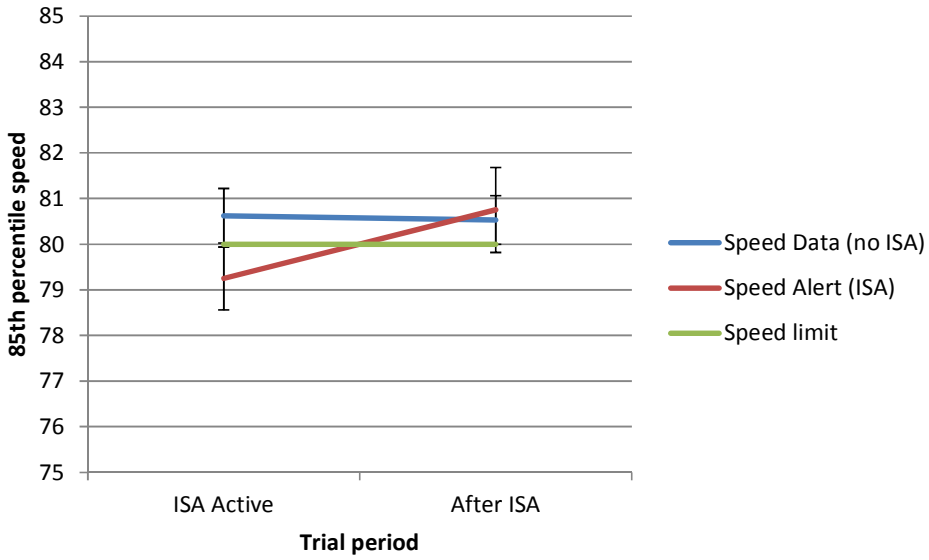


Figure 3.18 Average 85th percentile speeds in 80 km/h speed zones

In 100 km/h zones, even though the interaction between ISA Group and Period did not reach the conventional level for statistical significance, it was investigated in more detail because the p-value (p=0.077) indicated some evidence for an interaction. In 100 km/h zones, the 85th percentile speed in the Speed Alert group was significantly lower when the ISA was active (98.42 km/h) compared to when it was inactive (99.48 km/h, p=0.000 for difference) (Figure 3.19). Compared to the Speed Data group, the 85th percentile speed in 100 km/h zones was not statistically different from the Speed Alert group when ISA was active (98.42 cf 99.67 km/h, p=0.079) nor when ISA was inactive (99.48 cf 99.86 km/h, p=0.639).

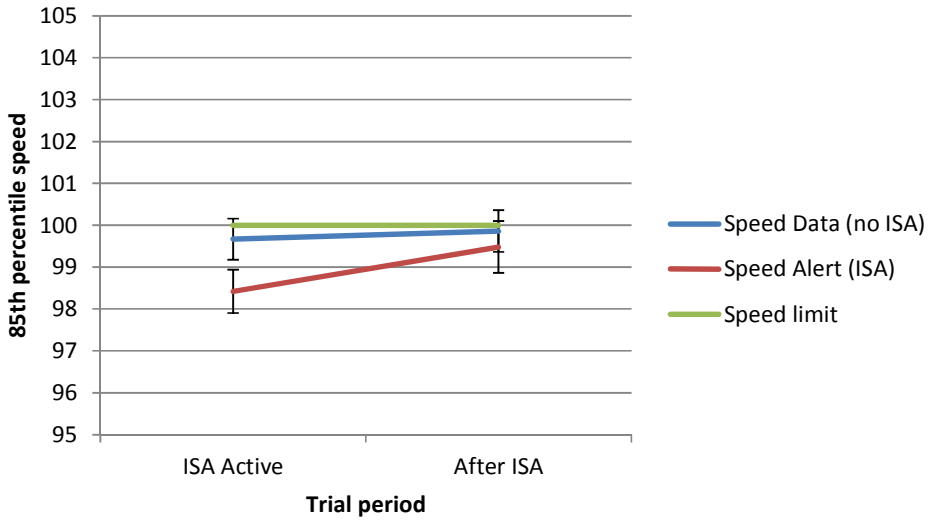


Figure 3.19 Average 85th percentile speeds in 100 km/h speed zones

3.3.3.h Time to Return to Speed Limit

The mean time in seconds taken to return to the speed limit after it was exceeded and an ISA warning was issued was examined across the four ISA groups, ISA periods and speed zones (Table 3.26). The GEE model was specified with an Identity link function and normal error distribution whilst the working correlation matrix was specified as unstructured. Instances where the maximum speed reached was less than 1.0 km/h over the limit were excluded as drivers should not have received a warning in such cases.

Table 3.26 Mean [95% Confidence Interval] time (s) taken to return to the speed limit after exceeding across ISA groups, ISA Periods and speed zones

Speed zone (km/h)	ISA Group							
	Speed Alert (No Demerit Points Removed) n=17		Speed Alert (Demerit Points Removed) n=23		Speed Data (No Demerit Points Removed) n=22		Speed Data (Demerit Points Removed)n=24	
	ISA Active	After ISA	ISA Active	After ISA	ISA Active	After ISA	ISA Active	After ISA
40	5.6 [4.3-7.0]	8.4 [7.4-9.5]	5.2 [4.1-6.2]	7.8 [6.7-9.0]	8.6 [7.6-9.7]	8.7 [7.6-9.7]	8.7 [8.0-9.4]	8.7 [8.2-9.2]
50	4.5 [3.2-5.7]	7.2 [5.8-8.7]	4.6 [3.5-5.7]	7.4 [6.2-8.6]	8.3 [6.5-10.2]	7.4 [6.5-8.2]	7.9 [7.0-8.8]	8.2 [7.2-9.3]
60	5.0 [3.9-6.2]	9.3 [8.3-10.4]	5.5 [3.9-7.2]	9.0 [7.1-10.8]	9.8 [8.5-11.1]	10.0 [8.6-11.3]	9.2 [7.9-10.4]	9.8 [8.8-10.9]
70	4.3 [3.4-5.2]	7.3 [6.1-8.5]	5.3 [3.8-6.7]	9.1 [7.1-11.1]	9.4 [7.9-10.8]	10.6 [9.0-12.2]	8.5 [7.3-9.7]	8.9 [7.7-10.1]
80	5.7 [3.7-7.7]	12.2 [9.3-15.2]	8.0 [4.5-11.5]	13.0 [8.0-18.1]	11.5 [8.7-14.4]	11.8 [9.6-13.9]	11.6 [9.4-13.7]	12.0 [10.1-13.8]
100	5.1 [3.1-7.0]	10.6 [6.4-14.9]	6.4 [3.5-9.3]	16.6 [9.2-24.0]	13.7 [10.3-17.2]	13.4 [9.9-17.0]	14.3 [9.2-19.4]	17.5 [11.9-23.2]

The results of the GEE model for the time taken to return to the speed limit for the effects of interest are displayed in Table 3.27.

Table 3.27 Time to return to speed limit GEE results for effects of interest

ISA effects of interest			**p-value**
Does the ISA have an effect when it is active, and does this vary across speed zone?	**3 way interaction**	**Period X ISA Group X Speed Limit**	**0.025**
Does ISA have an effect when it is active and does this differ according to whether or not demerit points are removed?	3 way interaction	Period X ISA Group X Trial Group	0.741
Does the effectiveness of ISA depend on whether it is active?	**2 way interaction**	**Period X ISA Group**	**0.000**
Trial group effects of interest			
Is Demerit Point removal more effective in different speed zones?	2 way interaction	Trial Group X Speed Limit	0.315
Is Demerit Point removal effective?	Main effect	Trial Group	0.267

Significant effects in bold

There was no main effect for Trial Group and no significant 3-way ISA Period X ISA Group X Trial Group interaction, suggesting that there was no effect of demerit point removal on the time taken to return to the speed limit after a warning was issued.

A significant ISA Group X Period interaction was found (p=.000). For the Speed Alert (treatment) group, the time taken to return to the speed limit was significantly lower, by 4.40 seconds (95%CI 3.51-5.29, p=.000), when the ISA was active compared to when it was not. In contrast, there was no significant difference in time taken to return to the speed limit between the two periods for the Speed Data (control) group (0.46 seconds, 95%CI -0.14-1.06, p=.133).

Comparing the Speed Data group and the Speed Alert group, the Speed Alert group had a significantly shorter time to return to the speed limit when the ISA was active (4.61 seconds, 95%CI 3.31-5.91, p=.000), however there was no significant difference between the Speed Alert group and the Speed Data group in the After ISA period (0.67seconds, 95%CI -0.79 – 2.14, p=.37) (Figure 3.20).

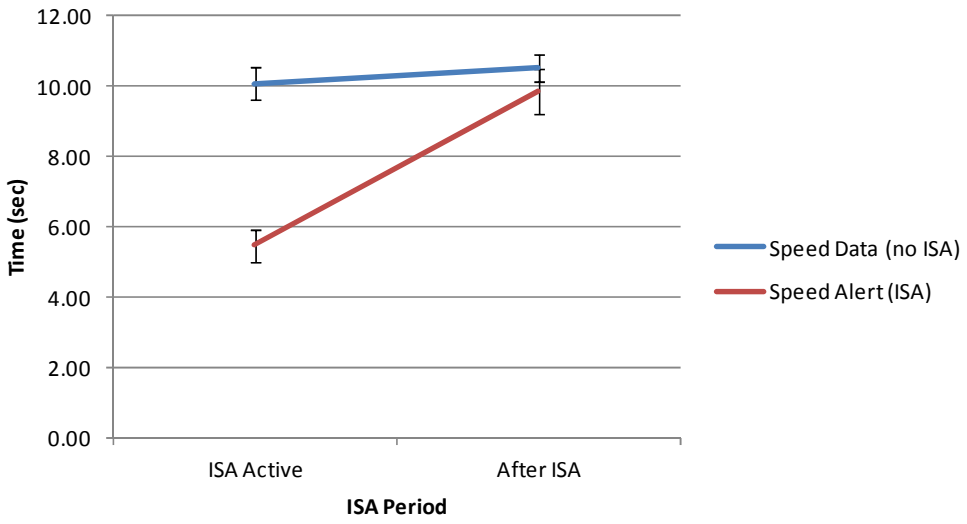


Figure 3.20 Marginal means of mean time to return to speed limit as a function of ISA Group and ISA Period (standard error bars)

There was also evidence that the effectiveness of ISA in improving the time to return to the speed limit differed according to speed zone, with a significant Period X ISA Group X Speed Limit interaction (p = .025). Figure 3.21 indicates that the greatest relative improvement was in 100 km/h zones.

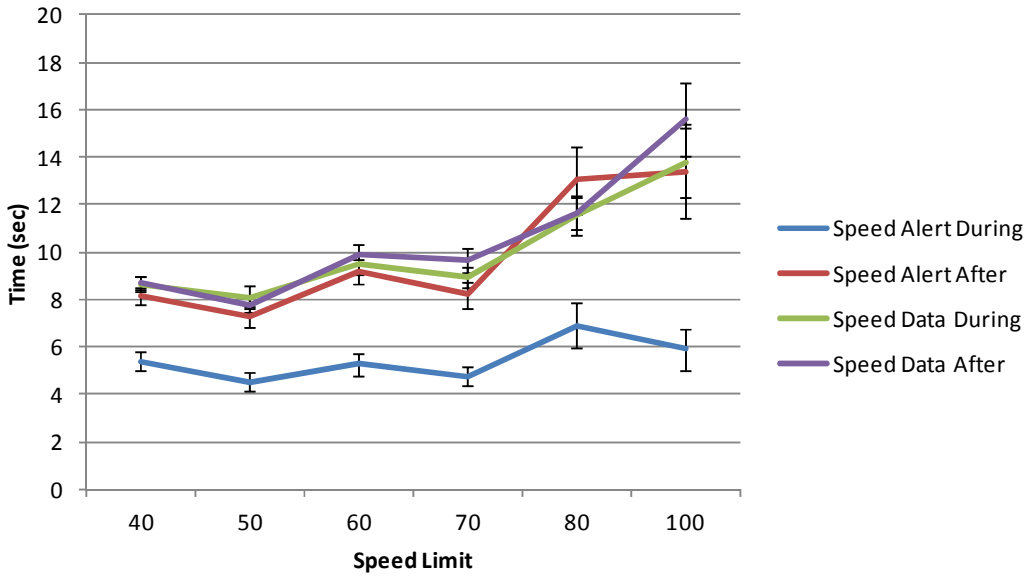


Figure 3.21 Marginal means of mean time to return to speed limit as a function of ISA Group, ISA Period and speed zone (standard error bars)

3.3.3.i Time to Return to ISA Auditory Warning Threshold

The mean time taken to return to the 3 km/h ISA auditory warning threshold after it was exceeded was examined across the four ISA groups, ISA periods and speed zones (Table 3.28). This 3 km/h auditory threshold was selected based on experience with ISA device effectiveness in the TAC SafeCar project (Regan et al., 2006), where it was found that the auditory warnings were more effective than the visual warnings at reducing speed. A threshold of 3 km/h was chosen as the mid-point at which the current ISA device first issues auditory warnings (i.e. single beep 2-4 km/h over limit).

As with the 'time to return to speed limit' data, the effects of the ISA system, demerit point removal , ISA period and speed zone on how quickly drivers returned to the auditory warning threshold were examined using a GEE model with normal error distribution, identity link function and an unstructured correlation matrix. Instances where the maximum speed reached was less than 4 km/h over the limit were excluded as drivers may not have received a warning.

