Centre for Accident Research & Road Safety - Queensland

Cooperative and Highly Automated Driving Safety (CHAD) Study

WP4: Public Awareness

Overall Summary Report
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ACRONYMS

AVs	Automated Vehicles
CAVs	Cooperative Automated Vehicles
CHAD	Cooperative and Highly Automated Driving
Dynamic demonstration	A public demonstration of the CHAD project's Society of Automotive Engineers (SAE) Level 4 electric CAV prototype, "ZOE2" where public participants are able to travel as passengers in the vehicle as part of the demonstration
M	Mean
N	Number
QUT	Queensland University of Technology
SAE	Society of Automotive Engineers
SatMDT	Step approach to Message Design and Testing
SD	Standard deviation
Static demonstration	A public demonstration of the CHAD project's Society of Automotive Engineers (SAE) Level 4 electric CAV prototype, "ZOE2" where the vehicle is on display but remains stationary
TMR	Department of Transport and Main Roads
WP4	Work package 4

1 INTRODUCTION

1.1 BRIEF BACKGROUND AND AIMS OF WORK PACKAGE 4

Work package 4 (WP4) of the Cooperative and Highly Automated Driving (CHAD) Project sought to develop, disseminate, and evaluate messages intended to raise public awareness of Cooperative and Automated Vehicles (CAVs), as well as increase public acceptance of and trust in the technology. WP4 comprised three main components: (1) a literature review; (2) the design, concept testing, and evaluation of messages; and (3) evaluation of public attitudes towards, and intentions to use, CAVs following involvement in and exposure to a CAV demonstration and the messaging. These components corresponded with a series of tasks and studies as depicted in Figure 1 and which represent the overall WP4 project.

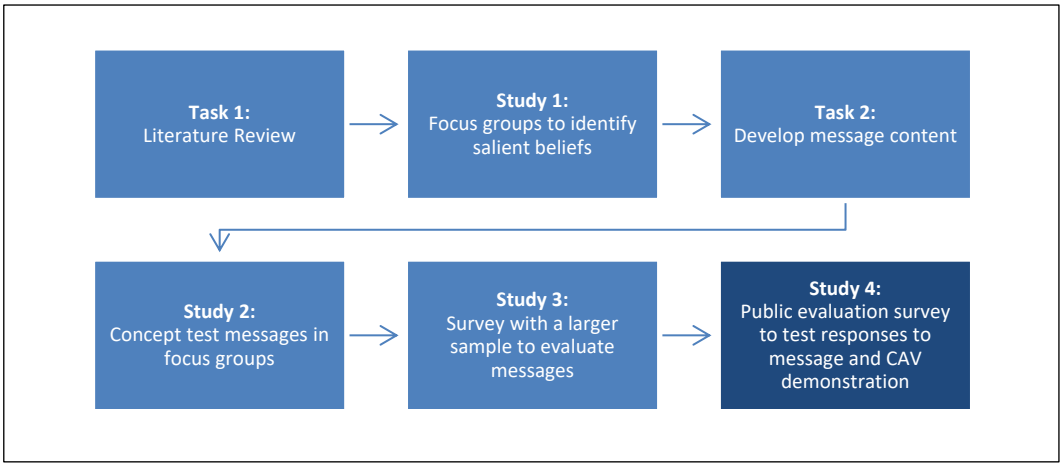

Figure 1. Tasks and studies comprising the WP4 project.

These tasks and studies are outlined in a series of unpublished reports prepared for the Department of Transport and Main Roads (TMR) including:

- *Lewis, I., Keane, R., & Kaye, S-A. (December 2018). WP4: Literature Review.* **[Task 1]**
- *Lewis, I., Nandavar, S., Kaye, S-A., Briant, O., & Keane, R. (September 2019). WP4: Study 1 Focus group findings (Belief elicitation).* **[Study 1]**
- *Nandavar, S., Briant, O., Neary, A., Kaye, S-A., & Lewis, I. (March 2020). WP4: Study 2 Focus group findings (Concept testing).* **[Study 2]**
- *Nandavar, S., Ho, B., Kaye, S-A., & Lewis, I. (September 2020). WP4: Study 3 Online survey evaluating messages.* **[Study 3]**
- *Nandavar, S., Lewis, I., & Kaye, S-A. (November 2021). WP4: Study 4 Public Evaluation Draft Final Report (including static demonstration only).* **[Study 4]**
- *Lewis, I., Nandavar, S., Kaye, S-A., & McDonald, M. (August 2022). WP4: Study 4 Public Evaluation Final Report (including static and dynamic demonstrations).* **[Study 4]**

This report summarises the aforementioned series of studies.

