Transport for NSW | Centre for Road Safety

Cooperative Intelligent Transport Initiative (CITI) Light Vehicle Study Driver Feedback

Summary Report June 2021

NSW GOVERNMENT

TOWARDS ZERO

Contents

1. Executive Summary

The Cooperative Intelligent Transport Initiative (CITI) is Australia’s first testing facility of Cooperative Intelligent Transport Systems (C-ITS). It was established by Transport for NSW in 2012 to explore the potential road safety benefits of the technology. C-ITS allow vehicles to communicate with each other and with infrastructure, such as traffic signals. Drivers can receive alerts about upcoming hazards and traffic signal information. The technology is sometimes referred to as ‘connected vehicles’.

The CITI Light Vehicle Study was an on-road trial involving participating members of the public having their vehicles fitted with C-ITS and telematics equipment. The study trialled three safety alerts: red light, intersection collision and harsh braking ahead warnings. Participants completed surveys and focus groups to provide their feedback on the technology.

Results indicated participants agreed connected vehicle technology would reduce crashes if fitted to all vehicles and traffic lights. Participants found the experience of driving with such technology to be positive overall and agreed it was user-friendly. Most participants agreed they would be supportive of a policy requiring all vehicles to be fitted with connected vehicle technology, would use it if it were made available to them as a free smartphone app, would recommend the technology to others, and would like to see more types of alerts available.

While participants were largely positive about the technology overall, they identified some limitations of the technology. Some participants experienced maintenance issues with the hardware components and would like to have had more control over alert delivery, particularly in terms of volume and brightness. Many participants did not agree the alerts they received during the study caused them to respond sooner to the relevant safety hazards.

While participants reported feeling safer when driving with connected vehicle technology, they did not perceive their driving performance and attention to the road to have changed after they stopped using it. This suggests participants’ general driving behaviour did not change beyond situations in which they directly interacted with the technology. These perceptions seem likely to be influenced by the small sample of vehicle, infrastructure, alert types and positioning of C-ITS equipped traffic signals deployed in this study. Nevertheless, participants agreed widespread use of the technology would lead to a reduction in the numbers of drivers running red lights, and crashes occurring at red lights and intersections

These findings demonstrate participants see the potential of the technology in providing value to them as drivers above the current suite of vehicle technologies aimed at reducing road trauma.

2. Background

This report describes findings from the participant survey conducted for the CITI Light Vehicle Study undertaken by Transport for NSW in 2018-19 as part of the Cooperative Intelligent Transport Initiative (CITI). The Centre for Road Safety commissioned the Australian Road Research Board (ARRB) to undertake this work.

2.1 CITI Light Vehicle Study

CITI is Australia's first testing facility of Cooperative Intelligent Transport Systems (C-ITS). It was established by Transport for NSW in 2012 to explore the potential road safety benefits of the technology. C-ITS allow vehicles to communicate with each other and with infrastructure, such as traffic signals. Drivers can receive alerts about upcoming hazards and traffic signal information. The technology is sometimes referred to as 'connected vehicles'. As part of the initiative, trucks, buses, a motorcycle and different types of roadside infrastructure have been fitted with C-ITS.

The CITI Light Vehicle Study was an on-road trial involving participating members of the public having their vehicles fitted with C-ITS. The study trialled three safety alerts: red light, intersection collision and harsh braking ahead warnings.

2.2 C-ITS Alerts trialled

The C-ITS technology fitted to participant vehicles were able to provide the following alerts types:

Red Light Warning (RLW)

This alert was activated when a participating vehicle approached a set of C-ITS equipped traffic signals and the upcoming turning arrow or straight-through light was amber or red. The alert was a chime sound and the spoken words 'red light ahead' and the image depicted in Figure 1.

Figure 1: RLW visual alert image on in-vehicle display screen

Intersection Collision Warning (ICW)

This alert was activated when two or more C-ITS equipped vehicles approaching an intersection were deemed by the equipment to be at risk of collision. The alert was five quick beeps and the spoken words ‘left left left’ or ‘right right right’, depending on the direction from which the other vehicle was approaching, and the image depicted in Figure 2.