Table 3.28 Mean [95% Confidence Interval] time (s) taken to return to the ISA 3 km/h auditory warning threshold across ISA groups, ISA Periods and speed zones

Speed zone (km/h)	ISA Group							
	Speed Alert (No Demerit Points Removed) n=17		Speed Alert (Demerit Points Removed) n=23		Speed Data (No Demerit Points Removed) n=22		Speed Data (Demerit Points Removed)n=24	
	ISA Active	After ISA	ISA Active	After ISA	ISA Active	After ISA	ISA Active	After ISA
40	4.6 [3.3-5.8]	7.4 [6.5-8.4]	4.5 [3.5-5.5]	7.0 [5.9-8.1]	7.9 [6.9-8.8]	7.8 [7.0-8.6]	7.5 [6.9-8.2]	7.3 [6.6-8.0]
50	4.3 [3.1-5.6]	6.7 [5.2-8.1]	4.4 [3.3-5.4]	6.5 [5.3-7.7]	7.6 [5.3-10.0]	6.7 [5.8-7.6]	7.0 [6.1-7.8]	7.2 [6.3-8.1]
60	4.6 [3.5-5.7]	7.7 [6.5-8.8]	5.3 [3.7-7.0]	7.4 [5.7-9.1]	7.7 [6.4-9.1]	8.4 [7.2-9.7]	7.1 [6.1-8.1]	7.6 [6.7-8.6]
70	3.8 [3.0-4.5]	5.5 [4.2-6.7]	4.9 [3.7-6.2]	7.9 [6.4-9.5]	7.8 [6.5-9.1]	8.5 [7.0-9.9]	7.3 [6.1-8.5]	6.9 [5.8-8.1]
80	7.3 [4.2-10.3]	10.8 [8.0-13.7]	9.3 [5.8-12.7]	11.6 [8.4-14.7]	10.7 [8.0-13.3]	11.1 [8.8-13.4]	11.0 [7.9-14.1]	11.0 [8.3-13.6]
100	5.4 [3.2-7.6]	7.1 [4.6-9.5]	7.4 [4.0-10.7]	9.1 [5.8-12.4]	10.2 [8.0-12.3]	11.2 [8.7-13.8]	10.1 [6.4-13.9	11.4 [7.9-14.8]

The results of the GEE model for the time taken to return to the auditory threshold for the effects of interest are displayed in Table 3.29.

Table 3.29 Time to return to auditory threshold GEE results for effects of interest

ISA effects of interest			**p-value**
Does the ISA have an effect when it is active, and does this vary across speed zone?	3 way interaction	Period X ISA Group X Speed Limit	0.297
Does ISA have an effect when it is active and does this differ according to whether or not demerit points are removed?	3 way interaction	Period X ISA Group X Trial Group	0.764
Does the effectiveness of ISA depend on whether it is active?	**2 way interaction**	**Period X ISA Group**	**0.000**
Trial group effects of interest			
Is Demerit Point removal more effective in different speed zones?	2 way interaction	Trial Group X Speed Limit	0.694
Is Demerit Point removal effective?	Main effect	Trial Group	0.674

Significant effects in bold

There was no main effect for Trial Group and no significant 3 way Period X ISA Group X Trial Group interaction, meaning there was no effect of demerit point removal on the time taken to return to the auditory warning threshold. There was also no evidence that the effectiveness of ISA differed according to speed limit (non-significant Period X ISA Group X Speed Limit interaction).

There was a significant ISA Group X Period interaction found (p=.000) (Figure 3.22). For the Speed Alert group, the time taken to return to the auditory threshold was significantly lower, by 2.21 seconds (95%CI, 1.73-2.69, p=.000), when the ISA was active compared to when it was not. In contrast, there was no significant difference in time taken to return to the auditory warning threshold between the two ISA periods for the Speed Data group (0.14 seconds, 95%CI -0.26-0.54, p=.484).

Comparing the Speed Data group and the Speed Alert group, the Speed Alert group had a significantly shorter time to return to the auditory warning threshold when the ISA was active (3.07 seconds, 95%CI 1.91-4.23, p=.000), but not during the ISA After period (1.00 seconds, 95%CI -0.18-2.02, p=0.054).

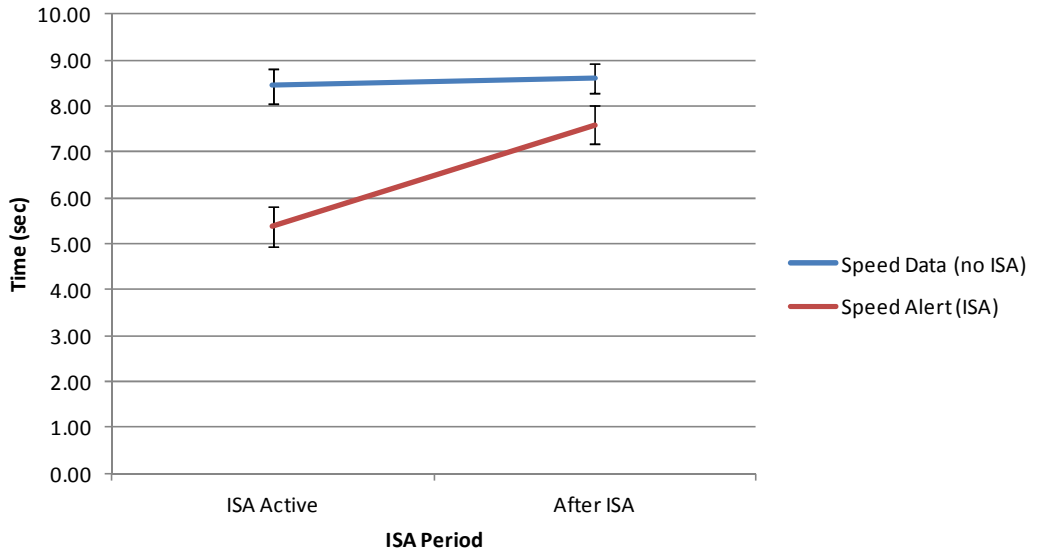


Figure 3.22 Marginal means for mean time to return to auditory threshold as a function of ISA Group and ISA Period (standard error bars)

3.3.3.j Proportion of Driving Time with Screen Status 'Off 'and Time with Mute 'On'

The mean proportion of driving time during the trial that the two Speed Alert groups spent with the screen off, as well as the mean proportion of driving time with the mute activated are summarised in Table 3.30. These measures are reported for the Speed Alert groups only given that the Speed Data groups did not have an ISA screen installed. The screen off measure may be a reflection of driver annoyance or frustration with the ISA device or due to non-participant drivers driving the car (it is not possible to distinguish between these).

Table 3.30 Mean percentage of time [95% Confidence Interval] spent with the screen off and mute activated across the Speed Alert groups

Speed zone (km/h)	ISA Group			
	Speed Alert (No Demerits Removed) n=17		Speed Alert (Demerits Removed) n=23	
	% time screen off	% time mute activated	% time screen off	% time mute activated
40	9.7 [2.0-17.5]	8.5 [0.5-16.6]	13.5 [4.0-23.0]	7.2 [3.3-11.0]
50	11.1 [3.9-18.3]	5.5 [0.0-11.1]	15.3 [6.3-24.2]	3.9 [1.6-6.2]
60	8.9 [2.0-15.8]	5.8 [0.3-11.3]	15.0 [5.7-24.4]	4.2 [1.8-6.6]
70	7.8 [1.9-13.8]	4.2 [-0.4-8.8]	14.4 [5.1-23.7]	3.7 [1.4-6.0]
80	6.5 [0.8-12.2]	6.5 [0.3-12.6]	13.0 [4.7-21.2]	5.5 [2.4-8.5]
100	4.9 [-1.2-10.9]	5.3 [-0.3-10.8]	10.0 [3.6-16.5]	5.9 [1.1-10.7]

During the period when ISA was active, the proportion of time spent with the screen turned off was measured. Differences across speed zone were assessed using GEE with a binomial error distribution, logit link and an exchangeable correlation matrix.

There was a significant difference between speed zones in terms of the proportion of time that drivers travelled with the screen turned off (p =.000). Drivers spent significantly less time with the screen turned off in the 100 km/h speed zone than all other speed zones (p<.05) except for the 40 km/h speed zone, and even then there was some trend toward a difference (p=.087). The odds ratios comparing the proportion of time spent with the screen turned off in the various speed zones are presented in Table 3.31. It illustrates that time spent with the screen turned off was more likely in 60 km/h zones, with the odds of drivers turning off the screen being twice what is was in 100 km/h zones.

Table 3.31 Odds ratios [95% Confidence Interval] for time spent with the screen off across speed zones

Speed zone	Odds ratio (compared to 100 km/h zone)	95%CI [p-value]
40	1.50	0.94-2.38 [0.087]
50	**1.80**	**1.24-2.63 [0.002]**
60	**2.00**	**1.46-2.74 [0.000]**
70	**1.52**	**1.05-2.20 [0.026]**
80	**1.68**	**1.22-2.32 [0.001]**
100	Reference	-

Significant effects in bold

During the period when ISA was active, the proportion of time spent with the mute button turned on was measured (Table 3.32). Differences across speed zone were assessed using GEEs with a binomial error distribution, logit link and an exchangeable correlation matrix.

There was a significant difference between speed zones in terms of the proportion of time that drivers travelled with the mute button on (p=.000). Speed Alert group participants spent a significantly lower proportion of time with the mute button on in the 70 km/h zone compared to the 100 km/h zone. There were no other differences across speed zones.

Table 3.32 Odds ratios [95% Confidence Interval] for time spent with the mute on

Speed zone	Odds ratio (compared to 100 km/h zone)	95%CI [p-value]
40	1.11	0.46-2.66 [0.817]
50	0.68	0.30-1.50 [0.335]
60	0.79	0.42-1.49 [0.465]
70	**0.46**	**0.23-0.90 [0.024]**
80	0.96	0.49-1.85 [0.955]
100	Reference	-

Significant effects in bold

3.3.4 Driver Characteristics and ISA Effectiveness

A range of driver characteristics were analysed to examine whether and how they influence the effectiveness of ISA and demerit point removal in reducing the proportion of time spent 5 km/h or more above the speed limit. The proportion of time spent 5 km/h or more above the speed limit was found in the previous analyses to be a sensitive measure of ISA effectiveness. The driver characteristics examined included age, gender, social desirability scores, propensity for angry driving, and whether drivers were high or low level speeders. The outcomes of these analyses are presented in the following sections.

3.3.4.a Influence of driver characteristics on ISA effectiveness

A series of GEE models were fitted to determine which driver characteristics moderate the effectiveness of ISA and demerit point removal, as measured by the proportion of time spent 5 km/h or more above the speed limit. The factors examined included participant age, gender, social desirability scores (Marlowe-Crowne) from Survey 1, and scores on the Australian Propensity for Angry Driving Scale (Aus-PADS) from Survey 1.

3.3.4.a.1 Driver age

The effect of driver age on ISA effectiveness was examined across the speed zones using a GEE model with a normal error distribution, logit link function and an exchangeable correlation matrix. The results of the GEE model for the effects of interest are displayed in Table 3.33.

Table 3.33 The impact of driver age on ISA effectiveness GEE results for effects of interest

ISA effects of interest		p-value
Does Age impact on the effectiveness of ISA, and does this vary by speed limit?	**4 way: Period X ISA Group X Speed Limit X Age**	**0.041**
Does Age impact on the effectiveness of ISA?	3 way: Period X ISA Group X Age	0.917

Significant effects in bold

There was a significant 4-way interaction between Period, ISA Group, Speed Limit and Age, which indicates that driver age does impact on the effectiveness of ISA, and that this impact varies by speed limit. The data were stratified by speed limit and the impact of age on the effectiveness of ISA was investigated for each speed limit separately (using a GEE with an unstructured correlation matrix). The results of these analyses indicate that driver age only significantly impacts on the effectiveness of ISA in 40 km/h speed zones (Table 3.34).

Table 3.34 The impact of driver age on ISA effectiveness: Separate speed limit GEE results for effects of interest

ISA effects of interest			p-value
Does Age impact on the effectiveness of ISA?			
40 km/h	**3 way interaction**	**Period X ISA Group X Age**	**0.003**
50 km/h	3 way interaction	Period X ISA Group X Age	0.285
60 km/h	3 way interaction	Period X ISA Group X Age	0.769
70 km/h	3 way interaction	Period X ISA Group X Age	0.121
80 km/h	3 way interaction	Period X ISA Group X Age	0.652
100 km/h	3 way interaction	Period X ISA Group X Age	0.162

Significant effects in bold

To investigate the interaction between Period, ISA Group and Age in 40 km/h zones in more detail, age was categorised into three categories (Table 3.35).

Table 3.35 Demographic details of three driver age categories

Age-group	Number of participants	Percent
<35	336	32.6
35-50	312	30.2
>50	384	37.2

Using the categorical age variable, the effect of age-group on the effectiveness of ISA was investigated for 40 km/h only (using a GEE with an unstructured correlation matrix). There was a significant 3 way

interaction between Period, ISA Group and Age-group (p=0.001). The data were then stratified by age and the effectiveness of ISA was determined for each age-group separately (Table 3.36 and Figure 3.23).

In 40 km/h zones, in all age-groups, the Speed Alert group had significantly lower odds of being more than 5 km/h over the speed limit when the system was active compared to when it was inactive, with the effectiveness of ISA increasing as age increased (38% reduction for under 35s, 53% reduction for 35 to 50 year olds and 66% reduction for over 50s). Compared to the Speed Data group, the Speed Alert group had significantly lower odds of travelling more than 5 km/h over the speed limit when ISA was active (65% reduction for under 35s, 58% reduction for 35-50 years olds and 84% reduction for over 50s). In addition, the effect seemed to last into the After ISA period for the under 35s, with the odds of the Speed Alert group travelling more than 5 km/h over the speed limit in the after period being 49% lower than for the Speed Data group.

Overall, these results indicate that driver age did impact on ISA effectiveness, but only in 40 km/h zones. It appears that ISA was effective at reducing the proportion of time spent 5 km/h or more above the speed limit for drivers of all ages, but was more effective as driver age increased.

