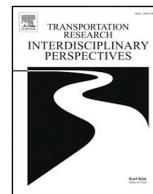




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How are car buyers and car sellers currently informed about ADAS? An investigation among drivers and car sellers in the Netherlands



A. Boelhouwer^{a,*}, A.P. van den Beukel^b, M.C. van der Voort^b, C. Hottentot^c, R.Q. de Wit^d, M.H. Martens^{e,f}

^a Centre for Transport Studies, University of Twente, Drienerloaan 5, 7522, NB, Enschede, the Netherlands

^b Department of Design, Production and Management, University of Twente, Drienerloaan 5, 7522, NB, Enschede, the Netherlands

^c ANWB, Wassenaarseweg 220, 2596, EC, Den Haag, the Netherlands

^d BOVAG, Kosterijland 15, 3981 AJ Bunnik, the Netherlands

^e TNO Traffic & Transport, Anna van Buerenplein 1, 2496, RZ, The Hague, the Netherlands

^f Department of Industrial Design, Eindhoven University of Technology, Groene Loper 3, 5612, AE, Eindhoven, the Netherlands

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ABSTRACT

This study provides a comprehensive overview of the way consumers and car sellers are currently informed about Advanced Driver Assistance Systems (ADAS). In order to gain any economical, comfort and safety benefits from automated car systems, drivers need to know how to safely and efficiently use them. Still, it remains largely unknown if, and how, consumers are informed about ADAS when buying a car. Naturally, sales staff has to be accurately informed and instructed as well to inform customers. Two separate nationwide surveys were administered among consumers and car sellers across The Netherlands to gain insight on how they are currently informed about ADAS. The results of our study show several issues about the way that both consumers and car sellers are informed about ADAS. First, almost a quarter of the drivers did not receive any information about the ADAS in the car that they bought. Of the drivers that did receive information, only 9% was able to try out the automated systems before taking the car home. Almost 40% of the car sellers did not receive (sufficient) information about ADAS. However, brand dealers more often received sufficient information about ADAS compared to independent dealers. These issues need to be addressed now to avoid unsafe use of ADAS, but also unsafe use of more complex automated systems that are being incorporated into commercial cars. We propose several opportunities for improvement and standardization which may be implemented by the automotive industry, stakeholder organizations or the government.

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1. Introduction

While cars with automated systems such as Advanced Driver Assistance Systems (ADAS) have the potential to increase traffic safety (Fagnant and Kockelman, 2015; Morando et al., 2017), this will only be the case if drivers (know how to) safely interact with their automated cars. Insufficient or inaccurate knowledge about the automated car systems is expected to result in two major issues (Beggiato and Kreams, 2013; Stanton and Young, 2000). First, drivers may rely on the car when it is unsafe, if they do not have an accurate understanding of the capabilities and limitations of the car (Parasuraman and Riley, 1997). This overreliance on the automation has severe safety implications when the driver does not operate the car (properly) when needed. Drivers may show increased distraction, response times, and lane variability, or not take back control when necessary at all, which all negatively affect the general traffic safety (Boelhouwer et al., 2019a; Körber, 2018; Popken et al., 2009; Rudin-Brown and Parker, 2004). Second, if the

driver does not know when and how to use the automated systems, he or she may not use them at all or not to their full capacity. Although this appears to be less critical, this disuse may greatly hinder the overall adaptation and any potential benefits of the new technology (Martens and van den Beukel, 2013). A recent study by Hams and Dekker (2017) showed a lack of understanding and usage of ADAS among business drivers. More strikingly, the large majority of the business drivers was unaware that their car was equipped with a particular ADAS. This lack of knowledge needs to be addressed as it will negatively influence traffic safety and any other potential automation benefits. This does not only hold for ADAS but for all increasingly complex automated car systems as they will be even more difficult for drivers to understand and operate.

Several factors contribute to the fact that current automated car systems are inadequately known to, and understood by, drivers. First, the currently available automated systems have a large variety of capabilities and limitations. There are systems that have the same functionalities but are named differently across car brands, while there are also systems with different functionalities that have the same (or a very similar) name. Second, as Abraham et al. (2017b) and Carsten and Martens

* Corresponding author.

E-mail address: a.boelhouwer@utwente.nl (A. Boelhouwer).

(2018) pointed out, the Human Machine Interface (HMI) in current automated systems are not standardized and cause confusion to drivers. Car brands differ in the way they provide drivers with information about the information while driving (Boelhouwer et al., 2019b; Capallera et al., 2019; Carsten and Martens, 2018). While some show the detected vehicles all around the car, others only show the distance to the car in front (Boelhouwer et al., 2019b). Car brands also differ largely in the symbols, colours and text messages that they use (Carsten and Martens, 2018). Last but not least, an important factor that impacts the current driver's knowledge about automated car systems is the information drivers receive during the car purchase process. The large US survey by Abraham et al. (2018) suggests that drivers are mainly reliant on themselves for getting information about ADAS. Most drivers got the information either through the owner's manual, or by trial-and-error practice while driving. Trial-and-error was the main way of learning for several different ADAS systems in the qualitative study in the Czech Republic by Viktorová and Šucha (2018), the US survey by Jenness et al. (2008), and among business drivers in the Netherlands (Harms and Dekker, 2017). In contrast however, the preferred way of learning about ADAS is through the dealership (Abraham et al., 2018). It is important to know if and how exactly non-business drivers are informed at car dealers, and how this may be improved. Especially as higher (self-reported) ADAS knowledge was found if the preferred learning method matched the actual learning method (Abraham et al., 2018). With the exception of a local study among US car dealers by Abraham et al. (2017a) indications of the way car dealers inform costumers remain mainly anecdotal. Are drivers mainly informed through verbal explanations, brochures or do they receive any practical training? On the other hand, in order for drivers to be properly instructed about the automated systems, clearly the sales staff has to be accurately informed as well. It is unclear how sales personnel of these systems are currently informed about the systems.

