



A Survey of Visually Impaired Consumers About Self-Driving Vehicles

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Abstract

This study investigated public opinion of persons who are blind or visually impaired related to user acceptance, concerns, and willingness to buy partially and fully automated vehicles; commonly referred to as self-driving vehicles. A 39-question Internet-based survey was distributed in the United States that collected 516 useable responses from persons 18 years and older who self-identified as visually impaired. Respondents generally had an optimistic view of the potential benefits of self-driving vehicles however a majority of respondents expressed concerns regarding the technology. Concerns focused on the possibility of equipment failure, vehicles getting confused by unexpected situations and vehicle interactions with pedestrians and bicycles. A majority of respondents agreed that the needs of individuals who are blind or visually impaired are being considered in the development of self-driving vehicle technology though higher education levels were associated with a decrease in a respondent's belief in this contention.

Keywords

Self-Driving Vehicles; Accessibility; Visual Impairment; Advanced Driver Assistance Systems

Introduction and Background

At present, a significant amount of consumer research is being conducted to understand consumer preferences regarding self-driving vehicle technology to ease consumer adoption. Despite wide-ranging research, it has been suggested that most self-driving vehicle technology being developed is not in fact accessible to individuals with visual impairments (National Federation of the Blind). We purport that this may be at least partially attributable to the scarcity of research that has focused specifically on the opinions and preferences of blind and visually impaired consumers. The present study was designed to contribute to the literature that is specifically focused on furthering the understanding of the opinions and concerns of consumers with visual impairments as it relates to self-driving vehicle technology and related issues.

Method

Online Survey

The present study was conducted as an online survey using the Qualtrics survey platform. The questionnaire was adapted from a public opinion survey regarding self-driving vehicles in the U.S, U.K. and Australia conducted by Schoettle and Sivak with format modifications designed to enable screen reader accessibility, scale adjustments and content modifications intended to address topics related to visual impairment. The survey addressed general opinions about self-driving vehicles, concerns, issues related to visual impairment and willingness to pay for the technology. Responses were gathered from January 4, 2017 through April 12, 2017.

Respondents

Participants were recruited through email notifications distributed by 16 state agencies for the blind and by the American Council of the Blind. Participation was restricted to individuals 18 years of age and older whom self-identified as blind or visually impaired.

Participants were entered into a drawing for a \$300 prepaid gift card as compensation. This recruitment strategy resulted in 556 replies from potential respondents with completed surveys received from 516 respondents. The final response rate of the survey was 92.8%. The margin of error at the 95% confidence level for the results is +/- 4.0%. Approximately 54% of respondents were female and approximately 45% were male. More than half of respondents were 45 years of age or older, while those in the 18-44 age range made up 33.45% of those participating in the survey. Nearly sixty percent of respondents held at least a bachelor's degree (58.92%), while fewer than 1% had less than a high school education. Those employed full-time (35.12%) exceeded the combined number of respondents who were full-time students, part-time students and those employed part-time (23.8%). More than half of respondents (55.34%) indicated that they had been blind or visually impaired all of their lives.

Results

General Opinion of Self-Driving Vehicles

A majority of survey respondents had heard of self-driving vehicles prior to the survey (95.96%) with most respondents having a positive impression of the technology (50.18% extremely positive, 30.44% moderately positive and 7.75% slightly positive). Fewer than 10% had a negative impression of the technology with 2.03% of respondents indicating that they held an "extremely negative" impression of self-driving vehicle technology.

Expected Benefits of Self-Driving Vehicles

Respondents were asked eight questions related to the anticipated benefits that might occur through the use of self-driving vehicle technology. With each question they were asked to select "extremely likely", "moderately likely", "slightly likely", "neither likely nor unlikely", "slightly unlikely", "moderately unlikely" or "extremely unlikely". Figure 1 illustrates

respondent perception of potential benefits accounting for all variations of “likely” (“extremely”, “moderately” and “slightly”), “neither likely nor unlikely” and all variations of “unlikely” (“extremely”, “moderately” and “slightly”). The majority of respondents felt that each of the expected benefits were likely to occur with self-driving vehicles with respondents expressing the most confidence in the likelihood of fewer automobile crashes (79.96% when all variations of “likely” combined), reduced severity of automobile crashes (79.21%) and better fuel economy (75.76%). Lower insurance rates were viewed as least likely (27.52% when all variations of “unlikely” combined).