Table 3.36 The impact of driver age on ISA effectiveness GEE results for effects of interest for 40 km/h zones

Speed Limit	**Age-group**	**p-value for ISA Group X Period interaction**			
40 km/h	**<35**	**0.017**			
	35-50	*0.055*			
	>50	**0.000**			
	<35	**Comparison**	**OR**	**95% CI**	**p-value**
		Speed Alert: Active vs. After	**0.62**	**0.51-0.76**	**0.000**
		Speed Data: Active vs. After	0.90	0.72-1.13	0.372
		Active: Speed Alert vs. Speed Data	**0.35**	**0.22-0.56**	**0.000**
		After: Speed Alert vs. Speed Data	**0.51**	**0.36-0.71**	**0.000**
	35-50	**Comparison**	**OR**	**95% CI**	**p-value**
		Speed Alert: Active vs. After	**0.47**	**0.27-0.82**	**0.008**
		Speed Data: Active vs. After	**0.82**	**0.71-0.94**	**0.006**
		Active: Speed Alert vs. Speed Data	**0.42**	**0.25-0.70**	**0.001**
		After: Speed Alert vs. Speed Data	0.73	0.39-1.40	0.345
	>50	**Comparison**	**OR**	**95% CI**	**p-value**
		Speed Alert: Active vs. After	**0.34**	**0.26-0.46**	**0.000**
		Speed Data: Active vs. After	1.14	0.96-1.34	0.132
		Active: Speed Alert vs. Speed Data	**0.16**	**0.06-0.45**	**0.001**
		After: Speed Alert vs. Speed Data	0.52	0.22-1.25	0.147

Significant effects in bold

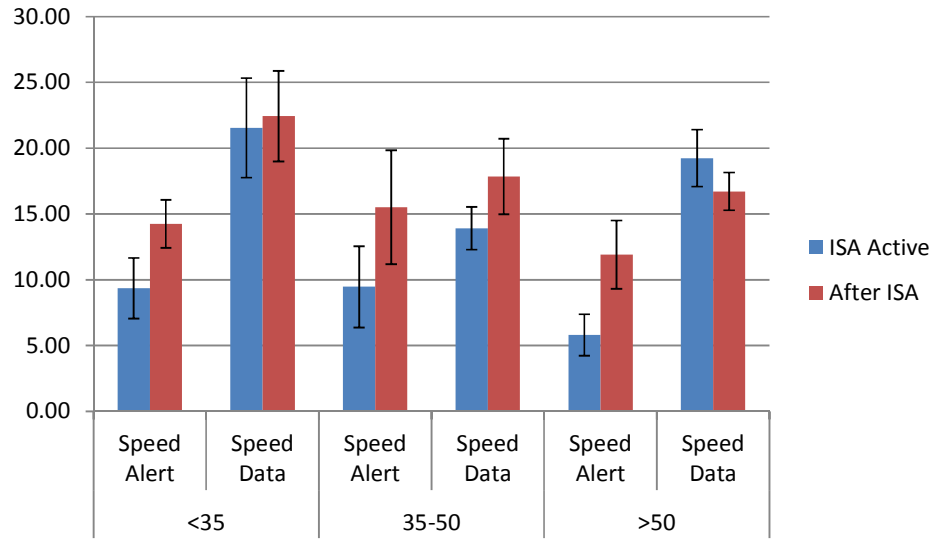


Figure 3.23 Proportion of time > 5 km/h over speed limit for each treatment group over time, across age group in 40 km/h speed zones

3.3.4.a.2 Driver gender

The effect of gender on ISA effectiveness was examined across the speed zones using a GEE model with a normal error distribution, logit link function and an exchangeable correlation matrix. The results of the GEE model for the effects of interest are displayed in Table 3.37.

Table 3.37 The impact of gender on ISA effectiveness GEE results for effects of interest

ISA effects of interest		**p-value**
Does Gender impact on the effectiveness of ISA, and does this vary by speed limit?	4 way: Period X ISA Group X Speed Limit X Gender	0.189
Does Gender impact on the effectiveness of ISA?	*3 way: Period X ISA Group X Gender*	*0.052*

Near significant effects in italics

There was some evidence for a 3-way interaction between Period, ISA Group and Gender, which indicates that gender might impact on the effectiveness of ISA. To investigate this further, the data were pooled across speed limit and a simpler model was fitted with Period, ISA Group and Gender as predictor variables and using an unstructured correlation matrix. The simpler model revealed a significant 3-way interaction between Period, ISA Group and Gender (p=0.023). Thus, the data were stratified by gender, and the effectiveness of ISA for each gender was investigated separately (using unstructured correlation matrices) (Table 3.38 and Figure 3.24).

In the Speed Alert group, both males and females had significantly lower odds of travelling more than 5 km/h over the speed limit when ISA was active compared to when it was inactive (40% reduction for males, 50% reduction for females). For males however, the Speed Data group also had a 16% reduction in the odds

of travelling more than 5 km/h over the speed limit in the ISA Active period compared to the After ISA period, whereas the females in the Speed Data group spent the same amount of time travelling more than 5 km/h over the speed limit in both periods. Overall, these results indicate that ISA was effective for both males and females, but may have been slightly more effective for females.

Table 3.38 The impact of gender on ISA effectiveness pooled across speed zones GEE results for effects of interest

Gender	**p-value for ISA Group X Period interaction**			
Males	**0.001**			
Females	**0.000**			
Males	**Comparison**	**OR**	**95% CI**	**p-value**
	Speed Alert: Active vs. After	**0.60**	**0.50-0.71**	**0.000**
	Speed Data: Active vs. After	**0.84**	**0.76-0.93**	**0.001**
	Active: Speed Alert vs. Speed Data	0.89	0.44-1.78	0.737
	After: Speed Alert vs. Speed Data	1.25	0.65-2.41	0.504
Females	**Comparison**	**OR**	**95% CI**	**p-value**
	Speed Alert: Active vs. After	**0.50**	**0.43-0.58**	**0.000**
	Speed Data: Active vs. After	1.00	0.87-1.15	0.972
	Active: Speed Alert vs. Speed Data	**0.31**	**0.16-0.62**	**0.001**
	After: Speed Alert vs. Speed Data	0.62	0.34-1.12	0.114

Significant effects in bold

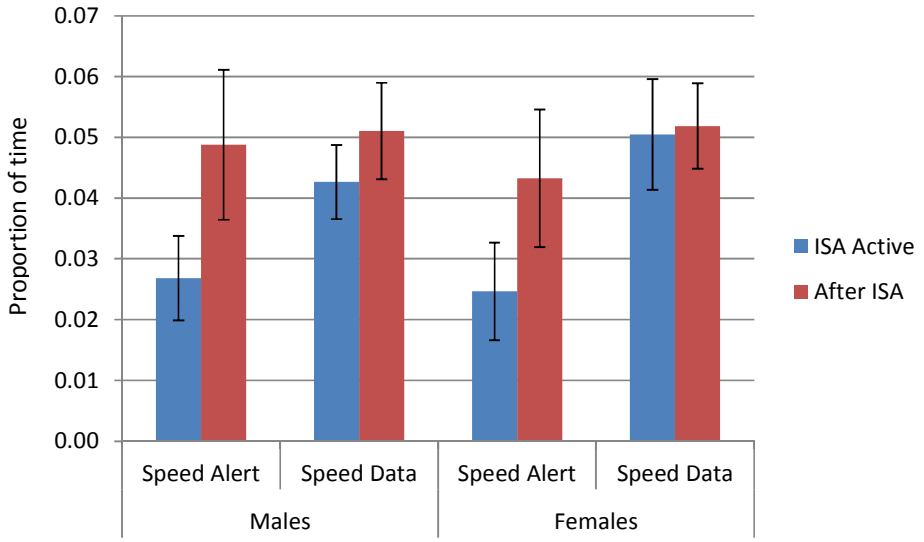


Figure 3.24 Proportion of time > 5 km/h over speed limit for each treatment group over time, for males and females

3.3.4.a.3 Social Desirability

The effect of social desirability on ISA effectiveness was examined across speed zones using a GEE model with a normal error distribution, logit link function and an exchangeable correlation matrix. The results of the GEE model for the effects of interest are displayed in Table 3.39. Results revealed that drivers' social desirability did not impact on the effectiveness of ISA.

Table 3.39 The impact of social desirability on ISA effectiveness GEE results for effects of interest

ISA effects of interest		**p-value**
Does Marlowe-Crowne Score impact on the effectiveness of ISA, and does this vary by speed limit?	4 way: Period X ISA Group X Speed Limit X Marlowe-Crowne Score	0.506
Does Marlowe-Crowne Score impact on the effectiveness of ISA?	3 way: Period X ISA Group X Marlowe-Crowne Score	0.101

3.3.4.a.4 Propensity for angry driving

The effect of drivers' propensity for angry driving (Aus-PADS) on ISA effectiveness was examined across speed zones using a GEE model with a normal error distribution, logit link function and an exchangeable correlation matrix. The results of the GEE model for the effects of interest are displayed in Table 3.40.

Table 3.40 The impact of Aus-PADS score on ISA effectiveness GEE results for effects of interest

ISA effects of interest		**p-value**
Does Propensity for Angry Driving Score impact on the effectiveness of ISA, and does this vary by speed limit?	*4 way: Period X ISA Group X Speed Limit X Propensity for Angry Driving Score*	*0.062*
Does Propensity for Angry Driving Score impact on the effectiveness of ISA?	*3 way: Period X ISA Group X Propensity for Angry Driving Score*	*0.060*

Near significant effects in italics

There was some evidence for a 4-way interaction between Period, ISA Group, Speed Limit and Propensity for Angry Driving Score, which indicates that propensity for angry driving may impact on the effectiveness of ISA, and that this may vary by speed limit. The data were stratified by speed limit and the effect of propensity for angry driving on the effectiveness of ISA was investigated for each speed limit separately (using an unstructured correlation matrix) (Table 3.41). This revealed that the propensity for angry driving significantly impacted on the effectiveness of ISA in 50 km/h zones (p=0.007 for Period by ISA by PADS score interaction) and there was some evidence for an effect in 60 km/h zones (p=0.055 for Period by ISA by PADS score interaction).

Table 3.41 The impact of Aus-PADS score on ISA effectiveness GEE results for effects of interest

ISA effects of interest			**p-value**
Does propensity for angry driving impact on the effectiveness of ISA?			
40 km/h	3 way interaction	Period X ISA Group X Propensity for Angry Driving Score	0.712
50 km/h	**3 way interaction**	**Period X ISA Group X Propensity for Angry Driving Score**	**0.007**
60 km/h	*3 way interaction*	*Period X ISA Group X Propensity for Angry Driving Score*	*0.055*
70 km/h	3 way interaction	Period X ISA Group X Propensity for Angry Driving Score	0.864
80 km/h	3 way interaction	Period X ISA Group X Propensity for Angry Driving Score	0.136
100 km/h	3 way interaction	Period X ISA Group X Propensity for Angry Driving Score	0.140

Significant effects in bold. Near significant effects in italics

The effect of the Aus-PADS score on the effectiveness of ISA in 50 and 60 km/h zones was further investigated. Figures 3.25 and 3.26 indicate that ISA is effective at reducing the proportion of time spent travelling more than 5 km/h over the speed limit for all drivers, however, the effectiveness increases as the propensity for angry driving increases. This suggests that, when active, ISA is more effective for angry drivers at reducing the amount of time they spend speeding, at least in 50 and 60 km/h zones.

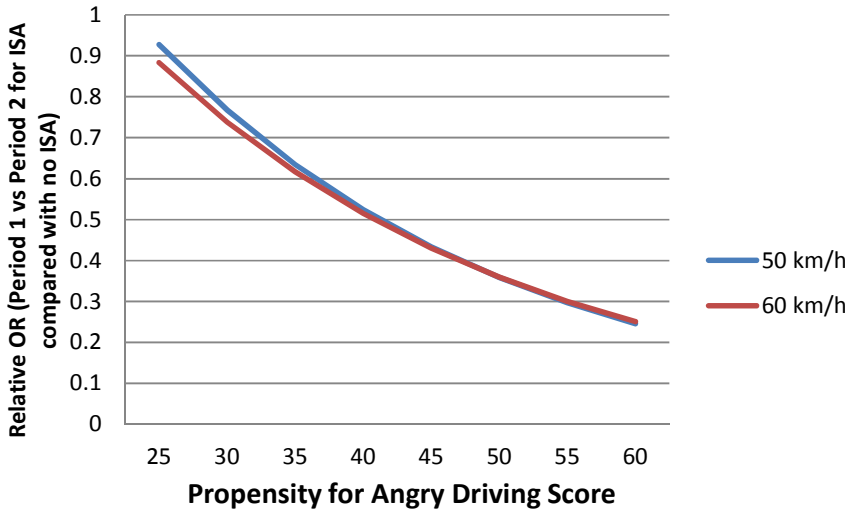


Figure 3.25 Relative odds of travelling more than 5 km/h over the speed limit when ISA was active compared to inactive for the Speed Alert group, adjusted for changes in the Speed Data group, by Aus-PADS score

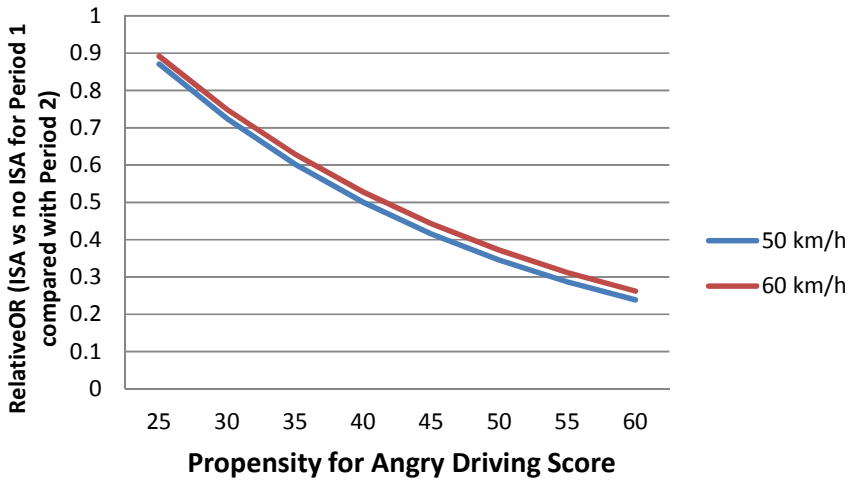


Figure 3.26 Relative odds of travelling more than 5 km/h over the speed limit in the Speed Alert group compared to the Speed Data group when ISA was active, adjusted for differences when it was inactive, by Aus-PADS score

3.3.4.b Effectiveness of ISA for high and low level speeders

An analysis was conducted to examine if the effectiveness of ISA differed across high and low level speeders. Drivers were classified as high or low level speeders by first determining the number of speed-related TINs received by each driver in the last 5 years and then splitting the drivers into high and low speeders based on a 50th percentile (median) split (those above 50th percentile classed as high level repeat speeders and those below as low level repeat speeders). The last 5 years of TIN history was used as drivers' behaviour can change considerably over time and also because speeding TIN classifications have changed numerous times across the TIN history data, making it difficult to classify offences across longer time periods.

