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Availability, Demand, Perceived Constraints and Disuse of ADAS Technologies in Spain: Findings From a National Study

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ABSTRACT Advanced Driver Assistance Systems (ADAS), created for enhancing the driving experience and actively preventing road crashes, have been progressively incorporated in vehicle designing essentially during the last decade. However, the literature has shown how some of these assisting technologies are not used by drivers in tandem with their potential. The aims of this study were, first, to examine the availability and demand of ADAS technologies among Spanish drivers and, secondly, to explore the perceived constraints and discouraging reasons for avoiding the use of ADAS available in their vehicles. For this national cross-sectional study, data from 1,207 Spanish drivers were analyzed. The results of this study show that, on one hand, GPS navigation, rain sensors and automatic lighting are the most frequently used ADAS features in Spain and, on the other, that gestural control, E-call and post-collision emergency braking are the less demanded. Also, there are age and gender-based differences in the valuation of certain ADAS features. Further, low perceived value, lack of confidence and potential distractibility constitute the main constraints perceived by drivers to actively use these assisting technologies while driving. In this regard, and jointly with a progressive vehicle automatization, a deeper emphasis on driver training, safety and efficiency-related benefits of ADAS technologies may strengthen its acceptance and progressive inclusion in everyday driving.

INDEX TERMS Advanced driver assistance systems (ADAS), drivers, demand, reliability, disuse.

I. INTRODUCTION

Advanced Driver Assistance Systems (ADAS) can be understood as electronic systems intended to enhance human-machine interaction and increase both vehicle and overall road safety, by means of aiding people while driving. Also, ADAS have been included within the several improvements of the Intelligent Vehicle Technology (IVT), that aim to improve driving experience and protect motor vehicle users from potentially preventable risks and crashes on the road [1]. Different benefits from ADAS, such as timely warnings and autonomously intervening in hazardous situations, undoubtedly constitute an opportunity for the progressive improvement of road safety through the reduction of causalities attributable to human factors [2], [3].

ADAS technologies may even contribute to strengthen road safety numbers of some specific population groups reporting considerably greater rates of traffic crashes, such as young and elderly drivers, since assisting features are designed to help drivers reacting properly to key critical events and difficult driving maneuvers [4], [5]. In other words, safety of drivers using ADAS are expected to be increased over time, to the extent that this population gives more frequent and better use to them [6]. Nevertheless, the recent evidence has demonstrated that, even when these features may be already integrated to their vehicles, only a limited percentage of drivers might be properly informed about the functioning, usefulness and actual potential of ADAS for road safety [7], [8]. In this regard, some studies [9]–[14] have identified several latent barriers for ADAS and other automated features, that may be limiting their potentiality and functionality among drivers [15], including: a relative disinterest from drivers for ADAS intervention during risky driving [9], the interference of ADAS in the skill development of novice drivers [9]–[11], the often low driver' trust on assisting features [12], [13] and the potential lack of proper understanding and using of ADAS in particular age-based groups, such as elderly drivers [7], [14]. Another evident

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barrier for the interaction between users and technical-commercial information on ADAS is the (sometimes inconsistent) nomination of these technologies between sources, that may explain potential confusions among customers at the moment of interacting with potentially useful information in this regard; as an example, the Automatic Emergency Braking (AEB) may be frequently presented using terms such as ''active braking'', ''front automatic braking'', ''pre-collision assist'', etc., making difficult its identification through a single nominal standard [16], [17].

Despite the above-mentioned barriers and limitations perceived by their potential users, the positive impact of ADAS in road safety issues has been previously documented in different recent studies. As a summary, developments such as forward collision warning systems have been demonstrated to shorten response times in high-risk (younger and older) groups of drivers [7], [18]. Visual-based sensors (e.g., eye trackers and face monitoring systems) have similarly been characterized as useful resources to prevent both distracted and drowsy driving, decreasing the number of crashes derived from fatigue, sleepiness and task repetitiousness, commonly prevalent in long-haul driving [19], [20]. Also, Lahausse *et al.* [21] found that automatic crash notification systems (ACNs) significantly improve the rapid attention in traffic crash cases, contributing to the decreasing of road fatalities. Other relevant ADAS technologies such as Adaptive Cruise Control (ACC-ISA) have been considered as a critical component for driving automation and crash prevention during the last years [22], [23]. Finally, further positive aspects of ADAS features for driving are worth to be mentioned. First, many efforts from manufacturers and designers have facilitated that, nowadays, on-board assisting features are more affordable and accessible for drivers and their benefits more evident, especially when social acceptance promotes its employment [24]. In this sense, the using of some of them have been normalized along the last decade, allowing vehicle manufacturers and policymakers to enhance the systematic inclusion of ADAS in everyday transport means [13], [25]. Both in the United States and the European Union, it is projected that by the year 2022 all new vehicles will be overall assisted by various ADAS, such as Autonomous Emergency Braking (AEB) and speed limiters [26], [27]. Moreover, by 2030, full-automated vehicles, that include several assisting features, are expected to be commonly commercialized, representing at least 30% of the automotive fleet [28]. Nevertheless, recent studies [29], [30] have found several human-based constraints, such as lack of information and confidence among drivers, fact that may limit their use assisting features during driving. Thus, the core motivation of this study was to describe the state-of-affairs, the availability, use, concerns and perceptions regarding ADAS features among Spanish drivers, as a manner of identifying points to address for strengthening its adoption among users and inclusion into transportation dynamics.

A. STUDY OBJECTIVES AND HYPOTHESES

The first objective of this study was to examine the availability and demand of ADAS (Advanced Driver Assistance Systems) technological features among Spanish drivers. The second aim was to identify the perceived constraints and discouraging reasons for avoiding the use of assisting tools available in their vehicles. Regarding the hypotheses of the study, formulated in accordance to each research aim, it was expected to find that: 1) the availability of more conventional ADAS features is currently high, but some of them - essentially related to higher SAE automatization levels- are still scarce, and 2) lack of confidence and distractibility may constitute the two main perceived constraints for using these features, even when available on-board.

II. METHODS

A. SAMPLE

The data was collected along the second half of year 2018 from a full sample of 1,207 Spanish drivers from all the 17 autonomous communities of Spain. In order to keep its proportionality to the driving population in the country, the sample was stratified using quotas, according to sex, age and regions of residence, through the use of quotas for the sampling procedure. An initial calculation of a sample size representative of the Spanish driving population was 665 individuals (assuming a confidence level of 99% and a maximum margin of error of 5%). However, the relatively high response rate allowed us to collect more than 1,200 respondents for the final sample.

From these 1,207 participants, 551 (45.7%) of them were females, and 656 (54.3%) males, aged between 18 and 65, with a mean value of $M = 40.5$ ($SD = 11.05$) years. All of them were frequent and licensed drivers, being the last in accordance with the current licensing regulations of the European Union for maneuvering motor vehicles. Regarding their tenure as drivers, 17% of participants had between 0 and 5 years, 31.1% between 5 and 15 years, and 51.9% has more than 15 years of (licensed) driving experience.

