

**THE NEW SOUTH WALES INTELLIGENT SPEED ADAPTATION TRIAL
FURTHER RESULTS**

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Abstract

This paper presents further results of the NSW Intelligent Speed Adaptation (ISA) Trial. The NSW Centre for Road Safety conducted the largest trial of this type in Australia in 2009 to 2010. Over 110 light vehicles from private and company fleets were fitted with an Advisory ISA device and a speed data recorder. Each vehicle remotely communicated with a centralised database to ensure it received up-to-date speed zone information. Over seven million vehicle speed records were collected during the Trial, which were analysed to measure changes in speed compliance. The Advisory ISA system reduced speeding in 89% of trial vehicles. The median probability of speeding was also reduced by almost 30% when Advisory ISA was active. When the Advisory ISA system was removed 85% of vehicles increased the proportion of their trip time that they travelled in excess of the legal speed limit. Results of the Trial demonstrate that Advisory ISA technology has the potential to realise substantial road safety benefits by increasing drivers' compliance with speed limits.

Keywords

Intelligent speed adaptation; ISA; speed compliance; GPS; vehicle technology

Introduction

The NSW ISA Trial has been the largest trial of intelligent road safety technology ever conducted by a government agency in Australia. The Trial involved over 110 vehicles, including a mix of non-government fleet and private vehicles.

Speeding is a significant road safety issue in Australia and worldwide. In NSW, almost 39% of all fatal crashes and 16% of injury crashes have speed as a contributing factor. On average, approximately 177 people die each year in NSW [1] as a result of being involved in a speeding related crash. Aside from the tragic cost in human lives and suffering, it is estimated that the cost to the NSW community of speed related crashes is around \$1.5 billion a year [1]. This is the cost that the community is willing to pay or forgo in exchange for a reduction in the probability of speed related casualties and towaway crashes. Furthermore, even small reductions in speed will yield substantial safety benefits [2].

Intelligent Speed Adaptation refers to in-vehicle technology systems which assist drivers to keep to or below the speed limit. By using GPS technology and on-board maps which are linked to a speed zone database, the vehicle 'knows' where it is and what the speed limit is for that street at all times. There are three different types of ISA systems:

- Advisory – this system warns the driver when the legal speed limit has been exceeded, by an audible alarm or message combined with visual feedback. This system allows the driver to make a decision on what action to take.
- Supportive – this system restricts the flow of fuel to the vehicle so it cannot exceed the speed limit. It allows the driver to override the system if necessary.
- Limiting – this system is similar to Supportive ISA systems, but it cannot be overridden by the driver.

Recent research conducted by the Centre for Automotive Safety Research suggests that the use of ISA across the road network could result in fatal crash risk reductions of between 11% for Advisory ISA and 28.3% for Limiting ISA, [3]. In addition to substantial road safety benefits, ISA offers the opportunity to save running costs, fuel and carbon emissions as well as traffic flow [4], [5].

The NSW ISA Trial focused on evaluating Advisory ISA, the most easily implemented type of ISA and was built upon the learnings of other Australian ISA trials conducted in Western Australia and Victoria. Some of the distinctive enhancements of the NSW ISA Trial included:

- a larger sample size of over 110 vehicles (including participants from a broad range of ages, genders and driving backgrounds)
- highly accurate speed zone mapping
- the inclusion of both non-government fleet drivers and private drivers
- the collection of extensive data (speeds and speed zone compliance, speeding infringements received, fuel usage and user acceptance).

The aims of the NSW ISA Trial were to:

- research the potential road safety benefits of Advisory ISA systems in NSW
- measure the economic effects in terms of fuel consumption and travel time
- assess the acceptability of Advisory ISA systems to drivers and fleet managers.

This paper presents the final results of the NSW ISA Trial and focuses on speed zone compliance changes associated with Advisory ISA technology.

Method

Trial Area

Three Local Government Areas (Wollongong, Shellharbour and Kiama) within the Illawarra Region were selected for the NSW ISA Trial. The total length of the road network in this area was approximately 2,500 km and boasts a population of more than 263,000. Over 4,000 speed signs were located allowing 932 speed zones and 452 curve advisory signs to be mapped. The Illawarra Region includes a large workforce that commutes up to 80 km per day into Wollongong from the neighbouring Shellharbour and Kiama Local Government Areas. The area has a wide variety of speed zones including 40 km/h high pedestrian, 40 km/h school zones, 50 km/h and 60 km/h urban areas, 80 km/h winding rural roads and 100 km/h freeways.