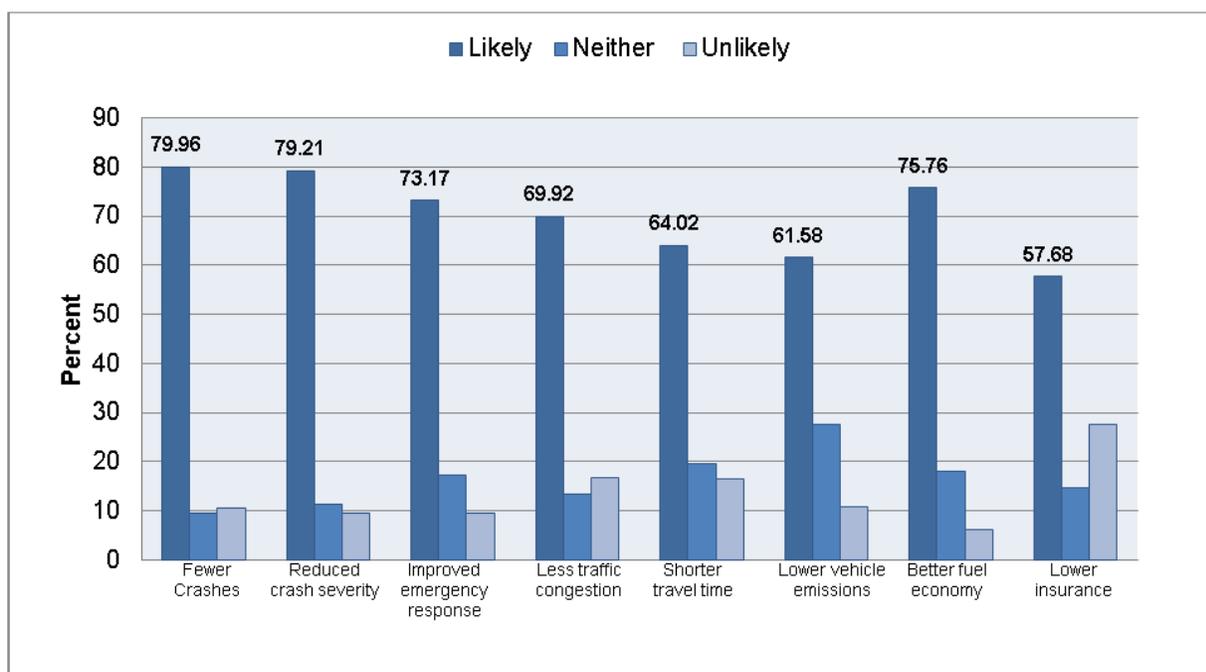


Fig. 1. Summary of responses to Q6-Q13: “Regarding self-driving vehicles, how likely do you think the following benefits will occur...?” All variations of “likely” and “unlikely” tallied.

Self-Driving Vehicle Concerns

Operational Concerns

Respondents were asked how concerned they would be about riding in a fully autonomous or self-driving vehicle as the primary operator. A definition describing a fully autonomous or self-driving vehicle accompanied the question. The most frequently selected response was “slightly concerned” (38.96%), followed by “moderately concerned” (22.82%), “very concerned” (16.70%) and “not at all concerned” (21.52%). Subsequently, respondents were asked how concerned they would be about riding in a *partially* autonomous vehicle as the primary operator. A definition describing a partially autonomous vehicle accompanied the question. The most frequently selected response was “slightly concerned” (30.91%), followed by “very concerned” (27.56%), “not at all concerned” (23.84%) and “moderately concerned” (17.69%). A majority of respondents expressed some degree of concern regarding their ability to operate a self-driving vehicle if one was made available to them (32.16% slightly concerned, 15.80% moderately concerned, and 17.66% very concerned). The most frequently selected response however was “not at all concerned” (34.49%).

Issue-Based Concerns

Respondents were asked 10 questions related to self-driving vehicle related issues; Figure 2 provides a summary of their responses. For each question respondents were asked to select “very concerned”, “moderately concerned”, “slightly concerned”, or “not at all concerned”. Respondents expressed the most concern (when all variations of concern are accounted for) about equipment failure or system failure (93.18%), followed by vehicles getting confused in unexpected situations (92.69%) and the interaction between self-driving vehicles and pedestrians

and bicycles (87.55%). The least concern was expressed about learning to use self-driving vehicles (44.09%).