B. QUESTIONNAIRE AND PROCEDURE

For gathering the data, we used a structured live-survey, always applied and assisted by a member of the research staff, fact that, in addition, allows researchers to solve potential doubts from participants during the data collection, thus minimizing data biasing derived from the misunderstanding of questions or statements. Respondents were informed on the purposes of the study, its scientific value and relevant ethical aspects explained in the next section. Once they agreed to participate, it was applied the survey, that was structured in two sections (also fully available in the Appendix):

In the first section, demographic data on the participants (age, sex, education, driving tenure, frequency and intensity) was collected.

In the second section, and with the aim of: *a*) ensuring that participants had a proper understanding of ADAS, and

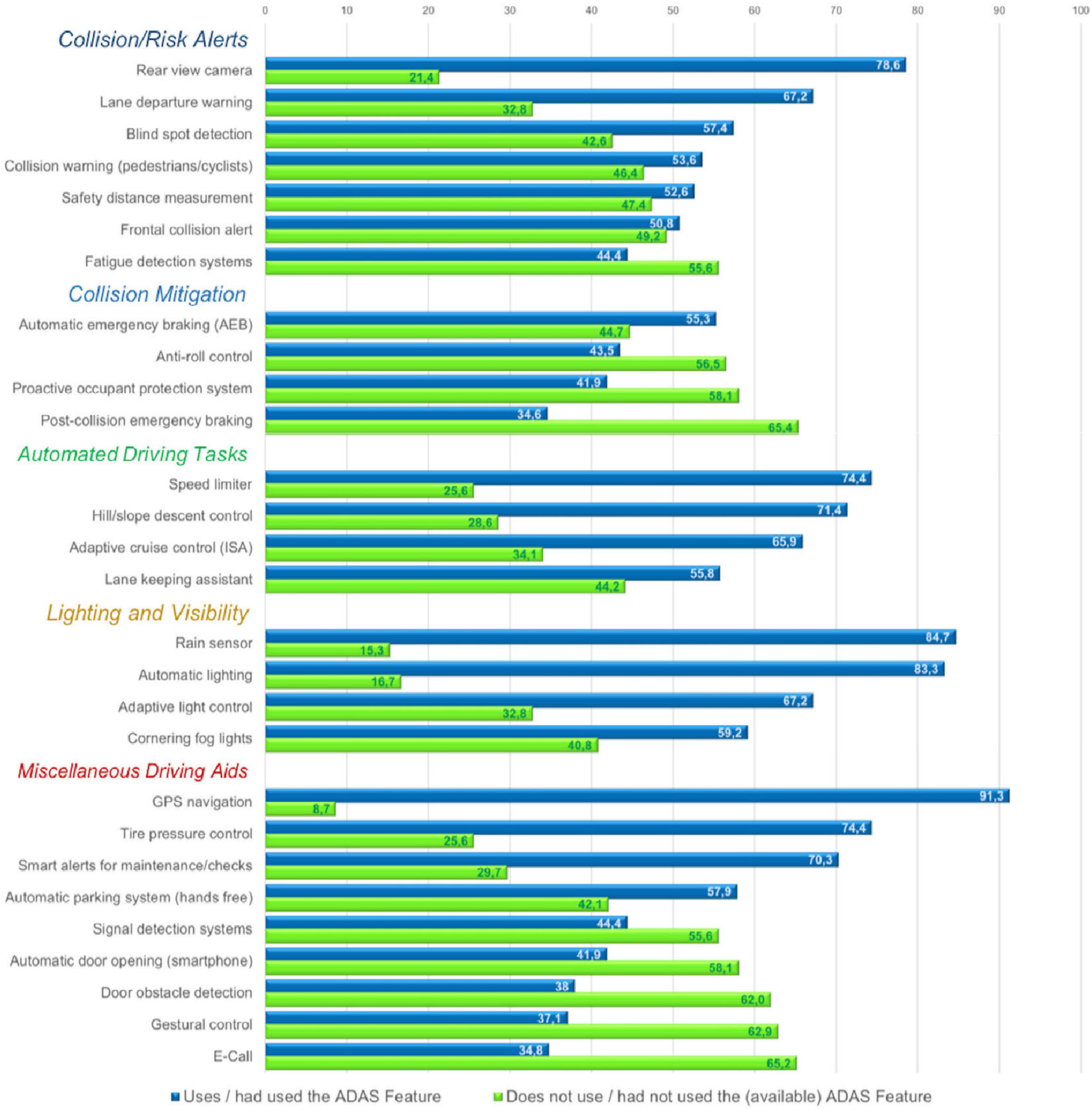

FIGURE 1. **Demand of available assisting features of ADAS among Spanish drivers (percentages).**

b) avoiding potential confusions regarding the naming and function of each one of the 28 ADAS included in this study, participants were provided with a summary stating its name (standard) and basic features, as shown in the Appendix of this paper. Once read this material, the survey included a series of questions on the availability (yes/no) and use (yes/no) of 28 ADAS presented by the interviewer. Also, participants were asked on how useful do they perceive these ADAS are, using a numeric scale (ranging between 1 = Not useful at all, and 10 = Very useful) to obtain their appraisal on the utility of each ADAS feature. Finally, participants were asked on why they do not use some ADAS that they stated not using despite having them available, with five potential response options, posteriorly identified through categorical analysis of the retrieved responses: *a) I don't need it/find it useless. b) I don't know how it works. c) I don't trust this feature; d) It distracts me; e) I find it annoying/uncomfortable.*

TABLE 1. Descriptive results of the study: Availability, usage, demand and valuation of ADAS technologies among Spanish drivers.