Trial participants

Trial participants included a combination of drivers from nine non-government Illawarra businesses and general population private drivers.

The Trial began with 114 participating vehicles, of which 104 participated for the full duration of the Trial. These vehicles consisted of

- 38 non-government fleet vehicles driven by exclusive drivers
- 3 non-government fleet vehicles driven by shared drivers
- 63 private vehicles driven by exclusive drivers.

All exclusive drivers were the nominated driver of their vehicle for at least 80% of the time, and they drove 80% of their time in the Wollongong, Shellharbour and Kiama Local Government Areas. Participation in the Trial required that vehicles were not replaced or retired during the trial period.

Participant recruitment was initially focused on non-government fleet drivers. However, an analysis of these drivers' characteristics showed that young drivers under the age of 25 years and drivers and over 60 years, were under-represented within the Trial at that stage. Most drivers recruited early in the Trial also had an excellent driving record, with only a few of them carrying demerit points for a speeding offence. The recruitment of the private driver sample therefore focused on additional drivers under the age of 25 years (including a substantial proportion of provisional drivers), drivers 60 years of age and over, and repeat speeding offenders.

ISA devices

The NSW ISA Trial originally intended to assess both Advisory and Supportive ISA technology. However, after an extensive search, a conforming supplier of Supportive ISA devices within Australia could not be found.

The ISA devices selected for the Trial were a GPS-based speed Advisory system marketed as Speed Alert™, supplied by Smart Car Technologies Pty Ltd. This Advisory system was unique in that each device communicated with a centralised computer which enabled wireless software updates and live speed zone change updates. With all vehicles connected to a live spatial server, each vehicle's location, device status and speed zone compliance could be displayed at all times.

Data Collection

A separate GPS based speed and location data recorder was fitted into all vehicles at least one month before the ISA device was installed, and it remained in the vehicle until the end of the Trial. This enabled researchers to develop a speed limit compliance profile for each vehicle in the Trial, and to establish before and after ISA driver behaviour profiles. The data recorder logged the speed and location of each vehicle every ten seconds.

The Trial consisted of the following data collection phases:

1. *'Before installation of ISA device period'* - At least one month before the ISA device was installed, each vehicle was fitted with a data recorder to independently (of the ISA device) record spatially referenced vehicle location and speed data in ten second increments.
2. *'ISA device active period'* - The ISA devices were installed and once deemed fully operational, operated for at least three months (December 2009 to February 2010).
3. *'ISA device de-activated period'* - The data recorders continued to record vehicle speeds and locations for two months after the ISA device was de-activated (March to April 2010).

Data Analysis

Speed Data Analysis

Separate sets of data were collected and analysed over the course of the Trial.

Participating drivers had their driver licence records (including any history of offences) reviewed by the NSW Centre for Road Safety, with the driver's consent. This information, combined with the driver's journey details gathered by the in-vehicle data recorders, enabled the creation of behaviour profiles for all drivers.

GPS data recorders had captured over seven million speed records by the end of the Trial. Details of each vehicle's journey, including GPS position, date, time and speed were continually recorded in ten second intervals. The data recorders provided baseline data on driver behaviour and speed compliance, tracked speeding patterns during the period the ISA devices were in the vehicles, and provided a measure of post-trial driver behaviour and speed compliance. This enabled any objective changes in driver behaviour and speed compliance to be measured.

For the purposes of speed data analysis, 106 vehicles were included in the analysis. In order to determine how effective the ISA devices were on a driver's choice of speed (that is, the driver's 'free speed'), it was important to remove as much as possible, instances where the vehicle's speed was dictated by the road environment, for example, slowing for intersections, or congested traffic. Free speed is defined for the purposes of this Trial as any vehicle travelling at least 75% of the speed limit.

Attitudinal Research

In addition to the objective data that was collected, a number of attitudinal and behavioural research studies were completed at various stages throughout the Trial by an independent social research company. A combination of qualitative and quantitative research was conducted with Trial participants, which provided a detailed exploration of the participants' attitudes towards the ISA technology, including:

- their expectations of the technology
- their views on the acceptability of the technology
- their perceived benefits of and concerns about the technology
- suggestions for improvement and marketability of the technology.

