AAA FTS FOUNDATION FOR TRAFFIC SAFETY

RESEARCH BRIEF

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.

Methodology

This study used data collected from the Traffic Safety Culture Index, which is a national online survey carried out by the AAA Foundation for Traffic Safety annually (AAA Foundation for Traffic Safety, 2021). In 2018, a set of questions inquiring about public understanding, expectations, and concerns across different levels of AVs (following SAE J3016) was added. Further details about the development of this questionnaire are available in a previous publication (Kim et al., 2019). Since then, the survey was administered in English and Spanish to an online research panel whose participants were recruited based on standard probability-based random digit dial and address-based sampling methods. Data were collected annually from U.S. residents ages 16 or older who are representative of the U.S. household population. Weights applied to the data accounted for the probabilities of being selected as online panelists and as survey respondents, as well as of non-response at both recruitment stages. Further, weights were adjusted to align respondents' characteristics to those of the U.S. population.

Table 1 summarizes the total number of survey respondents (unweighted) and their composition by age group and gender. Each year more than 3,000 respondents completed the survey. Among them, nearly half were male, 5% were teens younger than 19 years, and about one in five were 65 years or older (based on weighted results).

This study conducted descriptive analyses using cross-tabulations to summarize propensities of public perceptions and attitudes, using data from 2018 through 2020 that represent the most recent year for which these data were available. Further, a logistic regression model was performed to test whether the results were significantly different across the past three years at the 0.05 significance level, after controlling for major socio-demographic variables (gender, age, race, education, income, Census region, living area [metropolitan or non-metropolitan areas]) as well as frequency of driving and primary vehicle model year. All analyses included in this study have been conducted using weighted data, and results were reported on the following topics:

- Understanding of automated vehicle levels
- Trust of automated vehicles in crash prevention
- Potential concerns about automated vehicle levels
- Perception towards effectiveness of AV technologies in preventing crashes
- Comfort of owning an automated vehicle

Table 1. Survey respondents by age and gender

Year (Survey period)	2018 (Aug.–Sept.)		2019 (Sept.–Oct.)		2020 (Oct.–Nov.)	
Statistics	*n (unweighted)*	*% (weighted)*	*n (unweighted)*	*% (weighted)*	*n (unweighted)*	*% (weighted)*
Total	3,349	100%	3,511	100%	3,760	100%
16–18	917	5%	941	5%	1,036	5%
19–24	136	8%	97	7%	143	8%
25–39	516	25%	545	26%	612	26%
40–64	1,125	43%	1,214	43%	1,233	41%
>=65	655	19%	714	19%	736	20%
Male	1,649	49%	1,767	48%	1,910	49%
Female	1,700	51%	1,744	52%	1,850	51%

Results

Understanding of automated vehicle levels

As shown in Table 2, nearly 70% of respondents reported that they had a very good or excellent understanding of different levels of automated vehicle technology, while only about 5% reported little or no knowledge of the AV levels. These values were relatively consistent during the past three years.