Two separate nationwide surveys were administered across The Netherlands to get an insight in the way both consumers and car sellers are informed about ADAS. The first survey was distributed among ANWB members that purchased a car in the last two years. ANWB is the biggest membership association in The Netherlands. ANWB aims to represent the interests of its members in the areas of recreation, tourism, traffic and transportation, in the broadest sense of the word. Therefore they come up with a wide range of products and services all mobility and recreation related, such as consumer education, providing live traffic information and roadside assistance (comparable to the American Automobile Association). The goal was to investigate how consumers are currently informed about ADAS when purchasing a car with these systems. The second survey was distributed among brand car dealers and independent car dealers registered with BOVAG. BOVAG is a large Dutch trade organization for mobility retailers. The goal of the second survey was to investigate how car sellers are being informed and trained about the latest ADAS in The Netherlands. The methods and results of these surveys will be discussed separately and consequently combined in the discussion section.

By looking at both the consumer and car seller perspective, this study provides a comprehensive overview of the way both consumers and car sellers are informed about ADAS in the Netherlands. The results can be used for the development of guidelines and standardization of consumer education on automated car systems. This way, the results of this study can further stimulate safe, effective and efficient use of the new automated car systems.

2. Consumer survey

The following section specifically describes the methodology and results of the consumer survey among ANWB members in The Netherlands. This survey aimed to get an overview of the way consumers are currently informed about ADAS when purchasing a new or used car.

2.1. Methods

2.1.1. Participants

A survey was distributed in January of 2019 in The Netherlands to a random selection of ANWB members that signed up on "denkmeemetdeanwb.nl". By signing up to this website, participants indicated that they were interested in joining studies and surveys on transportation in general.

In total, 1241 started the online survey and 713 respondents fully completed the questionnaire and bought either a new (48.8%) or used (51.2%) car in the last two years. The average age was 59 years ($M = 59.0$, $SD = 12.0$) with the youngest respondent being 20 years and the oldest 85 years. The ratio of male to female respondents was skewed with 82.3% being male. The most bought car brands in the last two years by the respondents were: Opel (11.1%), Renault (8.8%), Peugeot (7.4%) and Ford (7.3%). The majority of the cars the respondents bought were built in 2016 or later (64.3%). 11.1% bought a car built in or before 2010. The majority of the participants indicated to use a car as their main mode of transportation (88.1%). Both the interest in general new technology and car technology was relatively high. 59.2% indicated to agree or fully agree with the statement: "I am interested in new technologies (for example gadgets and apps)". 11.1% disagreed or fully disagreed while the rest remained neutral. To the statement: "I am interested in the newest technological developments in cars", 62.4% said to agree or fully agree. 9.8% disagreed or fully disagreed while the rest was neutral.

2.1.2. Equipped ADAS and sales contact

The majority of the participants had Cruise Control (CC) (93.1%), while only 13 participants (1.8%) had Automated Lane Change (ALC) in their car. This small group size for ALC owners needs to be taken into account when interpreting the corresponding ALC survey data. The amount of participants that had Adaptive Cruise Control (ACC) was lower at 22.6%. 24.1% indicated to have Lane Keeping (LK), while 19.4% had Automated Parking (AP). All 713 participants had at least one system in their car. Participants mainly received their car personally at the car dealer (89.2%). 2.8% received the car at home (1.4%) or at work (1.4%) with personal guidance of a salesperson. Only 0.8% got their car personally at the official car manufacturer. The remaining 7.2% indicated another way of receiving their car. These included buying their car from a private seller, or importing a car themselves.

2.1.3. Materials and procedure

The online survey was conducted through the survey website [qualtrics.com](https://www.qualtrics.com). It took around 10 min for participants to complete the survey and participants could win one of three gift certificates of 10 euros. Although the survey was administered in Dutch, a translation was made for this paper which is available in [Appendix A](#).

The first section of the survey contained questions about the car of the participant. This included the car brand, model, production year and how/where they received the car. It also addressed which of the following automated systems were present in the car and how often they used it: Cruise Control (CC), Adaptive Cruise Control (ACC), Lane Keeping (also called lane centring)(LK), Automated Lane Change (ALC) and Automated Parking (AP). Each system was shortly described to the participant. The second section addressed the information participants had received about their automated systems at their car dealer. This included whether and when they received the information, and additionally, the mode and content of the information. Participants were further asked about their positive and negative experiences when receiving information on the automated systems. Lastly, participants were asked how and why they looked up information about the systems after purchase. The survey finished with several questions regarding the participant's demographics. These demographic questions included age, gender and education level.