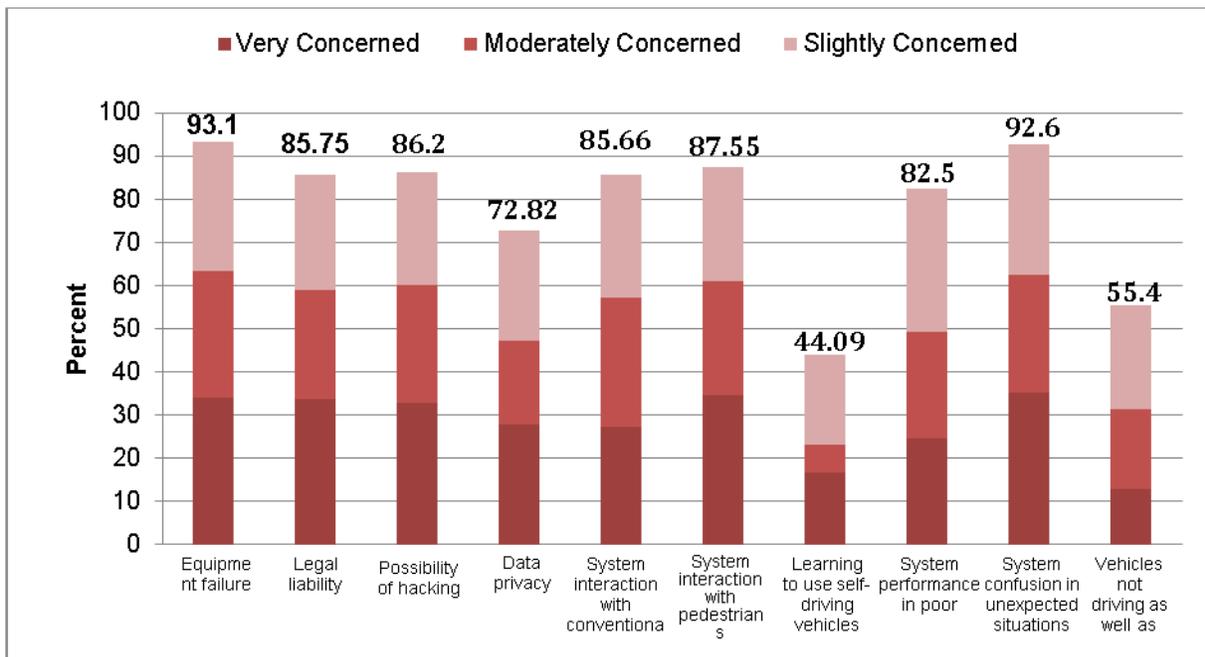


Fig. 2. Summary of responses to Q19-Q28; ‘not at all concerned’ is not displayed: “*Regarding self-driving vehicles, how concerned are you about...*”

Ownership Interest and Willingness to Pay

More than 90% of respondents expressed some interest in owning self-driving vehicle technology with 93.31% indicating that they were “extremely / very / moderately / slightly interested”. Respondents on average indicated that they were willing to pay \$6,346 US extra for this technology with those at the 50th percentile indicating that they would pay \$1,000 extra and those at the 90th percentile indicating that they would pay \$10,000 extra. About a third (n = 171) of respondents (33.11%) indicated that they would not be willing to pay extra for self-driving vehicle technology.

Discussion

Significant concerns were raised regarding all eight of the issues addressed within the study with respondents most concerned about equipment and system failure, self-driving vehicles getting confused by unexpected situations and interactions between self-driving vehicles, bicycles and pedestrians. While these findings are consistent with the literature in that public opinion surveys have generally suggested that consumers have significant concerns regarding self-driving vehicle technology (Daziano, Sarrias, and Leard; Schoettle and Sivak, “A Survey of Public Opinion about Autonomous and Self-Driving Vehicles in the US, the UK, and Australia”); Schoettle and Sivak, “Motorists’ Preferences for Different Levels of Vehicle Automation”) our findings suggest that the concerns of blind and visually impaired consumers may be somewhat different than consumers generally. While concerns regarding legal liability for owners and drivers has been a primary concern of respondents in studies by Howard and Dai and Schoettle and Sivak (Schoettle and Sivak, “A Survey of Public Opinion about Autonomous and Self-Driving Vehicles in the US, the UK, and Australia”), it placed 5th on the list of concerns in the present study. The same is true for concerns regarding self-driving vehicles not driving as well as human drivers, which placed 7th on the list of concerns in the present study but was 3rd in the Schoettle and Sivak study (Schoettle and Sivak, “A Survey of Public Opinion about Autonomous and Self-Driving Vehicles in the US, the UK, and Australia”).