The effectiveness of ISA for high and low level speeders was examined across speed zones using a GEE model with a normal error distribution, logit link function and an exchangeable correlation matrix. The results of the GEE model for the effects of interest are displayed in Table 3.42. Results revealed that being classified as a high speeder or a low speeder had no significant impact on the effectiveness of ISA in reducing speeding.

Table 3.42 ISA effectiveness for high and low level speeders GEE results for effects of interest

ISA effects of interest		**p-value**
Does being a high or low level speeder impact on the effectiveness of ISA, and does this vary by speed limit?	4 way: Period X ISA Group X Speed Limit X Speeder Type	0.885
Does being a high or low level speeder impact on the effectiveness of ISA?	3 way: Period X ISA Group X Speeder Type	0.641

3.3.5 Comparison of Logged Driving and Subjective Data

3.3.5.a Influence of Drivers' Experiences of ISA on ISA Effectiveness

The influence of Speed Alert drivers' subjective experience with ISA on its effectiveness as measured by the proportion of time spent 5 km/h or more above the speed limit was examined. Drivers' subjective experience of ISA was determined using three questions from the ISA experience interview (Section 3.3.7):

- Was the speed alert system effective at influencing your speed choice while it was active?
- Do you miss having the system in your car?
- Would you be willing to purchase the speed alert system?

The responses to these three questions were coded dichotomously according to whether drivers agreed or disagreed. The scores on the three questions were then summed and split according to the median to determine which drivers had high or low positive opinions of their experience with ISA. Only drivers who had ISA fitted were interviewed about their experiences with ISA, so this analysis was restricted to the Speed Alert groups only. To examine if drivers who had a more positive experience of ISA were more likely to respond to ISA by reducing speed, a 3 factor GEE model was fitted with a normal error distribution, logit link function and an exchangeable correlation matrix. The results of the GEE model for the effects of interest are displayed in Table 3.43. There was no evidence that positively (or negatively) rating the ISA device had any impact on the change in the proportion of time spent travelling 5 km/h or more over the speed limit while ISA was active compared to when it was inactive.

Table 3.43 Influence of ISA positivity on ISA effectiveness GEE results for effects of interest

ISA effects of interest		**p-value**
Does positivity rating impact on the change in speeding behaviour over time for the ISA Group, and does this vary by speed limit?	3 way: Period X Speed Limit X Positivity rating	0.456
Does positivity rating impact on the change in speeding behaviour over time for the ISA Group?	2 way: Period X Positivity rating	0.133

3.3.5.b Influence of Demerit Point Removal on Drivers' Experiences of ISA

A logistic regression was also conducted to examine the influence of demerit point removal on ISA positivity rating, but this found no significant association between demerit point removal and ISA positivity rating (OR=1.68, 95%CI 0.32-8.76, p=0.538).

3.3.5.c Alignment of logged driving data with self-reported behaviour

A descriptive analysis was conducted to examine to what extent the logged driving data aligns with drivers' self-reported behaviour as measured through the ISA experience interview. Originally, self-reported behaviour was going to be measured through the driver surveys, but this proved difficult for a number of reasons. The timing of the surveys rendered comparison of the logged and survey data problematic. The first survey was administered prior to the data logger being installed and thus, there was no comparable logged data with which to compare. The second survey was administered after the ISA system was removed and the data logger was still working. Much of the survey was focused on attitudes and beliefs rather than self-reported behaviours. The set of questions that asked directly about speeding behaviour were those that requested participants to state in how many of their previous 10 trips they had engaged in certain speed behaviours. However, the objective data recorded from the data logger in the after ISA

period was for an 8 week period and could not be narrowed down to those particular ten trips. Additionally, this question did not directly ask how often the participant travelled over the speed limit. Therefore, the ISA experience interviews were used to assess self-reported driving behaviour. This analysis looked at whether the proportion of time spent 5 km/h or more above the speed limit was correlated with drivers' agreement on two questions from the ISA experience interview: 1) 'How did you usually respond when the speed alert system gave a speed warning?' and 2) 'Was the speed alert system effective at influencing your speed choice while it was active?'.

For the interview question asking whether ISA was effective in reducing participants' travel speed when active, only one participant disagreed with this statement, while the other 22 participants agreed that ISA was effective in reducing their travel speed.

For each Speed Alert group participant, whether logged speed behaviour was reduced when ISA was active was compared to whether or not participants reported that ISA was effective. The speed measures examined included mean speed, % of time 0, 5 or 10 km/h over the speed limit and the time taken to return to the speed limit after a warning, when ISA was active compared to inactive. If ISA was effective in reducing travel speed, it would be expected that this would be reflected by lower time to return to speed limit, mean speeds and % of time over the speed limit (or 5 km/h or 10 km/h over the speed limit) when ISA was active.

Table 3.44 shows that, in general, most, but not all, of the participants who agreed that ISA reduced their travel speed did have better speed behaviour when ISA was active compared to when it was inactive. The only person who disagreed that ISA was effective in reducing their speeds did, in fact, show improvements in travel speed when ISA was active compared to when it was inactive. However, several of the participants who reported that ISA was effective actually displayed worse speeding behaviour when ISA was active than when it was inactive.

Table 3.44 Number of participants who agreed or disagreed that ISA was effective and the alignment of these response with logged driving behaviour

	Speed better when ISA active than when inactive		**Speed worse when ISA active than when inactive**	
Measure	**Agreed ISA effective**	**Disagreed ISA effective**	**Agreed ISA effective**	**Disagreed ISA effective**
40 km/h				
Time to return to speed limit	21	1	1	0
Mean Speed	16	1	6	0
% time over speed limit	18	1	4	0
% time > 5 km/h over speed limit	20	1	2	0
% time > 10 km/h over speed limit	19	1	3	0
50 km/h				
Time to return to speed limit	21	1	1	0
Mean Speed	13	1	9	0
% time over speed limit	17	1	5	0
% time > 5 km/h over speed limit	17	1	5	0
% time > 10 km/h over speed limit	15	1	7	0

	Speed better when ISA active than when inactive		Speed worse when ISA active than when inactive	
Measure	**Agreed ISA effective**	**Disagreed ISA effective**	**Agreed ISA effective**	**Disagreed ISA effective**
60 km/h				
Time to return to speed limit	21	1	1	0
Mean Speed	18	0	4	1
% time over speed limit	19	1	3	0
% time > 5 km/h over speed limit	19	1	3	0
% time > 10 km/h over speed limit	17	1	5	0
70 km/h				
Time to return to speed limit	19	1	3	0
Mean Speed	10	1	12	0
% time over speed limit	17	1	5	0
% time > 5 km/h over speed limit	15	1	7	0
% time > 10 km/h over speed limit	13	1	9	0
80 km/h				
Time to return to speed limit	20	1	2	0
Mean Speed	16	1	6	0
% time over speed limit	18	1	4	0
% time > 5 km/h over speed limit	17	1	5	0
% time > 10 km/h over speed limit	13	0	9	1
100 km/h				
Time to return to speed limit	19	1	1	0
Mean Speed	14	0	7	1
% time over speed limit	17	1	4	0
% time > 5 km/h over speed limit	16	1	5	0
% time > 10 km/h over speed limit	11	1	10	0

All of the participants agreed that they slowed down in response to the ISA warning. Mean speed, percentage of time 0, 5 or 10 km/h over the speed limit and the time taken to return to the speed limit after a warning when ISA was active were examined to see whether or not the logged data matched self-reported behaviour of slowing down in response to the ISA warnings.

If all participants were correct in reporting that they slowed down in response to ISA warnings, then all speed measures would be reduced when ISA was active. As shown in Table 3.45, this was the case for the majority of participants, although not all.

Overall, the majority of participants' self-reported behaviour did align with their actual logged driving behaviour. When self-reported and actual behaviour did not align, it was when participants thought ISA was effective in improving their speeding when actually it was not.

Table 3.45 Number of participants whose logged behaviour was better (lower) or worse (higher) when ISA was active compared to inactive

Measure	Time to return to speed limit		% time over speed limit		% time > 5 km/h over speed limit		% time > 10 km/h over speed limit	
Relative magnitude when ISA active	**Lower**	**Higher**	**Lower**	**Higher**	**Lower**	**Higher**	**Lower**	**Higher**
40 km/h	23	1	20	4	22	2	21	3
50 km/h	23	1	18	6	18	6	16	8
60 km/h	23	1	21	3	21	3	19	5
70 km/h	20	4	18	6	16	8	14	10
80 km/h	22	2	20	4	18	6	13	11
100 km/h	20	1	19	4	17	6	12	11

3.3.6 Expected Crash Benefits of ISA

Two analyses were conducted to examine the expected crash reduction benefits of ISA. The first analysis examined the expected reduction in casualty crashes for the entire population that is associated with the use of ISA. The second analysis looked at the expected annual aggregate benefit of introducing ISA into repeat speeders' vehicles. The outcomes of each analysis are discussed below.

3.3.6.a Reduction in casualty crashes expected with use of ISA for the entire population

The expected reduction in relative crash risk associated with the use of ISA and demerit point removal was examined through comparing travel speed distributions with established measures of the association between travel speed relative to the speed limit and crash risk. As a first step, the proportion of observations in the speed categories of <0, 0-5, 6-10, 11-15, 16-20, 21-25 and 26-30 km/h above the speed limit were compiled for each participant in each speed zone. Each speed category was then risk-weighted using the relative risk weightings established by Kloeden et al. (2002) and extended by D'Elia et al. (2008). For the purpose of the analysis, all travel speeds at or below the speed limit were assigned a relative risk weighting of 1. The risk-weighted speed observation data were then summed across the speed categories for each speed zone individually and then across all speed zones. The weighting given to each speed zone was derived from the average exposure of all trial participants to each zone. The resulting measure for each participant represents the relative risk of that participant being involved in a casualty crash. It should be noted that the measure is not an absolute crash risk measure derived from analysis of actual crash data but a best estimate of relative casualty crash risk across all participants, time periods and trial conditions.

The expected relative crash risk measure was analysed to determine the difference in relative crash risk between treatment (Speed Alert) and control (Speed Data) groups in each trial period using the GEE model described previously for the analysis of other key speed outcome measures. The GEE models were specified with a normal error distribution, a log link function and the correlation matrix was unstructured. Demerit point removal was considered in each model but was not statistically significant in any instance and is not reported further. The results of the GEE analysis are displayed in Table 3.46. Relative crash risk (Speed Alert vs. Speed Data groups) in each speed zone and aggregated across all speed zones for the ISA Active and After ISA periods is also represented graphically in Figure 3.27.

As displayed, the use of ISA appeared particularly effective at reducing expected crash risk in the lower speed zones. While ISA was active, expected crash risk was significantly lower for the Speed Alert group

compared to the Speed Data group in 40, 50, 60, and 70 km/h zones. Across all speed zones combined, there was a significant 12.2% reduction in expected crash risk for those drivers experiencing ISA compared to those in the Speed Data group.

Once ISA was removed, however, there were no significant reductions in expected crash risk found for the Speed Alert group compared to the Speed Data group for any of the speed zones examined, separately or combined. This suggests that once ISA is removed, the expected reduction in crash risk conferred by its use is not maintained.

Table 3.46 GEE results for relative crash risk

ISA Period	Speed zone	Relative crash risk (Speed Alert vs. Speed Data)	Relative crash risk reduction (%)	Significance value	Lower 95% C.L.	Upper 95% C.L.
ISA Active	**40**	**.595**	**40.50**	**.000**	**.455**	**.777**
	50	**.849**	**15.06**	**.044**	**.725**	**.996**
	60	**.885**	**11.52**	**.010**	**.806**	**.972**
	70	**.912**	**8.79**	**.039**	**.836**	**.995**
	80	.913	8.70	.323	.762	1.094
	100	.959	4.09	.158	.905	1.016
	All zones	***.878***	***12.17***	***.010***	***.795***	***.970***
After ISA	40	.853	14.73	.222	.660	1.101
	50	.916	8.45	.193	.802	1.046
	60	.995	0.45	.953	.856	1.158
	70	.922	7.80	.171	.821	1.036
	80	1.279	-27.85	.127	.932	1.753
	100	1.004	-0.38	.915	.936	1.077
	All zones	*1.015*	*-1.55*	*.829*	*.883*	*1.167*

