Survey Design for Autonomous Vehicle Safety Concerns

Problem Statement

Do people who use digital technologies too often feel differently about the safety risks posed by Autonomous Vehicles?

H0 = There is no relationship between people's digital technology use and their feelings about Autonomous Vehicle safety.

H1 = There is a relationship between people's digital technology use and their feelings about Autonomous Vehicle safety.

Rationale

We consider that digital technology usage could indicate a degree of openness to technology that would reveal itself if we can control the variables of infrastructure and technology implementation. In a sense, the "spookiness" of an AV vanishes as the consumer is more digitally literate. At the same time, it can also drive up critically thinking about implementing such emerging technologies. Digital literacy has a lot to do with schooling, education systems, state and national budgets, the use of ICT in education, etc. A more robust variable would be digital usage/proficiency. This proficiency symbolizes openness to technology and a readiness to change to adopt new versions as they come along, something peculiarly true about digital products and their software updates.

In designing our survey, we would like to gather enough data to build a digital proficiency index and AV safety concern index to find a correlation.

Literature Review

We reviewed research papers using forward and backward snowballing searches, looking for papers that build off our first search and backtrack papers back to 2012 when the first surveys regarding AVs emerged. In total, we looked at about 30 articles.

We see a nuanced distinction between willingness, acceptance, and adoption, with many overlaps in these concepts. A critical paper in this regard is "Acceptance of Driverless Vehicles: Results from a Large Cross-National Questionnaire Study" in 2018 by Nordhoff et al., which surveyed 7,755 respondents from 116 countries on the acceptance of driverless vehicles using a 94-item online questionnaire. Based on a Likert scale (1 = disagree strongly to 6 = agree strongly), the questions were quite comprehensive, owing to the sheer variety and number of questions asked. On the other hand, a 94-item questionnaire does introduce survey fatigue. Moreover, the tiredness could be a lot severe for non-native English speakers as the authors themselves remark that "Better English language skills may be a reason why respondents in higher-income countries took less time to complete the survey" (Nordhoff et al. 2018).

More straightforward questions were asked in "A Survey of Public Opinion about Autonomous and Self-Driving Vehicles in the U.S., the U.K., and Australia" (Schoettle and Sivak, 2014), but

the options were too detailed. They must have increased the cognitive load of the participant. i.e. one has to read a paragraph-long option before choosing one.

We also looked at a report that surveyed "more than 260 leaders from the automotive and technology industries, in addition to state and federal regulators" ("Autonomous Vehicle Survey Report" 2019). It contains a good set of questions helpful in evaluating consumer acceptance in industry-wide terms, especially in the context of regulations and technological developments. Yet, since this report only surveyed industry leaders and federal regulators, we miss the possibility of sentiment analysis of the public.

The American Trends Panel Wave 27 by Pew Research Center had some well-prepared questions regarding autonomous driving (Pew Research Center 2017). Some noteworthy questions were regarding threats posed by AVs and how enthusiastic Americans are about AVs. This panel strictly surveyed Americans in a broader survey on technologies.

Finally, we looked at a survey of how motorcyclists and cyclists perceive AV in the context of crashes (Pammer et al. 2021). Though this paper is specifically focused on the perception of these groups, we learned a lot about the ways in which safety concern questions can be asked.

Survey Design

- **19 questions**: We kept it short to get quality answers. We aimed to create a survey that would take less than 5 mins to respond to since the topic is complex and involves critical thinking. Similar questions were interspersed to test if the participant answers consistently.

