Should Automated Features Warn, Assist, or Take Control?

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ABSTRACT

Driver support and assistance features for vehicles have grown a lot during the last years. Despite a wealth of features, car brands and manufacturers differ in the implementation of these features. What insights can we gain on what drivers choose to (partially) automate their vehicles, given all these options? In this work in progress paper, we report the interim results of a survey which investigated this question. The survey contained hierarchical questions asking mainly Dutch respondents for their automated driving feature preferences. Results show that respondents choose a large number of features and were very diverse in their preferences. Nevertheless, there seems to be a preference of control type features over warning and passive-assist features. Based on these findings, we concluded that our sample supports the continuous development of features.

CCS CONCEPTS

• **Human-centered computing** → **Interactive systems and tools**.

KEYWORDS

automated driving; transitions of control; advanced driver assistance systems (ADAS); warnings; automated driving features

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1 INTRODUCTION

The past few years have seen a growth in terms of driver support and assistance features for vehicles. For example, a website by the University of Iowa and the National Safety Council of the USA has listed 30 'car safety features', that aid the driver and their safety (e.g., automatic parallel parking, obstacle detection, back-up warning; [1]). The purpose of this list was to educate people on new driver assistance features. However, although many new features continue to be developed: do people actually want all these features?

The aim of this work in progress paper is to investigate what features people want in their car and if they might have a preference for a specific type of feature. Presently, the number of features keeps increasing, making it hard to create a list with all features currently present in cars. In the event this is possible, the list would be very long. This makes it unsuitable for usage in a study so we used the aforementioned list as a static snapshot of the current features available.

The contribution of this work in progress paper is to provide insights into human preferences with regards to automated driver assistance features. We will look at preferences for individual features and preferences for three clusters that were derived inductively from the feature list. This gives us the following research question: what do drivers really want in terms of automated driving assistance? Specifically, what features do drivers choose? Do they want features (A) that passively assist them (e.g., back-up camera) without necessarily actively warning them, or (B) that (disruptively) warn drivers but leave the response to the human (e.g. blind-spot warning), or (C) that actively take control of an aspect of the driving task on the human's behalf (e.g., adaptive cruise control)? We present our initial partial results here.

2 METHOD

We conducted an online survey with the goal of collecting insights on user's automated driving features preferences.

2.1 Survey Design

Our survey was designed to investigate user's preference for automated features, with a specific focus on whether they would be interested in maintaining control themselves (by being informed by warning features) or (partially) handing control over to the car (by opting for control features). The survey was created and administered online using Qualtrics[1], and data was recorded anonymously. The survey had three blocks. The first block focused on respondents' feature preferences, the second block measured their affinity for technology interaction (ATI) scale [2], and the third block asked for demographic data. On average, the survey completion time was 12 minutes and 17 seconds.

[1]https://www.qualtrics.com, last access: 2021-07-09

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2.1.1 Feature Preferences. We collected feature preferences by using three questions: an open-question, a multiple-selection question, and a ranking question. Once a question was filled out, respondents could not go back to previous questions (to avoid bias by later questions in the open question or feature selection).

Open Question About Assistance / Automation Features We started by asking respondents an open question about their preferences for automated driving features. The open question can be seen as a recall task, in that respondents had to fill in information without having any cues towards specific technology. Therefore, their answers also indirectly reflect their knowledge about technology: they can only mention features that they know. In practice, we found that some respondents also used non-technical terms to describe their answers (i.e., describe a goal, not a technical feature, that the system should adhere to).

Multiple Selection Question: Selection of Concrete Features As a next question, we provided the respondents with a list of 30 features and definitions from mycardoeswhat.org (which was developed by the USA national Safety Council and the University of Iowa [1]) and asked respondents to select what features they wanted to have in their car. They had to select at least 1 feature but could select as many features as they desired. The feature selection task can be considered a recognition task: respondents were now cued with terms that maybe they did not think of during the open question, but would like regardless. In addition, due to the use of the definitions that appeared when hovering, respondents could also identify new features that they so far had not heard of, but wanted to use nonetheless. Due to the set-up of the survey, we do not know whether respondents recognized features, or which were new to them.