2.1.4. Analysis

The goal of this survey, identifying if and how most car buyers receive ADAS information, could mainly be achieved through descriptive statistics. Both Chi-Square (nominal data) and Mann-Whitney tests (Likert-scale data) were used to study potential differences between drivers that bought a new or used car. To avoid Type 1 Errors due to repeated testing for similar survey questions, Bonferonni corrections were necessary. The new alpha-value was obtained by dividing the original alpha-value ($\alpha_{\text{original}} = 0.05$) by the number of comparisons (Cabral, 2008; Proschan and Waclawiw, 2000; Weisstein, n.d.).

2.2. Results

Unless otherwise indicated, the results in this section refer to the full sample of 713 participants that bought a car in the last two years.

2.2.1. ADAS use

CC and ACC were used frequently or always by around 75% of their owners, and LK and ALC systems by around 60%. Table 1 shows an overview of the frequency with which participants used the automation in their car. LK was used regularly or during every drive by 61.2% of the 173 LK owners, and ALC by 61.5% of the 13 ALC owners. LK was only used sometimes or never by 32.9% while ALC was only sometimes or never used by 23.1%. Of the 139 AP owners, only 12.9% used it regularly or always. The percentage of AP owners that never or only sometimes used the AP system was very high at 84.9%. Participants indicated more often to never use LK (17.3%), ALC (23.1%) and AP (48.2%) compared to CC (6.8%) and ACC (8.7%).

2.2.2. Receiving information

Almost a quarter (24.4%) (95% CI = 21.3, 27.8) of all respondents reported that they *did not receive any information* on any of the systems at the car dealer. It appears that more used car owners (34.0%) don't receive information about any of the automated systems compared to new car owners (14.4%). A Chi-Square test confirms a relation between buying a new or used car and receiving information on the automated systems ($\chi^2(1, N = 713) = 37.1, p < .001$). Table 2 shows an overview of the participants that did not receive information per system. Answers were only considered of participants that had the particular system (respectively 664, 161, 173 and 139 participants). Especially high percentages of the ALC (46.2%) and LK (48.9%) owners said that they did not receive any information on this system. However it must be considered that the group of ALC owners was very small with 13 participants.

Of all the 713 participants, 48 (6.7%) (95% CI = 5.1, 8.9) said that they turned down any information from the car seller themselves. The main reason for turning down any information was prior experience with the system, either in their previous car or in the car of someone else ($N = 18$). Other reasons were: they wanted to look it up themselves ($N = 7$), they were not interested in the systems ($N = 4$) or they had knowledge and/or experience about technology in general ($N = 3$).

The answers to the question "When did you receive information about the systems from the car dealer?" were evenly divided. A third received

the information during the initial purchasing contact (33.1%), a third received it during the delivery of the car (32.5%), and the last third received it both during the initial purchasing contact and during the delivery of the car (34.4%).

2.2.2.1. Content of received information. All participants that received information about at least one automated system ($N = 453$) were asked about the content of this information (Table 3). Half of the participants received extensive to very extensive information about the general functionalities (56.1%), and how to operate the system (55.5%). The capabilities and limitations (39.8%) as well as the hardware and technical functioning was discussed extensively to very extensively to 41% of the participants. The capabilities and limitations (9.5%) as well as the hardware and technical functioning (12.8%) were not discussed at all for around 10% of the participants, while only around 1% of the participants never got information about the functions (0.7%) or operating the system (1.3%). Mann-Whitney tests ($\alpha_{\text{adjusted}} = 0.0125$) were performed for each topic to investigate any differences in distribution between the new- and used car owners. Please refer to section 2.1.3 on how the adjusted alpha value was determined. All topics showed different distributions between the two groups on the extent to which a topic was discussed (all $p < .003$).

2.2.2.2. Mode of received information. All participants who claimed to have received information about (at least one) of the automated systems ($N = 453$) were asked how they received this information (Table 4). This was a multiple choice question where multiple answers could be chosen. The most common ways of informing were verbal explanation by the seller, (a referral to) the owner's manual and brochures. 87.2% of the participants received verbal explanation. What is interesting is that only 8.8% of the participants has tried out the functions on the road with the seller. Furthermore, only 1 participant had an official training that consisted of both theoretical and practical training. Chi-Square tests ($\alpha_{\text{adjusted}} = 0.007$) confirmed that more new car owners received brochures ($\chi^2(1, N = 453) = 9.262, p = .002$). Similarly, more new car owners were referred to a website for information ($\chi^2(1, N = 453) = 7.637, p = .006$). As this was a question where participants could check multiple answers, we also looked at the most common combinations of ways that participants were informed. Around half of the participants (51.2%) solely received verbal explanation. The following most common combinations were all verbal explanations in combination with either a referral to the owner's manual (11.9%), a brochure (6.6%).

2.2.3. Looking up information

The most common ways participants looked up information on their automated systems themselves were through the paper owner's manual (69.8%), the internet (30.4%), and the digital owner's manual (29.9%). As people could choose multiple options, we looked at the most common combinations. Here we found that 28.9% of participants solely look up the information in their paper owner's manual. The following most common combinations all included the paper owner's manual in combination with either asking the car dealer (9.5%), searching on the internet (8.4%) and searching in the digital owner's manual (7.3%). 7.6% only searched in the digital owner's manual and 6.7% only searched on the internet.

Table 1

Overview of the question: "How often do you use the following systems?". Answers were only considered of participants that had indicated to have the particular system.