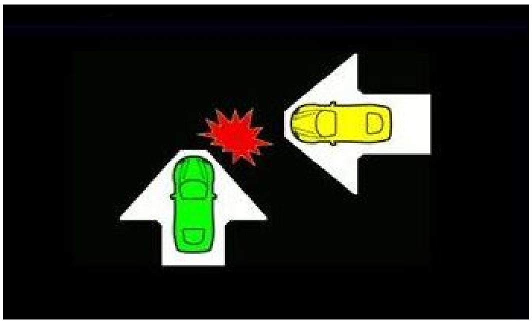

Figure 2 ICW alert image on in-vehicle display screen

Harsh Braking Ahead Warning (HBAW)

This alert was activated when the driver of the rear C-ITS equipped vehicle is alerted to another equipped vehicle ahead braking heavily, including when the vehicles are separated by several other non-equipped vehicles., The alert was a chime sound and the spoken words ‘braking ahead’, and the image depicted in Figure 3.

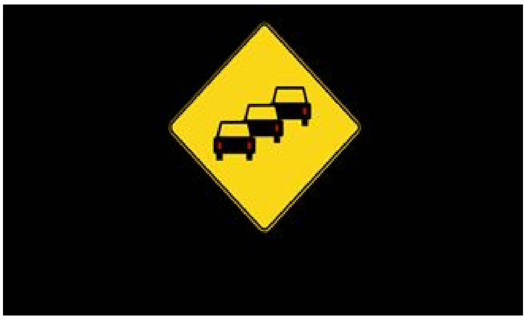

Figure 3 HBAW alert image on in-vehicle display screen

Vehicles were fitted with the equipment for a period of ten months from March 2018 to April 2019. The ten-month period consisted of an initial five month-baseline period, during which time participants did not see the alerts followed by a five-month treatment period, during which participants did see alerts. Findings in this report therefore relate to the five-month treatment period.

An example of an in-vehicle installed screen which displayed the alerts is shown in Figure 4.

Figure 4 Example set up of display screen which provided alerts

2.3 Participant recruitment

Participants were recruited in two waves. The first wave involved the recruitment of parents or carers of a child who attends one of the local schools near Wollongong's Central Business District (CBD) which supported the study. To be eligible for the study these parents or carers were required to drive to/from the school three or more times a week at the beginning or end of the school day. Sixteen participants consented to participate in the study in this first recruitment wave.

The second wave of recruitment was undertaken by a market research company who contacted residents of the Illawarra. To be eligible for the study these residents were required to drive to, from or through the Wollongong CBD three or more times a week. A further 38 participants consented to participate in the study through this recruitment method. One final participant was recruited via word-of-mouth. The study eligibility criteria of driving within certain areas was designed to maximise the chances of participating vehicles coming into frequent contact. Other eligibility criteria included driving 5+ hours/week and being the main driver of the vehicle (>80% of trips).

2.4 Participant feedback

Participants were asked to provide their feedback on the technology. The post-drive participant survey consisted of 118 items designed to capture participant experiences and opinions about driving with C-ITS technology. The aims of the survey were to investigate participant experiences with and perceptions about the technology including:

- benefits
- ease of use
- validity of the alerts
- overall perceptions
- interest in future use.

This survey was undertaken by 45 of the 55 participants of the Connected Light Vehicle Study who had completed the driving component of the study and had the C-ITS equipment removed from their vehicle. Of the other 10 participants, 6 withdrew prior to their vehicle being installed with the equipment and 4 during the baseline period (prior to the driver alerts being activated). Participants were fairly evenly split by gender (56%

female). The average age was 49 years (ranging from 24-76 years old). On average, participants held a driver licence for 31 years (ranging from 5-59 years).

3. Findings

3.1 The alerts

Participants were most likely to have experienced Red Light Warnings (RLWs) as compared to the other two alert types. Most (91%, n=41) participants reported receiving at least one red light warning (RLW). Half of participants (51%, n=23) reported receiving at least one Intersection Collision Warning (ICW). The proportion of participants reporting having received an ICW is higher than anticipated based on the number of vehicles fitted with C-ITS connected vehicle technology in the area and the expected rarity of events in which an ICW would apply. This increased proportion in reported ICWs received may, in part, be attributable to participants receiving false alarms (false positive alerts). Analyses of responses to questions specific to RLW and ICW alert types include responses from 41 and 23 participants respectively.

