

R&D in Human Factors for Safe Automated Driving: Past Efforts and Future Challenges

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Public Understanding and Perception of Automated Vehicles, United States, 2018 – 2020

April 2022

Automated vehicle (AV) technologies have been gaining much attention owing to a variety of potential benefits including reduction of congestion and emissions, and mobility and safety improvements. Despite a large volume of studies (e.g., Soteropoulos et al., 2019; Milakis et al., 2018; Childress et al., 2015), forecasting how AV technologies will shape the future and landscape of the transportation industry and built environment remains a challenge, largely due to uncertainties about user behaviors related to AV adoption (Rahimi et al., 2020).

Many studies have reported significant heterogeneity in individual's attitudes, perceptions, and adoption behaviors towards AV technologies (Shabanpour et al., 2018; Asmussen et al., 2020; Zhou et al., 2020). Studies have generally shown that males, high-income individuals, or those who attained high education levels had higher AV preference than their counterparts (Hudson et al., 2019; Potoglou et al., 2020). Interestingly, there has been no consensus in the association between age and AV adoption; some studies indicated younger people had lower AV preference than older people (Abraham et al., 2018), while others suggested the opposite (Spurlock et al., 2019). Additionally, many studies have found that other sociodemographic characteristics such as employment and daily vehicle miles traveled (Nazari et al., 2018), as well as other inherent individual characteristics (e.g., environmental concerns, technology knowledge, and perceived AV benefits/concerns) were significantly associated with AV adoption (Ward et al., 2017; Charness et al., 2018; Nazari et al., 2018).

In addition to the individual attributes discussed above, the onset of the COVID-19 pandemic in 2020 may have affected public perceptions and attitudes towards AV technologies to some degree. For example, a study by Othman (2021) indicated the pandemic led to increasing

conversations around AVs, and as a result, the level of public awareness and interests about AVs also increased.

