

Ethics involving autonomous vehicles and their effect on purchases

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Abstract— Recent reports promises that autonomous vehicles will reduce the number of accidents. Research show that people want the autonomous vehicle to self sacrifice in cases where they can save several lives, but less than $\frac{2}{3}$ believed that a autonomous vehicle will be programmed like this in the future [2]. However will people be willing to buy a vehicle that sacrifices them selves in case of an accident? In this paper we will examine what expectations customers have regarding manufacturer safety programming. What people would choose when encountering the ethical dilemmas autonomous vehicles certainly will encounter. What is currently known about ethical dilemmas in autonomous vehicles, and finally; will this affect peoples willingness to acquire an autonomous car. A quantitative method was used to try answering the research questions. The result shows that autonomous vehicles that reflects the owners moral behavior could increase the willingness to buy one.

I. INTRODUCTION

"Cars crash. So too will autonomous vehicles, a new generation of vehicles under development that are capable of operating on roadways without direct human control" [3]. Googles autonomous car accident in 2016 is one example that has drawn a lot of attention. Autonomous vehicles drive on highways at this moment and there will be more of them in the future. Autonomous vehicles promises to reduce the number of accidents, numbers from the National Highway Traffic Safety Administration shows that 94% of car accidents can be attributed to the driver, so there is a large room for improvement [5]. A limit on how safe the cars need to be compared to human drivers is a heavy debated question.

Research show that people want the autonomous vehicle to self sacrifice in cases where they can

save several lives, but less than $\frac{2}{3}$ believed that a autonomous vehicle will be programmed like this in the future [2]. Can a manufacturer sell a car that sacrifices the owner to save other lives?

In some cases there will be a choice between two situations with guaranteed bad outcome. How should we minimize this bad outcome and how should this moral decision be programmed? This study tries to answer if peoples willingness to purchase autonomous vehicles is affected by the way autonomous vehicles handle ethical dilemmas.

Building on what has been found in the referenced literature, the study will further explore the relationship between buyers of autonomous vehicles and the ethical dilemmas these will eventually encounter, with a focus on the willingness to purchase one.

MRQ Main Research Question:

How does the way autonomous vehicles handle ethical dilemmas affect peoples willingness to purchase them?

RQ 1:

What is known from research about ethical dilemmas in autonomous vehicle programming?

RQ 2:

What expectations do customers have regarding manufacturer safety programming?

RQ 3:

What will people prioritize when autonomous vehicles encounter ethical dilemmas?

II. LITERATURE BACKGROUND

An autonomous vehicle is a vehicle that senses its environment and makes decisions about how to navigate it without any human interaction [1].

Autonomous vehicles has been a hot topic the last couple of years, and a lot of research has been done on the ethics of autonomous driving [4]. While most agree that self-driving vehicles will make the roads safer as a result of the decision making being moved from the driver to the vehicle manufacturer. Some studies suggests that we will see an increase in lawsuits for the manufacturers despite a less accidents [3].

Even though humans are responsible for most crashes, not every accident can be avoided by replacing humans with automation. Vehicles will still crash, and it is important that the decisions made by the vehicles before the crash are in line with ethical values. Automated vehicles licensed for testing in California are required to provide the Department of Motor Vehicles with all of their sensor data for 30 seconds prior to any collision [4]. Something similar will probably be required wherever automated vehicles are in use as engineers will be able to reconstruct the events around crashes by using data from sensors such as video cameras, ultrasonic sensors, radar, and lidar (laser-based ranging).

Noah J. Goodall suggests a three-step process to make sure the vehicles have appropriate ethical values [1]. This is done by first coding some basic rules for the vehicle, then using machine learning to learn from a range of human drivers. And in the end, decode the learned ethics in a way that can be interpreted and improved upon by humans. While this might be a good approach, Bonnefond, Shariff and Rahwan found that most people wanted autonomous vehicles to act in an utilitarian way [2]. This is something that would most likely not be the result when learning from humans, as humans tend to act in a way that protects themselves (the driver) even when it might not be the best thing to do from an utilitarian perspective.

As autonomous vehicles become more common, laws today needs to be extended as they do

not cover nearly every scenario. For example most state laws in the United States relies on a driver's common sense and not the specific actions immediately before a crash [4]. Since a robot can perceive data and react much faster than a human, other standards needs to be set. Vehicles today are already programmed to break the law in specific situation. Google's vehicles will exceed the speed limit if the traffic around it is going faster as slowing down could be more dangerous [4].

Mass production will give rise to new ethical concerns as behaviour exerted by some parts of the population will now be exerted by every vehicle. Noah J. Goodall points out that Google programs its' autonomous vehicles in the scenario where it is on a three-lane road, between a large truck on the right and a small car on the left, so that center vehicle will position itself slightly to the left [4]. It will normally not be a problem when individuals behave like this, but when all autonomous vehicles exert this behaviour it will result in a significant risk to travelling in a smaller car.

The several ethical problems concerned with autonomous vehicles are quite complex, but not impossible to solve. Noah J. Goodall states that "The ethics of road-vehicle automation is a solvable problem. We know this because other fields have handled comparable risks and benefits in a safe and reasonable way. Donated organs are distributed to the sick based on metrics based on quality-adjusted life years and disability-adjusted life years, among other variables. And the military draft has added exemptions for certain useful professions, such as farmer and teacher." [4]

III. CASE AND RESEARCH METHODS

Based on research activities and the number of self driving vehicles being produced, a question about how the morality should be implemented and enforced by the law is reasonable. As a consequence, there could be a moral disagreement between the factory and the buyer of such a vehicle. This creates the base for the research.

To best answer the research question, a quantitative research method was used. Relevant data for the quantitative method was collected by a survey.