Class[a]	ADAS Technology	On-board Availability[1]		Overall Usage[2]		Demand[3]	User Valuation[4]	
		Percent	n	Percent	n	Percent	Mean	SD
MA	GPS navigation	40.0%	483	36.5%	441	91.3%	8.61	1.59
LV	Automatic lighting	39.2%	473	32.6%	394	83.3%	8.54	1.74
LV	Speed limiter	38.5%	465	28.7%	346	74.4%	8.37	1.79
LV	Rain sensor	34.7%	419	29.4%	355	84.7%	8.15	1.95
MA	Tire pressure control	32.4%	391	24.1%	291	74.4%	8.44	1.77
AT	Adaptive cruise control (ISA)	25.5%	308	16.8%	203	65.9%	8.48	1.79
AT	Cornering fog lights	24.2%	292	14.3%	173	59.2%	8.10	2.12
CR	Adaptive light control	20.0%	241	13.4%	162	67.2%	8.31	1.75
MA	Rear view camera	19.0%	229	14.9%	180	78.6%	8.72	1.65
AT	Smart alerts for maintenance/checks	18.4%	222	12.9%	156	70.3%	8.30	1.90
CR	Hill/slope descent control	17.4%	210	12.4%	150	71.4%	8.51	1.60
CM	Safety distance measurement	16.2%	196	8.5%	103	52.6%	8.12	2.19
CR	Blind spot detection	14.6%	176	8.4%	101	57.4%	8.42	1.95
AT	Automatic emergency braking	12.4%	150	6.9%	83	55.3%	8.58	1.71
CR	Anti-roll control	11.4%	138	5.0%	60	43.5%	8.48	1.58
CR	Signal detection systems	11.2%	135	5.0%	60	44.4%	8.28	1.85
CR	Post-collision emergency braking	11.0%	133	3.8%	46	34.6%	8.41	1.63
CR	Lane departure warning	10.9%	131	7.3%	88	67.2%	8.51	1.60
MA	Fatigue detection systems	10.4%	126	4.6%	56	44.4%	7.57	2.14
MA	Frontal collision alert	9.9%	120	5.1%	61	50.8%	8.49	1.88
CM	Automatic parking system (hands free)	9.4%	114	5.5%	66	57.9%	7.98	2.18
MA	E-Call: emergency call and localized assistance	9.3%	112	3.2%	39	34.8%	8.59	1.55
LV	Door obstacle detection	8.9%	108	3.4%	41	38.0%	8.24	1.87
CM	Gesture control	8.7%	105	3.2%	39	37.1%	7.85	1.63
MA	Lane keeping assistant	7.1%	86	4.0%	48	55.8%	8.48	1.57
CM	Proactive occupant protection system	7.1%	86	3.0%	36	41.9%	8.53	1.56
MA	Collision warning (pedestrians/cyclists)	5.7%	69	3.1%	37	53.6%	8.89	1.31
MA	Automatic door opening (smartphone)	5.1%	62	2.2%	26	41.9%	8.23	1.77

Notes: [a]Classification of ADAS: CR=Collision/Risk Alerts; CM=Collision Mitigation; AT=Automatic Driving Tasks; LV=Lighting and Visibility; MA=Miscellaneous Driving Aids. [1]Drivers whose vehicles include the ADAS feature. [2]Absolute percentage of drivers using the ADAS feature (considering the full sample). [3]Relative percentage of drivers using the ADAS feature (among those having it in their vehicles). [4]Valuation based in a 1 to 10 scale.

Following the typologies and basic definitions suggested by the American Automobile Association (AAA) [31], the ADAS included in this study were classified in five different groups, according to its function and main features: Collision/Risk Alerts (CR); Collision Mitigation (CM); Automatic Driving Tasks (AT); Lighting and Visibility (LV); and Miscellaneous Driving Aids (MA). For further information, please see Figure 1 and the glossary of Appendix.

C. ETHICAL CONSIDERATIONS

To carry out this multidisciplinary study, the Social Science in Health Research Ethics Committee of the University of Valencia was consulted, certifying that our research responded to the general ethical principles, and certifying its accordance with the Declaration of Helsinki, and that funding issues do not interfere with the quality and transparency of the results (IRB approval number H15355481258595). Furthermore, an Informed Consent Statement containing ethical principles and data treatment details was used, explaining the objective of the study, the mean duration of the survey, the treatment of the personal data and the voluntary participation, always provided to the participants before surveying. Personal and/or confidential data were not used, and the partaking was anonymous, implying no potential risks for the integrity of our participants. Respondents did not receive any payment or economical reward for their participation in the study.

TABLE 2. Significant differences in the valuation of available ADAS by sex and age group of drivers.

Gender-based significant differences								
Class[a]	ADAS feature	Female drivers		Male drivers		Mean comparison test		
		Mean	SD	Mean	SD	df	F	p-value[1]
CM	Automatic emergency braking (AEB)	9.08	1.49	8.12	1.77	1, 81	19.047	0.010
CM	Post-collision emergency braking	9.11	1.24	7.93	1.70	1, 44	15.051	0.014
MA	Smart alerts for maintenance/checks	8.63	2.12	8.02	1.65	1, 154	14.012	0.049
MA	Door obstacle detection	8.89	1.18	7.68	2.12	1, 58	14.997	0.036

Age group-based significant differences									
Class[a]	ADAS feature	Mean/Age Group					Mean comparison test		
		<25	25-34	35-44	45-54	>54	df	F	p-value[1]
CR	Rear view camera	9.00	8.08	8.92	8.86	9.31	4, 175	2.793	0.028
CM	Automatic emergency braking (AEB)	8.82	8.87	7.71	9.07	9.25	4, 78	2.642	0.047
AT	Hill/slope descent control	8.17	8.76	8.00	8.90	9.18	4, 145	2.944	0.022
AT	Adaptive cruise control (ISA)	9.29	8.30	8.28	8.67	8.77	4, 57	3.197	0.020
LV	Rain sensor	8.12	8.00	7.95	8.24	9.07	4, 261	2.854	0.024
MA	Automatic parking system (hands free)	8.00	8.25	7.35	8.13	9.67	4, 55	3.813	0.019

Notes: [a] Classification of ADAS: CR=Collision/Risk Alerts; CM=Collision Mitigation; AT=Automatic Driving Tasks; LV=Lighting and Visibility; MA=Miscellaneous Driving Aids. [1] Significant at the level 95% of confidence when p<0.05.

D. STATISTICAL ANALYSIS (DATA PROCESSING)

Prior to the data analysis, data curation was carried out, checking and categorizing the responses provided by the participants of the study. Frequency analyses were performed in order to obtain percentages of on-board availability and usage of the 28 stated ADAS features. Overall usage rate was estimated through the absolute frequency of drivers using each ADAS technology. The values on ADAS demand were calculated using relative percentages, i.e., number of drivers using it over number of vehicles having the feature. User valuation (perceived usefulness) was estimated through basic descriptive analyses (means and standard deviations). Also, comparisons on the valuation of available ADAS according to the gender and age group of drivers were carried out through ANOVA-based robust tests with a level of significance of $p<0.05$. Finally, discouraging reasons for available ADAS technologies were calculated through a categorical (nominal) analysis, considering only the available and non-used features of each participant. All statistical analyses were performed using ©IBM SPSS (Statistical Package for Social Sciences), version 24.0.

III. RESULTS

Descriptive results of the study are summarized in Table 1. Overall, the most frequently available assisting features were GPS navigation (40%), automatic lighting (39.2%), speed limiter (38.5%), rain sensors (34.7%) and tire pressure control (32.4%). On the other hand, the less available ADAS features in the vehicles used by Spanish drivers were: automatic door opening-via smartphone (5.1%), collision warning for pedestrians and cyclists (5.7%), proactive occupant protection systems and lane keep assistant (both available only in 7.1% of vehicles), and gesture control (8.7%).

Moreover, and considering the fact that the sole availability of ADAS does not necessarily imply their acceptance and use among drivers, a demand analysis was carried out. Therefore, it was calculated the percentage of Spanish drivers using (and not using) the whole list of 28 ADAS features presented in the survey, based in the relative percentage of participants whose vehicles include each one of the assisting systems. Figure 1 shows, hierarchically, the most and the least demanded features. Individual frequency-based analyses shown that the most commonly used (available) systems or features were GPS navigation (91.3% of drivers have used it), rain sensors (84.7%), automatic lighting systems (83.3%), rear view camera (78.6%) and tire pressure control (74.4%).