While four participants reported experiencing at least one Heavy Braking Ahead Warning (HBAW), there were no records of a HBAW being issued to any participant in the in-vehicle data. Therefore, results from questions specific to this alert type are not described in this report. The study team consider participants who reported receiving a HBAW may have remembered the event incorrectly.

3.2 Timing of alerts

Participants were asked whether they received the RLWs before seeing the red/amber traffic light. The results show 32% of participants reported they typically received a RLW before seeing a red or amber traffic light. The three signalised junctions at which the RLWs were operational were on level ground and have good sight distance for approaching drivers.

For ICWs, most participants (57%) reported they received an ICW before seeing the other vehicle driving into an intersection.

Participants were asked to report whether they typically had sufficient time to respond to each type of alert. The majority of participants indicated they always had sufficient time to respond to both RLWs (68%) and ICWs (74%).

3.3 Response to alerts

Participants were asked how they usually responded to each type of alert. The majority of participants reported they scanned the road to identify the cause of the alert and prepared to brake, for both RLWs (63%) and ICWs (61%) (Figure 5). A minority of participants reported ignoring the alert (7% for RLWs and 9% for ICWs).

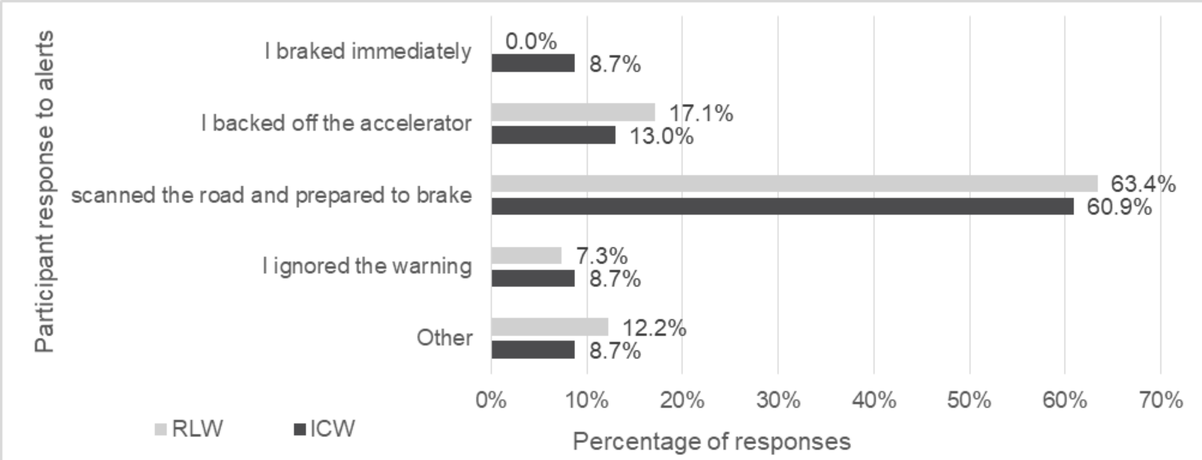

Figure 5 Participant response to alerts (RLW n = 41, ICW n = 23)

Over half (56%) of participants agreed the alerts in general helped them to respond to upcoming hazards sooner than they would have if they had not received the alert. For RLWs and ICWs, 27% and 35% of participants, respectively, indicated the alert caused them to respond to the traffic light or approaching vehicle sooner than they would have if they had not received the warning. This result does not seem to align well with 56% of participants agreeing the alerts in general helped them to respond to upcoming hazards sooner. Possibly this difference related to participants interpreting the words ‘caused’ and ‘helped’ differently.

3.4 User friendliness of the alerts

A majority of participants agreed the technology was user-friendly (75%). Participants were asked to state their level of agreement with statements about the ease of understanding the alerts, and the effectiveness of the alerts in getting their attention. The majority of participants agreed the alerts were easy to understand (86%) and effective at getting their attention (96%).