Significant effects in bold

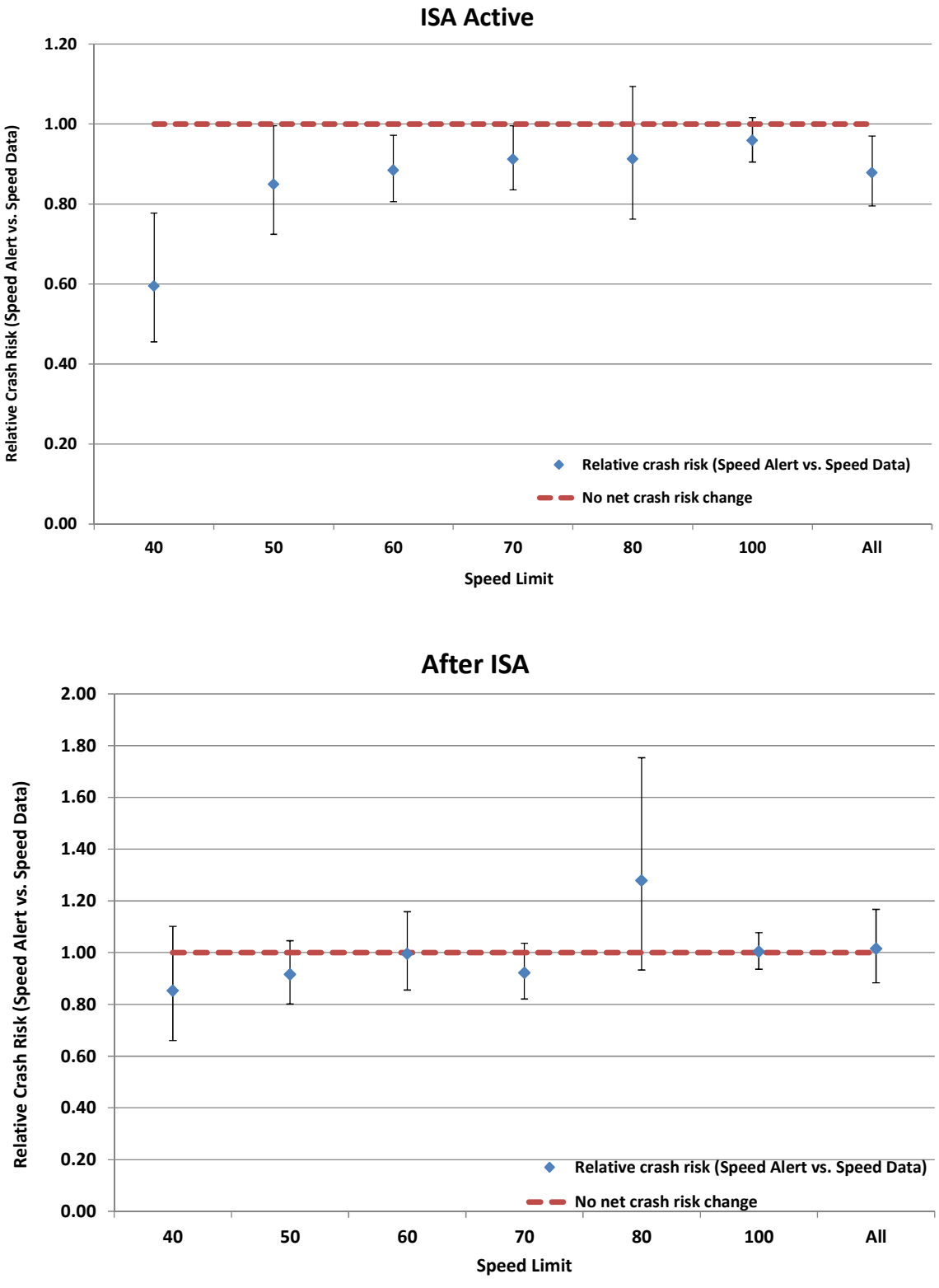


Figure 3.27 Relative crash risk (Speed Alert vs. Speed Data) for the ISA Active and After ISA periods as a function of speed zone (95% CI bars)

3.3.6.b Annual aggregate benefit of introducing ISA for offending drivers

The aggregate casualty crash reductions that would be expected to occur over a five year period if offenders were to have ISA installed in their cars continuously were also estimated. To do this, it was necessary to estimate how many crashes per year the target group were involved in, in order to apply the estimated crash reductions (described previously).

The target group were defined as those who were eligible to be recruited into the RST, as follows:

1. full licence holders
2. aged over 21 years
3. recently received a three point TIN for speeding
4. total demerits between 8 and 11 points
5. at least one previous 3 point TIN for speeding, or two previous 1 point TINs for speeding
6. never have reached 12 demerit points
7. never had licence suspended, cancelled or disqualified
8. no criminal convictions.

There was one exception. For practical reasons only, to be eligible for the RST, participants had to reside within 150 km of Melbourne, which covers approximately 89.4% of the population of Victoria (Department of Planning and Community Development, 2012). However, offenders living more than 150 km from Melbourne who met all the other criteria would be covered under any new law. Thus, the crash estimates needed to be adjusted to account for offenders living within Victoria but more than 150 km outside Melbourne.

6588 Victorian drivers were assessed as eligible for recruitment in the RST over approximately a six month period. Licence numbers were available for 4710 (71.5%) of these drivers.

Data on casualty crashes that occurred in Victoria between 2006 and 2011, including the licence numbers of the 4710 drivers involved were obtained (licence details were not available for between 4% and 10% of drivers involved in crashes across those years). These data were linked to a file containing the licence numbers of the Victorian drivers eligible to participate in the RST, in order to determine how many crashes these drivers were involved in over the 6 year period between 2006 and 2011. Again, it was necessary to adjust the estimate to account for the proportion of drivers involved in crashes for whom no licence number was available, and the proportion of drivers eligible for the RST for whom no licence number was available.

The crash risk reduction estimates derived in the previous section (e.g. 0.878 relative crash risk for all speed zones; see Table 3.46) were then applied to the adjusted number of crashes that this sample of the population were involved in over the 6 year period, to determine how many crashes would be prevented with the use of ISA. It was assumed that, once installed, ISA would remain active.

On average, based on the number of casualty crashes the drivers eligible for recruitment into the RST were involved in between 2006 to 2011, the estimated casualty crash reduction was 7.22 crashes per year (95% CI 1.79-12.14, Table 3.47).

Table 3.47 Calculations to determine the casualty crash reduction, per year, if all eligible drivers in the RST were to have ISA installed and active for 12 months

Number of crashes eligible drivers were involved in between 2006-2011	208
Number of crashes, adjusted for - **missing licence numbers in crash file** - **missing licence numbers for RST sample** - **proportion of population living more than 150km outside Melbourne**	355.89
Number of crashes expected over 6 years if this sample were to have ISA installed and active (RR=0.88, 95%CI 0.80-0.97 for all speed zones)	312.59 (283.08-345.18)
Estimated crash reduction per year	7.22 (1.79-12.14)

Considering that these 6588 drivers who resided within 150 km of Melbourne were found to meet the eligibility criteria over a six month period (the recruitment period for the RST), and 89.4% of Victorians live in that area, then we would expect 7369 drivers across the whole of Victoria would meet the criteria in any six month period. If we assume that the number of drivers who meet the criteria for the target group is constant over time, then we would expect twice this number (14,738) to become eligible for ISA installation each year. Assuming that the drivers were identified continually across the 12 month period, and that ISA was installed soon after identification, the cohort of 14,738 drivers would have ISA active in their vehicles for 6 months, on average, during the first year. Therefore, in the first year after it becomes a legal requirement to install ISA for offending drivers, we would expect these drivers to have 7.22 (95% CI 1.79-12.14) fewer casualty crashes in that 12 month period. In the next year, that first cohort of 14,738 drivers would be expected to have 14.44 fewer casualty crashes (because they had active ISA for the full year), and a new cohort of 14,738 drivers who were caught offending would have 7.22 casualty crashes, leading to a total reduction of 21.65 casualty crashes in the second year. As long as ISA is required to remain active after installation, the benefits would be cumulative and would range from a crash reduction of 7.22 casualty crashes per year after the first year to approximately 65 crashes per year after the fifth year (Table 3.48), with a cumulative reduction of approximately 180 casualty crashes over the first 5 years. The number of crashes saved by repeat speeders' use of ISA is expected to grow each year that the ISA program is in effect; however, this assumes that ISA will remain permanently active. Given the finding that the effectiveness of ISA dissipates after its removal, it is anticipated that ISA would need to stay permanently active for such crash reductions estimates to be maintained.

Table 3.48 Cumulative estimated crash reductions with mandated ISA for all offending drivers

	Average time ISA active for these drivers	**End of year 1**	**End of year 2**	**End of year 3**	**End of year 4**	**End of year 5**
Number of drivers eligible for ISA installation that year	6 months	14738	14738	14738	14738	14738
Number of drivers with ISA already in the vehicle from previous years	12 months	0	14738	29476	44214	58952
Estimated crash reduction per year		7.22 (1.79-12.14)	21.65 (5.36-36.41)	36.09 (8.93-60.68)	50.52 (12.50-84.95)	64.96 (16.08-109.23)

3.3.7 ISA Experience Interview Results

3.3.7.a Participants and Procedure

The ISA experience survey interviews were conducted with 24 participants from the Speed Alert Trial. These 24 participants comprised 12 drivers from each of the two Speed Alert Trial sub-groups: demerit point relief and no demerit point relief. Interview participants from the no demerit point removal group had a mean age of 47.3 years (SD=18.0 years; range 22-72), while the demerit point removal group had a mean age of 45.3 years (SD=12.6 years; range 29-66). The interviews were conducted by Your Source between May and November 2011. All interviews were conducted via telephone by a trained interviewer from Your Source using an interview guide (Appendix G). MUARC then conducted a content analysis of the interview transcripts, which involved reviewing each transcript, drawing out the key themes regarding participants' experience with using the Speed Alert system, and comparing these themes across participants.

The key findings to emerge from the ISA experience interviews are outlined below. Key similarities and differences in the experiences of the two ISA sub-groups are highlighted.

3.3.7.b Driver Responses to Speed Alert System

All participants from the demerit removal sub-group and nine of the twelve participants from the no demerit removal sub-group reported that they had never used a speed alert device before participating in the trial. Of the three who reported using a speed warning device prior to the trial, two had used a manually set speed alerting system and the other had used a GPS navigation system that provided over speed alerts.

3.3.7.b.1 ISA Effectiveness

All participants from both sub-groups reported that the ISA system was effective at reducing their travel speed, with the majority of participants stating that they would slow down in response to the warnings. Two participants, one from each sub-group, noted that they would check their speedometer when they received a warning, but did not state that they would reduce speed.

Three drivers reported that the system was annoying and intrusive, particularly where they believed the warnings to be incorrect. Two participants would mute the speed warnings when they believed them to be incorrect or when overtaking, and one participant from the demerit removal group reported that the effectiveness of the speed warnings reduced over the period of the trial and they would slow down less in response.

Almost all participants reported that they did temporarily override (mute) the auditory alerts at some point during the trial. This typically occurred in cases where the system was inaccurate and issuing false warnings, but several drivers also reported overriding the warnings when overtaking or running late.

3.3.7.b.2 Situations Where ISA was Useful

Participants reported a range of situations and areas where they found the ISA system particularly useful. The most common was 40 km/h school zones, with participants reporting that it is easy to forget when these zones are active throughout the day. The next most common area was unfamiliar areas where drivers were often not sure of the posted speed limit, followed by residential areas, shopping strips (particularly those with 40 km/h speed restrictions), and poorly signed roads (including obscured or infrequent signage and roads with frequent speed changes). Other areas and situations where ISA was reported as useful by a small number of participants was when travelling on open roads (including freeways), downhill, and when unconsciously following the traffic flow when this is moving above the speed limit. Responses were similar across the two sub-groups.

3.3.7.b.3 Impact of ISA Removal

When asked if their driving behaviour had changed since the removal of the ISA system, seven of the no demerit removal sub-group said no, three said that they had reverted back to their old speeding habits and only one said that they were more conscious of their speed. In comparison, five of the demerit removal group said that their speed behaviour had not changed since the removal of ISA, two said that they speed more and two said that they are more aware of their speed and speed changes. One participant from the demerit removal group said that they did not know if their behaviour had changed, while the remaining participant was not asked this question (due to language barrier).

Participants were also asked if they miss having the system in their car. Seven of the no demerit removal sub-group said that they do miss having the system, while the remaining five reported that they do not miss the system. In contrast, only one participant from the demerit removal group reported that they missed having the system, nine did not miss the system, one was unsure and one was not asked the question (language barrier).

3.3.7.b.4 Willingness to buy

Only four participants in each group stated that they would purchase the system, and would be willing to pay between $50 and $300 to purchase it. Two of these participants qualified that they would only be willing to purchase the system if it was 100% accurate, with one further stating that they would not want it to have auditory warnings. Reasons for not wanting to purchase the system included it being too inaccurate, annoying, and big and bulky and that they were worried it would encourage theft from their vehicle.

3.3.7.b.5 Effect of ISA on Trip Times

All except three participants stated that use of the ISA system did not appear to affect their trip times. The three who reported that the system did affect their trip times said that it increased trip times, but only marginally (up to 10 mins for a long trip).

3.3.7.c Usability of Speed alert

All participants reported that the ISA system was easy to use and learn to use and that the meaning of the warnings were clear. The majority of participants in both groups found the visual alert clear and noticeable, however, five participants did find the visual display bright and they had to turn down the brightness of the display at night. Two participants from the demerit removal group reported that they did not notice the visual warnings, while one participant from the no demerit removal group reported that they didn't even know that the system issued visual warnings.

In terms of the auditory alert, most participants noted that these alerts were 'good', while four participants from each group voiced strong opinions about the alerts being too loud and 'annoying' for both themselves and passengers.

All participants voiced positive opinions towards having the current speed limit constantly on display; mainly reporting that it was helpful in unfamiliar areas where they were unsure of the speed limit.

3.3.7.c.1 Behavioural Response to Visual and Auditory Alerts

In terms of whether participants responded to the visual or auditory warnings, around half of the participants in each group said that they would primarily respond to the auditory alerts. The majority of other participants reported responding to the visual alerts; however, three participants reported that the visual and auditory alerts were issued so close together (within 1-2 km/h of each other) that they could not distinguish between them.

3.3.7.c.2 Accuracy of ISA

Almost all participants reported that the ISA system displayed speed limits that were inaccurate; although, most of these said that the number of inaccurate limits was 'minimal' or that they were 'minor glitches'. A number of participants noted that the inaccuracies related to the system picking up limits on service lanes or not detecting temporarily lowered speed limits, such as lowered speeds around roadwork.

Most participants reported that the ISA system would detect speed limit changes quickly (within seconds or metres) upon entering a new speed zone. Most participants agreed that they were impressed with the efficiency with which the system detected speed changes.

Participants were also asked how much over the limit they were according to their speedometer when the visual and auditory warnings were issued. For the visual warnings, estimates varied but were typically between 1 and 3 km/h over the limit. Several participants reported receiving visual warnings when the speedometer was right on the speed limit and a small number indicated that they received visual warnings before the speedometer was at the posted speed limit.

3.3.7.d Errors and Over-Reliance

None of the participants confused the ISA speed alerts with any other vehicle warnings (e.g. low fuel, service warnings), noting that the sound was unique and easily distinguishable. Almost all participants also reported that they looked at their speedometer more often when the ISA system was active, mainly to verify the accuracy of the system or to check that they were indeed travelling above the indicated speed limit. Only one participant in the demerits removed group reported that they looked at the speedometer less when the ISA system was active.