How often do you use the following system? N(%)	Never	Sometimes	Regularly	Every time I drive	I don't know	N/A	Total
Cruise Control (N = 664)	45 (6.8%)	107 (16.1%)	221 (33.3%)	287 (43.2%)	1 (0.2%)	3 (0.5%)	664 (100%)
Adaptive Cruise Control (N = 161)	14 (8.7%)	28 (17.4%)	42 (26.1%)	75 (46.6%)	0 (0%)	2 (1.2%)	161 (100%)
Lane Keeping (N = 173)	30 (17.3%)	27 (15.6%)	17 (9.8%)	89 (51.4%)	1 (0.6%)	9 (5.2%)	173 (100%)
Automated Lane Change (N = 13)	3 (23.1%)	0 (0%)	1 (7.7%)	7 (53.8%)	0 (0%)	2 (15.4%)	13 (100%)
Automated Parking (N = 139)	67 (48.2%)	51 (36.7%)	17 (12.2%)	1 (0.7%)	0 (0%)	3 (2.2%)	139 (100%)

Table 2

Overview of new- and used car owners that did not receive information on a particular automated system. Example: of the drivers that bought a new car with cruise control, 26.5% did not receive information.

I did not receive any information on:	New	Used	Total
Cruise Control ($N_{Total} = 664$, $N_{New} = 310$, $N_{Used} = 354$)	82 (26.5%)	141 (39.8%)	223 (33.6%)
Adaptive Cruise Control ($N_{Total} = 161$, $N_{New} = 119$, $N_{Used} = 42$)	28 (23.5%)	13 (31.0%)	41 (25.5%)
Lane Keeping ($N_{Total} = 173$, $N_{New} = 145$, $N_{Used} = 28$)	41 (28.3%)	9 (32.1%)	50 (28.9%)
Automated Lane Change ($N_{Total} = 13$, $N_{New} = 10$, $N_{Used} = 3$)	4 (40.0%)	2 (66.7%)	6 (46.2%)
Automated Parking ($N_{Total} = 139$, $N_{New} = 94$, $N_{Used} = 45$)	24 (25.5%)	17 (37.8%)	41 (29.5%)

Table 3

Overview of the question “To what extent did the information you received cover the following topics?” ($N_{Total} = 453$, $N_{New} = 264$, $N_{Used} = 189$).

To what extent did the information you received cover the following topics?		Not at all	Little	Not extensively/not little	Extensively	Very extensively	
General functionalities	New *	0,0%	4,9%	35,2%	47,3%	12,5%	100%
	Used *	1,6%	9,5%	38,1%	43,9%	6,9%	100%
	Total	0,7%	6,8%	36,4%	45,9%	10,2%	100%
Operating and handling the system	New *	0,4%	6,4%	35,2%	45,1%	12,9%	100%
	Used *	2,6%	6,3%	39,2%	45,5%	6,3%	100%
	Total	1,3%	6,4%	36,9%	45,3%	10,2%	100%
Capabilities and limitations	New *	8,0%	13,3%	37,5%	30,3%	11,0%	100%
	Used *	11,6%	13,8%	37,0%	33,3%	4,2%	100%
	Total	9,5%	13,5%	37,3%	31,6%	8,2%	100%
Hardware and technical functioning	New *	11,4%	12,5%	33,3%	33,0%	9,8%	100%
	Used *	14,8%	13,8%	32,8%	33,9%	4,8%	100%
	Total	12,8%	13,0%	33,1%	33,3%	7,7%	100%

Participants who looked up the information on the internet ($N = 217$) were asked on which websites they mainly searched. Participants were free to choose multiple options. Searching through a general search engine such as Google was used most often as 72.3% used this method. 59.5% of the participants said to look on the website of the car manufacturer, 33.6% looked on video sharing websites such as [youtube.com](https://www.youtube.com), 20.3% looked on a car news website such as [autoweek.nl](https://www.autoweek.nl) and 19.4% looked on the website by ANWB, the Dutch traffic organization.

2.2.4. Customer experience

All participants that received information on any of the automated systems ($N = 453$) indicated how satisfied they were with the information on a 1–5 scale from “Very dissatisfied” until “Very satisfied”. The majority was satisfied or very satisfied (76.0%), while 18.3% was neutral and 5.7% was dissatisfied or very dissatisfied. There appears to be a slight satisfaction difference between new- and used car owners. Of the used car owners, 61.9% were satisfied and 13.8% very satisfied. Of the new car owners, 50% were satisfied and 26.1% was very satisfied. A Mann-Whitney test

confirmed a difference in satisfaction between the new- and used car owners ($U = 22,373$, $p = .038$).

Next, participants described what they were specifically (dis)satisfied with about the information in an open question. The main positive aspects about the given information were that it was clearly explained ($N = 172$) and enough time was taken ($N = 30$) by the seller. Other aspects that were named mainly considered the car itself ($N = 18$), friendliness of the staff ($N = 11$) and the demonstration ($N = 10$) or brochure ($N = 7$). Negative aspects of the provided information were: too little/insufficient or no information ($N = 26$), too much information at once/giving information once is insufficient ($N = 10$), not taking enough time to explain the systems ($N = 9$) and not being able to try out the systems ($N = 3$).

3. Car seller survey

This chapter describes the methodology and results of the survey that was distributed to car sellers of official brand car dealers (OBD) and independent car dealers (ICD) in The Netherlands. This survey was conducted to gain insights in the way car sellers are currently informed about, and trained on, ADAS in commercial cars.