In addition, the attitudinal research enabled the RTA to ascertain whether the use of the ISA technology resulted in an increased awareness of road safety issues, and a more positive attitude towards speed limits and speeding, as well as any changes in self-reported speeding behaviour.

Vehicle based observations were conducted early in the trial to examine how drivers interacted with the ISA device.

Results

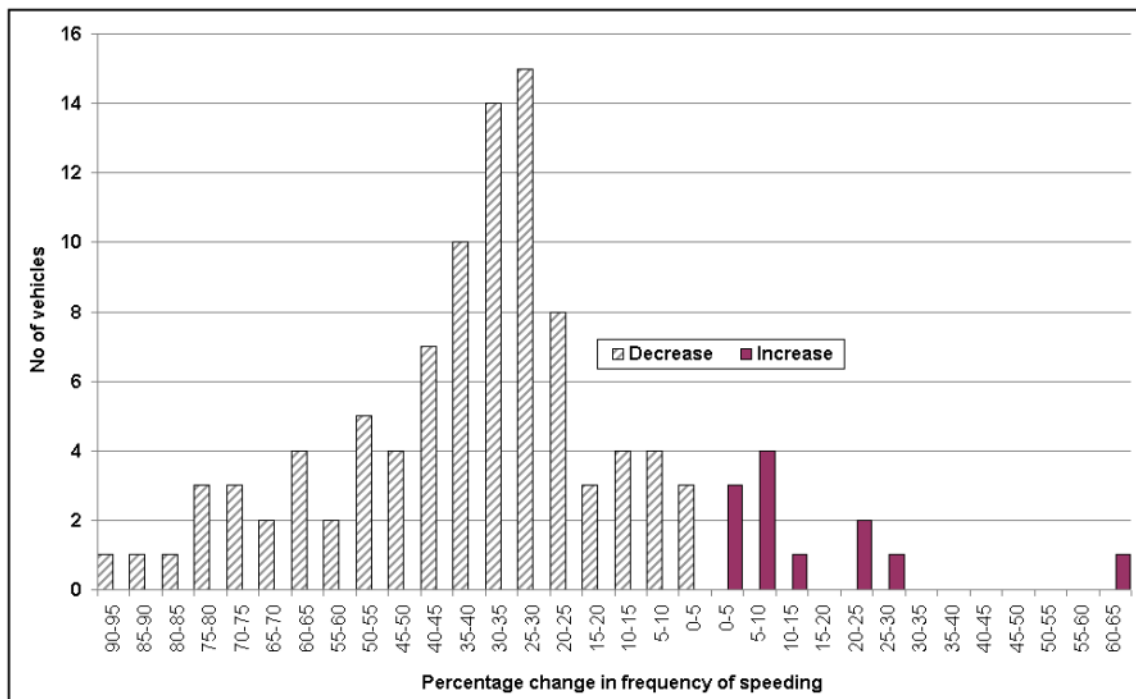
Speed Data Analysis

Proportion of driving time spent speeding – free speeds

Since the main function of the ISA device is to discourage drivers from speeding, the first test was to determine whether there was a reduction in the proportion of time drivers spent speeding.

Results from measuring free speeds showed that when the ISA device was fitted in the vehicles, 94 out of the 106 vehicles (89%) reduced the amount of time they spent exceeding the speed limit, compared to before the ISA devices were fitted.