Ranking Question: Importance of Features To further gain insight into whether respondents have a preference for specific features, we asked them to rank the previously selected features. They only had to rank those features that they selected during the feature selection question. The ranking was done in a "drag and drop" manner, by dragging items from their selected set of features listed on the left to a ranking box on the right. Respondents were not required to rank all their items. In practice, all respondents provided at least a top-5. Therefore, our analysis focuses on the top-5. The ranking question is a preference task that determines automated driving features respondents really want.

2.1.2 ATI Scale. In addition to the features preference questions, we also included the 9-item affinity for technology interaction (ATI) scale [2] and asked respondents for their demographic information: self-identified gender, age bracket, nationality, whether they had their driver's license less than 5 years (considered 'novice' driver in the country of the authors [4]) or at least 5 years (considered 'experienced' drivers [4]), and how respondents learned about the survey (with a list of social media as options, and an option to select "other" and fill out information).

2.2 Respondents

After a 3-week recruitment period, 65 people filled in the survey, of which 49 finished the full survey. Age was binned in ranges 18–20 (N = 1), 20-25 (N = 13), 25–30 (N = 12), 30–40 (N = 9), 40–50 (N = 5), 50–60 (N = 4), and 60+ (N = 5) years. The sample can be considered a relatively young, Dutch, male (N_{males} = 41 and $N_{females}$ = 8) sample of self-declared experienced drivers.

2.3 Analyses

For this work in progress paper, only the feature selection and the feature ranking questions were analysed. Standard statistics (e.g., counts, mean, median) were used to analyse the responses to the two questions.

3 RESULTS

64 respondents completed the feature selection question. Figure 1 shows the frequency with which respondents selected features out of our set of 30 features. They selected between 5 and 30 features with a median of 18 (M = 18.03, SD 7.40). Each feature was selected between 17 and 56 times (M = 38.47, SD = 0.27). All features were selected at least once and none of the features was selected by all respondents. Adaptive Cruise Control (ACC) was selected most frequently (56 times) and drowsiness alert least frequently.

We clustered features in sets based on whether they covered control features (12 features), passive-assist features (5 features), or warning features (13 features). The classification of features followed the description of the features on mycardoeswhat.org (which was also used in the survey). If the feature discussed actively takes over a driving component (e.g. adaptive cruise control), it was considered as control. If the feature assisted the driver in a non-intrusive ways (i.e., without warning or actively taking over control) it was labeled as passive-assist (e.g., back-up camera). If it provided a warning, it was considered as a warning feature (e.g., blind spot warning).

The red dashed line in Figure 1 highlights how frequently we would have expected each feature to be selected if each respondent had selected the average number of features and if these selections had been assigned evenly across features. Bars that are above this line can therefore be considered features that respondents had more preference for than would be expected by chance. For all three clusters, we see that about half of the features were selected more frequently than chance: control (6 out of 13), passive-assist (3 out of 5), and warning (5 out of 12). The main conclusion that can be drawn from the feature selection – when rank is not yet considered – is that respondents prefer a high number of features on average (median of 18 out of 30).

Figure 1 also highlights how often a feature was ranked in first, second, third, fourth, or fifth place, or ranked lower or not ranked. We also again provided a dashed line that shows how frequently each feature was expected to be in the top-5 if respondents had randomly assigned their top-5.

The top-5 of the selected features again reflects diversity. Each feature was at least ranked once in the top-5, and no single feature was ranked in the top-5 by all respondents. The features anti-lock braking system (26x top-5 appearances), adaptive cruise control (ACC; 25x top-5 appearances), and automatic emergency braking (19x top-5 appearances) stand out as features that were often ranked highly – more than twice as frequent as would be predicted under random assignment (i.e., 7.93 top-5 appearances).