Table 4

Participants that answered “Yes” to the question “Did you receive information from the dealership in the following way?”.

Did you receive information from the dealership in the following way? Answer = yes.	New ($N = 264$)	Used ($N = 189$)	Total ($N = 453$)
Verbal explanation by the car seller	231 (87.5%)	164 (86.8%)	395 (87.2%)
Referral to the owner's manual	72 (27.3%)	52 (27.5%)	124 (27.4%)
Brochure	69 (26.1%)*	27 (14.3%)*	96 (21.2%)
Trying out the functions on the road with the car seller	27 (10.2%)	13 (6.9%)	40 (8.8%)
Referral to a website	24 (9.1%)*	5 (2.6%)*	29 (6.4%)
By video's shown by the car seller	10 (3.8%)	1 (0.5%)	11 (2.4%)
An official training	1 (0.4%)	0 (0%)	1 (0.2%)

3.1. Methods

3.1.1. Participants

An online survey was distributed among both OBD and ICD members of BOVAG in July 2019. This distinction was purposefully recorded and analysed as it is expected that these different types of dealers have different information resources. It was stressed that this survey was specifically targeted towards the car salespersons within the dealerships. Any participant needed to have experience with direct sales contact with the customers, and sell cars younger than 12 years old as older cars are less likely to have ADAS. While a total of 468 participants completed the survey, 336 participants met all requirements and were used in the analysis. 141 participants worked at an official brand car dealer (OBD), while 195 worked at an independent car dealer (ICD). The large majority of the participants was male (97.6%). The average age was 48 years ($SD = 11.2$), ranging from 21 to 73 years.

A majority of the participants sold cars with parking sensors or cameras (97%), ACC (82.1%), Lane Departure Warning (79.5%), Emergency brake (75.6%), Blind Spot Detection (72.3%), Lane Keeping (72%), Automated Parking (67.9%), Live Navigation (67.9%), Distance Alert (61.3%) and Fatigue Recognition (61%). 42.9% of the participants sold cars with Intelligent Speed Adaptation. Only 12.2% sold cars with an Automated Lane Change system. 3 participants (0.9%) did not know whether they sold cars with any of these systems. 3 participants indicated that none of these systems were present in the cars they sold and were excluded from further analysis.

3.1.2. Materials

The survey took about 10 min to complete. Participants did not receive any compensation. Although the survey was distributed in Dutch, a translated version was created for this paper which is available in Appendix B.

The first part of the survey addressed the information that car sellers themselves received about (the latest) ADAS. Several questions asked the sellers from whom they received information, in what mode and what training they received. Furthermore it asked whether they looked up information about the automated systems themselves, why they did this, and where they looked up the information. Then, sellers were asked from whom they specifically expected to receive information about (new) automated systems. The second part of the survey addressed the information sellers give about ADAS towards customers. When do they provide (potential) customers with the information, what do they specifically address about ADAS and through which means? The last part of the survey asked the seller about their age, gender and job title.

3.1.3. Analysis

The goal of this survey was to identify if and how car sellers are currently informed and trained about ADAS. Similar to the consumer survey this goal could largely be studied through descriptive statistics. In order to investigate any differences between dealer type (OBD or ICD), Chi-Square (nominal data) and Mann-Whitney analyses were required. As in the consumer survey, corrected alpha-values were applied to analyse multiple similar to control for Type 1 Errors. Again, the corrected alpha-values were determined by dividing the original alpha-value ($\alpha_{\text{original}} = 0.05$) by the number of comparisons (Cabral, 2008; Proschan and Waclawiw, 2000; Weisstein, n.d.).

3.2. Results

The following sections discuss the results of the distributed survey among both official brand car dealers (OBD) and independent car dealers (ICD).

3.2.1. Receiving information

3.2.1.1. Sufficient information. 126 out of 333 participants (37.8%) (95% CI = 32.7, 43.3) indicated that they did not receive any (12%) or insufficient (25.8%) information about ADAS (Table 5). It appeared that less OBD sellers (8.5%) receive insufficient (or no) ADAS information compared to ICD sellers (59.1%). A Chi-Square test confirmed a difference between OBD and ICD sellers ($\chi^2(2, N = 333) = 88.1, p < .001$).

3.2.1.2. Looking up information. 54.1% (95% CI = 48.5, 59.5) of the sellers looked up ADAS information by themselves. They did this because: they thought the subject is interesting (54.4%), they didn't receive enough information (31.7%), they didn't receive the correct information (5%), or the information they received was too complicated and confusing (4.4%). Again, there appeared to be a difference between OBD and ICD sellers as 11.1% of the OBD sellers looked up the information because the information they received was insufficient, incorrect or confusing against 51.2% of the ICD sellers ($\chi^2(1, N = 333) = 48.61, p < .001$). Sellers looked for ADAS information in multiple places ranging from any relevant website (61.7%), video websites such as [youtube.com](https://www.youtube.com) (51.1%), the paper owner's manual (48.3%), asking colleagues (40.6%), the digital owner's manual (38.9%) and internet forums (33.3%). 4.4% looked up information in a different place. Only 3.9% requested information from a stakeholder organization, and the same holds for looking up information in an app (3.9%).