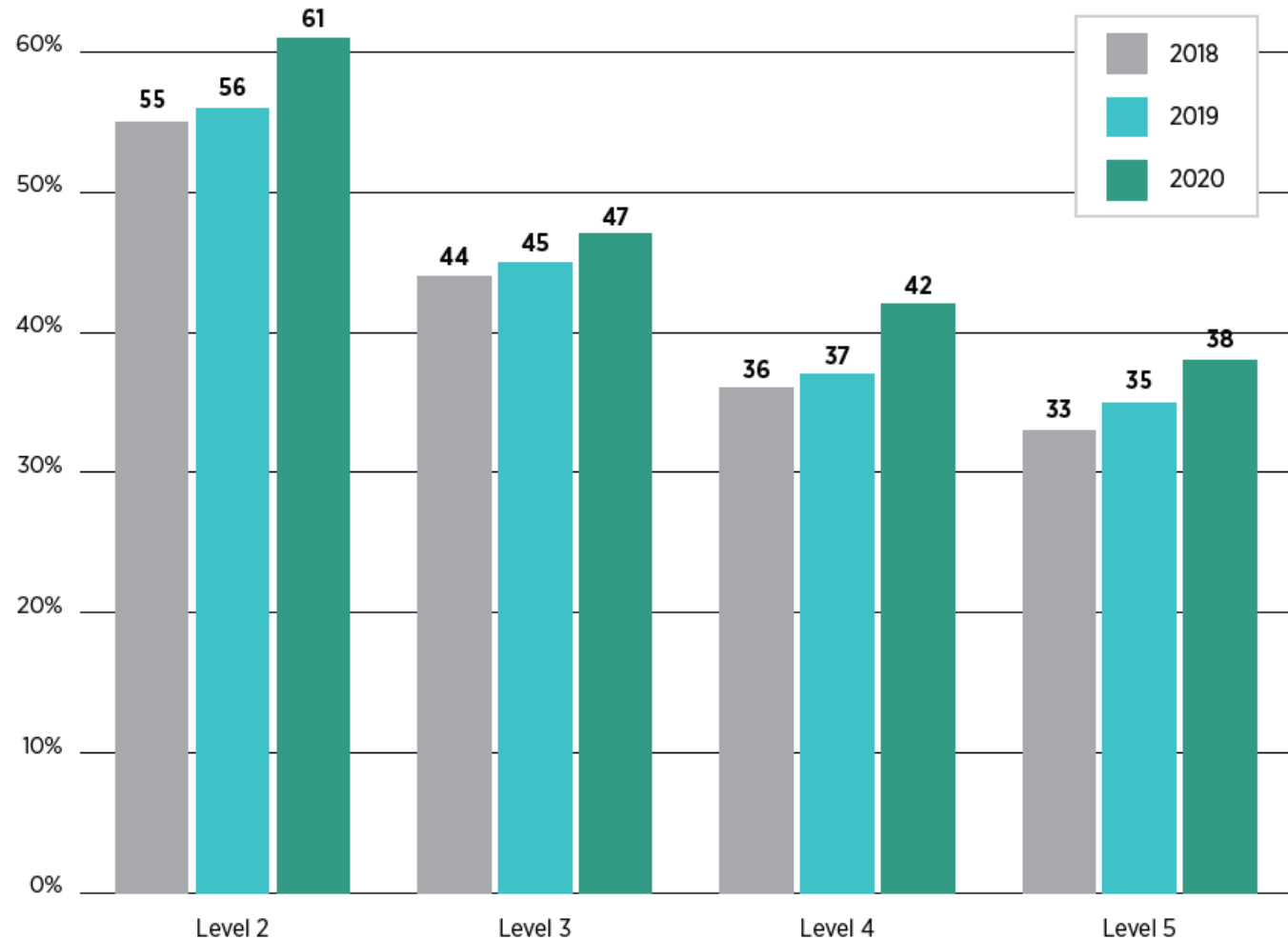
Since 2018, AAA Foundation for Traffic Safety has surveyed people's understanding of and expectations about AVs annually. This research brief, like previous briefs (Kim et al., 2019; Kim & Kelley-Baker, 2021), continues examining public trust in, adoption of, and concerns about different levels of AVs by looking into the dynamics of these measures over time (2018 to 2020), with particular attention to 2020 when the COVID-19 pandemic considerably changed people's lifestyles, travel routines, and perceptions about public health. The results show that overall, significant changes were found mostly pertaining to lower-level AV (e.g., Levels 2 or 3 AVs). Specifically, in 2020, public trust for Level 2 in preventing crashes significantly increased compared with 2018 and 2019. Also, for Levels 2 and 3, responses in 2020 suggested that people were less concerned about many potential issues with AVs as compared with 2018 and 2019. Further, about half of respondents still preferred either no driving automation (Level 0), Level 1, or Level 2 AVs as their own vehicles in the next couple of years, even if cost was no barrier. In terms of specific unsafe driving behaviors or challenging driving situations, people's expectations for lower-level AVs to help prevent crashes decreased over time, while their expectation for higher-level AVs remained nearly constant.

Results show that changes in public perception and attitudes toward AVs were marginal over the study period, even amid the pandemic. This, therefore, reiterates the importance of continuous efforts for raising public awareness regarding benefits and potential of widespread AV implementation along with education and training on capabilities and limitations specific to each AV level.

- National online survey carried out annually
- >3,000 respondents each year, representation of U.S. household population
- Results summarized propensities of public perceptions and attitudes, 2018-2020 data

- Trust in AV to prevent crashes increased annually, across all AV levels
- In general, people tend to trust Levels 2 and 3 more vs. Levels 4 and 5 in crash prevention

Trust in Crash Prevention of Each AV Level





MAY 2020

The Impact of Driver's Mental Models of Advanced Vehicle Technologies on Safety and Performance

John Gaspar, PhD
Cher Carney, MS
Emily Shull
National Advanced Driving Simulator
The University of Iowa

William J. Horrey, PhD
AAA Foundation for Traffic Safety



MARCH 2022

An Examination of How Longer-Term Exposure and User Experiences Affect Drivers' Mental Models of ADAS Technology

Cher Carney, MS
John Gaspar, Ph.D.
Cheryl Roe, BS
University of Iowa
William J. Horrey, Ph.D.
AAA Foundation for Traffic Safety