- **Target Population**: Americans between ages 18-60, living in or near urban centers. The US is one of the leading countries in AV technologies. The audience age group is extensive since any demographic between these ages can use autonomous vehicles, including college grads, laborers, elderly, disabled, etc. We select "in or near urban center" participants to capture our most likely consumer group for AVs.
- **Sample Size** = approx. 1000 respondents. Since we are targeting a wide audience and that too just using 19 questions, we need a substantial sample to make the results generalizable. We must also perform random probability sampling and apply weights to ensure we have a representative sample of the target population mentioned above. Most importantly, we want a good ratio of digital vs. non-digital literate people in our representative sample. Thus, we will need to collect survey responses from crowdflower.com as well as from on-the-ground surveyors.
- **5-7 Personas**: We created the questions keeping in mind 5-7 personas that are almost limit cases to our hypothesis to makes sure that such people are not excluded from our dataset i.e. these people should be able to answer our survey questions as accurately as possible.
- **Choice of Scale**: Likert Scale. Since we do not wish to know their opinions but rather gauge their feelings as they experience them, we want to avoid using an agree-disagree Likert scale. Yet, we would still like to keep options in linear order along with the minimal cognitive load. For this reason, we chose informal language answers presented on a Likert scale as our multiple-choice options. The options will be clickable (online) or a check box (offline) and presented below the question in a linear order (order shown by numbering).
- We are already thinking about the data in terms of how we could sort it in SPSS i.e**. Initial questions** are formulated to control for certain variables such as education, whether the

participant has a driving license, whether they heard of autonomous vehicles before the survey, etc.

Questionnaire

The following is a survey regarding Autonomous Vehicles referred to as AVs or self-driving cars. These vehicles require almost no assistance from the driver and can drive themselves. The driver does not engage in steering, accelerating, or braking. Many companies have already deployed autonomous passenger cars on the road in states like California and Arizona. In the coming years, many companies are planning to deploy fully autonomous cars and freight trucks. This survey will take 5 minutes to complete. If there is a question you do not wish to answer, then please leave it blank.

#	Category	Questions	Options	Relevance
1	Education	**What is your level of education?**	1= less than high school, 2= high school, 3= some college, 4= graduate, 5= post graduate	To see the relation between level of education with AV related responses, digital use responses since there might these might be icfluenced by a mediating variable like digital literacy.
2	Driving Experience	**Do you have a driving license?**	1= yes, 2= no	Use to situate respondent's views is on how they think of AV in a practical "hands-on" sense.
3		**Before the pandemic began, how often did you travel per week in a vehicle (including cars and buses)?**	1= not at all, 2= once in a week, 3= twice/thrice a week, 4= four/five times a week, 5= everyday.	Use to situate repondent's views in 'lived experiences' during normal times.
4	Knowledge	**Had you ever heard of autonomous vehicles before participating in this survey?**	1= yes, 2= no	To provide context for responses from participants who have never heard of AVs.
5		**How well do you understand autonomous vehicle technology?**	1= not at all, 2= a little bit, 3= just enough, 4= well, 5= very well)	To gauge depth of knowledge about AVs; checking for a correlation between AV technology understanding and digital technology skills/usage