Table 2. Self-rated understanding degree of automated vehicles levels

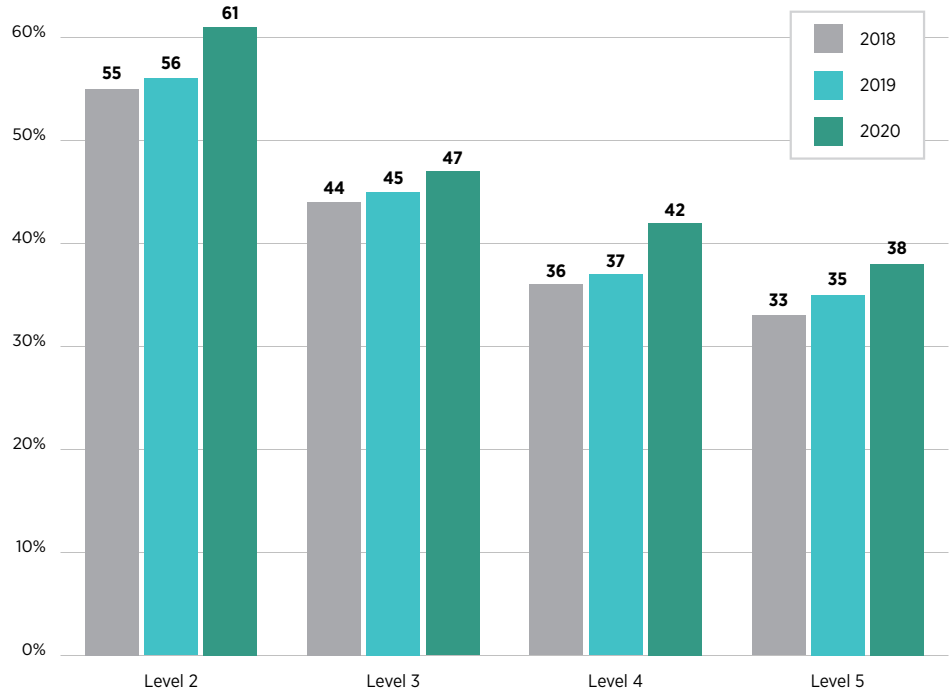
	2018	2019	2020
Excellent understanding	22%	24%	21%
Very good understanding	46%	45%	48%
Understand some things	27%	26%	27%
Don't understand much	3%	3%	3%
Don't understand anything	2%	1%	1%

Note: The results from 2018 to 2020 were not significantly different from one another.

Trust of automated vehicles in crash prevention

The proportion of respondents who trusted AVs to prevent crashes increased in the past three years, across all AV levels, although the increase was significant only between 2019 and 2020 for Level 2. In general, people tend to trust lower-level AVs (Levels 2 and 3) more than higher levels (Levels 4 and 5) in crash prevention, and this propensity was consistent over the past three years (see Figure 1).

Figure 1. People's trust (strongly or somewhat) in crash prevention of each automated vehicles level



Note: In Level 2, the results from 2018 and 2019 were significantly different from 2020 but were not significantly different from each other. For other levels, the result from each of the years was not significantly different from the others.

Potential concerns about automated vehicle levels

The proportions of respondents who were extremely or very concerned about technology malfunction and driver's over-reliance on technology decreased over the past three years across all AV levels (if applicable) (see Table 3). Specifically for Levels 2, 3, and 4, the decreases in 2020 compared with 2018 and 2019 were significant. For example, in 2020, 50% of respondents were concerned about technology malfunction for Level 2 AVs, which was significantly smaller than proportions in 2018 (61%) and 2019 (60%). Similar propensities were found regarding other concerns examined in this survey. Overall, in 2020 compared with 2018 and 2019, people tended to be less concerned about all potential AV issues examined in this study.

Table 3. Potential concerns with automated vehicles technologies (Extremely or very concerned (%))

AV Level	Level 2			Level 3			Level 4			Level 5		
Year	2018	2019	2020	2018	2019	2020	2018	2019	2020	2018	2019	2020
Technology Malfunction	61[a]	60[a]	50[b]	66[a,b]	68[a]	62[b]	71[a]	71[a]	67[b]	75	76	74
Over-Reliance	53[a]	57[a]	47[b]	62[a]	65[a]	58[b]	66[a]	67[a]	61[b]	NA	NA	NA
No Manual Driving Option	NA	NA	NA	NA	NA	NA	NA	NA	NA	71[a]	72[a]	67[b]
No/Lack of Driving Control	42[a]	44[a]	35[b]	53[a]	53[a]	47[b]	58[a,b]	60[a]	54[b]	70[a]	73[a]	68[b]
Purchase Price	56[a]	57[a]	49[b]	61[a]	66[b]	61[a]	66	68	66	72	74	74
Vehicle Hacking	50[a]	54[a]	45[b]	58[a]	60[a]	52[b]	63[a]	64[a]	59[b]	68	69	65
Data Privacy	45[a]	47[a]	38[b]	49[a]	53[b]	45[a]	52[a,b]	55[a]	49[b]	57	60	55
Distraction/Annoying*	36[a]	41[b]	33[a]	41[a]	45[b]	35[c]	49[a]	48[a]	43[b]	NA	NA	NA
Confusion on How/When to Use*	34[a]	39[b]	29[c]	43[a]	45[a]	35[b]	45[a]	48[a]	40[b]	NA	NA	NA

Note: Each year proportion with the same superscript letter denotes a non-significant difference. When the superscript letter is different, the proportions of years are significantly different from each other at a 0.05 significant level. For example, for Over-Reliance in Level 2, the results from 2018 and 2019 were significantly different from 2020 but were not significantly different from each other. Likewise, for Technology Malfunction in Level 3, the result from 2018 was not significantly different from 2019 and 2020. However, the result from 2019 was significantly different from 2020.