- Assess drivers' **mental models** on ADAS → **knowledge & understanding of technology**
- Simulator study examined performance in critical “edge case” scenarios with ACC
- Poor understanding resulted in:
 - **Less likely to deactivate ACC** in some scenarios
 - **Slower ACC deactivation time**
- Training should focus on understanding technology limitations → **important for appropriate responses in edge cases**

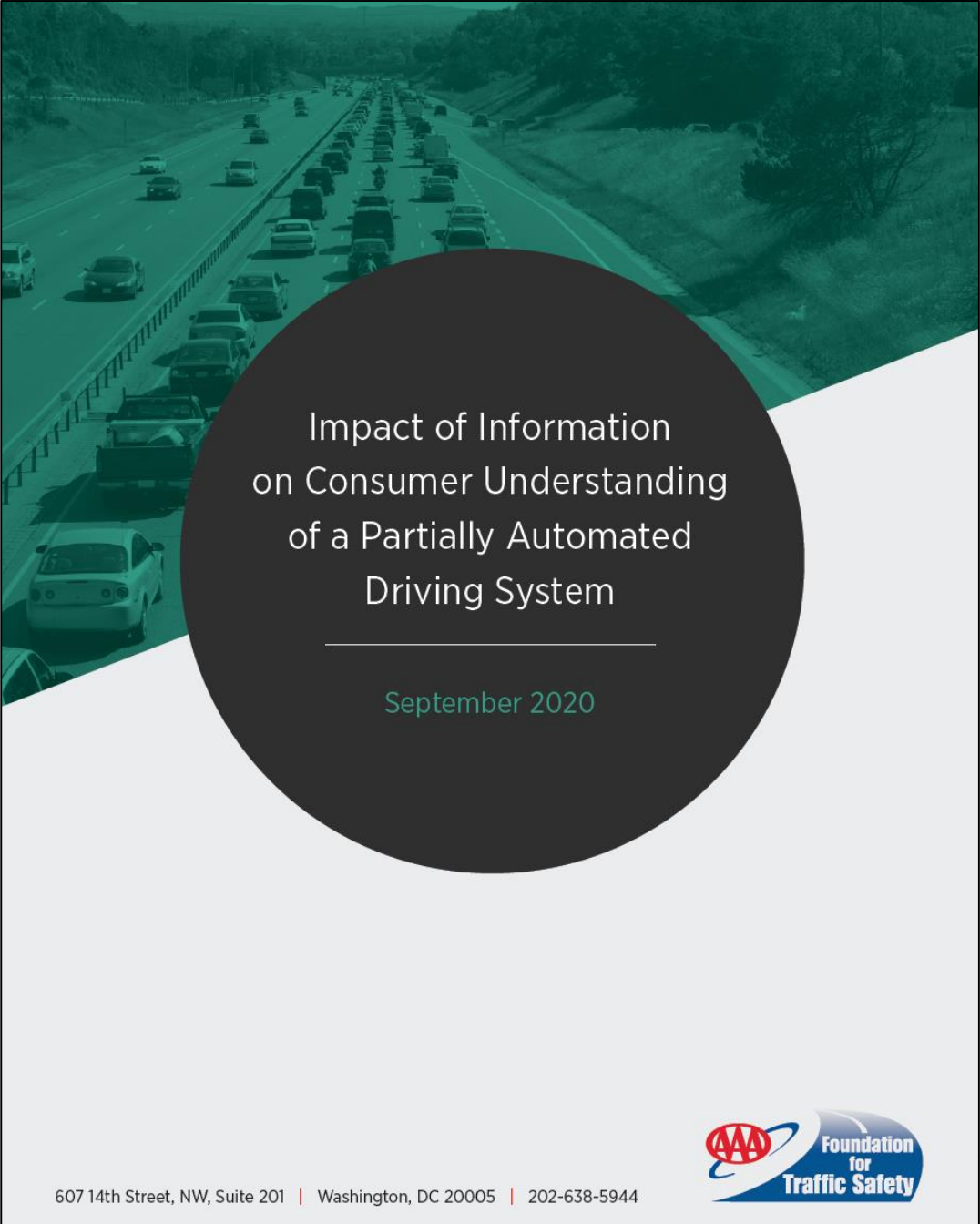
Subject with a Strong Mental Model on How ACC Works



Subject with a Weak Mental Model on How ACC Works



Explore how information given to drivers about a L2 system influences expectations & how they interact with it

The image shows the cover of a report. The background is a photograph of a multi-lane highway with many cars, overlaid with a semi-transparent teal filter. A large dark grey circle is centered on the right side of the cover, containing the title and date. At the bottom right, there are logos for AAA and the Foundation for Traffic Safety (FTS).