On the other hand, the least used ones, even when available in vehicles, were post-collision emergency braking (65.4% of drivers had never used it), E-Call (65.2%) (these two subjected to the fact of having suffered a traffic crash), gestural control (62.9%), door obstacle detection (62%) and proactive occupant protection systems (58.1%). Further, other emerging ADAS such as fatigue detection systems, safety distance measurement and frontal collision alerts

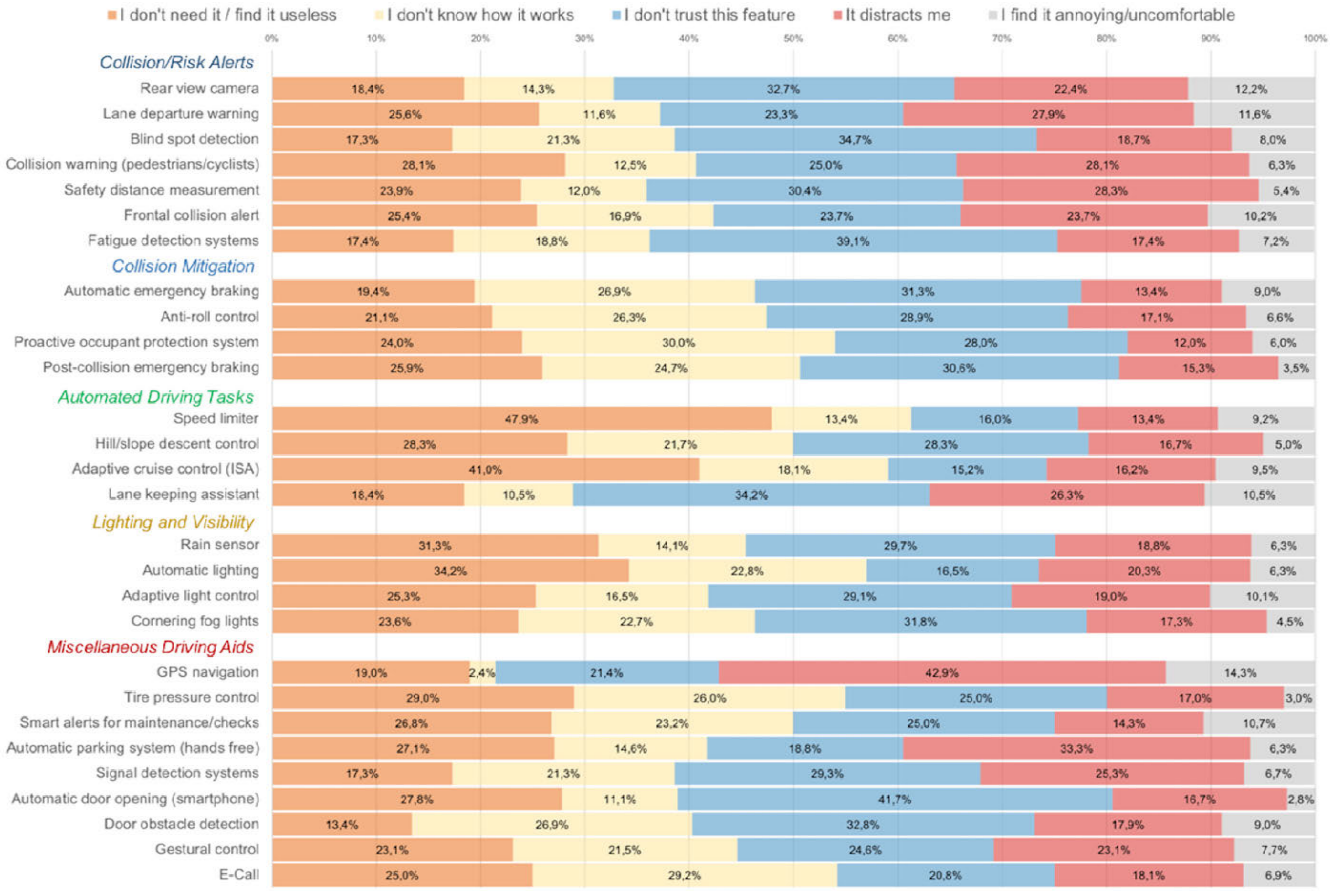

FIGURE 2. Reasons for avoiding the use of available ADAS technologies (percentages).

present a fairly balanced demand trend, with around half of drivers using it when available in their vehicles (see also Table 1).

A. AGE AND GENDER-BASED DIFFERENCES IN USEFULNESS-VALUATION OF ADAS

Since demographic variables or features of drivers may explain differences in their valuation of ADAS features, comparative analyses were performed using two categorical variables for contrasting the mean valuation (how useful do they perceive each feature) provided on the ADAS already available in the vehicles of participants: gender (female vs. male drivers) and age group, by splitting the sample in five intervals: *1)* drivers younger than 25; *2)* drivers between 25-34; *3)* drivers between 35-44; *4)* drivers between 45-54; and *5)* drivers older than 54 years (55 or more). The results show that: a) there are differences in the valuation of four ADAS features between genders, and b) significant differences by age group are present in the case of six ADAS. In the first case (gender), it was found that female drivers have a significantly greater valuation of Automatic emergency braking, Post-collision emergency braking (collision mitigation ADAS), Smart alerts for maintenance/checks and Door obstacle detection (miscellaneous driving aids). As for the second set of comparisons (based in age groups), it was found that age-based differences exist for the case of Rear view camera, Automatic emergency braking, Hill/slope descent control, Rain sensor and Automatic parking system (all higher for drivers >54), as shown in Table 2, where specific means anre found for other ADAS features.

B. REASONS FOR NOT USING ADAS TECHNOLOGIES

As it was pointed before, drivers do not only perceive benefits, but some key constraints and risks related to the use of ADAS. Although some of the ADAS features included in this study reported a high demand (e.g., the case of GPS navigation, rear view cameras and smart alerts), participants also alleged critical reasons for avoiding its employment. Particularly, categorical analyses on the provided responses allowed to establish five dismiss criteria: finding the specific feature useless or unnecessary; not knowing how to use it; not trusting the feature; considering that it distracts them; and finding it uncomfortable. Figure 2 presents the percentage of responses provided for the case in which they decided not using each one of the ADAS they have available in their vehicles.