3.2.1.3. How is the information provided. Shows the results of the multiple choice question: "How do you receive information about ADAS?". Most car sellers received information by trying out the functions on the road themselves (44.7%), or through a training by the car manufacturer, importer or wholesaler (42.9%) (95% CI = 37.6, 48.5) (Fig. 1). There appeared to be large differences between OBD and ICD sellers as 80.7% of the OBD sellers received this training against 15.5% of the ICD sellers. A Chi-Square ($\alpha_{\text{adjusted}} = 0.05/10 = 0.005$) confirmed this difference for both the training by car manufacturers ($\chi^2(1, N = 333) = 140.65, p < .001$), and those by the dealer's location or holding ($\chi^2(1, N = 333) = 12.95, p < .001$). The same holds for the use of brochures as 37.1% of the OBD sellers received brochures, against 10.4% of the ICD sellers ($\chi^2(1, N = 333) = 34.40, p < .001$). Furthermore, OBD sellers more often tried out the functions themselves (53.6%) compared to ICD sellers (38.3%) ($\chi^2(1, N = 333) = 7.612, p = .004$). Last, more ICD sellers did not receive any information (31.6%) compared to the OBD sellers (3.6%) ($\chi^2(1, N = 333) = 40.13, p < .001$).

All participants that received training ($N = 158$) were asked about the availability, capacity and relevance of these trainings. 69.1% rated the availability as good or very good, and 27.2% as sufficient. Only 3.8% considered the availability to be insufficient. A similar trend is seen in the capacity of the trainings as 72.8% rated it as good or very good, 24.7% as sufficient and 2.5% as insufficient. The relevance of the training content to their daily sales job was considered good or very good by 69.7%, sufficient by 25.9% and insufficient by 4.4%.

3.2.1.4. Who should provide the information. All participants were asked from whom they wanted to receive information about ADAS ($N = 333$) (Fig. 2). OBD sellers mainly wanted this information from the car manufacturers/importers (87.2%) and BOVAG (Dutch stakeholder organization) (17%). In contrast, the ICD sellers mainly wanted information from the BOVAG (58%), followed by car manufacturers/importers (38%) and wholesalers (36.4%). The majority of the sellers expected digital materials targeted at informing their sales personnel (64.9%) and half of the sellers (50.3%) expected digital information for the consumer that they could apply directly during the sale and delivery.

Table 5

Overview of the question “Do you think that you receive enough information about ADAS (from your car manufacturer, importer, holding, nearby dealership or wholesaler) to inform customers?”.

Do you think that you receive enough information about ADAS to inform customers?	OBD N = 140	ICD N = 193	Total N = 333
Yes, I receive sufficient information	128 (91.4%)	79 (40.9%)	207 (40.9%)
No, I receive insufficient information	9 (6.4%)	77 (39.9%)	86 (39.9%)
I receive no information	3 (2.1%)	37 (19.2%)	40 (19.2%)
	140 (100%)	193 (100%)	333 (100%)

3.2.2. Giving information to customers

23.4% of the car sellers (strongly) agreed that they do not have enough time to inform customers about ADAS (See Fig. 3). 26.7% (strongly) agreed that they do not have the right training or education. 38.1% (strongly) agreed to miss the required materials to provide ADAS information, and 21.3% (strongly) agreed that they do not have enough time nor resources to investigate ADAS themselves. ICD sellers appeared to agree more with the presented statements. Even with a rather conservative adjusted alpha ($\alpha_{adjusted} = 0.0125$) (Cabral, 2008; Proschan and Waclawiw, 2000), separate Mann-Whitney tests confirmed a relationship between the dealer types and level of agreement with each statement. (all $p < .001$).

56.7% of the participants often or always gave information about ADAS to customers (85% OBD versus 36.3% ICD), while 18.9% rarely or never gave information about ADAS (5% OBD versus 29% ICD). The main strategies of informing customers included: Verbal explanation (85%), test drives (46.3%), and referring to the owner's manual (37.8%)

4. Discussion

The goal of this study was to get a comprehensive overview how both car drivers and car sellers are currently informed about ADAS in The Netherlands. Our study extends consumer surveys like those by Abraham et al. (2018) and Viktorová and Šucha (2018) by presenting the perspectives of both consumers and car sellers. Any identified gaps in informing consumers and car sellers about ADAS may be used to develop standardized information materials and -strategies.

4.1. Consumers

Our results show that almost a quarter of the drivers that bought a car in the last two years did not receive any information about their car's ADAS. This is a worrisome amount of drivers that left their car sales point without ADAS information considering the complexity and variety of ADAS. In the previous study by Abraham et al. (2018) in the US, only 12% of the participants did not receive any ADAS information at their dealership. However, during that study, the vast majority of participants had bought a new car. In our study, used car owners were less likely to have received information compared to buyers of new cars. This may be a reason for the differences between our and Abraham's study. Furthermore, differences in sales points might be a potential explanation for the differences between new and used car owners, as used cars are more often bought at independent car dealers or private sellers. The different sales points do not have the same resources to provide the drivers with information, as is shown by our survey among car sellers. Unfortunately, the current survey did not allow us to investigate an effect of sales point on received information.