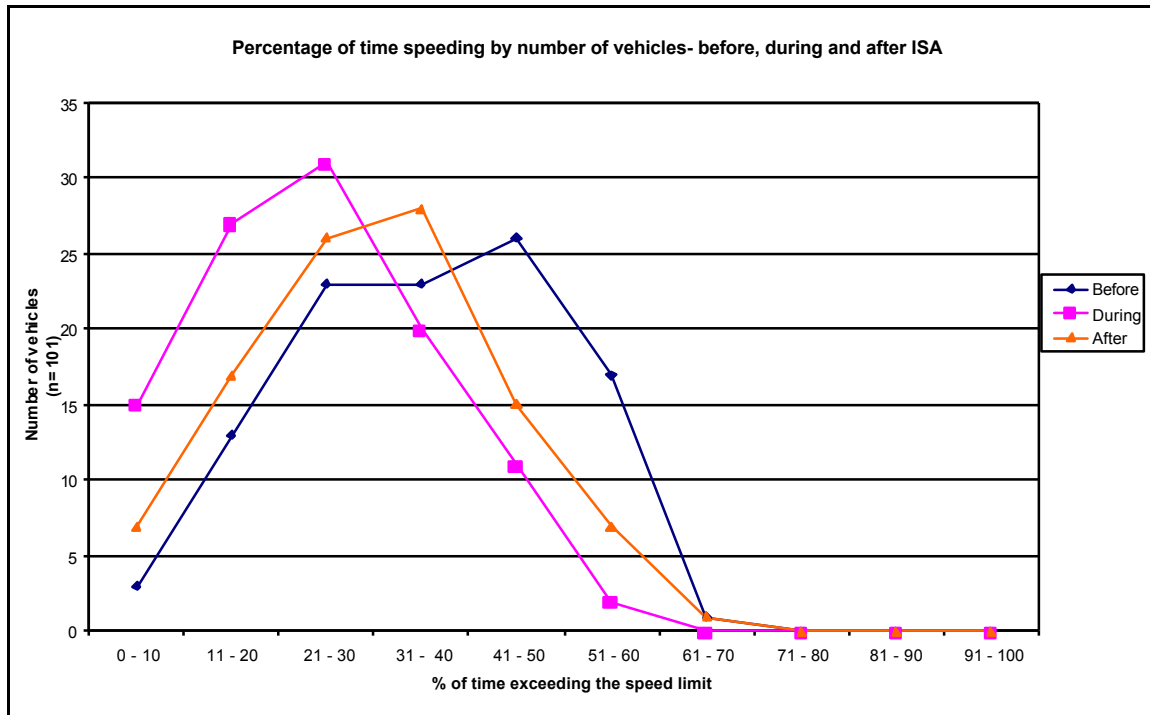
Figure 1: Frequency of speeding with ISA fitted compared with frequency of speeding before device was fitted.



After the ISA devices were removed, the vehicles were more likely to speed than during the time when they were fitted. In the post-period, data was successfully collected for only 101 of the 106 vehicles. Eighty seven of the 101 vehicles (86%) spent more time driving above the speed limit, after the device was removed, than while it was fitted.

The graph on the next page shows the effect of ISA on the frequency of vehicles by proportion of time travelling over the speed limit. ISA substantially reduced the number of vehicles travelling more than one third of their time above the speed limit. Whilst the frequency of vehicles travelling more than one third of the time above the speed limit increased when the ISA device was removed, drivers did not appear to have returned to the levels of non-compliance seen at the start of the trial.

Figure 2: Frequency of vehicles by proportion of time spent travelling above the speed limit; before, during and after the ISA device was activated.



Probability of speeding

If a score is assigned to each vehicle, equal to the proportion of time it was speeding, then this could be considered as an estimate of the probability that it would be speeding in free speed conditions.

The median proportions of time speeding were:

- Before 36.3%
- During 24.1%
- Post 30.5%.

If, for each vehicle, the proportion of time speeding during the time the ISA device was fitted is compared with the proportion before, this can be seen as a change in the probability of speeding. (for example, if one vehicle had sped 36% of the time before the device was fitted and 27% during the time it was fitted, then this would be a reduction of 25% in the probability of speeding, because $(36-27)/36 = 25\%$). The Trial’s median reduction in the probability of speeding was 31.8% (i.e. the median across all vehicles).

Proportion of driving time spent speeding by 5 km/h or more – free speeds

Eighty nine of the 106 vehicles (84%) spent a lesser proportion of time exceeding the speed limit by 5 km/h or more when the ISA device was fitted than before.

Eighty six of the 101 vehicles (85%) spent a greater proportion of driving time exceeding the speed limit by 5 km/h or more after the ISA device was removed than while it had been fitted.

Mean speeds

To measure whether the ISA device resulted in a reduction in mean speed, the change in mean speed for each vehicle was measured separately. Some of the vehicles spent little or no time in a particular speed zone. A vehicle was not included in the analysis of a particular speed limit, unless it had at least five minutes in total in the before-period and five minutes in the during-period, at a speed of at least 75% of the speed limit.