1.2 CONCEPTUAL UNDERPINNING OF MESSAGE DEVELOPMENT AND EVALUATION

The development of message content and the subsequent concept testing and evaluation studies as shown within Figure 1 were informed by the conceptual underpinning of WP4, the Step approach to Message Design and Testing (SatMDT; Lewis, Watson, & White, 2016) (see **Error! Reference source not found.**).

Figure 2. The Step approach to Message Design and Testing (SatMDT; Lewis et al., 2016).

The SatMDT framework incorporates principles derived from social psychological theories of behaviour prediction, attitude-behaviour relations, and persuasion. As **Error! Reference source not found.** shows, the S atMDT comprises four steps: (1) getting to know the audience, (2) development of message content, (3) concept testing, and (4) final message evaluation. The theoretical models that inform the SatMDT include the Theory of Planned Behaviour (TPB; Ajzen, 1991), The Elaboration Likelihood Model (Petty and Cacioppo, 1986), the Extended Parallel Process Model (EPPM; Witte, 1992), and Social Learning Theory (Bandura, 1969). Now well-established as a robust theoretical framework, the SatMDT has underpinned the development and/or evaluation of an array of messaging relating to various road user behaviours and road safety issues including connected vehicle technology (Elrose, Lewis, Hassan, and Murray, 2022) as well as messages delivered via various media types (see Lewis, Watson, White, & Nandavar, 2021, for a review of the SatMDT's application).

Each study within WP4 was devised in accordance with the steps of the SatMDT (Figure 2):

- Step 1 (Pre-existing individual characteristics): Study 1, which involved conducting focus groups in Brisbane and Toowoomba to elicit individuals' salient behavioural, normative, and control beliefs regarding Level 4 and 5 CAVs.
- Step 2 (Message-related characteristics): Study 2, which involved the development of messaging concepts and the conduct of focus groups in Brisbane to pilot the messaging.
- Step 3 (Individual responses): Study 3, which involved online surveys to test effectiveness of messaging with a larger sample (than that used in Study 2) of Queensland drivers.
- Step 4 (Message outcomes): Study 4, which involved an evaluation of the messaging at two public demonstrations of the CHAD project's Level 4 electric CAV prototype, "ZOE2", on the Gold Coast (static demonstration) and in Bundaberg (dynamic demonstration).

2 SUMMARY OF WP4 STUDIES

2.1 STUDY 1: BELIEF ELICITATION

2.1.1 AIMS

Study 1 involved a qualitative, in-depth investigation surrounding public perceptions of CAVs with participants residing in urban (i.e., Brisbane) and regional (i.e., Toowoomba) areas of Queensland. Consistent with Step 1 of the Step approach to Message Design and Testing (SatMDT; Lewis et al., 2016) and the Theory of Planned Behaviour (TPB; Ajzen, 1991), this study elicited individuals' salient behavioural (i.e. perceived advantages and disadvantages), normative (i.e., perceived people who would approve or disapprove of an individual's use of such vehicles), and control (the perceived facilitators and barriers to use) beliefs regarding the use of Level 4 and 5 CAVs. Responses regarding Level 4 private CAVs as well as Level 5 private and shared (e.g., shuttle) CAVs were explored. In addition, insights were gained as to individuals' preferences regarding message mediums for finding out more information about CAVs.

2.1.2 METHOD

A qualitative study consisting of 11 focus groups and a total of 43 individuals (18 males, 25 females) who were licensed drivers. Six focus groups were conducted in Brisbane (N = 27) and five focus groups were conducted in Toowoomba (N = 16) as the metropolitan and regional locations, respectively. Group facilitators used a semi-structured interview schedule, with the groups running for approximately 40 minutes to 1.5 hours.