3.5 Validity of alerts

Participants were asked the extent to which they agreed the alerts they received were justified, by alert type. The majority of participants either strongly agreed or somewhat agreed the alerts were justified, for both RLWs (73%) and ICWs (57%) (Figure 6).

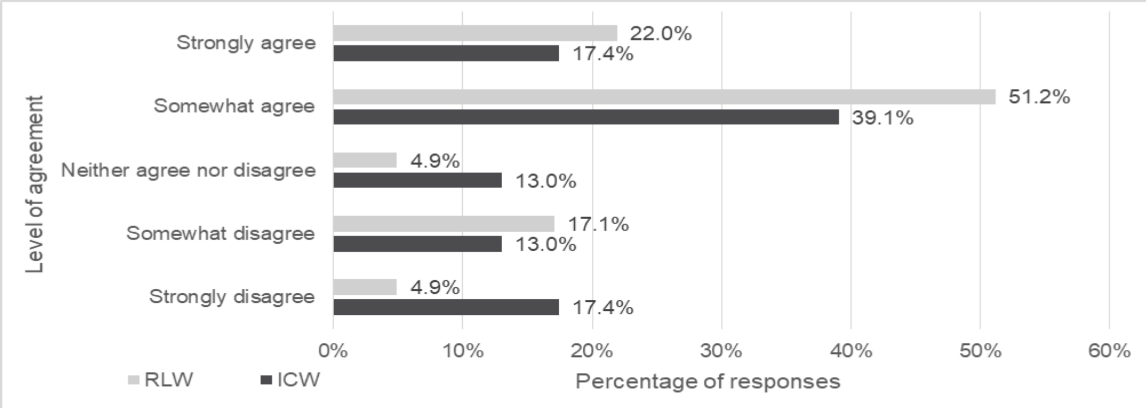

Figure 6 Extent to which participants agree the alerts they received were justified, by alert type (RLW n = 41, ICW n = 23)

Participants who disagreed the alerts were justified commented that the RLW alerts did not apply to them or were provided when they had already seen and were responding to the red light.

Participants who disagreed the ICWs were justified mainly described situations in which they received a false alarm or an alert they perceived to be unnecessary (e.g. they were stationary at the time, parked in a car park, or there were no intersections). It is important to note participants had no way of identifying other vehicles that were fitted with C-ITS. It is possible that alerts perceived to be false alerts may have been true alerts, meaning they were working as designed, in situations participants did not perceive to have a safety risk. This could mean the ICWs are too sensitive, or it could mean participants have not perceived a risk or hazard where one existed.

The majority of participants reported they never received a false alarm, i.e. an alert for no reason, for both RLWs (66%) and ICWs (74%).

3.6 Distraction

The majority (60%) of participants reported they did not find the technology distracting. Participants who indicated they found it distracting overall were asked the extent to which they agreed with nine possible reasons why it was distracting. Statements which the majority of participants agreed with were ‘I had to take my eyes off the road to look at the visual alerts’ (78%), ‘the screen fell of the dashboard / windscreen’ (72%), ‘the alert tones were too loud’ (72%), and ‘I had to scan the road for the cause of alerts rather than concentrate on driving’ (56%).

3.7 Benefits of connected vehicle technology

Participants were asked the extent to which they agreed with the statement ‘the technology was useful’ in reference to the C-ITS connected vehicle technology overall. The majority of participants agreed (61%) while a minority disagreed (14%).

Participants were asked how useful they found each type of alert. RLWs were generally perceived to be more useful than ICW, with 44% of participants indicating RLWs were somewhat or very useful (Figure 7). A comparatively smaller proportion of 27% of participants rated the ICW to be somewhat or very useful. This appears to contradict the earlier finding where a majority of participants indicated that the technology was useful overall.