In Table 1 below:

- The column headed *Number of vehicles* shows the number of vehicles with at least five minutes of free speed in that speed limit.
- For each vehicle, the mean speed before the ISA device was fitted was calculated and the mean speed when the ISA device was fitted was calculated. The difference between each was then found. This gave a score for each vehicle. This was positive value if the mean speed was less in the after period, and negative if it was greater.
 - The numbers in the *Mean* column are the vehicle scores, averaged over vehicles, for each speed limit.
 - The numbers in the *Median* column are the medians of the vehicle scores, for each speed limit.
- *Percentage speeding less* is the proportion of the vehicles where the proportion of time speeding, in that speed limit, was less when the ISA device was fitted than before the device was activated. In the 110 km/h speed limit, two of the 47 qualifying vehicles never sped, before or after, and so were not included in the percentage speeding less calculation.

Table 1: Number of vehicles, mean and median decrease in speed, percentage of vehicles speeding less when ISA was fitted.

Speed limit	Number of vehicles	Decrease in speed (km/h)		Percentage speeding less
		Mean	Median	
40 km/h	90	1.53	1.79	71%
50 km/h	106	0.91	1.00	91%
60 km/h	105	1.07	1.27	84%
70 km/h	90	1.84	1.68	88%
80 km/h	104	1.62	1.40	81%
90 km/h	81	2.34	2.21	78%
100 km/h	94	1.87	1.90	85%
110 km/h	47	3.22	2.89	78%

Note: Where decrease in median or mean speed is negative, it shows an increase in vehicle land speed

Table 1 demonstrates that, across all speed limits, the majority of vehicles spent less time speeding when the ISA device was installed, compared to before installation.

Gender and age

Driver characteristics such as age group and gender were analysed for 102 of the 106 vehicles in the Trial, as 102 vehicles had a driver who was exclusive to that vehicle.

In the sample, each age group had about the same ratio of males to females (about 4:7).

The independent variable was the number of drivers who reduced their time spent speeding when the ISA device was installed (compared to before installation), which was examined separately for males and females, and for younger (25 years or less) and older (over 25 years) drivers. Fisher's exact test was employed to examine age and gender differences.

The difference between males and females was not statistically significant at the .05 level.

Alternatively, there was a significant difference between younger and older drivers ($p < 0.04$). As outlined in Table 2, a smaller proportion of drivers aged 25 years or younger sped less than expected. Although less than a third of the drivers were in the youngest age group, more than half of the drivers who did not speed less were in that youngest group.

Table 2: Whether exclusive drivers sped less when the ISA device was fitted, by age group

Age group	Number of Drivers			% of Drivers Reducing Time Spent Speeding
	Yes	No	Total	
25 or less	23	7	30	77%
over 25 years	67	5	72	93%
Total	90	12	102	88%

Attitudinal research

Perceived benefits of the ISA Technology

The most common benefit of the ISA technology mentioned in group discussions was that drivers felt they were always aware of the speed limit on any given stretch of road. Other commonly mentioned benefits included that the technology:

- alerted them when they had accidentally drifted over the speed limit
- increased their awareness of how often they exceeded the speed limit, and how often other motorists exceeded it
- made them more aware of speed zones
- made their decision to speed a conscious one, i.e. to take that risk (a benefit only articulated by some male drivers)
- provided reassurance that they would not unwittingly get caught for speeding
- helped them relax by encouraging them not to be in a rush and worry about their speed.

With the ISA technology active in their vehicles, almost two in three (65%) agreed with the notion that the technology was 'of great use' to them.

Concerns about the ISA Technology

The main concern expressed in the group discussions was that the ISA technology was ‘unforgiving’, and it did not allow the driver to travel a few kilometres per hour over the speed limit, before it started ‘beeping’. Other concerns included that the ISA technology was:

- disconcerting or distracting at first when they were still unfamiliar with the device or when it did not functioning correctly
- unreliable at times – i.e. not starting up and picking up side streets,
- intrusive when there were passengers in the car
- a potential target for thieves
- not positioned optimally in their vehicle such that they had to turn their head to look at the device and hence take their eyes off the road.

Concerns about drivers being tailgated if they reacted to the ISA device warnings (and kept to the speed limit) were not expressed by many participants. While some raised this as a concern, in the group discussions more seemed to consider it a hypothetical problem (having been tail-gated but being unperturbed).

Use of the ISA device

Among those participants who admitted to having turned the ISA device off on occasion, the majority (63%) said they generally turned it off for a short period of time before turning it back on.