In brief, categorical analyses shown that, depending on the perceived constraint, the disuse trend may vary according to each individual assisting feature. Firstly, most of drivers stated not using the following ADAS since they perceive them as useless or unnecessary: speed limiters (47.9%), adaptive cruise control (41%), automatic lighting (34.2%), rain sensors (31.3%), tire pressure control (29%), slope descent control (28.4%), collision warnings (28.2%), smart alerts (26.8%), and frontal collision alert (25.4%). The second category was related to driver do not properly knowing how specific assisting technologies work. Two ADAS were majorly characterized under this typology: proactive occupant protection systems (30% of drivers) and E-Call (29.2%). Thirdly, the disuse of some ADAS was related to the lack of confidence of users: automatic door opening (41.7%), fatigue detection systems (39.1%), blind spot detection (34.7%), lane keeping assistants (34.2%), door obstacle detection (32.8%), rear view cameras (32.7%), cornering fog lights (31.8%), automatic emergency braking systems (31.3%), post-collision emergency braking (30.6%), safety distance measurement systems (30.4%), signal detection systems (29.3%), adaptive light control (29.1%), anti-roll control (28.9%), and gestural control (24.6%). As for the fourth category, three assisting features were not used by drivers, since they considered them as distracting sources, as main disusing reason: GPS navigation (42.9%), automatic parking systems (33.3%), lane departure warnings (27.9%). Finally, for the case of the lack of comfortability as a perceived constraint, it was found that, although in none of the cases it constitutes a core reason for dismissing them, GPS navigation (14.3%), rear view cameras (12.2%) and lane departure warnings (11.6%) were the assisting features in which that perception was prevalent (see Figure 2).

IV. DISCUSSION AND CONCLUSION

Based on the information provided by 1,027 Spanish drivers taking part in this research, and bearing in mind the aims of the study, this paper examined, first, the availability and demand of ADAS' assisting features among Spanish drivers and, secondly, the perceived constraints and discouraging reasons for avoiding the use of available assisting tools in their vehicles.

As for the first objective, we found how, in accordance to the global trends observed along the last decade in most of European countries, some ADAS present a high availability, supported on the fact that -due to its proven utility and adaptation to transport dynamics- nowadays are easily involved in vehicle design trends (even in low ranges of vehicles), enhancing their demand by different groups of drivers but, at the same time, opening the discussion on potential implications for the road safety of vulnerable ones [1], [4], such as younger and older drivers [3], [5], [32]. Overall, the most commonly available ADAS features were GPS navigation (40% of on-board availability and 91.3% of demand among drivers), followed by other common technologies such as automatic lighting (39% of availability and 83% of demand) and speed limiters (38.5% and 74%, respectively). It is worth mentioning that, regardless of demand, all ADAS presented in this study had a considerably high valuation among users, with means oscillating between 7.5 (fatigue detection systems) and 8.9 (collision warnings) over 10, suggesting that, even when eventually disused -or misused-, ADAS features are noticeably positively valued among drivers.

Although an overall *positive* valuation does not directly imply potential users' demand, it reflects, in accordance to other studies such as the performed by Eby *et al.* [33], a certain level of awareness of drivers in different population segments on the ADAS' benefits and their protective value for the strengthening of road safety. Thus, it raises a further question that should be subsequently investigated: why, and despite the relatively positive assessment they give, some drivers decide not to use certain ADAS they have available in their cars? Based on the data provided by this study and other previous researches in the field of vehicle automation [13], [15], [30], confidence and knowledge may play a crucial role on: *a*) increasing the demand of ADAS features that are already available to drivers, and *b*) raising more interest in acquiring other ADAS that may improve, even more, their driving safety and comfort.

A. WHY COULD BE DRIVERS DISUSING SOME ADAS TECHNOLOGIES?

As for the second aim (i.e., to identify the constraints perceived by drivers in ADAS, that may explain their disuse), the core analysis was based in five main categories, using the responses provided by the participants of the study. In short, previous researches on the field have highlighted different constraints perceived by users on aspects such as the utility, usage directions and potential implications of on-board systems related to vehicle automation, being interesting to find how these studies have discussed the role of driving-assistance tools as a *double-edge sword* [6], [9], [10], [15]. Even though some assisting devices/systems only entail a passive use from drivers, other features need some level of direct intervention of users to intend the expected result, creating secondary tasks that may interfere with driving performance throughout small inattention lapses and distractions, or well requiring a continuous manual handling from users [34], [35]. This is the case of, for instance, GPS navigation systems; even when new alternative functions such as voice control, spatial learning and usual trip recognizance were applied along the last years to most existing interfaces [36], some disparities on the ratio between available functions vs. user's awareness on it have been recently identified [32], [37].

Particularly on the disuse reasons of ADAS reported by Spanish drivers, 9 out of the 28 studied ADAS (32.2%) were mainly perceived as useless or unnecessary by them (see Figure 2). Further, a relevant proportion of drivers stated not knowing how to properly handle ADAS features as main reason for not using them, even though they were already available in their vehicles. Specifically, both proactive occupant protection systems (a collision mitigation feature that may protect drivers and passengers during a traffic crash) and E-Call (1 out of each 3 of drivers affirm not knowing how it works, that makes sense when considering that its use may highly depend on the fact of having suffered an accident) are perceived as assisting features difficult to be operated,

Root Questionnaire [Researcher Form]

Study on Advanced Driving Assistance Systems (ADAS). FESVIAL – Samsung, 2018

[Basic instructions for respondents]

Thanks for your participation. Next, we will ask you a series of questions about **Advanced Driving Assistance Systems (ADAS)**: we would like to know your opinion and personal appraisal on this topic.

Prior to start responding, please refer to the sheet you received. There, you will find a detailed explanation on each one of the ADAS we are inquiring about; please use it anytime during responding to this survey.

There are no good or bad answers, so you can answer with full sincerity. As previously explained in the Informed Consent form, your answers will remain anonymous and will be treated confidentially.

Questions for participants:

[Please fill answers into the response sheet by using the assigned codes]

1. **Age** [*Quotas*]: _______

2. **Sex** [*Quotas*]: Male___ Female___

3. **Autonomous Community (Region)** [*Quotas*]: __________________

4. **Educational level:**
   No studies ____; Primary studies ____; Secondary-mid-high school ____; Technical/meduim studies ____; University studies ____

5. **Job Situation / Occupation:**
   Working ____; Retired ____: Unemployed ____; Student ____; Other (specify): ______________

6. **Driving experience (licensed):**
   Less than 5 years ____; Between 5-15 years _____; More than 15 years ____

7. **Driving frequency:**
   Once a week or less ____; Between 2-5 days a week ____; More than 5 days a week ____

8. **Which of these ADAS do u have already available in the vehicle you regularly drive?**

   [Check the indicated (**available ADAS**) ones for proceeding with the next question]

9. **From these ADAS that are available in your vehicle, which of them do you have used at least once?**

   [Check the indicated (**ADAS used**) ones for proceeding with the next question]

10. **What is the level of UTILITY you assign to these ADAS features that you use?**
    Please rate from 1 to 10 the ADAS you use, based on this scale:

    1=Not useful at all - 10=Very useful

    [Please ensure the participant understands the degree scale before checking]

11. **Now, let's talk about the ADAS that, despite being available in your vehicle, you decided not to use. We are interested in knowing why you don't use them*.**

    [Please refer to the ADAS available in the question 8, but not checked in the question 9]

    ***The following categories were found once performed the categorical analysis of the data provided by participants:**

a) I don't need it / find it useless.
b) I don't know how it works.
c) I don't trust this feature.
d) It distracts me.
e) I find it annoying/uncomfortable.