Impact of Information
on Consumer Understanding
of a Partially Automated
Driving System

September 2020

- Participants drove 31 miles on a limited-access highway with a 60 MPH posted speed limit
- Participants received information about a L2 driving assistance system with two versions of emphasis:
 - “AutonoDrive” – system capabilities & driver convenience
 - “DriveAssist” – system limitations & driver responsibility

- Drivers who were trained with **AutonoDrive** information:
 - **More likely** to believe that system could detect and take action to avoid other vehicles
 - **Higher likelihood** to engage in distracting/risky behaviors while using the system

AAA Foundation Forum: *Impact of Vehicle Technologies and Automation on Users*



2017 Forum on the Impact of Vehicle Technologies and Automation on Users: A Summary Report

January 2018

607 14th Street, NW, Suite 201 | Washington, DC 20005 | 202-638-5944



2018 Forum on the Impact of Vehicle Technologies and Automation on Vulnerable Road Users and Driver Behavior and Performance: A Summary Report

January 2019

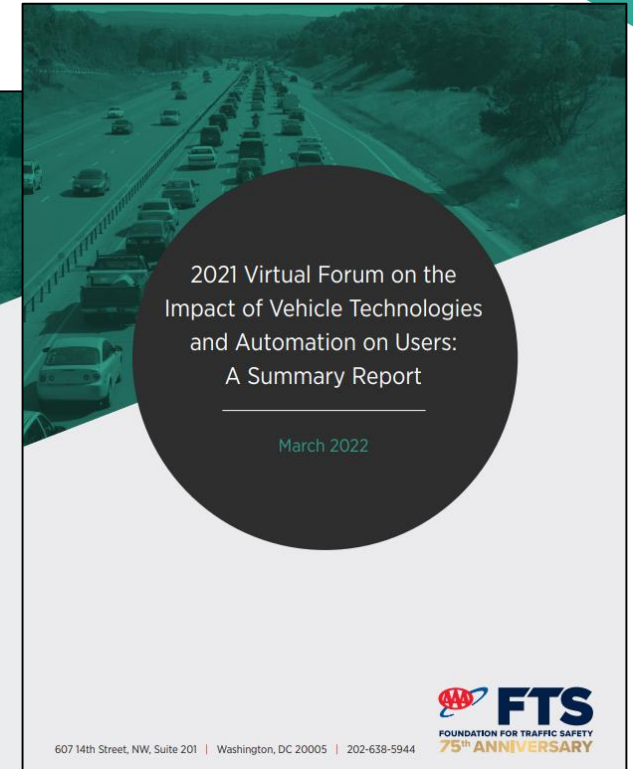
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2019 Forum on the Impact of Vehicle Technologies and Automation on Users – Design and Safety Implications: A Summary Report

April 2020

607 14th Street, NW, Suite 201 | Washington, DC 20005 | 202-638-5944



2021 Virtual Forum on the Impact of Vehicle Technologies and Automation on Users: A Summary Report

March 2022

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75th ANNIVERSARY

Forthcoming 2022 Forum report,
<https://aaafoundation.org/>

Public Acceptance & Driver-Related Issues

- Improve clarity surrounding technology for public consumption
- Determine what types of information resonate best with consumers in terms of acceptance, adoption and use
- Alignment of stakeholder expectations
- Understand perspectives and needs of different users

Training/Education & System Understanding

- Effective ways of conveying information about automated systems, including capabilities and limitations
- Tailor consumer education to specific vehicle/technology and needs of the individual user group

System & HMI Design

- Effective approaches to promote accurate mode awareness for drivers and means to exit/change modes
- Incorporate data concerning driver state into allowable functions
- Elements to include in HMI to promote system transparency, comprehension and ease of learning
- Methods to keep drivers engaged while using automated systems



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