More than 90% of respondents expressed an interest in owning self-driving vehicle technology; high interest in ownership that is consistent with the literature (Kyriakidis, Happee, and de Winter; Schoettle and Sivak, “A Survey of Public Opinion about Autonomous and Self-Driving Vehicles in the US, the UK, and Australia”; Schoettle and Sivak, “Motorists’ Preferences for Different Levels of Vehicle Automation”). A majority of respondents however

indicated a willingness to pay extra for self-driving vehicle technology. Much of the literature in this regard, which has presumably focused on sighted consumers, has indicated that consumers generally are unwilling to pay extra for self-driving vehicle technology (Kyriakidis, Happee, and de Winter; Schoettle and Sivak, “A Survey of Public Opinion about Autonomous and Self-Driving Vehicles in the US, the UK, and Australia”; Schoettle and Sivak, “Motorists’ Preferences for Different Levels of Vehicle Automation”). Our findings indicate that blind and visually impaired consumers, on average, may be willing to pay more than \$6,000 extra for self-driving vehicle technology, a sum higher than the \$4900 found by Daziano, Sarria and Leard (Daziano, Sarrias, and Leard), presumably with sighted consumers and approaching the recent findings of Bansai, Kockelman and Sing (Bansal, Kockelman, and Singh) of \$7253.

Conclusion

Our findings suggest that while the opinions and concerns of blind and visually impaired consumers may *broadly* parallel the opinions and concerns of consumers generally there are key differences that may impact how these consumers approach and interact with this technology. Awareness of these differences will become increasingly critical if manufacturers are interested in wider consumer adoption of self-driving car technology beyond a core base of sighted users.

Works Cited

- Bansal, Prateek, Kara M. Kockelman, and Amit Singh. "Assessing Public Opinions of and Interest in New Vehicle Technologies: An Austin Perspective." *Transportation Research Part C: Emerging Technologies* 67 (2016): 1–14. CrossRef. Web.
- Daziano, Ricardo A., Mauricio Sarrias, and Benjamin Leard. "Are Consumers Willing to Pay to Let Cars Drive for Them? Analyzing Response to Autonomous Vehicles." *Transportation Research Part C: Emerging Technologies* 78 (2017): 150–164. CrossRef. Web.
- Howard, Daniel, and Danielle Dai. "Public Perceptions of Self-Driving Cars: The Case of Berkeley, California." *Transportation Research Board 93rd Annual Meeting*. Vol. 14. N.p., 2014. *Google Scholar*. Web. 3 Apr. 2017.
- Kyriakidis, M., R. Happee, and J.C.F. de Winter. "Public Opinion on Automated Driving: Results of an International Questionnaire among 5000 Respondents." *Transportation Research Part F: Traffic Psychology and Behaviour* 32 (2015): 127–140. CrossRef. Web.
- National Federation of the Blind. "National Federation of the Blind Resolutions for 2016 | National Federation of the Blind." N.p., n.d. Web. 16 Jan. 2017.
- Qualtrics. "The Leading Research & Experience Software." *Qualtrics*. N.p., n.d. Web. 25 Apr. 2017.
- Schoettle, Brandon, and Michael Sivak. "A Survey of Public Opinion about Autonomous and Self-Driving Vehicles in the US, the UK, and Australia." *Ann Arbor: The University of Michigan Transportation Research Institute: Transportation Research Institute*. (2014): n. pag. *Google Scholar*. Web. 3 Apr. 2017.

---. "Motorists' Preferences for Different Levels of Vehicle Automation: 2016." *University of Michigan Sustainable Worldwide Transportation* (2016): n. pag. *Google Scholar*. Web. 3 Apr. 2017.