Drivers that did receive information, indicated that this mainly addressed just the basic handling and functionalities, but not the limitations and physical equipment. Especially knowing the limitations of ADAS is important as inappropriate use can have dangerous consequences (Capallera et al., 2019; Dickie and Boyle, 2009). Furthermore, only 9% was able to try out the automated systems before taking the car home. This seems concerning considering the impact practice can have on a driver's ability to understand, accurately trust and safely operate ADAS (Beggiato and Kreams, 2013; Ebnali

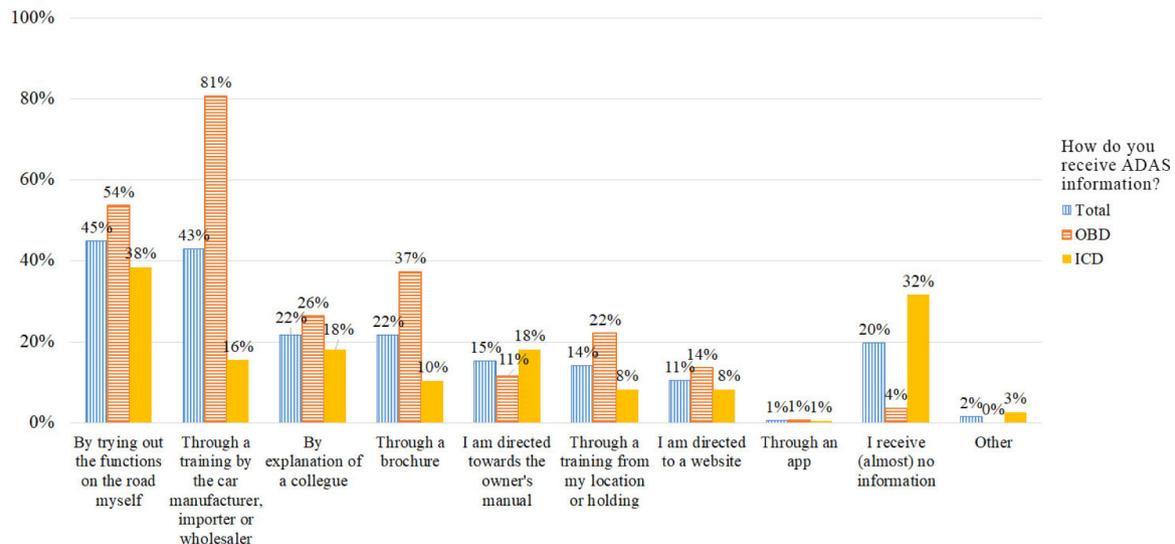


Fig. 1. Overview of the question: “How do you receive information about ADAS (from your car manufacturer, importer, holding, nearby dealership or wholesaler)?”. Participants (N = 333) could choose multiple options.

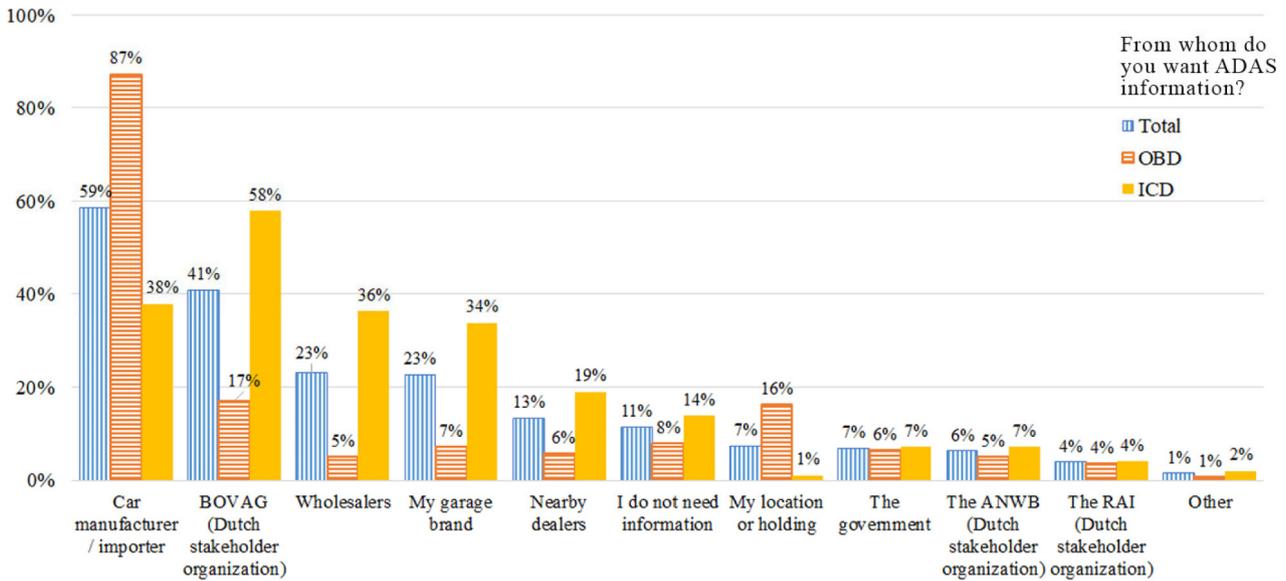


Fig. 2. Overview of the question: “From whom do you want information about ADAS?”. Participants ($N_{Total} = 333, N_{OBD} = 141, N_{ICD} = 195$) could choose multiple answers.

et al., 2019; Forster et al., 2019; Larsson, 2012; Payre et al., 2017). Ebnali et al. (2019) found that simulator training allowed drivers to better decide when it was necessary to take back control of the automation. Similarly, Payre et al. (2017) saw a decrease in reaction times and number of pedal interactions after extensive training and practise in a driving simulator.