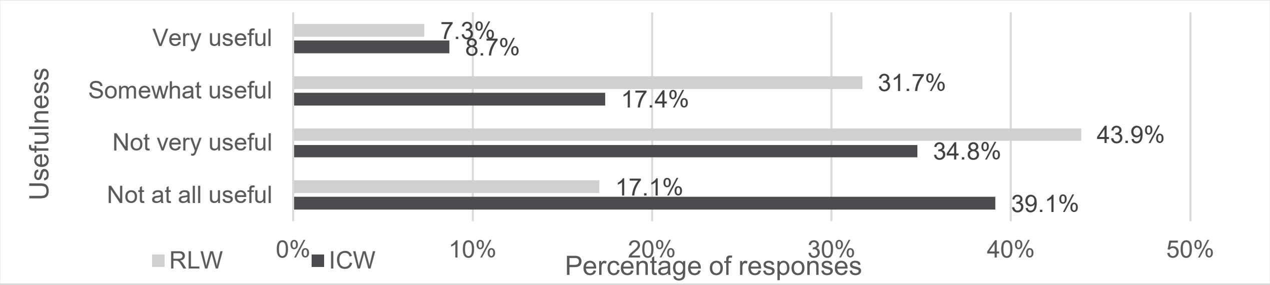

Figure 7 Perceived usefulness of alerts by alert type (RLW n = 41, ICW n = 23)

Comments about why the alerts were not useful included:

- There were not enough other vehicles and traffic lights fitted with the technology to be useful
- They were already stopped
- The alerts either did not apply to them or were false alarms
- The alerts were startling or distracting
- They were already checking the intersection up ahead

Comments about how the alerts were useful included:

- The alerts raised awareness of the situation
- The spoken alerts were more useful as drivers were able to look at the road

Participants were asked to state their agreement with statements about the benefits of having all vehicles and traffic lights fitted with C-ITS. The majority of participants agreed, if all vehicles were fitted, there would be fewer instances of drivers running red lights (73%), fewer crashes at red lights (66%) and fewer intersection collisions (78%) (Figure 8).

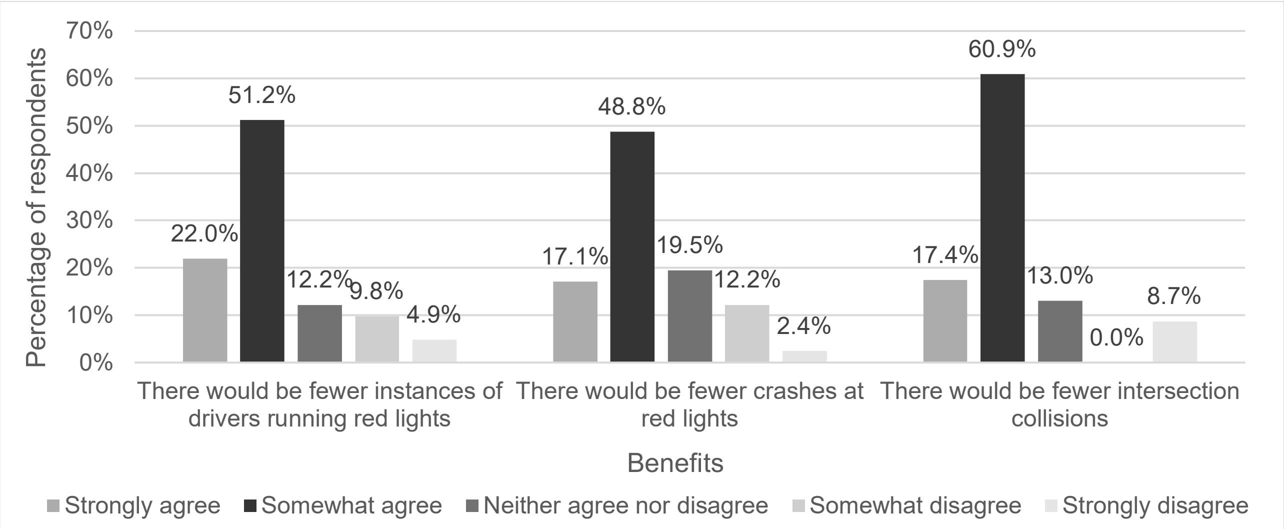

Figure 8 Benefits of having all vehicles and traffic lights fitted with C-ITS connected vehicle technology (n = 41, red light questions; n = 23, intersection collision question)

Participants were asked the extent to which they agreed with statements concerning the influence of the technology overall on the incidence of crashes. The majority of participants agreed the technology could reduce crashes if fitted to all vehicles (80%) or fitted to all traffic lights and vehicles (82%). However, participants were less likely to agree they personally found the alerts helpful in avoiding crashes (42%). One possible explanation for this result is that given that crashes are rare events, it is likely that participants did not experience any situations during the study where an alert personally helped them to avoid a crash.

