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Factors Influencing Trust in Advanced Driver Assistance Systems for Current Users

Chelsea A. DeGuzman[1] and Birsen Donmez[1]

Abstract

Understanding the factors influencing trust in advanced driver assistance systems (ADAS) may help inform training and education to support appropriate use. We surveyed 369 drivers with experience using both adaptive cruise control (ACC) and lane keeping assist (LKA). The survey included questions to assess trust in ADAS, along with objective knowledge about ADAS limitations, self-reported understanding of ADAS, familiarity with technology, propensity to trust technology, and demographics. Regression results showed that self-reported understanding, but not objective knowledge, predicted trust in ADAS. Self-reported understanding was not correlated with objective knowledge; overall, participants were not aware of many of the system limitations included in the survey. Propensity to trust technology was also a significant predictor of trust. Training/educational materials could be designed to inform drivers of potential gaps in their understanding and adjust expectations of ADAS to support appropriate trust for those with a high propensity to trust technology.

Keywords

driving automation, SAE Level 2 driving automation

Advanced driver assistance systems (ADAS) available to consumers can assist drivers with maintaining the vehicle's speed and lane position, through systems like adaptive cruise control (ACC) and lane keeping assist (LKA), respectively. Although drivers are required to continue monitoring the roadway while ADAS are engaged (SAE International, 2021), several collisions have occurred while drivers have been using ADAS, at least partially because of a lack of attention to the roadway (e.g., National Transportation Safety Board, 2018, 2020). This misuse of ADAS highlights the importance of research into drivers' knowledge and trust of ADAS, as knowledge and trust have been shown to influence whether drivers use ADAS appropriately (e.g., Bianchi Piccinini, Rodrigues, Leitão, & Simões, 2015; Victor et al., 2018).

We surveyed 369 drivers with experience using both ACC and LKA to investigate the factors that influence trust in these ADAS. This study was a follow-up study to expand on our previous survey of North American drivers (DeGuzman & Donmez, 2021) with a larger sample of Canadian drivers who have experience using ACC and LKA. The survey included questions to assess trust in ADAS, along with questions related to the following factors that may influence trust in ADAS: objective knowledge about ADAS limitations (i.e., situations where the ADAS may have difficulty maintaining control of the vehicle and/or avoiding a collision), self-reported understanding of ADAS (i.e., how correct and complete drivers thought their knowledge of ADAS was), number of methods they had previously used to learn about ADAS, frequency of ACC and LKA use, familiarity with technology, propensity to trust technology, and demographics (highest level of education, age, household income).

As an initial inspection of participants' knowledge of ADAS limitations, we calculated the percent of system limitations participants correctly identified. In addition, we calculated sensitivity (d') and bias (c, criterion location) based on signal detection theory (e.g., Macmillan & Creelman, 2005). A signal was a situation that was a known ADAS limitation. Thus, sensitivity reflected participants' ability to identify situations where ADAS may not work, independent of response bias. Response bias reflected participants inclination towards a certain response. A positive bias would indicate that participants had an inclination to report that ADAS would work in a given situation, regardless of the situation, whereas a negative bias would indicate an inclination to report that ADAS would not work.

[1]Department of Mechanical and Industrial Engineering, University of Toronto, Toronto, ON, Canada

Corresponding Author:
Chelsea A. DeGuzman, Department of Mechanical and Industrial Engineering, University of Toronto, 5 King's College Rd, Toronto, ON M5S 3G8, Canada.
Email: deguzman@mie.utoronto.ca

On average, participants identified less than half of the nine limitations among the knowledge items ($M = 42.0\%$, $SD = 24.1\%$). Despite poor performance on the objective knowledge measure, participants rated their own understanding of ADAS highly ($M = 5.6$ on a 7-point scale, $SD = 1.0$). Self-reported understanding was not significantly correlated with percent of limitations correctly identified or sensitivity. Based on sensitivity scores (average $d' = 1.2$, $SD = 1.7$), participants performed above chance at identifying the limitations among all the items in the knowledge questions ($d' = 0$ indicates chance performance; Macmillan & Creelman, 2005). However, participants also had a positive response bias ($M = 0.9$, $SD = 0.9$), indicating that they had an inclination to respond that ADAS would work in a given situation regardless of whether it was a limitation or not.

Overall, respondents tended to trust ACC and LKA ($M = 4.0$ on a 5-point scale, $SD = 0.6$) and had a relatively high propensity to trust technology in general ($M = 3.9$ on a 5-point scale, $SD = 0.6$). Regression results showed that self-reported understanding of ADAS, $t = 5.47$, $p < .001$, and propensity to trust technology, $t = 10.67$, $p < .001$, were the only significant predictors of trust in ADAS. Higher self-reported understanding of ADAS and higher propensity to trust technology were associated with higher trust in ADAS.

Our findings suggest that drivers' trust in ADAS may be based on overestimations of their own knowledge, given that self-reported understanding predicted trust but was not correlated with objective knowledge of ADAS limitations and that overall, participants did not have a good awareness of ADAS limitations. These findings highlight the importance of training and education to increase drivers' self-awareness of gaps in their understanding of the technology. In addition, training could be tailored depending on drivers' propensity to trust technology. For example, drivers who have a high existing propensity to trust technology may need more caution on the risks of overrelying on ADAS.

ORCID iD

Chelsea A. DeGuzman https://orcid.org/0000-0001-8248-2696

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