2.1.3 KEY FINDINGS

The findings suggested that there were not any substantial differences between the responses provided by participants living in regional or metropolitan areas in Queensland. In addition, responses did not substantially differ based on participants' age or gender. Table 1 presents the key findings from the focus groups as per the three salient beliefs investigated in this research: behavioural, normative and control beliefs. For the preferred messaging options to find out more about CAVs, options included increasing exposure to such vehicles through test drives, free trials, and demonstrations, as well as information provided from trusted, non-biased sources (e.g., TMR/Government), and messaging via broadcast (TV, radio) and online media (e.g., YouTube, Facebook).

		Level 4 CAV (Private)	Level 5 CAV (Private)	Level 5 CAV (Shared)
Behavioural beliefs	**Advantages**	• increased safety • convenience for drivers with mobility issues or long commutes	• increased trust in the safety of the technology • reduced traffic congestion and fuel efficiency	• assisting drivers with mobility issues • potentially low vehicle/transport costs
	Disadvantages	• liability • driver complacency	• potential ethical dilemmas • lack of vehicle control	• personal safety issues • limited usefulness for long distance drives

Normative beliefs	**Approve**	• younger drivers	• younger drivers	• environmentally conscious individuals
	Disapprove	• car enthusiasts • older drivers	• older drivers • car enthusiasts	• taxi industry • car enthusiasts
Control beliefs	**Facilitators**	• affordability • rigorous testing and demonstrations/test drives	• increased safety • affordability	• affordability • feelings of safety
	Barriers	• safety or trust issues in technology • whether current infrastructure would support its use	• perceived lack of control • expensive costs	• vehicle speed/distance • security and privacy issues.

Table 1. Key findings from focus groups

2.2 STUDY 2: CONCEPT TESTING

2.2.1 AIMS

Study 2 involved qualitative, in-depth piloting of potential message concepts related to Level 4 CAVs from members of the public residing in Brisbane, Queensland. Consistent with the SatMDT, this study elicited individuals' responses to six message concepts developed in consultation with TMR. This feedback was provided in terms of participants' thoughts and feelings regarding different aspects of the message concepts (e.g., target audience, main message, etc.), the persuasiveness of these concepts for them personally and for others in general, and further suggestions in terms of changes that could be made to these concepts and/or aspects that could be kept the same. Feedback was also sought regarding the potential tagline ("*Innovating today for a safer tomorrow*") being used in the message concepts, along with their overall thoughts on the use of animated graphics versus real images in the campaign materials.

2.2.2 METHOD

Six focus groups were undertaken, comprising 29 individuals (15 males, 14 females) who were licensed drivers. A semi-structured interview schedule guided discussion, with the groups running for approximately 75 to 90 minutes. Participants were also asked to complete brief self-report surveys after each concept was presented prior to engaging in group discussion (to garner individuals' responses to messaging first and prior to the discussion with the group). Group composition was based on age and gender, with groups comprising four to five participants. To control for order and/or fatigue effects, the facilitator changed the order of the message concepts presented to participants in each focus group.

2.2.3 KEY FINDINGS

Overall, the findings suggested that not one message was rated by participants as the most preferred of the six message concepts tested. Participants seemed to like different aspects of each message concept, and there was not an overall best or worst concept. That being said, there were potential revisions that could be made to each concept based on participant feedback in this study. First, out of the two options for Message Concept 1, most participants preferred Option A over Option B, indicating that Option A should be used in the next phase of the study. However, showing a driver fall asleep behind the wheel was raised as a concern among some participants and would, on a policy level, have further implications that would need to be considered going forward as to the depiction of appropriate activities to engage in when travelling in CAVs. Along similar lines, it was noted that Message Concept 3 may need to be revised to ensure consistency with current policy, given that showing a young person sketching/drawing while driving reflects distracted driving. Additionally, it was thought that Message Concept 2 could be revised to make it clearer that the focus of this message was on Level 4 CAVs, and Message Concept 5 would benefit from including more information about the vehicle as well. Finally, Message Concept 4 was found to be too technical and, as such, could be used as a source of information rather than a message concept in and of itself. Finally, generally speaking, participants were of the view that it would be beneficial to replace the word "innovating" with "working" in the tagline that will be used in the message concepts ("*Innovating today for a safer tomorrow*"), and to use real images instead of animated graphics in campaign materials.

