

Working at 70mph? Non-driving related tasks in future autonomous vehicles

Christopher Wilson, Diane Gyi and Andrew Morris

Loughborough University, UK

ABSTRACT

Autonomous vehicles will provide an exciting opportunity for drivers and passengers to disengage from the task of driving and engage in non-driving related tasks. However, little is known about how future owners of autonomous vehicles will use their vehicles and understanding this will allow car manufacturers to re-invent the journey experience. This paper presents the development of a survey as well as results with 1,378 drivers. The survey found that those who are most likely to own an autonomous vehicle prioritise leisure activities, resting and socialising. The results will lead to priorities for the design of the interior space to support non-driving related tasks.

KEYWORDS

Autonomous vehicles, non-driving related tasks, driver attitudes

Introduction

Over the next ten years, there will be a paradigm shift in the automotive industry towards what is known as ACES (Autonomous, Connected, Electrified, Shared). It has been predicted that future vehicles that use ACES technology could help to improve road safety, reduce traffic congestion and increase free time for the occupant (Shanker et al., 2013). This detachment of control could also reduce discomfort, both physically and mentally. With the benefit of free time, the occupant will also be free to engage in Non-Driving Related Tasks (NDRTs) such as relaxing, reading or working.

A commonly accepted description of the capability of an autonomous car has been defined by the Society of Automotive Engineers (SAE). They have determined six levels of autonomy, from level zero, where there are no driver aids, to level five with full self-driving capability (SAE International, 2014). The focus of this research is level four, which allows for full detachment from the driving tasks under certain idealised conditions such as location and weather. There is also no requirement for an emergency handover of control allowing the occupant to fully engage in a NDRT.

Previous surveys have investigated the wider topic of autonomous vehicles (Schoettle and Sivak, 2014; Kyriakidis et al., 2015; Bansal et al., 2016). These included questions on participants' willingness to pay, safety of future vehicles as well as which activities the participants will likely perform. When asking questions concerning the activities, a criticism could be that the surveys presented individual activities with little or no context. They also did not distinguish between those who would be likely to adopt an Autonomous Vehicle (AV), and those who would not. This could mean that activities that require a higher cognitive or motoric workload can be seen to be less important due to a lack of trust in the system by some participants.

This paper outlines the development of a survey as well as preliminary findings from a global scoping survey that aims to understand the types of activities that may be undertaken by those who are likely to adopt an AV.

Method

The purpose of this study is to understand current drivers' attitudes towards current driving and future needs. As passenger cars are usually a global product, a global survey method was chosen to understand a wide range of views.

A stratified purposive sampling technique was used for the survey. The sample has been stratified by gender (50% male) and then by age in the following categories: 18-30, 31-45, 46-65, 66-75, 75+ with an aim to achieve approximately equal distribution (20% in each). The exclusion criteria for the survey was by age (participants must be over 18) and participants must hold a driving license. The survey was approved by the Loughborough University Ethics Committee and conformed to GDPR. The survey was distributed online through social media, forums such as Speak EV and AV Forums, and through charities and organisations such as Royal Society for the Prevention of Accidents (RoSPA) and the University of the Third Age. The survey opened on 12/08/2019 and concluded on 29/11/2019.

The survey contained a description of an autonomous car as an attempt to quickly educate the participants on what autonomy is. This includes a description of the vehicle's capabilities as well as informing the participants that vehicle occupants would be free to move out of the driving position. The survey was made using Bristol Online Surveys and contains 42 questions in the following sections:

- Views on technology: to understand views on technology, questions were adapted from Zmud et al. (2016), as well as questions regarding technology ownership adapted from Panagiotopoulos and Dimitrakopoulos (2018).
- Car journeys of the future: there are two sets of questions in this section, the first aims to understand the issues with current driving using statements from published literature (Beirão and Sarsfield, 2007). The participants were then asked if they agreed or disagreed with different statements regarding what they would do in an AV. An example of one of the statements is: *"I would carry out some or all my morning routine in the self-driving car (e.g. eat breakfast, do my make-up, shave)"*. For both sets of questions, a Likert scale was used ranging from 'strongly disagree' to 'strongly agree'.
- About self-driving cars: questions have been adapted from previous studies that have used technology acceptance models to understand attitude towards self-driving cars (Zmud et al., 2016; Osswald et al., 2012; Koul and Eydgahi, 2018).
- Demographic information: basic demographic information such as age, gender and level of education, work status and location (by country) have been collected. There are also questions relating to vehicle use.