With regard to overreliance on the ISA system and whether participants looked at the roadside speed limit signs more or less often when ISA was active, responses were mixed: nine participants said they looked more often, seven reported looking less often and seven said that there was no change. This suggests that around one third of the participants may have become over reliant on the system to warn them of the posted limit, while another third became more conscious of monitoring speed signs.

Most participants reported that, since having the system removed, they do not believe that they speed more because they are waiting for the system alerts and not monitoring speed signs; however, seven drivers did indicate that they speed more since removal of the system. Also, three participants reported that they still expected the system to warn them of excessive speeding even after its removal. These results again suggest that overreliance on the system was a concern for a number of drivers.

3.3.7.e Driver Workload and Distraction

The majority of participants did not report that there were situations where they were too busy to pay attention to the ISA alerts. However, two participants from the no demerit removal group and four from the demerit removal group reported that they were too busy to attend to the ISA warnings if they were in heavy or fast moving traffic or in other situations that required concentration such as when overtaking. Many participants reported that the ISA system was distracting at times, particularly the visual display being too bright at night and when the auditory alerts were issued in high workload situations (e.g. heavy traffic or when overtaking). Nine participants stated that they did not find the warnings distracting.

Twelve of the participants, split across the two groups, reported that they felt frustrated by the lower speeds caused by use of the ISA system. This frustration mainly occurred when the system issued inaccurate warnings. Nine others reported that they did not ever feel frustrated by the slower speeds brought about by using the system. The majority of participants, mainly from the no demerit removal group, felt that they were pressured by other drivers to drive faster when using the ISA system.

3.3.7.f Effects of Data Logger

Only one participant was concerned about being monitored by the data logger during the trial, claiming that they thought the device might be capable of sending data to the police. Ten of the participants reported that being monitored changed their driving behaviour over and above the changes brought about by the speed alert system. These changes included being conscious of their speeding and other behaviours.

Most participants forgot that their driving was being monitored during the trial, and said that this occurred within one or two weeks of having the logger installed in their vehicle.

3.3.7.g System Improvements

The main suggestion provided by participants for improving the ISA system related to the need to improve the accuracy of the speed limit database in order to reduce the number of false warnings issued. A number of participants also suggested that the system should be capable of detecting new speed zones sooner. Other suggestions included making the system more compact and better integrated into the vehicle and allowing the display to be dimmed at night.

4 DISCUSSION

The aims of the Repeat Speeders Trial (RST) were to test and evaluate two interventions to assist recidivist speeders to reduce their speeding. The first intervention was an advisory ISA system evaluated during an on-road trial with half of the participants receiving demerit point removal and the other half not receiving this bonus. The second intervention involved drivers attending a two-part behavioural intervention program designed to improve drivers' speed behaviour and attitudes, coupled with demerit point removal. The key findings from each of the sub-trials are discussed in this chapter, followed by a discussion of the methodological limitations of the trial and recommendations for follow-on work with the trial data.

4.1 SUMMARY OF BI SUB-TRIAL RESULTS

The BI sub-trial aimed to evaluate the effectiveness of completing a speed behaviour program, comprising a two-part behavioural intervention course coupled with demerit point removal. Effectiveness of the program was measured through changes in drivers' self-reported speed behaviour and attitudes, as assessed using surveys completed before and after course attendance (and equivalent timelines for the Survey group). Overall, the results of the surveys suggest that the speed behaviour program had a positive influence on repeat speeders' self-reported speeding behaviour and attitudes towards speeding specifically and driving in general, at least in the short-term (average of 5 weeks after completing the speed behaviour program).

4.1.1 Perception of Road Safety Issues

4.1.1.a Factors Contributing to Road Crashes

BI participants were asked to indicate how often they thought that various factors contributed to road crashes. The findings were positive, with the Program group's awareness of the contribution of many factors improving after attending the BI program. In terms of how often speeding contributed to crashes, prior to the program, there was no difference between the two BI groups in terms of the odds of indicating that speeding 'often' or 'very often' contributes to road crashes. After attending the program, the odds of the Program group indicating 'often' or 'very often' were over two times the odds of the Survey group saying so. Thus, while the Program group's awareness of the dangers of speeding improved, there was no commensurate improvement in the Survey group's responses.

There was also evidence that the Program group's awareness of other aspects of road safety were improved by attending the program, with this group more likely to indicate that drink driving, carelessness, disregard for the road rules and being young/risk taking contribute to crashes 'often' or 'very often' after attending the program. Again there was no significant change in the Survey group's responses for these factors. These findings suggest that as well as increasing awareness of the dangers of speeding, the BI program may also raise drivers' awareness of the dangers of other risky behaviours. It is important to note, however, that awareness of some road safety factors did not change after program completion, such as inattention, lack of driver training, weather conditions and too few police on road. The reason why these factors did not improve when other non-speed related ones did is most likely due to the course content not covering these aspects of behaviour.

4.1.1.b How dangerous is it to Travel above Speed Limit

Participants were then asked how dangerous it is to travel at various speeds above the speed limit in 50 km/h, 60 km/h and 100 km/h zones. Results revealed that the program was effective at changing respondents' opinions over time in terms of how dangerous it is to travel 5 km/h and 10 km/h over the speed limit. Indeed, after completing the program, the Program group was more likely to believe it was dangerous to drive 5 or 10 km/h over the speed limit than prior to going through the program. In contrast, however, the BI program was not effective at changing participants' attitudes about whether or not travelling 20 km/h over the speed limit was dangerous. This finding is probably due to the fact that the

proportion of respondents who thought this activity was dangerous was already very high at the first survey time point and, thus, the program offered limited scope for further improvement.

4.1.1.c At How Many Kilometres Over Limit are Drivers Speeding?

The next set of questions asked respondents to indicate, for 50, 60 and 100 km/h zones, how many km/h over the limit a driver has to be before they are speeding. Again the results suggest improvements in the Program group's speeding knowledge after attending the program. While there were no differences across the groups in responses on the first survey, the Program group were significantly more likely to answer correctly after completing the program. This was the case for all three speed zones.

4.1.1.d Likelihood of Being Caught by Police

Respondents were then asked by how much they can exceed the speed limit before being booked by police. There was some evidence for an improvement in knowledge for the Program group, with a smaller proportion of the Program group choosing incorrect responses after attending the program. Further, a smaller proportion of the Program group responded 'don't know' after attending the program than did the Survey group.

The final question on the perception of road safety issues asked respondents what the likelihood was of being caught by the police for travelling 5, 10 and 20 km/h above the speed limit. After attending the program, the odds of the Program group thinking it was likely they would be caught for travelling 5 and 10 km/h over the limit was significantly higher than it was prior to the program. In terms of the likelihood of being caught for travelling 20 km/h over the speed limit, both BI groups had higher odds of indicating that this was likely in survey 2 compared to survey 1. These results provide further support that attendance at the BI program improved repeat speeder's knowledge of what constitutes speeding.

4.1.1.e Factors Influencing Speeding

An interesting insight into what might be impelling repeat speeders' speed behaviour comes from a question asking drivers about the factors that influence their decision to speed. The responses provided by drivers in both the Program and Survey groups suggest that they perceive their speeding as largely unintentional and that a lack of situation awareness of their own speed and the prevailing speed limit may play a role. Indeed, the most commonly reported factors that influence speed were 'losing track of my own speed', 'the speed of other traffic', and 'unaware of speed limit'.

4.1.2 Attitudes Toward Speeding and Driving

4.1.2.a Attitudes Towards Speeding

The first question regarding attitudes asked respondents to indicate if they agree or disagree with a range of statements regarding speeding. The findings were positive, with the Program group's attitudes towards most of the speeding statements improving after attending the BI program. Prior to the program, there was no difference between the two BI groups in terms of their attitudes to almost all of the speed items. But, after attending the program, the Program group's attitudes were significantly more positive than the Survey groups. That is, after completing the speed behaviour program, the Program group had significantly higher odds of agreeing with statements such as 'speeding is always wrong', and 'you are more likely to be in a crash if you increase your speed by 5 km/h' than the Survey group. Also, while the Program group's attitudes towards speeding improved, there was no commensurate improvement in the Survey group's responses over the two survey time points, suggesting that it was the combination of attending the speed behaviour program course and demerit point removal that underlies these improvements (as the Survey group did not have demerit points removed).

4.1.2.b Speeding Attitudes Scale (SAS)

Participants were also asked to complete the Speeding Attitudes Scale (SAS), in which respondents indicated if they agreed or disagreed with a range of statements regarding speeding. Lower scores on the

SAS indicate a more favourable attitude to speeding. Results of this scale revealed that after completing the program, the Program group's speeding attitudes had improved significantly from their pre-program levels and were significantly more positive than the attitudes of the Survey group. Indeed, the Survey group's mean score on the SAS increased significantly between time 1 and time 2, suggesting that their attitudes toward speeding became more negative over the trial. While it is unclear why the Survey groups' attitudes would have become more negative over time, the results for the Program group are positive and lend further support that the BI program can improve repeat speeder's attitudes towards speeding, at least in the short-term.

4.1.2.c Perceived Effectiveness of Road Safety Measures

The survey results also suggest that completion of the BI program improved Program participants' attitudes toward how effective they believe a range of 10 road safety measures are in helping drivers to keep to the speed limit. Again, significant improvements were seen across the two survey time points for the Program groups: after completing the speed behaviour program, the Program group had a statistically significant increase in the odds of stating that measures such as speed cameras, speed signs and speed radar guns are effective compared to the Survey group. There was no such improvement in the Survey group's responses over the two survey time points. There were a handful of measures for which no differences were found across either the groups or survey time points. These included speed humps, roundabouts and police car presence. This may be because a high number of the BI participants already believed that these measures were 'effective' or 'very effective' in the first survey and thus, the program had little opportunity to further improve attitudes towards these measures, or it may simply be because these issues were not covered in the course content.

4.1.2.d Driver Behaviour Questionnaire (DBQ)

The survey results also offer insight into how the BI program affected self-reported driving behaviour. As part of the survey, participants completed the Driver Behaviour Questionnaire (DBQ), which asked respondents to indicate how often various driving situations happened to them in the preceding 4 weeks. The findings were again positive: after completing the program, the Program group reported engaging in fewer violations and making fewer mistakes, missing fewer things due to inattention, or forgetting fewer things due to inexperience than they did before the program. While there was some evidence that the Survey group also improved their self-reported driving behaviour over the trial in terms of violations, mistakes and lapses, the improvements seen were greater for the Program group. The greater improvements in these self-reported driving behaviours among Program participants are interesting because many of the behaviours were not directly addressed in the speed behaviour program course. The fact that the Program group improved might be because they became more aware of risky driving practices overall, as a positive 'side effect' of attending the course. However, it could also be possible that participants were simply answering all questions in a socially desirable way.

4.1.2.e Speeding Behaviour During Last 10 Trips

Participants were also asked to report how often they engaged in a range of eight different speeding behaviours (e.g., accidently or intentionally driving over the limit, or making a real effort to look out for speed signs) in their last ten driving trips. Again, for many of the speeding behaviours listed, improvements were found in the Program group's self-reported behaviours. After completing the program, the odds of Program participants reporting that they had engaged in negative speed behaviours, such as intentionally or unintentionally exceeding the speed limit, had reduced significantly. This improvement over time was not seen for the Survey group for some items but was for others, such as making an effort to look for speed signs and keeping at a safe speed even though others were driving faster. This suggests that simply completing the surveys and thinking about their speed behaviour may have led to some improvement in the Survey participant's behaviour. Alternatively, some other external factor occurring during the trial, such as a speed enforcement campaign, may have led to the observed improvements in some reported behaviours.

4.1.2.f Stages-of-change

The observed improvements in self-reported speeding behaviour are further supported by the Stages-of-change items, where results indicate that Program participants had moved from not even thinking about changing their speed behaviour (Pre-contemplation) at survey 1, to actively taking steps to change their speeding behaviour (Action) after completing the program. After completing the program, the Program group's Pre-contemplation scores reduced significantly from pre-program levels, while there Action scores increased significantly. The scores for all stages did not change significantly for the Survey group over the two survey points. These results suggest that the speed behaviour program was effective in bringing about positive self-reported speed behaviour change. However, it is important to note that, although statistically significant, the changes observed in the Pre-contemplation and Action scores for the Program group were small in practical terms (less than half a point change) and as such, may not translate into an appreciable difference in actual speeding behaviour. This can only be confirmed through examination of speed offences in the months after completing the program.

4.1.2.g Factors Moderating Program Effectiveness

The influence of a number of driver-based factors in moderating the effectiveness of the speed behaviour program was examined. Program effectiveness was measured by the Stages-of-change scores and course knowledge retention items. The factors examined included participant age, gender, driving experience, social desirability scores (Marlowe-Crowne), scores on the Aus-PADS, and course retention items total score from Survey 2. None of the factors examined moderated drivers' scores on the Pre-contemplation and Contemplation Stages-of-change items. For the Action scores, there was some evidence of an effect of gender, with evidence that Action scores increased for males, but increased slightly more for females in the Program group compared to the Survey group. This suggests that females in the Program may have been taking more action toward improving their speed behaviour than the males. It is possible, however, that this finding might be partly driven by the fact that females in the Survey group actually had a reduction in Action scores.

Analyses were also performed to determine if the effectiveness of the program in increasing retention of course-related knowledge was modified by age, gender, driving experience, Marlowe-Crowne score or Aus-PADS score. Age, gender, driving experience, or Marlowe Crowne total score were not found to impact the effectiveness of the program in increasing awareness. However, there was evidence that the propensity for angry driving did modify the effectiveness of the BI program. Specifically, drivers with a greater propensity for angry driving retained significantly more knowledge from the BI course than those with a lower propensity.

4.1.2.h Course Retention Items

Further evidence of the benefits of the BI Program comes from the results of the course retention items. The Program group answered a greater number of retention items correctly after attending the course, while there was no commensurate increase in the number of items answered correctly for the Survey group. These results suggest that the BI Program participants had retained at least some of the information learnt at the speed behaviour program course.

4.1.2.i Comments on Trial Experience

Finally, BI participants were asked to provide open-ended comment about their experience in the trial. Differences were evident across BI groups in the types of responses provided. The comments from the Program group were largely positive, with many participants stating that being involved in the speed behaviour program has had a positive influence on their speeding behaviour and attitudes towards speeding. Participants in the Survey group, in contrast, were less likely to report that participating in the trial had changed their actual behaviour, but did report that the trial had changed their attitudes towards speeding and increased their motivation to improve their driving behaviour.