Participants were asked to indicate how their driving changed after driving a car with connected vehicle technology. The majority of participants indicated their driving ‘stayed the same’ (91%) while the remaining participants reported their driving ‘improved a little’ (9%). The majority of participants reported their attention to the road ‘stayed the same’ (71%), while the remaining participants indicated their attention ‘increased a little’ (22%) or ‘increased a lot’ (7%).

3.8 Interest in future use

The majority of participants (60%) reported they would support a policy that required all vehicles to have connected vehicle technology installed, while 18% indicated they would not. The remainder of participants (22%) were unsure whether they would support this policy or not.

The most frequently selected reasons by those who would support this policy (n=27) were ‘there would be less crashes’ (63%) and ‘it would help others be safer drivers’ (60%) (Figure 9). Interestingly, comparatively fewer participants selected the response options ‘it would help me be a safer driver’ (26%) and ‘I would be less likely to have a crash’ (19 %). This pattern of responses suggests participants believe other drivers will benefit from this technology, while they are less likely to believe the technology will influence their own driving behaviour.

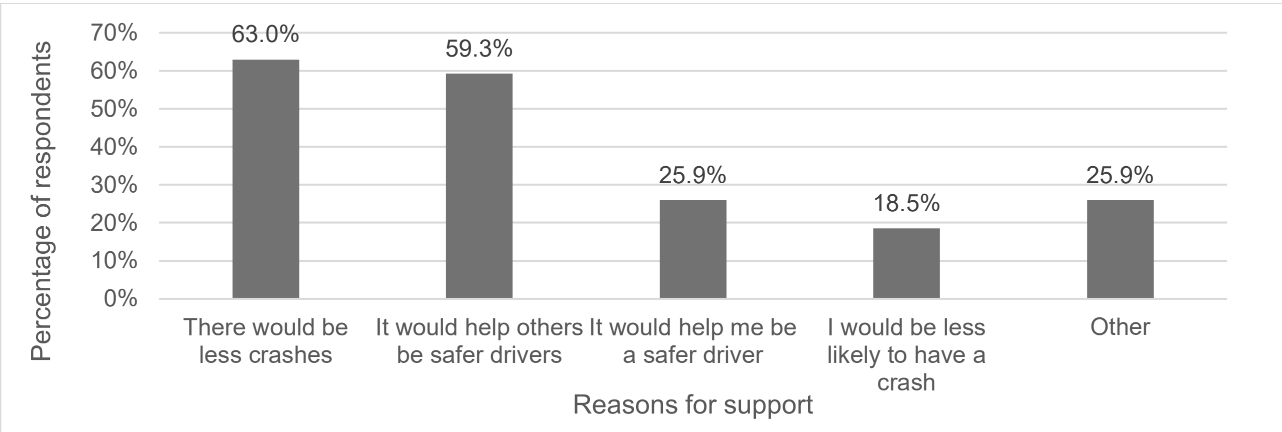

Figure 9 why would you support a policy that required all vehicles to be fitted with connected vehicle technology? (n = 27)

The most frequently stated reasons by participants who were not supportive of a policy that would require all vehicles to have connected vehicle technology installed (n=8) were ‘I think the alerts are distracting’ (75%) and ‘I found the device annoying’ (63%).

Participants were asked whether they would use connected vehicle technology if it was made available to them as a free application for their smartphone. The majority of participants (73%) indicated they would use an app providing connected vehicle technology.