2.3 STUDY 3: ASSESSING EFFECTIVENESS OF MESSAGING

2.3.1 AIMS

Consistent with the SatMDT, Study 3 built upon Study 2 and involved assessing the effectiveness of six message concepts (relative to a control condition who was not shown any messages) in a larger sample of Queensland drivers (i.e., larger than the number of participants involved in Study 2's focus groups). These messages were developed in consultation with TMR. Two of the six messages featured a main character that related to each of the following intended target demographics: (a) older adults, (b) younger adults, and (c) professionals. Two concepts were designed for each demographic so as to emphasise either the safety or mobility benefits of Level 4 high CAVs.

2.3.2 METHOD

Participants (N = 432) were recruited via Farron Research in July 2020 and were aged between 18-80 years (M_{age} = 39.14, SD = 14.64), 57.6% female. Participants were randomised into 1 of 7 conditions (to view one of the six messages, or to not view a message and thus were assigned to the control group) and completed an online self-report survey which was hosted in Qualtrics. The survey comprised demographic items (e.g., age and gender) as well as items relating to participants responses towards the message concepts including direct measures of effectiveness (e.g., perceived effectiveness and extent of message rejection) and indirect measures of effectiveness (i.e., attitudes, subjective norms, groups norms, descriptive norms, perceived behavioural control [PBC], severity, susceptibility, and intentions as they relate to use of Level 4 CAVs and CAVS in general), and participants' perceptions on who should be responsible to deliver information regarding CAVs. On average, participants completed the survey within 15-20 minutes.

2.3.3 KEY FINDINGS

The findings suggested that there were not any substantial differences between the six message concepts. All six concepts were viewed as having a slightly stronger emphasis on mobility over safety benefits. Further, the mean ratings suggested that all concepts were perceived by the overall sample as somewhat effective, and participants rated that it was unlikely that they would reject any of the concepts (i.e., change channels or close the web browser or ignore the advertisement). The Theory of Planned Behaviour (TPB) variables of attitudes, subjective norm, and perceived behavioural control (PBC) and the Extended Parallel Process Model (EPPM) variables of severity and susceptibility predicted between 59-79% of variance in intentions to use a Level 4 CAV in the future, after viewing a message concept. In other words, key factors influencing intentions to use such vehicles in the future could be identified and provided some insight into the manner in which the messages may have been influencing individuals' intentions. Normative influences played an important role in the prediction of intentions to use CAVs in the future, highlighting the influence that important others may have in determining ones' future use of CAVs.

2.4 STUDY 4: PUBLIC EVALUATION SURVEY AT DEMONSTRATIONS

2.4.1 AIMS

Study 4 comprised the public evaluation survey which was conducted at two demonstrations of the Level 4 CAV, "ZOE2". One demonstration was static whereby the vehicle was stationary, and this display occurred at the Gold Coast show in August 2021. The second demonstration was dynamic and involved opportunity for the public to travel (as a passenger) in a drive within "ZOE2". This display occurred in Bundaberg in June 2022. The survey sought to examine not only what attendees thought of the demonstration but, also their responses to the messaging devised specifically to raise awareness about CAVs. Surveys from both demonstrations comprised responses from intervention participants who attended a demonstration and who saw the message as well as a control group of participants who did not either attend a demonstration or receive the messaging. The message evaluated in the survey was informed by findings from the previous studies within WP4 and devised in accordance with the conceptual underpinning of the program of research, the SatMDT (Lewis et al., 2016).

2.4.2 METHOD

Regarding the static demonstration, a total of 180 participants aged between 19-83 years (M_{age} = 46.57, SD = 16.88) completed the online survey. Of these participants, 84 were recruited, and completed the survey, at the demonstration and, as part of the survey, viewed a message (i.e., intervention group); while 96 participants were recruited through paid Facebook advertising, completed the survey at a place of convenience to them, and were not shown a message as part of their survey (i.e., control group). Regarding the dynamic demonstrations, a total of 206 participants aged between 18-87 years (M_{age} = 56.14, SD = 14.74) completed the online survey. A total of 118 participants attended the demonstration and completed the survey (i.e., intervention group). A total of 88 control group participants were recruited via various promotional efforts (e.g., paid Facebook advertising), completed the survey at a place of convenience to them, and were not shown a message as part of their survey (i.e., control group).