In summary, the results of the BI surveys provide evidence that, at least in the short-term, completing the BI program increased repeat speeders' knowledge of the dangers of speeding, improved their attitudes

towards speeding and other driving behaviours in general, and led to improvements in their self-reported speeding behaviour. Although numbers are low, there is also some evidence that completion of the speed behaviour program decreased the number of self-reported crashes the Program participants were involved in during the four weeks after attending the course, with only 1 crash reported by the Program group and eight reported by the Survey group. Future work should focus on examining if these observed improvements are maintained over a longer period of time, through the examination of crash or traffic infringement data (see Section 4.3).

4.2 SUMMARY OF ISA SUB-TRIAL RESULTS

The ISA sub-trial aimed to evaluate the effectiveness of an alerting ISA system, either coupled with demerit point removal or not, in reducing drivers' speeding. Effectiveness of the intervention was evaluated using self-report surveys and a range logged driving measures. The key results from the logged and survey data are discussed below.

4.2.1 Logged Driving Data

4.2.1.a ISA Effectiveness

The logged driving results suggest that the use of ISA is effective in reducing mean speed, 85th percentile speed, the time spent exceeding the speed limit by various amounts, and the time taken to return to the speed limit and the ISA auditory warning threshold after being exceeded. When ISA was active, the Speed Alert group had significantly lower mean and 85th percentile speeds and spent significantly less time travelling at any speed over the limit, or >5 km/h and >10 km/h over the speed limit, compared to the Speed Data group who did not experience ISA warnings. Also, the time taken to return to the speed limit and the auditory threshold speed was lower for those drivers who experienced ISA. These results are especially promising given that this is the first study known to the authors to demonstrate the effectiveness of ISA in a sample of recidivist speeders.

The speed reduction benefits of ISA have been established in numerous other studies (Brookhuis & de Waard, 1999; Hjälmdahl et al., 2002; Regan et al., 2006; Sundberg, 2001; Várhelyi, et al., 2002; Wallén Warner & Aberg, 2008). Previous ISA research has typically found mean speed reductions of up to 5 km/h for ISA alerting systems in samples of private car drivers drawn from the general public. In the current study, speed reductions could not be examined across pre-ISA and ISA Active levels given the design of the study where pre-ISA speeds were not measured, however, comparisons across the treatment and control groups suggest that ISA resulted in mean speed reductions of 1-2 km/h in the current sample. The results examining the proportion of time spent travelling above the speed limit show even more promising results, with drivers who experienced ISA spending an average of 34% less time travelling at any speed above the limit while ISA was active compared to when it was inactive.

4.2.1.b ISA Effectiveness over Time

The analysis of mean speeds at various intervals when ISA was active suggests that while there was a trend for mean speed to increase slightly over the period when the ISA was active, this increase was not significant and similar changes over time were also present for the groups who did not have ISA fitted. This implies that changes in speed behaviour over time when the ISA was active were not due to the ISA device.

4.2.1.c Impact of ISA Removal

A clear finding from the current study is that the speed reducing effects of ISA do not appear to remain once the device has been removed from the vehicle. That is, mean speed, time to return to the speed limit and auditory threshold, and time travelling at any speed over the limit, or >5 km/h and >10 km/h over the speed limit were all significantly higher in the After ISA period compared to the ISA Active period for the Speed Alert group. Further, there was no significant difference between the Speed Alert and Speed Data groups' speed measures in the After ISA period, suggesting that speed behaviour had returned to pre-ISA levels once it was removed. The analysis looking at mean speed at 2 week intervals across the After ISA

period further suggests that, once ISA was removed, drivers' speed behaviour increased quickly and these increases were maintained for the remainder of the trial.

The finding that the positive speed reduction effects of ISA did not persist after the ISA system had been deactivated has been observed in a number of other ISA trials (e.g. Adell et al., 2008; Regan et al., 2006; Wallén Warner & Aberg, 2008). Such findings indicate that ISA affects speed changes by means of tactical and operational speed support, rather than by affecting long-term behavioural or attitudinal change in drivers. The findings also suggest that ISA systems need to remain active in order to confer their safety benefits.

4.2.1.d Effectiveness of Demerit Point Removal

While ISA was found to be effective, there was insufficient evidence for benefits arising from the prospect of demerit point removal upon completion of the trial. The addition of demerit point removal did not appear to further improve speed behaviour over and above that of the ISA system for any of the measures examined. Furthermore, it is worth noting that the impact of the actual removal of demerit points upon subsequent risky driving behaviour is not addressed by this study and at present is unknown. Overall, the results in this study suggest that ISA alone is sufficient to bring about positive changes in repeat speeders' speed choices, potentially because of the immediacy of the feedback.

4.2.1.e ISA Effectiveness across Speed Zones

Finally, very few effects of speed limit zone were found in the current study. The difference across the ISA Active and After ISA periods in the time taken to return to the speed limit was found to be largest in 100 km/h zones compared to the other speed zones examined, but no other effects of speed limit were found. Previous research has found significant effects of ISA alerting systems on mean speeds in some speed zones/road types, but not others (Hjämldahl et al, 2002; Paatalo et al., 2002; Regan, et al., 2006; Várhelyi, 1999). An on-road study by Hjämldahl and colleagues in the Swedish city of Lund, for example, found that the ISA actively supporting system trialled had the greatest effects on speed reduction on arterial roads, but had no effect on speeds in built-up/residential roads (Hjämldahl, 2004). The TAC SafeCar project also found evidence that an alerting ISA system appeared to be particularly effective in 60 km/h zones (Regan et al., 2006). The reason for the lack of speed zone differences in the current study is unclear, but do suggest that, at least for repeat speeder, ISA appears equally effective in the different speed zones examined.

4.2.2 Impact of Driver Characteristics on ISA Effectiveness

A range of driver characteristics were analysed to examine whether and how they influence the effectiveness of ISA and demerit point removal in reducing the proportion of time spent 5 km/h or more above the speed limit. The driver characteristics examined included age, gender, social desirability scores, propensity for angry driving, and whether drivers were high or low level speeders.

The results revealed that some driver characteristics do impact on the effectiveness of ISA in reducing speeding. While ISA was found to be effective for all drivers, some driver characteristics were associated with ISA being even more effective. Driver age was found to have an influence on ISA effectiveness, but only in 40 km/h zones. While ISA was effective at reducing the proportion of time spent 5 km/h or more above the speed limit for drivers of all ages, it became more effective as driver age increased and was particularly effective for drivers aged over 50 years. This suggests that ISA may be slightly less effective at improving the speeding behaviour of younger repeat speeders than it is for those over 50 years of age.

The analysis of drivers' gender also revealed some effects with results indicating that ISA was effective for both males and females, but may have been slightly more effective for females. Drivers' propensity for angry driving also appears to impact on ISA effectiveness, with effectiveness increasing as the propensity for angry driving increases. Drivers' social desirability scores did not impact on ISA effectiveness significantly. Finally, ISA was found to be equally effective at reducing speeding for high and low level repeat speeders.

4.2.3 Comparison of Logged Driving and Subjective Data

The influence of Speed Alert drivers' subjective experience with ISA on its effectiveness was examined. There was also no evidence that drivers' self-report rating of their ISA experience (whether positive or negative) had any impact on the effectiveness of ISA on speeding behaviour.

Also examined was the extent to which the logged driving data aligned with drivers' self-reported behaviour as measured through the ISA experience interview. Overall, the majority of participants' self-reported behaviour did align with their actual logged driving behaviour and when self-reported and actual behaviour did not align, it was typically because participants thought ISA was effective in improving their speeding when actually it was not.

4.2.4 Expected Crash Benefits of ISA

The expected reduction in relative crash risk from the use of ISA and demerit point removal was also examined across and within individual speed zones. The use of ISA appears particularly effective at reducing crash risk in the lower speed zones, with an expected reduction in crash risk of 40.5% in 40 km/h zones for drivers who used ISA. While ISA was active, expected crash risk was also significantly lower for the Speed Alert group compared to the Speed Data group in 50, 60, and 70 km/h zones. Across all speed zones combined, a 12.2% reduction in crash risk was found for those drivers experiencing ISA compared to the Speed Data group. No significant reduction in crash risk was found for 80 and 100 km/h zones while ISA was active, most likely due to the lower levels of speeding found in these zones compared to the lower speed zones.

In line with the speed data measures examined, once ISA was removed there were no significant reductions in expected crash risk found for the Speed Alert group compared to the Speed Data group for any of the speed zones examined. This suggests that once ISA is removed, its effectiveness in reducing crash risk is not maintained. Also consistent with the speed measures examined, the removal of demerit points, on its own or in combination with ISA, was found to have no statistically significant effect on relative crash risk in any speed zone.

The aggregate casualty crash reductions that would be expected to occur over a five year period if offending drivers in Victoria (who were eligible for this study) were to have ISA installed in their cars permanently were also estimated. Offending drivers were defined as those eligible to participate in the RST. On average, based on the number of crashes the drivers eligible for the RST were involved in between 2006 to 2011, the crash reduction estimated from repeat speeders' use of ISA was 7.22 casualty crashes per year. The cumulative effect of ISA use was also estimated over a five year period. Assuming that the number of drivers who meet the criteria for the target group is the same amount each year and that ISA is required to remain active after installation, the cumulative benefits would range from a crash reduction of 7.22 crashes per year after the first year to approximately 65 casualty crashes per year after the fifth year, with a total cumulative reduction of approximately 180 casualty crashes over the first 5 years.

4.2.5 Subjective ISA Effectiveness, Usability and Workload

4.2.5.a Subjective Effectiveness and Acceptability

Overall, participants reported that they found the ISA system effective in getting them to reduce the speeds at which they travel, with the majority of participants stating that they slowed down in response to the ISA warnings. The ISA system also did not appear to noticeably increase trip times despite reducing participant speed. Participants reported that they found ISA particularly effective in areas with transient speed limits (e.g. school and shopping zones) and in unfamiliar or poorly signed areas where the speed limit often was not known. All participants found the ISA system easy to use and learn to use and reported that the meaning of the warnings were clear and easily distinguishable from other vehicle sounds and warnings. The majority of participants reported that their speed behaviour had not altered since the ISA device was removed from their vehicle. It is important to note, however, that at the time of the interviews being conducted, the ISA system had only been removed from Speed Alert participants' vehicles for a short

period of time (approximately one week) and the logged data suggested that these participants' speed did in fact increase over time after ISA was removed.

Despite stating that ISA was effective, only one third of participants reported that they would be willing to purchase the system, stating that they would be willing to pay $50 - $300 for it. The remaining two thirds stated that they would not purchase the ISA system because it was too inaccurate, annoying, and big and bulky and that they were worried it would encourage theft from their vehicle.

4.2.5.b Usability Issues

A number of usability issues were reported with the system which may lead to issues with system acceptability and increased workload and distraction. First, almost all participants reported that they experienced inaccurate speed limits displayed by the system, although most said that the number of inaccurate limits was 'minimal' or that they were 'minor glitches' and drivers would tend to mute the auditory warnings in these instances. Many participants did state, however, that they felt frustrated by these inaccurate warnings and stated that they would not purchase an ISA system unless it was more accurate and reliable, so although the inaccuracies were reported as minor, this issue still clearly had an impact of drivers' willingness to purchase. A second issue revolved around the issue of drivers becoming too reliant on the system to inform them of speed limit changes. The results suggest that around one third of the participants may have become over reliant on the system to warn them of posted limits, despite participants being informed at the start of the trial that the ISA was not 100% accurate and that they still needed to take full responsibility for complying with all posted speed limits. Further, just under one third of participants reported that they sped more since removal of the system because they were waiting for the system alerts. Based on the mean speed analysis over the ISA After period, it appears that this increased speeding behaviour was maintained for the entire After ISA period. A final usability issue concerned the brightness of the visual display, with many participants reporting that the visual display was too bright, particularly at night.

Overall, it appears that participants found the ISA systems effective in helping them to better manage their speed despite the system not being 100% accurate and having a number of usability issues. While it is not possible to determine if the ISA system would have been even more effective and resulted in greater speed reductions if its accuracy had been higher, it is important that such usability and accuracy issues are addressed as they are likely to affect the overall acceptability and take-up of ISA technology by the driving community.

4.2.6 Survey Data

Perception of Road Safety Issues

4.2.6.a Factors Contributing to Road Crashes

ISA participants were first asked to indicate how often they think that various factors contribute to road crashes. In terms of how often drivers think that speeding contributes to crashes, there was some evidence that the Speed Alert group who received ISA warnings, but no demerits point removal, were *less* likely than the Speed Data (no demerits removed) group to believe that speeding contributes to crashes after experiencing ISA. There were no differences observed across the Speed Alert and Speed Data groups who did have demerit points removed. This result is unexpected and indicates that use of ISA has not improved repeat speeders' awareness of the dangers of speeding and its contribution to crashes. In terms of the other factors that contribute to crashes, very few differences were found across the ISA groups. For some factors, such as drink driving, ignorance of road rules, poor road design, road and weather conditions, there was evidence that the awareness of all groups had increased from the first to the second survey. This suggests that simply being involved in the trial (i.e. having a data logger fitted and completing surveys) may have improved awareness of road safety issues, but the presence of ISA did not influence awareness further.

4.2.6.b How dangerous is it to Travel above Speed Limit

Participants were then asked how dangerous it is to travel at various speeds above the speed limit in 50 km/h, 60 km/h and 100 km/h zones. The lack of significant findings involving ISA group and time indicate that experience with the ISA system did not lead to changes in opinion over time in terms of whether or not it is dangerous to travel more than 5, 10 or 20 km/h over the limit in 50, 60 or 100 km/h speed zones. Demerit point removal was also not found to lead to changed opinions. There was, however, an effect observed across speed zone, with drivers, regardless of ISA group or survey time, much more likely to believe that travelling 5, 10 or 20 km/h over the speed limit was dangerous in 50 km/h and 60 km/h zones compared to 100 km/h zones.

4.2.6.c At How Many Kilometres over the Limit are Drivers Speeding?