** Surveyed only pertaining to levels 2 to 4*

Perception towards effectiveness of AV technologies in preventing crashes in specific situations

People's perceptions regarding the effectiveness of automation in preventing crashes related to specific unsafe driving behaviors or challenging driving situations increased as the AV level increased. These propensities were consistent throughout the study period. For Levels 2 and 3, in 2020, people were more skeptical about such effectiveness compared to 2018 and 2019, while the perceptions towards higher-level AVs remained relatively constant over time.

Table 4. Perception towards effectiveness (extremely or very) of AV Technologies on crash prevention due to unsafe driving behaviors or challenging situations (%)

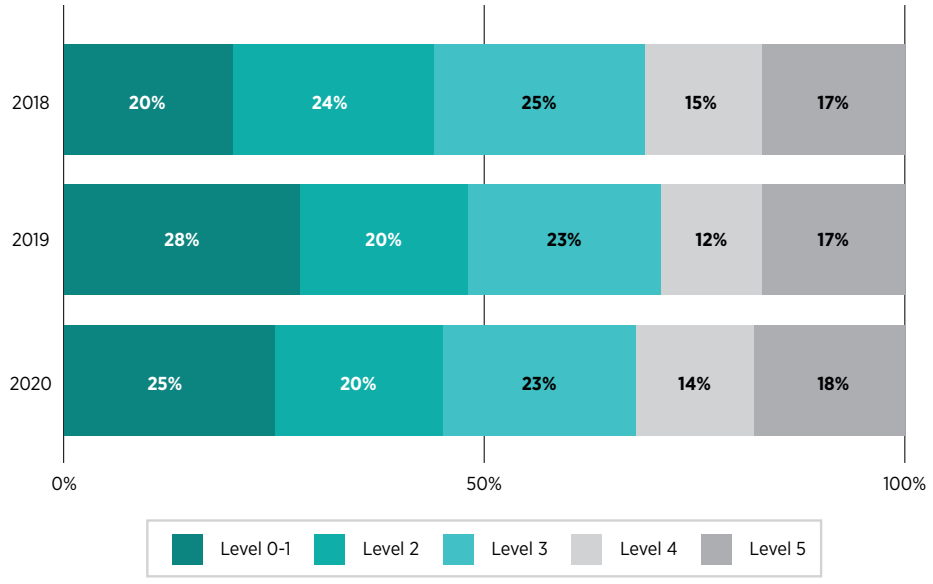
AV Level	Level 2			Level 3			Level 4			Level 5		
Year	2018	2019	2020	2018	2019	2020	2018	2019	2020	2018	2019	2020
Mobile Phone	22[a]	23[a]	17[b]	35[a]	39[a]	33[b]	50	53	52	61[a]	59[a,b]	58[b]
Speeding	26[a]	26[a]	20[b]	39[a]	42[a]	35[b]	47	49	50	56	57	57
Running Red Lights	26[a]	26[a]	22[b]	40	41	38	47	51	51	56	57	56
Driving Aggressively	26[a]	26[a]	18[b]	36[a]	38[a]	32[b]	44	48	47	56	56	56
Drowsy Driving	21[a]	22[a]	17[b]	30[a]	36[b]	31[a]	48	51	49	60	59	58
Impaired (Alcohol) Driving	19[a,b]	19[a]	15[b]	26[a]	31[b]	26[a]	47	49	47	59	59	59
Impaired (Drugs) Driving	18[a]	18[a]	13[b]	25[a]	30[b]	26[a]	46	47	46	59	59	58
Congested Traffic	27[a]	28[a]	21[b]	33[a]	37[b]	29[c]	42	45	43	55	55	55
Bad Weather	23[a]	21[a]	15[b]	25[a]	30[b]	23[a]	33	33	32	53[a]	48[b]	49[b]