Participants were asked to select the types of alerts and features they would like to have if they drove a vehicle fitted with connected vehicle technology, out of a list of ten options. The types of alerts which the largest proportion of participants wanted to have in a vehicle fitted with connected vehicle technology were speed zone alerts (89%), school zone alerts (87%), variable speed zone alerts (76%) and presence of motorcyclist (71%) and bicyclist (67%) alerts (Figure 10). These findings indicate participants desire speed related alerts and alerts related to the presence of vulnerable road users, while those related to weather conditions are less important.

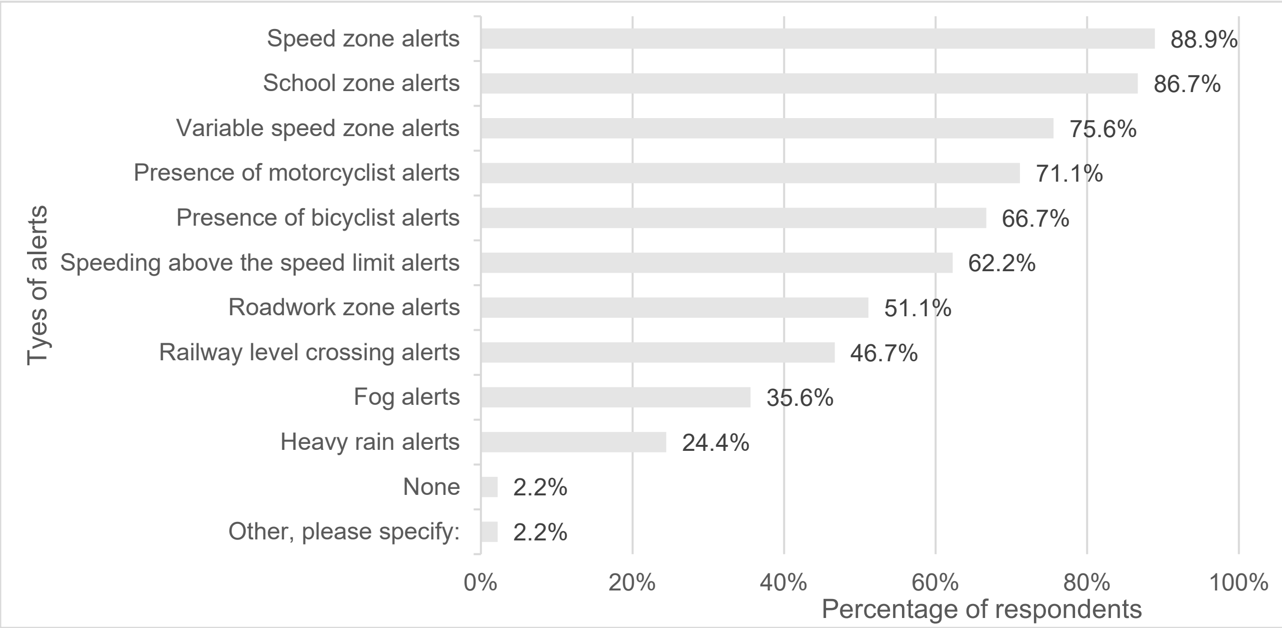

Figure 10 Alerts participants would like to have in a vehicle fitted with connected vehicle technology (n = 45)

3.9 Overall impressions of C-ITS connected vehicle technology

Participants were asked to rate their experience of driving a vehicle with the connected vehicle technology installed and operating, from very positive to very negative. The majority of participants indicated their experience was either very or somewhat positive (58%) (Figure 11).