The next set of questions asked respondents to indicate, for 50, 60 and 100 km/h zones, how many km/h over the limit a driver has to be before they are speeding. Again, there was no evidence that experience of ISA or demerit point removal lead to an improvement in knowledge. Likewise, there were no significant differences between ISA groups or across time in terms of the proportion of respondents who believed it was likely or very likely to be caught by the police for travelling 5, 10 and 20 km/h above the speed limit. These results suggest that neither ISA nor demerit point removal improved repeat speeder's knowledge of what constitutes speeding.

4.2.6.d Factors Influencing Speeding

An interesting insight into what might be impelling repeat speeders speeding behaviour comes from a question asking drivers about the factors that influence their decision to speed. Similar to the BI sub-trial participants, the responses suggest that drivers in the ISA sub-trial perceive their speeding as largely unintentional and that this is due to a lack of situation awareness, both of their own speed and the speed limit. The most commonly reported factors that influence speeding behaviour were 'losing track of my own speed', 'the speed of other traffic', and 'unaware of speed limit'.

Attitudes toward Driving

4.2.6.e Attitudes towards Speeding

The first question regarding speeding attitudes asked respondents to indicate if they agreed or disagreed with a range of statements regarding speeding. For 11 of the 14 speeding statements, no significant differences were found across ISA groups or demerit point removal groups, suggesting that neither ISA nor demerit point removal were very effective in improving repeat speeders' attitudes toward speeding behaviour. For two of the speeding items there was some evidence of a difference in attitudes across ISA group or time, but this only approached statistical significance. For the statement 'you are much more likely to be involved in a crash if you increase your driving speed by 5 km/h', the Speed Alert group were more than twice as likely as the Speed Data group to agree that this statement is true (pooled over time and demerit point removal). For the statement 'speed limits are too low – it is usually safe to driver faster than the speed limit', there was some evidence for improvement in attitude over time regardless of ISA or demerit point removal status, but, again, this only approached significance.

Finally, demerit point removal was found to significantly improve the odds of agreeing/strongly agreeing that people who exceed speed limits are major contributors to crashes. The reasons why some effects were found for these three statements is unclear, but overwhelmingly, the results indicate that ISA and/or demerit point removal do little to improve repeat speeders' attitudes towards speeding.

4.2.6.f Speeding Attitudes Scale (SAS)

Participants were also asked to complete the Speeding Attitudes Scale (SAS), in which respondents indicated if they agreed or disagreed with a range of statements regarding speeding. Lower scores on the SAS indicate a more favourable attitude to speeding. Results of this scale revealed that there were no significant differences across ISA groups in SAS scores, nor were there any differences observed across

time. These findings suggest that participating in the ISA sub-trial, regardless of group did not impact on drivers' attitudes toward speeding as measured by the SAS.

4.2.6.g Perceived Effectiveness of Road Safety Measures

The survey results also suggest that neither experience with ISA nor demerit point removal improved participants' attitudes toward how effective they believed a range of 10 road safety measures (e.g. Speed signs, in-car technology) are in helping drivers to keep to the speed limit. For all of the 10 road safety measures listed, no differences were found across ISA group or time.

4.2.6.h Driver Behaviour Questionnaire (DBQ)

The survey results also offer insight into how ISA and demerit point removal affects self-reported driving behaviour. As part of the survey, participants completed the Driver Behaviour Questionnaire (DBQ), which asked respondents to indicate how often various driving situations happened to them in the preceding four weeks. Results revealed that there were no differences across ISA groups in drivers' reported engagement in violations, mistakes, missing things due to inattention, or forgetting things due to inexperience. However, regardless of ISA group, drivers reported engaging in fewer violations and missing fewer things due to inattention after completing the trial.

4.2.6.i Speeding Behaviour during Last 10 Trips

Participants were also asked to report how often they engaged in a range of eight different speeding behaviours (e.g., accidently or intentionally driving over the limit, or making a real effort to look out for speed signs) in their last ten driving trips. The survey results suggest that neither experience with ISA nor demerit point removal reduced self-reported engagement in the speeding behaviours. In fact, there was some evidence that drivers' self-reported speeding behaviour increased over the course of the trial, regardless of which ISA group they were in. It is important to note there that participants completed both surveys while ISA was not active. In the case of Survey 2, ISA had been removed from the vehicle for at least 4 weeks. Given that the benefits of ISA on speed behaviour were found to diminish quickly after ISA removal, it is not surprising that few differences were found in self-report speeding behaviour to these items. If participants had been surveyed while ISA was active, responses to these items may have been more promising.

4.2.6.j Stages-of-change

The lack of differences in self-reported speeding behaviour are also reflected in the Stages of Change items, where results indicate that experiencing ISA or demerit point removal did not cause a significant change in the participants' Pre-contemplation, Contemplation or Action scores. There was some evidence of a main effect of time for the Pre-contemplation and Contemplation scales. The Pre-contemplation scores were slightly higher and Contemplation scores were slightly lower at survey 2 compared to survey 1, but these results only approached statistical significance. No significant changes in Action scores were found across time.

These results suggest that participants in the ISA sub-trial, regardless of ISA or demerit point status, may have regressed back from contemplating reducing their speeding behaviour before participating, to not even contemplating their speeding behaviour after participating in the trial. It is important to note, however, that the differences in scores on these two scales across survey times were very small in practical terms, and mean scores on the Action scale were higher, at both time points, than the mean scores for the Pre-contemplation and Contemplation scales, suggesting that participants may have already felt that they were taking action to reduce their speeding before the trial and that the trial did little to aid further improvement.

Comments on Trial Experience

Finally, ISA participants were asked to provide open-ended comment about their experience participating in the trial. Most comments were positive, with participants stating that being involved in the trial had a

positive influence on their speeding behaviour and has made them more aware of their travel speed and speed limits. These positive comments were made by drivers in all ISA groups, not just those who experienced ISA, suggesting that simply having the data logger in their vehicle and completing the surveys had a positive effect on their attitudes towards speeding.

In summary, the logged driving results suggest that, at least while it is active, the use of ISA is effective in reducing mean speed, the time spent exceeding the speed limit, and the time taken to return to the speed limit and the ISA auditory warning threshold after being exceeded. The removal of demerit points had little further influence on speeding behaviour over and above that of the ISA system. The results of the surveys suggest that using ISA or having demerit points removed had little influence on repeat speeders' self-reported speeding behaviour and attitudes towards speeding specifically and driving in general. Taken together, the logged driving and survey results suggest that ISA, while effective at supporting drivers to perform the immediate tactical and operational aspects of driving (i.e., maintaining the legal speed limit), simply did not bring about a lasting attitudinal or behavioural change. It may be the case that in-vehicle systems, such as ISA, that support drivers at the tactical and operational levels of driving are less able to have an appreciable effect on drivers' attitudes or bring about lasting behaviour change that is sustained when the system is no longer active. Rather, tactical and operational behaviours, such as speed, may need constant and sustained support from an in-vehicle system.

4.3 METHODOLOGICAL ISSUES & RECOMMENDATIONS FOR FURTHER RESEARCH

The RST contained a number of methodological and technical issues that may affect the interpretation and generalisability of the results. These issues should be addressed in any further behavioural intervention and on-road trials of ISA systems. These issues are summarised below:

- **Inaccuracies with the ISA data map** – There were a small number of inaccurate speed zones contained in the ISA digital map that were identified through participant reporting and the weekly examination of the data for dangerous speeding. These inaccuracies were addressed by removing from the analyses, all data for roads that had been identified as containing map inaccuracies. Another related issue was that the ISA maps were updated periodically during the trial to address the identified inaccuracies. This potentially means that the ISA sub-trial participants who entered the trial later were potentially exposed to fewer false warnings from the device than those entering at the beginning of the trial. The differential impact of the ISA map updates is likely to be minimal, however, given that all ISA participants included in the logged data analysis were recruited within a four month period (January – May 2011) and map updates commenced towards the end of this recruitment period (late April 2011).

- **Recruitment delays** – During the RST there were significant delays to the recruitment of participants, particularly to the BI sub-trial. These delays meant that some participants were completing the trial over a year later than the first participants through the BI sub-trial. The effect of this time delay is difficult to determine, but potentially means that the participants who completed the trial later may have been exposed to speed enforcement or awareness campaigns that the earlier participants were not exposed to during their trial. The effect of these delays and any potential time-based confounding factors, however, have been largely controlled for through the addition of the control groups who were recruited alongside the treatment participants and thus should have been also exposed to any time-based factors.

- **Delays to participant completion of Survey 2** – There were significant delays in some participants completing Survey 2. These delays were particularly apparent for the BI sub-trial. This issue was addressed by removing from the analyses, the data for any BI participants who had taken over 4 months (120 days) to complete Survey 2. The ISA participants were less affected by survey completion delays and no action was required to exclude data from the ISA survey analyses for this reason.

- **Baseline (pre-ISA) speed behaviour not known** - The design of the RST meant that baseline speed data were not collected. Rather, conclusions regarding ISA effectiveness are made by comparing the treatment and control groups' speeds. Baseline data were not collected because participants for the RST were recruited immediately after they received a traffic infringement notice (TIN) for speeding (the trigger TIN) which may have affected their speed behaviour in any baseline recording period. This meant that any baseline (pre-ISA) data collected may have been affected by the receipt of the TIN and, thus, would not be a true reflection of participants' baseline speeding behaviour. Also, the design of the ISA intervention, as it would be implemented by VicRoads in reality, meant that the ISA device was required to be installed as soon as possible after recruitment and receipt of the trigger TIN. It is important to note, however, that the design of the ISA sub-trial does affect the types of conclusions that can be drawn regarding the effectiveness of ISA and, particularly, the effects of ISA after the system was removed from the vehicle. As there are no baseline speed data, it cannot be determined if the observed increase in drivers' speed after the ISA was removed represents a return to baseline speed levels or merely just an increase towards baseline levels. Likewise, it is difficult to know the absolute magnitude of the speed reduction affected by the use of ISA for the Speed Alert group, only the relative reduction compared to the control group. If the randomisation worked correctly, the difference between the Speed Alert (ISA) and Speed Data groups is the absolute effectiveness of ISA.

A number of future research avenues could be followed to make further use of the data collected during the RST and to follow-up the effectiveness of the interventions over time. These include:

- Conducting a follow-up with RST participants to examine any long-term effects of the two sub-trials on the number and type of Traffic Infringement Notices (TINs) received by participants in the 6 – 24 month period post-trial.

- Conducting a follow-up (interviews or surveys) with RST participants to examine any long-term effects of the two sub-trials on the number and type of crashes involving participants in the 12 – 24 month period post-trial.

4.4 CONCLUSIONS AND RECOMMENDATIONS

4.4.1 Behavioural Intervention Sub-Trial

- The results of the surveys suggest that the speed behaviour program had a positive influence on repeat speeders' self-reported speeding behaviour as well as their attitudes towards speeding specifically and driving more generally.

- The observed improvements in driver attitudes and self-reported behaviour do not appear to be moderated by driver characteristics such as age, gender, driving experience, social desirability, propensity for angry driving and course knowledge retention.

- It is important to note that driver attitudes and self-reported behaviour was only measured short-term (approximately five weeks after course completion). It is therefore not possible to determine from the current study if the observed improvements will be sustained longer-term.

- The effectiveness of the speed behaviour program was evaluated in terms of self-reported attitudes and behaviour. It is not clear if the benefits of completing the program would extend to actual behaviour as measured through, for example, crash involvement and the receipt of speeding offences in the months after program completion.

- While the short-term effects of the speed behaviour program look promising, it is recommended that the longer-term benefits of the program on actual driving behaviour, including crashes and

speed offence rates, be established before an investment is made to implement the program in the community on a wider-scale.

4.4.2 ISA Sub-Trial

- Alerting ISA is effective in reducing speeding and, in particular, higher end speeds in a sample of repeat speeders. Specifically, the use of ISA significantly reduced mean speed, 85th percentile speed, the time spent exceeding the speed limit, and the time taken to return to the speed limit and the ISA auditory warning threshold after being exceeded.

- A robust finding of the current study, which is also supported by previous research, is that the speed reducing effects of ISA do not appear to remain once the device has been removed from the vehicle.

- A number of usability issues were reported with the system, such as the ISA speed map not being accurate in all areas, drivers becoming over-reliant on the system to warn them of speeding episodes and the visual display being too bright, particularly at night.

- Based on the survey results it appears that the use of ISA has little effect on improving driver attitudes towards speeding.

- Taken together, the study findings indicate that ISA affects speed changes by means of tactical and operational speed support. It does not bring about an attitudinal change in drivers, nor does it sustain behaviour change after it has been removed. As such, ISA needs to remain active in order to confer its safety benefits.

- Overall, the alerting ISA device appears to be an effective in reducing speeding by recidivist speeders. However, if implemented as part of a repeat speeders intervention, ISA would need to remain in the vehicle as it does not change driver attitudes or behaviour long-term.

- It is important that, prior to wider-scale implementation, the usability issues observed with the ISA system be addressed, as these could lead to problems with system acceptability, increased workload and distraction, and, ultimately, undermine the effectiveness of the system.

- The addition of demerit point removal did not further improve speed behaviour over and above that of the ISA system for any of the measures examined. Demerit point removal also did not appear to have any benefits in regard to improving drivers' attitudes towards speeding or how positively they rated the ISA system. As such, demerit point removal does not appear to be an effective addition to a repeat speeder intervention program.

- Although the ISA and BI sub-trials were run separately and no formal comparisons were made across the two, based on the results from both trials it is possible that combining ISA use and the speed behaviour course may bring about greater effects on driver attitudes and behaviour than either of the interventions alone. This is particularly the case with ISA use, which was not found to influence drivers' attitudes towards speeding and only benefited driver behaviour while it was activated. It is possible that attending the speed behaviour program in conjunction with ISA use may bring about more sustained behaviour change in repeat speeders. Further research is required to examine if combining the interventions would indeed have the benefits suggested. The ideal trial design to investigate the effectiveness of both interventions combined on behaviour and attitude change is to include four study groups as follows: Group 1: ISA Only, Group 2, Speed Behaviour Program Only, Group 3: Both ISA and Speed Behaviour Program, Group 4: Control group receiving neither intervention.

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