

Seating preferences in highly automated vehicles are dependent on yearly exposure to traffic and previous crash experiences

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I. INTRODUCTION

Highly automated vehicles (HAV) are expected to rapidly penetrate the market in the coming years. In the future, HAVs may not require any vehicle occupant to be a driver, therefore occupants' positions, as well as the orientation of the seats within the vehicle, will be much more flexible. This flexibility may present an opportunity to improve occupants' safety, although it will also pose challenges to the design of vehicle interiors and restraints. In any case, it is necessary to understand how occupants will accept new vehicle configurations and seating positions compared to the traditional ones. To our knowledge, few studies have tried to quantify users' preferences in travelling scenarios involving HAVs [1-2]. This paper presents preliminary data from a multi-country study in which participants were asked about their preferences regarding HAV configurations and seating positions across several travelling scenarios.

II. METHODS

Data

A questionnaire was developed that included demographics, exposure to traffic and to previous crashes, vehicle configuration and seating position preferences in different travelling scenarios. The participant was asked to imagine travelling in a HAV, in which they select their destination and do not need to drive. Participants in the study were required to be 18 years old or older and fluent in English or Spanish. Participants were recruited through different online and social media advertising, including university and organization newsletters, Facebook pages, Twitter and LinkedIn sites, etc. The content of the questionnaire and the study methods were reviewed and approved by the existing ethics committees at Monash University, St Joseph's University and Comillas Pontifical University.

For the purpose of this study, the relevant variables in the study were: HAV configuration (1-5) and seating position for a given HAV configuration (A-D), as shown in Fig. 1; participant's age and gender; number of kilometers travelled in a motor vehicle per year; exposure to a previous crash in which there was an injured victim (regardless of the severity of the injury).

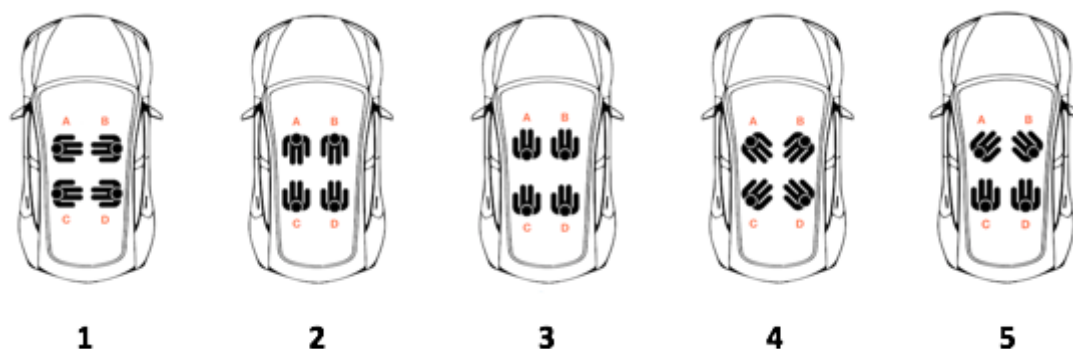


Fig. 1. Hypothetical HAV configurations (1-5) and seating positions (A-D).

Analysis

Descriptive analyses were conducted to describe the sample. Multinomial regression was used to estimate the

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effects of exposure to traffic and to previous crashes in the selection of a particular HAV configuration and seating position for a given travelling scenario, controlling by age and sex. Travelling scenarios included: driving by themselves, and sharing the ride with other family members or even unknown people. HAV configuration #1 and seating position A were used as the reference status in the multinomial regression models. All analyses were performed in R and statistical significance was established at the $p \leq 0.05$ level.

III. INITIAL FINDINGS

In total, 552 participants (Mean = 36.6 years, SD = 14.0 years, Range = 18–78 years) completed the online survey. Most participants were: aged between 31 and 64 years (52.4%), male (50.5%), and from Australia (40.9%), Spain (16.5%), Sweden (15.6%), or Lebanon (19.4%). Sixteen participants had been involved in a motor vehicle crash that had resulted in at least one injury or fatality. Table I shows participants' exposure to traffic, defined as distance travelled in a year, split by gender. Even if the differences in exposure by gender were not substantial, gender was kept as a covariate in all the multinomial analyses. HAV configuration #3 was chosen by 73% of the participants in the travelling by themselves scenario, but this proportion decreased for the travelling scenarios in which the participant would share the vehicle with other family members. Seat position A was the participants' preferred one regardless of the travelling scenario.

TABLE I

EXPOSURE TO KM TRAVELLED IN A MOTOR VEHICLE IN ONE YEAR BY PARTICIPANT'S GENDER

	<1,000	1,001-3,000	3,001-5,000	5,001-10,000	10,001-15,000	15,001-20,000	20,001-25,000	>25,000
Female	7.8%	5.3%	5.3%	9.8%	7.6%	5.6%	4.0%	4.0%
Male	2.9%	5.4%	4.4%	6.7%	9.1%	9.1%	4.4%	8.7%

Influence of being in a previous crash on HAV configuration and seating position preferences

In the travelling scenario in which the participants were driving by themselves, the experience of a previous crash was not a significant factor in the preferred vehicle configuration (HAV #3), but it was related to choosing seating positions B or C over seating position A. These results were statistically significant controlling by age and sex. However, in the travelling scenario in which the participants were with their partner/spouse, the experience of a previous crash was significant to the choice of HAV#1 over HAV#3 and HAV#4. Interestingly, participants who had experienced a previous crash did not change their preferred seating position compared to those who had not.

Influence of exposure to traffic on HAV configuration and seating position preferences

To increase statistical power, exposure was classified as 'low' (< 5,000 km travelled per year), 'medium' (between 5,000 and 20,000 km travelled per year) and 'high' (> than 20,000 km travelled per year) exposure. In the scenario in which the participants were travelling by themselves, exposure to traffic did not modify the preferred HAV configuration nor the seating position (although participants with high exposure tended to be less likely to choose seat D over seat A compared to those with low exposure, p -value=0.055). When asked about travelling with their partner/spouse, HAV#3 was significantly less preferred than HAV#1 in the group with high exposure compared to the group with the lowest exposure to km, controlling for age and sex. In this scenario, exposure to traffic was not significantly related to seating position preferences.

IV. DISCUSSION

This study provides preliminary results from the analysis of preferences in hypothetical scenarios in which participants were riding in a HAV either by themselves, with different members of their families or with strangers. The value of the dataset relies on covering passengers from multiple geographical areas in several continents. As the market penetration of HAV is expected to increase over the coming years, this information is useful to understand how occupants might modify their seating position preferences depending on their personal characteristics, who is travelling in the HAV and their travelling exposure.

V. REFERENCES

- [1] Jorloy, *et al.*, IRCOB, 2017.
- [2] Östling, *et al.*, ESV, 2019.