2.4.3 RESULTS

This study found that there were positive effects of messaging and public demonstrations in helping to raise public awareness and acceptance of CAVs, both in general as well as regarding Level 4 CAVs like "ZOE2" specifically. Key findings from this study included:

- Across various measures of effectiveness, the messaging and the demonstrations (both static and dynamic) were well-received by the public.
- The intervention group participants in both demonstrations reported improved knowledge about AVs, as well as positive increases in acceptance measures comprising attitudes towards, intentions and willingness to use, as well as trust in, AVs both in general and specific levels of AV like "ZOE2".
- Relative to control group participants, intervention group participants at both demonstrations reported significantly higher scores on all the acceptance measures. It is acknowledged, however, that pre-existing differences in acceptance measures were found between intervention and control group participants highlighting that there is a self-selection bias in those who choose to partake in a demonstration about AVs (and associated research).
- Intervention group participants from the dynamic demonstration reported significantly higher scores in relation to how effective they found the messaging to be compared with intervention

group participants from the static demonstration. The former group also rated the perceived helpfulness and usefulness of the dynamic demonstration in increasing knowledge about AVs (generally as well as in relation to specific levels of AV like ZOE2) significantly higher than the intervention participants from the static demonstration. However, inspection of the mean scores revealed that in all instances, although significantly different, results indicated that scores were still high on these measures irrespective of the demonstration type.

- The results found 96.4% and 98.3% of intervention participants from the static and dynamic demonstrations, respectively, reported they would recommend others to attend the demonstration they had attended to increase their knowledge about AVs.

3 OVERALL IMPLICATIONS OF WP4

In accordance with the SatMDT, the formative studies in WP4 (i.e., Studies 1 and 2) identified potential barriers and facilitators to the public's intended future use of automated vehicle technology. These findings subsequently guided the development of a range of message concepts that were tested in Study 3. The final study, Study 4, found that there are positive effects of messaging and public demonstrations in helping to raise awareness and acceptance of CAVs, both in general as well as regarding Level 4 CAVs like "ZOE2" specifically. Across various measures of effectiveness, when comparing intervention groups' pre- versus post-viewing of the messaging responses as well as differences between intervention and control groups, the findings highlighted that the message and the demonstrations, both static and dynamic, were well-received by the public. This section outlines the implications of WP4 of the CHAD project:

- While the dynamic demonstration featured members of the public travelling as passengers within "ZOE2" when operating in automated mode (and thus necessitated additional staffing and resourcing requirements to conduct relative to the static demonstration), the findings revealed similar positive outcomes irrespective of whether participants attended the static or dynamic demonstration. We contend that this finding does not imply that static demonstrations should be the principal approach going forward but, rather, if for whatever reason a dynamic demonstration is not feasible, a static demonstration could be conducted as an effective and viable alternative as part of TMR's on-going public awareness raising efforts.
- Going forward, at least for the foreseeable future, both static and dynamic demonstrations will likely represent important components of public awareness raising efforts given each approach offers its relative strengths. For instance, static demonstrations will likely offer the means to expose more people more readily across different regions across Queensland to the technology relative to dynamic demonstrations. In contrast, dynamic demonstrations enable first-hand experience of what it is like to travel within a CAV in automated mode. Both aspects are important to public awareness raising efforts. Over time, however, the relative effectiveness of the different demonstrations may be expected to vary as more members of the public will have seen ZOE2. If an individual had not partaken in a dynamic demonstration previously, it is reasonable to assume they would be keen to travel in the vehicle as direct, on-road experience of the automated technology. This aspect would need to be monitored to determine when the critical mass of public exposure to the vehicle may have been achieved.
- Regarding the messaging, while the "*Steps and Levels*" message tested in the current program of research was associated with positive effects and could be expected to do so also for the foreseeable future, as technology continues to evolve and public awareness and knowledge increases, there will be need for new and innovative messaging to ensure that the message remains current and engaging. Again, this aspect would need to be monitored and message effectiveness assessed to address wear-out effects of messaging and ensure on-going public engagement.
- The findings also provide support for the value of applying the conceptual framework, the SatMDT, in developing and evaluating awareness raising messaging. Messaging that is targeted at specific beliefs regarding CAVs will help to ensure its effectiveness.

In conclusion, representing a world-first, the WP4 of the CHAD project comprised an innovative and significant program of research. The findings have confirmed the potential benefits of messaging as well as public demonstrations, both static and dynamic, in TMR's awareness raising efforts regarding cooperative and highly automated vehicles and the work the Department is undertaking in this space in readiness for the future.

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