Glossary: Detail on ADAS features – Names and definitions

[Please provide it to participants and ensure they read it before starting to respond the questionnaire section on ADAS]

Advanced Driver Assistance Systems (ADAS) can be defined as electronic systems intended to enhance human-machine interaction and increase both vehicle and overall road safety, by means of aiding you while driving. Below, you will find a summary of the ones included in this study:

Collision/Risk Alerts	
Frontal Collision Alert	Also known as Forward Collision Warning. Detects impending collision while traveling forward and alerts driver.
Lane Departure Warning	Monitors vehicle's position within driving lane and alerts driver as the vehicle approaches or crosses lane markers.
Blind Spot Detection	Detects vehicles to rear in adjacent lanes while driving and alerts driver to their presence.
Collision Warning (pedestrians/cyclists)	Detects pedestrians, cyclists and other users in front of vehicle and alerts driver to their presence.
Rear View Camera	Detects vehicles approaching from side and rear of vehicles while traveling in reverse and alerts driver.
Safety Distance Measurement	Automatically detects other vehicles or obstacles and, based in a field appraisal, alerts drivers to keep a minimum safety distance from them.
Fatigue Detection Systems	Help preventing accidents caused by the driver getting drowsy by monitoring facial-eye patterns of drivers and/or other physiological parameters.
Collision Mitigation	
Automatic Emergency Braking (AEB)	Detects potential collisions while traveling and automatically applies brakes to avoid or lessen the severity of impact.
Anti-Roll Control	Gives stability to the vehicle, in order to reduce risk of rollover after a crash or loss of control.
Post-Collision Emergency Braking	Automatically stops a car after a crash, to avoid a more than possible second impact against another obstacle or vehicle.
Proactive Occupant Protection System	Detects when an emergency maneuver is being made and prepares the vehicle and its occupant restraint systems in advance of a possible collision.
Automated Driving Tasks	
Adaptive Cruise Control	Controls acceleration and/or braking to maintain a prescribed distance between it and a vehicle in front. May be able to come to a stop and continue.
Lane Keeping Assistant	Controls steering to maintain vehicle within driving lane. May prevent vehicle from departing lane or continually center vehicle.
Speed Limiter	Advise drivers of the current speed limit and, based on a previous configuration provided by the driver, automatically limit the speed of the vehicle as needed.
Hill/Slope Descent Control	Allows a controlled hill descent in rough terrain without any brake input from the driver, activating the brakes to automatically slow the vehicle
Lighting And Visibility	
Automatic Lighting	Increases visibility by lighting the headlight automatically when the surrounding illuminance is detected and found to be a minimum value or less.
Cornering Fog Lights	Provide an additional illumination when cornering. When the driver turns the steering wheel or indicate, the front fog light turns towards this direction.
Adaptive Light Control	Help drivers see better and further in the darkness. Allows the headlights to swivel and rotates to better illuminate the roadway through corners and in other circumstances.
Rain Sensor	Protect the interior of an automobile from rain and support the automatic mode of windscreen wipers.
Miscellaneous Driving Aids	
GPS Navigation	Provide visual and vocal live directions for route-choosing and traffic data useful for optimizing trips.
Automatic Parking System (hands free)	Help drivers to parallel park; in high-complexity systems, perform the full parking task.
Door Obstacle Detection	Alerts the driver on the presence of potential obstacles at the moment of opening the doors of the vehicle.
E-Call: Emergency Call and Localized Assistance	Automatically makes a free emergency call if the vehicle is involved in a serious road crash, providing specific details on its location and severity of the incident.
Tire Pressure Control	Monitor the air pressure inside the pneumatic tires, showing alerts when tires blow-out or have an inadequate pressure level.
Smart Alerts for Maintenance/Checks	Notify the driver on potential failures or damages in the vehicle that need to be revised, through a self-diagnose-based alert.
Automatic Door Opening (Smartphone)	Offers a keyless entry option and motion sensors to automatically open when the driver approaches, through a live connection with the smartphone.
Signal Detection Systems	Also known as Traffic Sign Recognition (TSR). Recognizes traffic signs (e.g., speed limits) and displays the recognized information on a display panel.
Gesture Control	Makes easier to use built-in systems through voice and motion-based commands, reducing the probability of causing a distraction-related crash.

implying the need of putting more efforts on informing and training drivers for its proper use.

Other studies such as the performed by Souders *et al.* [1] and Eby *et al.* [33], have shown the significant differences that exist in the valuation of some assisting features between age-based groups, suggesting that the willingness to acquire, adopt and use ADAS should be highly influenced by driver's demographic factors, as suggested in this study when finding that: *a*) female drivers and tend to value more positively collision mitigation and miscellaneous ADAS, such as automatic and post-collision emergency braking (CM), and smart alerts - obstacle detection systems MAs) than males, and *b*) drivers aged over 55 years tend to perceive more usefulness in some ADAS features of all types (see Table 2). In brief, various ADAS technologies directly aimed at improving in-trip safety, such as lane departure warning systems still present a considerably high disuse among drivers: the *disused when available* percentage reaches 22% in Braitman *et al.* [38], in a study performed with North American drivers, and 32.8% for the specific case of Spanish users.

Further, the basic question on in what extent attitudes and acceptance influence the use of ADAS is still pending to be responded; while the numbers demonstrate that some of them have been systematically naturalized in everyday driving, as previously seen in the results of this study, some others remain highly disused as a consequence of the lack of awareness, negative appraisals and different concerns on their reliability, stability and usefulness. In this sense, automotive designers may find useful putting these key aspects on the social discussion on automation technologies applied to the field of transportation, showing potential users how these developments may strengthen their safety and welfare.

Finally, it is worth stating some potential practical implications of this study. First of all, this research offers useful information about the state-of-affairs on the current availability, demand and concerns about different ADAS features among drivers, allowing other researchers to have a preliminary diagnosis on the matter. Secondly, and since this study was carried out on the basis of the interest of corporative and market stakeholders, the information can be used for strengthening the promotion of non-frequently used ADAS, that also may play a relevant role in the improvement of driving safety and comfort. Finally, gender and age-based differences on valuation of ADAS identified in this study may help to address population segments on which more work and information is needed to increase the knowledge, value and use of assisting driving features.