Main findings and discussion

In total, 1378 persons have completed the online survey to date. The responses consist of all age groups, genders and employment statuses.

- 51% of the participants were fully employed, 15% worked part-time, 17% were retired and 11% were students.
- 10% of participants spend less than 1 hour in the vehicle per week, 49% spend 1-5 hours 27% spend 6-10 hours, 10% spend 11-15 hours and 4% spend over 16 hours.

- 43% would describe themselves as someone who is amongst the first in their family or friends to adopt new technology or services.

It was found that males (47%) were more likely to own an AV in the future whereas the corresponding percentage regarding females' likelihood was smaller (32%). When asked about using or renting rather than owning, the percentage for males was 48% compared to 44% for females. This is in contrast to research conducted by Panagiotopoulos and Dimitrakopoulos (2018) who found that females were more likely to have or use an AV when they become available (almost 78%). This is likely because the questions asked in this survey included a 'neutral' response, whereas Panagiotopoulos and Dimitrakopoulos did not and instead used a four-point likert scale ranging from 'not at all likely' to 'extremely likely'.

In this survey, 41% (n=566) of participants 'agree' or 'strongly agree' to the statement "*I intend to own a self-driving car when they become available*". For this research, those that agree or strongly agree to owning an autonomous vehicle will be referred to as 'likely to adopt an AV', with the remaining 59% (n=812) 'unlikely to adopt an AV'.

Figure 1 shows the comparison between the 'likely to adopt an AV' group and those that are unlikely to adopt when asked which of the following statements most closely relates to them. In this survey, 38% of respondents who are unlikely to adopt an AV would like to feel in control when they drive, compared to 8% of those who are likely to adopt an AV. A similar but less pronounced difference can be seen for the statement "*I find driving on a motorway to be a waste of time*". This shows clearly that there is potentially a fundamental difference in attitude toward autonomy between those that do and those that don't want to own an AV.