6	Safety	**How safe do you feel during the following scenarios?** Sharing the road with an autonomous car? Riding in an autonomous vehicle? Sharing the road with an autonomous freight truck?	1= not safe at all, 2= not too safe, 3= somewhat safe, 4= very safe	To directly ascertain the level of safety that a repsondent feels regarding various AV scenarios (could include actual experiences or imagining the scenario)
7		**In how many accidents were you involved in when driving/riding a vehicle in the last 2 years (minor collisions and major collisions)? Please Include all accidents, regardless of who was at fault, how they were caused, how severe they were, or where**	1= None, 2= 1 - 3, 3= 4 - 6, 4= 7 - 9, 5= More than 9.	Use to situate respondent's views on AV crashes and safety concerns
8		**If autonomous vehicles become widespread, do you think that the number of people killed or injured in traffic accidents will _____.**	1= increase, 2= slightly increase, 3= stay the same, 4= slightly decrease= 4= decrease	Gauging opinions on positive vs negative impact of AV on road safety
9		**Have you heard or read about any autonomous vehicle crashes?**	1= yes, 2= no	To check if knowledge of previous crashes affects their estimate of "the likelihood of AV crash reduction" in the next question
10		**If you had to guess, 5 years from now, do you think that an Autonomous Vehicle would have very few crashes?**	1= not at all likely 2= not very likely 3= somewhat likely 4= very likely	To check if proficient digital technology users differ significantly in their opinion about the future of AV tech
11	Digital Use	**How many hours per day do you do the following?** Use a Smartphone Use a Computer? Browse the Web?	1= I don't, 2= less than 2 hrs, 3= 2-5 hrs, 4= more than 5 hrs, 5= more than 8 hrs	Use to aggregate various levels of digital usage across the population to arrive at a mean digital usage.
12		**How many hours per week do you play games on smartphone/computer/xbox/PlayStation/other gaming consoles?**	1= I don't, 2= less than 2 hrs, 3= 2-5 hrs, 4= more than 5 hrs, 5= more than 8 hrs	
		**** PROMPT: WE ARE ALMOST COMING TO THE END OF THE SURVEY ****		
13	Digital Skills	**How comfortable do you feel during he following activities?** Using your electronic devices (could include gadgets, computers, electronic equipment, digital tools, smartphones, gaming consoles, etc)?	1= not that comfortable, 2= somewhat comfortable, 3= comfortable, 4= extremely comfortable	To determine skill level of digtal users and check for a pattern with AV safety concerns
14		Learning to use unfamiliar electronic devices (could include gadgets, computers, electronic equipment, digital tools, smartphones, gaming consoles, etc)?		
15	Digital Tech Adoption	**How many people in your friends and family use smartphones, internet and other digital technologies?**	1= very few, 2= some, 3= a lot, 4= almost everybody, 5= everybody	Social influence indicator on digital adoption/'acquaintance with digital technology'
16		**I am often an early adopter of latest electronic devices (include gadgets, computers, electronic equipment, digital tools, smartphones, gaming consoles, etc)?**	1= strongly disagree, 2= disagree, 3= neither agree nor disagree, 4= agree, 5= strongly agree	Trying to gauge if early adoption means an openness to new technologies

17	Feedback	**How accurately do you think you think you could answer the questions on the questionnaire?**	1= not that accurately, 2= somewhat accurately, 3= accurately.	To discard responses from participants who answer "not that accurately"
18		**Please leave any feedback regarding how we could improve the survey**	1=	To integrate suggestions for next round of survey
19		**Your views matter to us. Please indicate if you would like to be interviewed in exchange for a small gift and our gratitude.**	1= Yes, 2= No	To get some qualitative data
		Thank You!		

Limitations:

A few questions listed above, such as "how many hours per day do you use a smartphone?" rely on responders' self-evaluation, which may or may not be accurate. Ultimately this shall affect our gauging of their digital usage. Secondly, the scenario question in no 6 relies on the active imagination of participants in most cases. Since we ask it in a single battery of questions, one answer will tend to influence all the options. We considered asking questions separately, but our initial survey testers found the experience annoying.

Conclusion

There is a fine line between digital usage and digital proficiency. Measuring digital proficiency without making the participant go through a comprehensive survey is going to be difficult. But this round of survey is essential so that we can gather both the AV safety concern index and digital proficiency index from one target audience. The most challenging aspect is devising the options, which could range across many types of variables. As an example, consider the question "how often do you use the smartphone. We could choose (not too often - too often), (0-1hrs…7-8hrs). We had to look at actual vs. reported screen times to formulate options that somebody could intuitively select.

One of my concerns is that we are aiming for high respondents with just 20 questions. But answering these questions requires some thinking, and it might be a problem when we are administering this survey to 1000 respondents. Moreover, to accumulate a representative sample, one cannot just use survey monkey or crowdflower.com. One will need to enlist the help of on-the-ground surveyors who can reach digitally illiterate people as well. After critical examining previous survey questionnaires, comparing responses to expectations based on theories, and trying to look for alternative questions that could yield more accurate answers, we were able to create 19 succinct questions that have been survey-tested by 10 individuals, checked for complications, and are ready to be deployed.

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