Regarding the three bigger clusters, control features seem to stand out as popular – with 7 out of the 13 features (54%) surpassing

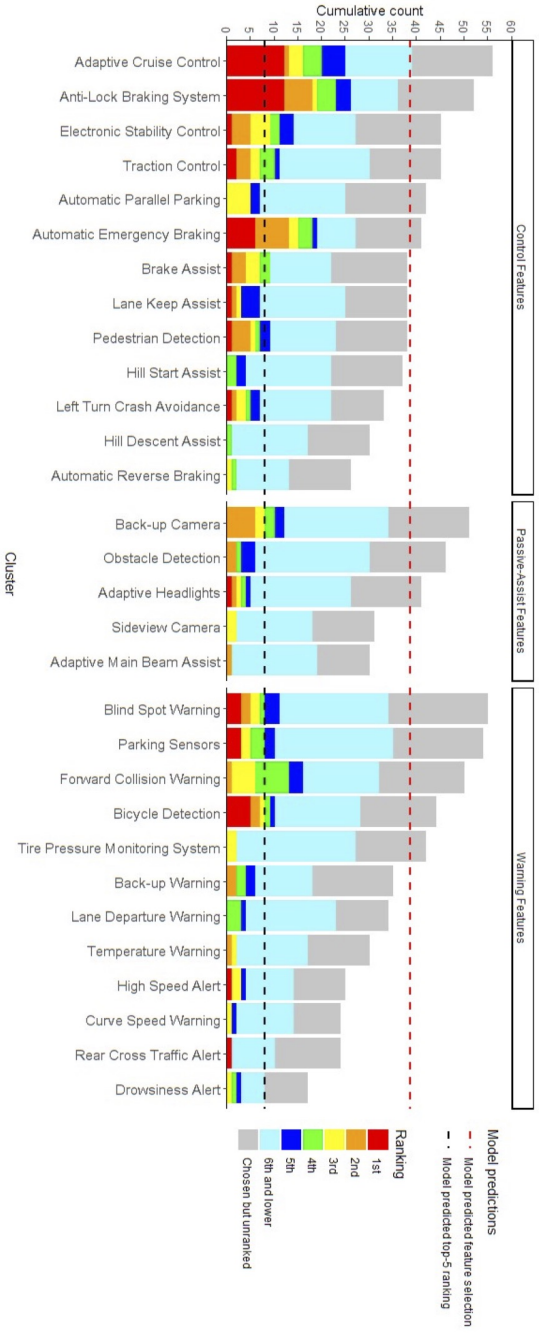

Figure 1: Frequency with which features were selected and ranked in the top-5. Dashed lines show model predictions if features had been selected randomly (red) and if the top-5 had been selected randomly (black).

the top-5 model prediction. By comparison, for the warning features this was the case for 4 of the 12 (33%) features, and for passive assist for 1 out of 5 features (20%). In addition, when only looking at features that were ranked the number 1 spot, more than two-thirds (69.8%) of the respondents selected a control feature as their top feature. Hence, features that take active control over an aspect of the drive seem to be preferred over the warning and passive-assist features.

4 DISCUSSION

Even though our respondent sample was relatively uniform in its characteristics, a lot of variation was found in the responses and

preferences. This suggests that people vary in their preferences for features in their cars. We expect that a more varied sample would likely show similar or even higher levels of variance.

In addition, on average, respondents selected a large number of features. This suggests that they would like to have a lot of features in their car. Together with the notion that they want a lot of variance, this could imply that our sample supports the continuous development of diverse features to cater to the desires of users.

The survey contained additional questions that have yet to be analyzed. This includes an analysis of the open feature preference question, and an analysis of whether results differ based on people's affinity for technology interaction [2] and whether in their open questions they reveal a preference for higher or lower levels of automation (i.e., higher or lower SAE levels, [3, 5]). We hope to get deeper insights regarding the user's wishes on automation levels and features and whether these align with the guidelines set by the industry. Beyond the survey, we plan to research human behavior concerning feature preferences. In other words, do people *use* the features that they *say* they want in their car? Moreover, it can be investigated whether the preferred features align with safety requirements and other standards.

5 CONCLUSION

By conducting this survey study on automated driver assistance feature preferences we can conclude that people vary in their preferences for features in their cars. Yet, within our sample, there seems to be a slight preference towards control features over features that passively assist or warn the human driver. Our sample seems to support the continuous development of features.

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