The survey was built up by three parts. First part was gender and age, second was a survey made by MIT called 'Moral Machine' [6] where the survey participant was supposed to imagine himself in the driver seat (See figure 1 at page 3) and the last part was questions related to our research question. This survey was written in both Norwegian and English and posted on several social media sites to get as many participants as possible. To protect participants a anonymous Google survey was used. Results from 'Moral machine' was a random generated link that was pasted in the survey. The result from the survey shows that most of the people that participated from social media was men with age from 18 to 25 years old. To make sure that the survey participants have some heterogeneity, a partition of the survey participants was selected personally based on age and background.

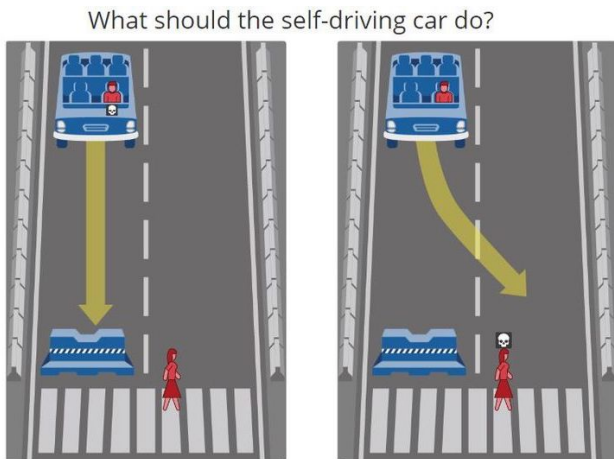


Fig. 1: Decision problem in the survey

The last part of the survey contained these two questions; *How important is it that a self-driving car represents your moral values?(Q1)* and *How likely are you to purchase a self-driving car?(Q2)*. These questions was answered with a score from 0 to 5 where 5 is most likely to buy a autonomous vehicle. Pearson product-moment correlation coefficient(PPMCC) was used to check for correlation between question Q1 and Q2. The correlation between Q1 and age was also checked with PPMCC.

IV. FINDINGS

The 'Moral Machine' part of the survey revealed a good approximation to what actions participants

would choose when faced with moral dilemmas an autonomous vehicle could encounter. [RQ2] In short, the average participant preferred to be selfish and would generally opt to save the themselves and the passengers of their vehicle. Even if the number of people and animals that would be killed to do so was significantly higher than the number of passengers in the car. Fitness and gender did not impact the outcome. Additionally, there was a strong tendency towards saving humans over animals and upholding the law over breaking it. There was also a slightly higher preference towards saving more people, females, young people and people with high social value as opposed to their alternatives.

The average of the answers submitted by the participants of this survey shared close resemblance with the global average of recorded by 'Moral Machine' in all metrics other than passenger versus pedestrian, as the participants in this survey favored saving the driver. This was probably caused by the fact that 'Moral Machine' does not ask the participants to imagine them selves as either pedestrian or passenger, whereas the participants of this survey was asked to answer the 'Moral Machine' from the perspective of the driver of the car.

The survey was answered by 124 participants ranging in age from 16 to 49, whereof close to 80 percent were male. Half of the participants answered the English survey and the other half answered the one in Norwegian. The PPMCC of the answers to Q1, and the users age was positive at 0.290, indicating that , the importance of the moral reflection grew along with the age of the participants in the sample group. The PPMCC of Q1 and Q2 was negative at -0.216, indicating a negative correlation between the importance of moral reflection and probability of purchase. [RQ3] Thus the participants who did not believe they would acquire an autonomous vehicle, were the ones who attached the most importance to whether it should reflect their moral values.

V. DISCUSSION

In this paper the results of a quantitative survey performed are presented. Along a case study of relevant literature combined with our findings we

will make an effort to answer the proposed research questions. The main research goal of the paper is to answer how the willingness to purchase autonomous vehicles is affected by how they handle ethical dilemmas.

Findings

The most significant findings of our survey suggest that there is a anti-correlation between moral reflection and willingness to buy autonomous vehicles. Results also suggest that individuals that have a higher expectation of an autonomous vehicle to reflect their own ethical values also are less likely to buy one. Our literature review reveals that expectations of documentation of the time-line before accident occur will be increased [1]. Increased access to accident documentation and enhanced possibilities to make a rational decision in extreme situations makes it necessary to include a set of ethical values in the programming of autonomous vehicles.

Meaning of findings

Having increased access to documentation of the reasoning made by the autonomous vehicles will open a opportunity to discuss outcome of various situations before they actually happen. Customers that has a higher degree of reflection around these kind of ethical issues will certainly ask these kind of questions, car companies will make sure these questions will be answered in a favourable manor to make a sale.

Relevance

Development and research of autonomous vehicles is very relevant and interesting. Many of the vast possibilities autonomous vehicles gives to the transportation sector and new business opportunities is yet unknown but it is a desired development that human technology now can support.

Limitations

Considering the size of the survey group and the high share of male participants the results cannot be considered representative of the general population. There is also a uncertainty regarding the chosen media for spreading the survey, it might be a reason for not getting a representative spread of the population.

Further research

Further research should address the need of new laws and review old laws that might be relevant for the development of futuristic self driven cars. If these kind of considerations are not made the society might be stuck with self driven cars programmed with a selfish individual perspective. This will probably not yield the optimal ethical outcome for the human race as a whole.

VI. CONCLUSION

Autonomous vehicles has promoted a change in how we move from a place to another and the opportunity for interaction between vehicles. The research in this paper is relevant for both factories and society. Factories want to sell as much cars as possible. Society want cars that kills as few peoples as possible, but at the same time saves them self in an accident. Autonomous vehicles that reflects the owners moral behavior could increase the willingness to buy one.

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