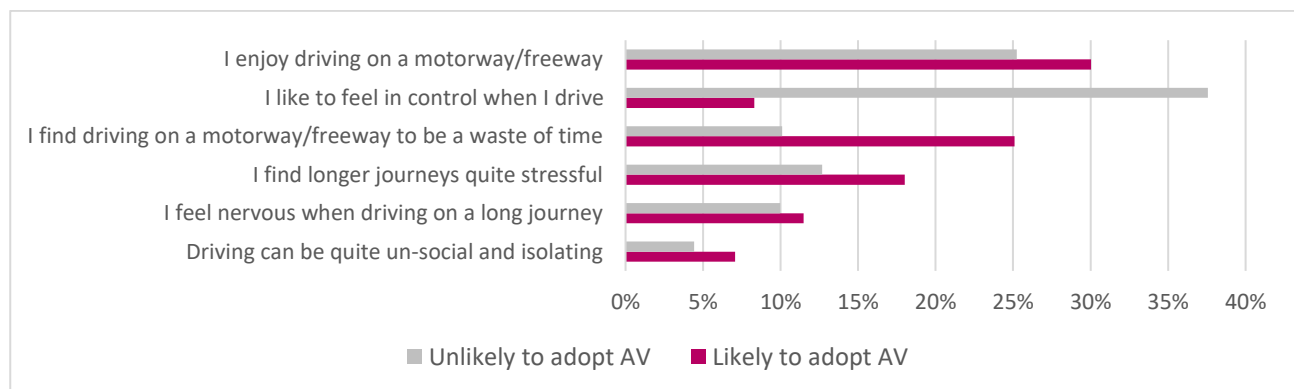


Figure 1: Comparing the two sample groups with statements on current driving

The 'likely to adopt an AV' group were then asked if they agreed or disagreed with different statements relating to what activities they would perform in an autonomous vehicle. When combining 'agree' and 'strongly agree', leisure activities scored 88%, resting and sleeping scored 75%, socialising scored 70% and being productive scored 64%. Both the morning routine and working with a colleague scored lower than remaining in the driving position amongst this sub-group. Further to this, 79% of those who are 'unlikely to adopt an AV' would agree or strongly agree to remaining in the driving position compared to 52% of those that are likely to adopt.

Comparing these results to previous surveys is difficult due to the different categorisations used; however, there are some similarities. For example, interacting with other passengers (socialising) scored only 47% in a survey conducted by Kyriakidis et al. (2015). This could be because the survey presented the results from all participants, rather than just those willing to own an AV. It could also be because attitudes have changed since the survey was conducted.

Conclusion

Future autonomous vehicles have enormous potential to enhance the journey experience by allowing opportunities for NDRTs. It is therefore critical that we begin to understand the needs of the occupants as well as any NDRT requirements. An online survey was carried out with drivers to investigate their motivations and needs. The implications of the preliminary results show that those that are likely to adopt an AV would perform leisure activities, rest and sleep, socialise or be productive. There are also clear differences between those that are likely to adopt an AV and those that are not. It is important to note that the findings from the preliminary results should be interpreted carefully, as highly or fully autonomous vehicles do not yet exist. As individuals learn more about the capabilities of autonomous vehicles, and begin to experience them, the attitudes and perception towards them may change.

Acknowledgment

We would like to acknowledge the EPSRC and Nissan Motor Co. Ltd for funding this research.

References

- Bansal, P., Kockelman, K. M., Singh, A. (2016). Assessing public opinions of and interest in new vehicle technologies: An Austin perspective. *Transp. Res. Part C Emerg. Technol.* 67, 1–14.
- Beirão, G., Sarsfield, C. J. A. (2007). Understanding attitudes towards public transport and private car: A qualitative study. *Transport Policy* 14, 478–489.
- Koul, S., Eydgahi, A. (2018). Utilizing Technology Acceptance Model (TAM) for driverless car technology. *Adoption. J. Technol. Manag. Innov.* 13, 37–46.
- Kyriakidis, M., Happee, R., de Winter, J. C. F. (2015). Public opinion on automated driving: Results of an international questionnaire among 5000 respondents. *Transp. Res. Part F Traffic Psychol. Behav.* 32, 127–140.
- Osswald, S., Wurhofer, D., Trösterer, S., Beck, E., Tscheligi, M. (2012). Predicting information technology usage in the car. In *Proceedings of the 4th International Conference on Automotive User Interfaces and Interactive Vehicular Applications - AutomotiveUI 12:51*. New York ACM Press.
- Panagiotopoulos, I., Dimitrakopoulos, G. (2018). An empirical investigation on consumers' intentions towards autonomous driving. *Transp. Res. Part C Emerg. Technol.* 95, 773–784.
- SAE International. (2014). Taxonomy and definitions for terms related to on-road motor vehicle automated driving systems. *Surface Vehicle Information Report reference J3016_201401*.
- Schoettle, B., Sivak, M. (2014). A survey of public opinion about autonomous and self-driving vehicles in the U.S., the U.K. and Australia. *University of Michigan Transportation Research Institute*. Ann Arbor, MI.
- Shanker, R., Jonas, A., Devitt, S., Huberty, K., Flannery, S., Greene, W. et al. (2013). *Autonomous cars: Self-driving the new auto industry paradigm*. Morgan Stanley Research.
- Zmud, J., Sener, I. N., Wagner, J., 2016. Self-driving vehicles: Determinants of adoption and conditions of usage. *Transp. Res. Rec. J. Transp. Res. Board* 2565, 57–64.