V. LIMITATIONS OF THE STUDY

Research on transportation and technology issues may be biased by different factors. Although our sample size was considerably large and nationally representative, basic parameters and data curation were accurately and satisfactorily tested, some specific issues should be listed as potential sources of bias. First, this study is based on a self-report method, implying the risk of presenting common method biases, frequently observed in cross-sectional designs for research [39]. These sources of bias may range from social desirability to lack of sincerity and acquiescence bias, and may still affect participants even though they were informed on the non-existence of wrong answers [40]. Also, if we consider that the survey addressed a topic encompassed in the current social discussion, it may emerge concerns expressed by many sectors of society about whether vehicle automatization may imply potential risks for drivers and other road users [41], [42]. This is a common problem in transportation research when based on self-reports, since some research topics, such as vehicle automatization, may be socially stigmatized and therefore tend to be biased, and may affect driver's perceptions on the usefulness and reliability of assisting features.

Moreover, and as for further studies on the area, it is worth suggesting, firstly, a deeper assessment on encouraging reasons, trustiness and perceived safety of ADAS features by means of supplementary measures; secondly, the complementary collection of qualitative data that would allow researchers to obtain more insights in this regard; thirdly, it is worth suggesting to study this matter in population aged over 65 years, considering their relevant role on road safety issues; and finally, we would like to suggest the crossing of data on ADAS with other interesting indicators, such as the individual accident history and driving patterns, that might increase the knowledge on the relationship between technological advances in traffic and road safety issues.

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APPENDIX

Root Questionnaire [Researcher Form] is shown at the top of the page 8 and Glossary: Detail on ADAS features - Names and definitions is shown at the top of the previous page.

REFERENCES

[1] D. J. Souders, R. Best, and N. Charness, "Valuation of active blind spot detection systems by younger and older adults," *Accident Anal. Prevention*, vol. 106, pp. 505–514, Sep. 2016. doi: 10.1016/j.aap.2016.08.020.

[2] R. Spicer, A. Vahabaghaie, G. Bahout, L. Drees, R. M. von Bülow, and P. Baur, "Field effectiveness evaluation of advanced driver assistance systems," *Traffic Injury Prevention*, vol. 19, pp. S91–S95, Oct. 2018. doi: 10.1080/15389588.2018.1527030.

[3] R. J. Davidse, "Older drivers and ADAS: Which systems improve road safety?" *IATSS Res.*, vol. 30, no. 1, pp. 6–20, 2006. doi: 10.1016/S0386-1112(14)60151-5.

[4] M. Dotzauer, S. R. Caljouw, D. de Waard, and W. H. Brouwer, "Intersection assistance: A safe solution for older drivers?" *Accident Anal. Prevention*, vol. 59, pp. 522–528, Oct. 2013. doi: 10.1016/j.aap.2013.07.024.

[5] S. Classen, M. Jeghers, J. Morgan-Daniel, S. Winter, L. King, and L. Struckmeyer, "Smart in-vehicle technologies and older drivers: A scoping review," *Proc. OTJR*, vol. 39, no. 2, pp. 97–107, 2019. doi: 10.1177/1539449219830376.

[6] M. Dotzauer, D. de Waard, S. R. Caljouw, G. Pöhler, and W. H. Brouwer, "Behavioral adaptation of young and older drivers to an intersection crossing advisory system," *Accident Anal. Prevention*, vol. 74, pp. 24–32, Jan. 2015. doi: 10.1016/j.aap.2014.09.030.

[7] D. Souders, N. Charness, H. Pham, and N. Roque, "Older drivers' acceptance of longitudinal and lateral vehicle warning systems," *Innov. Aging*, vol. 2, p. 972, Nov. 2018. doi: 10.1093/geroni/igy031.3601.