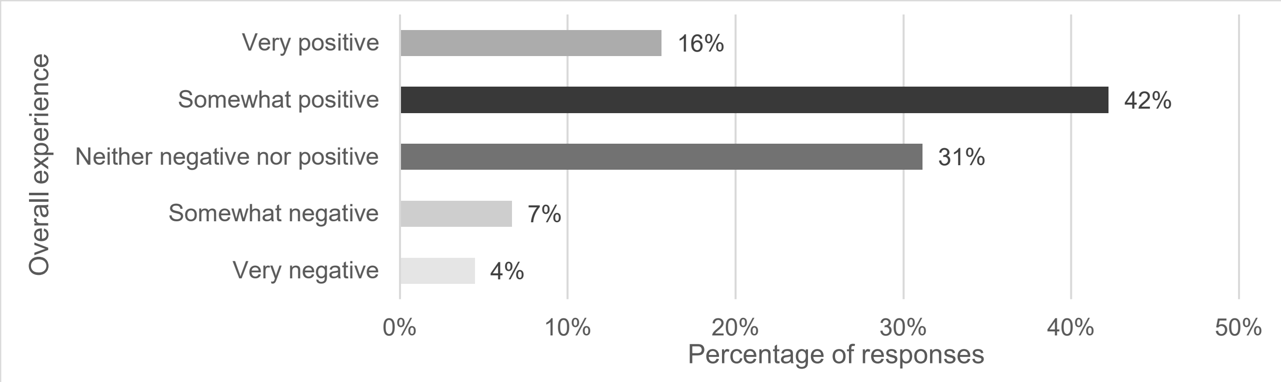

Figure 11 Overall participant experience of driving with connected vehicle technology (n = 45)

Participants were asked the extent to which they agreed they felt safer driving a vehicle fitted with connected vehicle technology. The largest group of participants agreed with this statement (41%), while 36% neither agreed nor disagreed, and 23% disagreed. These responses may have been influenced by the study conditions, including intersection collisions being rare events and the study period and sample of vehicles fitted with connected vehicle technology being relatively small for identifying collisions, and the C-ITS equipped signalised junctions having good sight distance upon drivers' approach.

4. Conclusion

Participants are generally supportive of C-ITS connected vehicle technology overall. Most participants agreed they would be supportive of a policy requiring all vehicles to be fitted with it, would use it if it were made available to them as a free smartphone app and would like to see more types of alerts available.

While most participants agreed the technology is useful overall, most participants did not agree the individual alert types trialled in the study, RLW and ICW, were useful. Some reasons participants did not find the alerts useful included because participants received alerts (a) after they had already responded to the hazard, (b) when the alert did not apply to them (i.e. false alarm/error), or (c) when they perceived there to be no safety issue. It is important to note participants in this study had no way to identify other vehicles fitted with the equipment, thus may not have been able to distinguish between alerts which were false alarms and alerts attributable to another connected vehicle technology fitted vehicle. Nevertheless, participants agreed widespread use of the technology would lead to a reduction in the numbers of drivers running red lights, and crashes occurring at red lights and intersections

Reassuringly, participants reported their usual response to the alerts were to scan the road and prepare to brake. These responses indicate participants are not overly reliant on the technology and use the alerts as a prompt to attend to any possible hazard on the road rather than a replacement to their own senses.

It is common for participants in driving studies to perceive their own driving ability as being better than others' and are thus less likely to believe they have a need for and will benefit from countermeasures that may increase their safety on the road. Similar findings were evident in this study. Almost three quarters (74%) of participants agreed the technology helps drivers notice potential hazards sooner. However, a comparatively smaller percentage of participants (56%) agreed the alerts helped them personally respond to upcoming hazards sooner. Similarly, when asked why they would support a policy which required all vehicles be fitted with connected vehicle technology, participants were more likely to select 'There would be less crashes' (63%) than 'I would be less likely to have a crash' (19%), and more likely to select 'It would help others be safer drivers' (60%) as a reason for their support than 'It would help me be a safer driver (26%)'. These patterns of responses indicate participants believe other drivers will benefit from this technology, while they are less likely to believe the technology will be required to influence their own driving behaviour (optimism bias).

These findings demonstrate participants see the potential of the technology in providing value above the current suite of vehicle technologies aimed at reducing road trauma.

Participants are supportive of the technology and see potential for future use of the technology, but found the personal usefulness of the technology to be limited in its current form. Future CITI trials will look at addressing the limitations identified by participants and build our evidence-base of what is working well, and what needs improvement. Trials will continue so that we can leverage connected vehicle technologies to become the safest transport network in the world. We are continuing to focus on our ‘Towards Zero’ goal of no fatalities on our roads, and NSW’s Road Safety Plan prioritises the uptake of new safety technologies in the vehicle fleet, including automated and connected safety features.

Transport for NSW, Centre for Road Safety

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