Note: Each year proportion with the same superscript letter denotes a non-significant difference. When the superscript letter is different, the proportions of years are significantly different from each other at a 0.05 significant level. For example, for Mobile Phone in Level 2, the results from 2018 and 2019 were significantly different from 2020 but were not significantly different from each other. Likewise, for Impaired (Alcohol) Driving in Level 2, the result from 2018 was not significantly different from 2019 and 2020. However, the result from 2019 was significantly different from 2020.

Comfort of owning an automated vehicle

In 2019, nearly half of respondents reported preferring Levels 0, 1, or 2 to own as their vehicles within the next couple of years, even if cost were no barrier, and this proportion was slightly but significantly greater than those in 2018. The proportion, however, decreased in 2020 to be more analogous to that of 2018. Meanwhile, about one-in-five respondents indicated interests in owning Level 5 AVs, and this propensity was constant from 2018 to 2020.

Figure 2. Preferred AV levels



Note: The result from each of the years was significantly different from the others.

Discussion

Overall, people's self-reported knowledge levels about AV technologies changed little over time, but their attitudes and perceptions have become more positive and optimistic. Across all levels of AVs, people's trust in preventing crashes increased over time, although a statistically significant increase was found only for Level 2. Their concerns about potential AV-related issues (e.g., technology malfunction and vehicle hacking) tended to decrease over the study period.

It is noteworthy that in this study, people were more likely to trust Levels 2 and 3 AVs than higher-level AVs in crash prevention when the question is stated more generally. However, given a specific scenario or situation such as driving while engaging in unsafe driving behaviors (e.g., distracted or impaired driving) or in unfavorable driving conditions (e.g., inclement weather), people indicated that higher-level AVs would be more effective than lower-level AVs for crash prevention. Additionally, for lower-level AVs, public trust in general crash prevention increased over time, but decreased given a specific driving scenario/situation. These inconsistencies may be explained by the multi-faceted nature of trust. According to Lee (2020), trust mediates between human and technology from "micro interactions" such as how vehicle automation facilitates drivers to safely engage in non-driving tasks, to "macro interactions" such as how the public accepts new forms of transportation. Additionally, the level of specification or precision of wording in a question may affect people's responses as well (Rosenman et al., 2011; Choi and Pak, 2005); individuals may find it easier to put themselves in a specific situation than in a general context.

For AV adoption, there were some changes in 2019, but 2018 to 2020, about half of people constantly felt more comfortable with the prospects of owning a vehicle with no automation or lower levels of automation (Levels 1 and 2) compared with higher levels. Acharya and Humagain (2022) reported that AV adoption interest in Washington State tended to increase gradually over time (i.e., 2015 to 2019). Additionally, Long and Axsen (2022) found in their Canadian survey that for vehicles with advanced driver-assistance systems (e.g., adaptive cruise control and lane-centering steering), "latent demand" (i.e., who is interested in future usage) is higher than "realized demand" (i.e., who is currently using these technologies). Results from the current study and Long and Axsen (2022) included responses from surveys administered during the COVID-19 pandemic (mid-2020), which could have impacted the pattern of responses (although neither survey was designed to quantify the impact).

The results also indicated that people's reported knowledge remained fairly constant over time. This underscores the importance of continued efforts for education and training on benefits of AV implementation as well as capabilities and limitations specific to each AV level, to boost their acceptance and adoption. These efforts, however, should not be limited to drivers; education and training are needed for other road users (e.g., pedestrians and cyclists) as well, as recent work has revealed differences in AV perceptions, understanding, and expectations across different road users (Horrey et al., 2021). Relevant stakeholders and experts have also underscored many pressing research needs related to education and training (AAA Foundation for Traffic Safety, 2022). More work to better understand people's perceptions and expectations of emerging transportation technology and their behaviors, therefore, is needed.

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ABOUT THE AAA FOUNDATION FOR TRAFFIC SAFETY

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