[8] G. A. M. Meiring and H. C. Myburgh, "A review of intelligent driving style analysis systems and related artificial intelligence algorithms," *Sensors*, vol. 15, no. 12, pp. 30653–30682, 2015. doi: 10.3390/s151229822.
[9] C. Hannan, A. J. Palumbo, M. C. F. Thiel, E. Weiss, and T. Seacrist, "Advanced driver assistance systems for teen drivers: A national survey of teen and parent perceptions," *Traffic Injury Prevention*, vol. 19, pp. S84–S90, Oct. 2018. doi: 10.1080/15389588.2018.1494383.
[10] E. Weiss, M. F. Thiel, N. Sultana, C. Hannan, and T. Seacrist, "Advanced driver assistance systems for teen drivers: Teen and parent impressions, perceived need, and intervention preferences," *Traffic Injury Prevention*, vol. 19, pp. S120–S124, Mar. 2018. doi: 10.1080/15389588.2017.1401220.
[11] D. L. Fisher, A. P. Pollatsek, and A. Pradhan, "Can novice drivers be trained to scan for information that will reduce their likelihood of a crash?" *Injury Prevention*, vol. 12, pp. i25–i29, Jun. 2006. doi: 10.1136/ip.2006.012021.
[12] H. Liu, H. Wei, T. Zuo, Z. Li, and Y. J. Yang, "Fine-tuning ADAS algorithm parameters for optimizing traffic safety and mobility in connected vehicle environment," *Transp Res Part C Emerg Technol*, vol. 76, pp. 132–149, 2017. doi: 10.1016/j.trc.2017.01.003.
[13] D. G. Kidd, J. B. Ciccino, I. J. Reagan, and L. Kerfoot, "Driver trust in five driver assistance technologies following real-world use in four production vehicles," *Traffic Injury Prevention*, vol. 18, pp. S44–S50, Apr. 2017. doi: 10.1080/15389588.2017.1297532.
[14] N. Aksan, L. Sager, B. Lester, S. Hacker, J. Dawson, S. W. Anderson, and M. Rizzo, "Effectiveness of a heads-up adaptive lane deviation warning system for middle-aged & older adults," in *Proc. Int. Driving Symp. Hum. Factors Driver Assessment, Training, Vehicle Design*, Dec. 2015, pp. 422–428.
[15] L. Montoro, S. A. Useche, F. Alonso, I. Lijarcio, P. Bosó-Seguí, and A. Martí-Belda, "Perceived safety and attributed value as predictors of the intention to use autonomous vehicles: A national study with Spanish drivers," *Saf. Sci.*, vol. 120, pp. 865–876, Dec. 2019.
[16] A. B. McDonald, D. V. McGehee, S. T. Chrysler, N. M. Askelson, L. S. Angell, and B. D. Seppelt, "National survey identifying gaps in consumer knowledge of advanced vehicle safety systems," *J. Transp. Res. Board*, vol. 2559, no. 1, pp. 1–6, Jan. 2016. doi: 10.3141/2559-01.
[17] D. Friedman, J. Fisher, K. Funhouser, and W. Wallace. (2018). *A Consumer Reports Initiative to End Confusion About Advanced Driver Assistance Systems*. [Online]. Available: https://advocacy.consumerreports.org/research/advanced-driver-assistance-systems-standard-nomenclature/
[18] B. D. Lester, L. N. Sager, J. Dawson, S. D. Hacker, N. Aksan, M. Rizzo, and S. Kitazaki, "Pilot results on forward collision warning system effectiveness in older drivers," in *Proc. Int. Driving Symp. Hum. Factors Driver Assessment, Training, Vehicle Design*, 2015, pp. 345–351.
[19] J. Xu, J. Min, and J. Hu, "Real-time eye tracking for the assessment of driver fatigue," *Healthc Technol Lett*, vol. 5, no. 2, pp. 54–58, 2018. doi: 10.1049/htl.2017.0020.
[20] A. Fernández, R. Usamentiaga, J. L. Carús, and R. Casado, "Driver distraction using visual-based sensors and algorithms," *Sensors*, vol. 16, no. 11, p. 1805, 2016. doi: 10.3390/s16111805.
[21] J. A. Lahausse, B. N. Fildes, Y. Page, and M. P. Fitzharris, "The potential for automatic crash notification systems to reduce road fatalities," in *Proc. Ann. Adv. Automot. Med.*, vol. 52, 2008, pp. 85–92.
[22] Y. Li, Z. Li, H. Wang, W. Wang, and L. Xing, "Evaluating the safety impact of adaptive cruise control in traffic oscillations on freeways," *Accident Anal. Prevention*, vol. 104, pp. 137–145, Jul. 2017. doi: 10.1016/j.aap.2017.04.025.
[23] A. H. Eichelberger, and A. T. McCartt, "Volvo drivers' experiences with advanced crash avoidance and related technologies," *Traffic Injury Prevention*, vol. 15, no. 2, pp. 187–195, 2014. doi: 10.1080/15389588.2013.798409.
[24] E. Sezgin and S. Lin, "Technology-based interventions, assessments, and solutions for safe driving training for adolescents: Rapid review," *JMIR mHealth uHealth*, vol. 7, no. 1, 2019, Art. no. e11942. doi: 10.2196/11942.
[25] Y. Page, T. Hermitte, and S. Cuny, "How safe is vehicle safety? The contribution of vehicle technologies to the reduction in road casualties in France from 2000 to 2010," in *Proc. Annu. Sci. Conf.*, vol. 55, 2011, pp. 101–112.
[26] N. Hubele and K. Kennedy, "Forward collision warning system impact," *Traffic Injury Prevention*, vol. 19, pp. S78–S83, Sep. 2018. doi: 10.1080/15389588.2018.1490020.
[27] M. Edwards, A. Nathanson, and M. Wisch, "Estimate of potential benefit for Europe of fitting autonomous emergency braking (AEB) systems for pedestrian protection to passenger cars," *Traffic Injury Prevention*, vol. 15, pp. S173–S182, Oct. 2014. doi: 10.1080/15389588.2014.931579.
[28] McKinsey & Co. (2016). *Automotive Revolution–Perspective Towards 2030 How the Convergence of Disruptive Technology-Driven Trends Could Transform the Auto Industry*. [Online]. Available: http://go.uv.es/G6b8o63
[29] P. Bansal and K. M. Kockelman, "Forecasting Americans' long-term adoption of connected and autonomous vehicle technologies," *Transp. Res. A, Policy Pract.*, vol. 95, pp. 49–63, Jan. 2017.
[30] S. Pettigrew, Z. Talati, and R. Norman, "The health benefits of autonomous vehicles: Public awareness and receptivity in Australia," *Austral. New Zealand J. Public Health*, vol. 42, no. 5, pp. 480–483, 2018. doi: 10.1111/1753-6405.12805.
[31] American Automobile Association (AAA). (2019). *Advanced Driver Assistance Technology Names: AAA's Recommendation for Common Naming of Advanced Safety Systems*. [Online]. Available: https://www.aaa.com/AAA/common/AAR/files/ADAS-Technology-Names-Research-Report.pdf
[32] K. A. Brookhuis, D. de Waard, and W. H. Janssen, "Behavioural impacts of advanced driver assistance systems–an overview," *Eur. J. Transp. Infrastruct. Res.*, vol. 1, no. 3, pp. 245–253, 2019.
[33] D. W. Eby, L. J. Molnar, L. Zhang, R. M. S. Louis, N. Zanier, L. P. Kostyniuk, and S. Stanciu, "Use, perceptions, and benefits of automotive technologies among aging drivers," *Injury Epidemiol.*, vol. 3, no. 1, Dec. 2016, Art. no. 28. doi: 10.1186/s40621-016-0093-4.
[34] P. Gershon, K. R. Sita, C. Zhu, J. P. Ehsani, S. G. Klauer, T. A. Dingus, and B. G. Simons-Morton, "Distracted Driving, Visual Inattention, and Crash Risk among Teenage Drivers," *Amer. J. Preventive Med.*, vol. 56, no. 4, pp. 494–500, 2019. doi: 10.1016/j.amepre.2018.11.024.
[35] C. N. Pope, T. R. Bell, and D. Stavrinos, "Mechanisms behind distracted driving behavior: The role of age and executive function in the engagement of distracted driving," *Accident Anal. Prevention*, vol. 98, pp. 123–129, Jan. 2017. doi: 10.1016/j.aap.2016.09.030.
[36] K. Gramann, P. Hoepner, and K. Karrer-Gauss, "Modified navigation instructions for spatial navigation assistance systems lead to incidental spatial learning," *Frontiers Psychol.*, vol. 8, p. 193, Feb. 2017. doi: 10.3389/fpsyg.2017.00193.
[37] C. Crump, D. Cades, B. Lester, S. Reed, B. Barakat, L. Milan, and D. Young, "Differing perceptions of advanced driver assistance systems (ADAS)," in *Proc. Hum. Factors Ergonom. Soc. Annu. Meeting*, 2016, vol. 60, no. 1, pp. 861–865. doi: 10.1177/1541931213601197.
[38] K. A. Braitman, A. T. McCartt, D. S. Zuby, and J. Singer, "Volvo and infiniti drivers' experiences with select crash avoidance technologies," *Traffic Injury Prevention*, vol. 11, no. 3, pp. 270–278, 2010. doi: 10.1080/15389581003735600.
[39] P. M. Podsakoff, S. B. MacKenzie, J.-Y. Lee, and N. P. Podsakoff, "Common method biases in behavioral research: A critical review of the literature and recommended remedies," *J. Appl. Psychol.*, vol. 88, no. 5, pp. 879–903, 2003. doi: 10.1037/0021-9010.88.5.879.
[40] T. Razavi, "Self-report measures: An overview of concerns and limitations of questionnaire use in occupational stress research," in *Discussion Papers in Accounting and Management Science*. Southampton, U.K.: Univ. Southampton, 2001, p. 23. [Online]. Available: https://eprints.soton.ac.uk/35712/
[41] D. Silver. (2018). *Will Self-Driving Cars Cause Unemployment?* [Online]. Available: https://medium.com/self-driving-cars/will-self-drivin204g-cars-cause-unemployment-42006dcfedfb
[42] F. Terrade, H. Pasquier, J. Reerinck-Boulanger, G. Guingouain, and A. Somat, "L'acceptabilité sociale: La prise en compte des déterminants sociaux dans l'analyse de l'acceptabilité des systèmes technologiques," *Le Travail Humain*, vol. 72, pp. 383–395, Jan. 2009.

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