After having experienced the ISA device in their vehicle, participants were more likely to agree with the statement ‘the ISA technology would be wasted on drivers who speed intentionally because these drivers would ignore or override the warnings’. Indicatively from feedback in the group discussions, this response was likely influenced by the ISA device being able to be turned off if the driver wished.

Overall acceptability and personal interest in keeping the technology

The majority of trial participants (61%) rated the overall acceptability of the ISA technology positively. Participants were more likely to have a positive view of the technology (in terms of overall performance, usability, functionality and acceptability) than be inclined to recommend the technology to others or be interested in using the technology themselves. Participants were divided on whether or not they would be interested in continuing to use the ISA technology, with a fifth of participants stating they would not be interested at all in keeping the technology, but almost exactly the same proportion (21%) were very interested in keeping the technology. Indicatively, it appears that those with speeding offences recorded against them in recent years were more likely to be interested in having the technology in the future.

Use of ISA technology by the broader community

Participants in the Trial were most likely to nominate provisional or P plate drivers as a group that would particularly benefit from having the ISA technology in their vehicle (nominated by more than 8 in 10 participants). Even 69% of the provisional drivers in the trial felt that the ISA technology would be beneficial for drivers of this licence type. People who speed accidentally, people who had their licence cancelled or suspended for speeding in the past and younger drivers were also each nominated by more than 70% of participants.

Discussion

Analysis of the NSW ISA Trial speed data records has shown that the Advisory ISA device has had a positive impact on reducing speeding amongst the majority of Trial participants. The attitudinal research has shown that, by and large, the ISA technology was well received and accepted by those participating in the Trial.

During the time when the ISA device was fitted in Trial participants' vehicles, most drivers were less likely to speed, with a substantial reduction (32%) in the probability of speeding.

Considering the concept of 'free speed', being the times when a driver was travelling at least 75% of the speed limit, when the ISA device was fitted, 89% of drivers reduced the amount of time they spent exceeding the speed limit.

There appears to have been little 'learning effect' among participants after having driven with the ISA device for three months. Although some participants mentioned in the attitudinal research that the Trial had made them more aware of the fact that they did speed, once the ISA device was removed, 86% of drivers increased the amount of time spent driving in excess of the speed limit compared to when it was fitted. While the ISA device was fitted, substantially fewer drivers engaged in speeding in all speed zones. There was a reduction in the mean speed in all speed zones, with the largest reductions tending to be in the higher speed zones.

Young drivers were less likely to reduce the proportion of time spent speeding with the ISA device installed. More than half of the drivers who did not slow down were in the youngest age group, 25 years or less. Indicatively, based on feedback in group discussions, participants under the age of 25 years were also more likely to turn the device off at times.

The results from the attitudinal research indicate that the ISA technology was seen, overall, to have merit. The technology is seen as acceptable, even if participants wouldn't necessarily recommend the technology to others or be interested in using the technology themselves.

Based on attitudinal research feedback the ISA device seems to have been most useful in preventing accidental speeding. A significant challenge will be to slow people down in situations such as when they perceive they have a need to speed, for example if they are running late for an appointment. Prevention of low-level speeding is also a challenge, as many believe they won't or can't be booked by police for being a few kilometres per hour over the speed limit. In situations such as this, many drivers may choose to switch the ISA device off when not in a trial. A quantitative study of attitudes towards speeding in New South Wales conducted by the NSW Centre for Road Safety in 2009, found that low-level speeding has high levels of social acceptability. Furthermore there is a perception that Police allow a speeding tolerance band when enforcing the speed limit [6].

One of the most common concerns participants had about the ISA device was that the technology did not include such a leeway or tolerance before the audio warnings began.

Indicatively from the attitudinal research, it appears that those drivers who perceive they have a need or desire to speed, outside of a trial situation, would choose to switch the ISA device off so they do not get 'annoyed' by the audio warnings. Trial participants under the age of 25 years were more likely to admit to switching their ISA device off. Analysis of the Trial speed data records also showed that a smaller proportion of under 25 year old drivers sped less than expected. It could therefore be hypothesised that those drivers who could benefit the most from the ISA technology are also those most likely to switch the ISA device off, or not take notice of the audio warnings when they exceeded the speed limit. Further research is required to determine ways to create a need for drivers with a desire to speed to keep the device switched on, and thereby gain the full safety benefits that ISA technology can offer.

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