Drivers mainly received their information from the paper owner’s manual, a brochure or from their seller. When looking for information

by themselves, they combine these resources with several websites. While online channels may be used to reach drivers and distribute standardized ADAS information, unregulated websites may be currently giving inaccurate ADAS information. That drivers mainly get their information from the owner’s manual is consistent with the studies in the US by Abraham et al. (2018) and Jenness et al. (2008). Still, we must take the relatively high average age in our study into consideration as this age group may rely more on non-digital resources (Van Deursen,

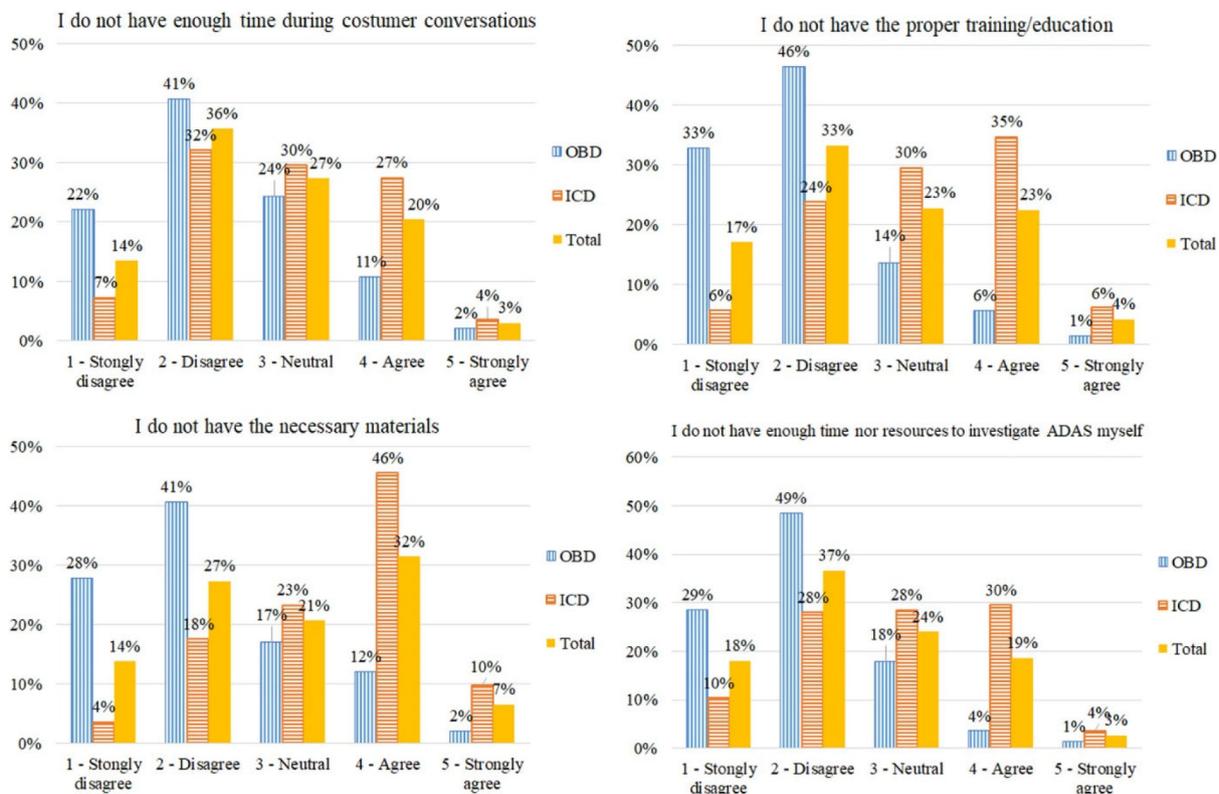


Fig. 3. Sellers’ perspectives on providing ADAS information to customers. Sellers rated their agreement to the depicted statements on a scale from 1 - strongly disagree to 5 - strongly agree ($N_{Total} = 333, N_{OBD} = 141, N_{ICD} = 195$).

2019) (i.e. paper manuals and brochures). Almost all drivers had personal contact with a car seller during the purchase and delivery of their car. This is a positive opportunity for the transfer of ADAS information towards the driver.

4.2. Car sellers

The results further show that almost 40% of the car sellers did not receive (sufficient) information about ADAS. However, it is very important to correctly perceive 'the average percentage' outcomes of the study among sellers of cars, as large differences were found between official brand car dealers and independent car dealers. This likely originates from the fundamental different market position of the dealers. Official brand dealers are formally linked to direct information sources from the manufacturers. Independent car dealers basically miss this primary information resource. While official brand dealers are mainly supplied with ADAS information by their car manufacturers and importers, independent car dealers less often receive the information from car manufacturers. They require multiple resources which include looking up the information themselves, asking other nearby official brand dealers and requesting information from their wholesaler. Another possible explanation for the differences between official brand car dealers and independent car dealers lies in the market penetration of current ADAS systems within The Netherlands. While simple systems like Cruise Control have been a standard feature in most new cars for over 10 years, newer systems like, Lane Change Assist have only just started to become standard features (BOVAG and VMS, 2019). Considering the fact that independent car dealers generally sell cars of a higher age (RDC, 2019), car sellers in these companies may not yet have been extensively confronted with the newer systems.

It appears that there is an opportunity to improve the information provision and training specifically towards independent car dealers. While a large share of the official brand car dealers receive some form of training on ADAS, this only holds for a small part of the independent car dealers. Any standardization of information needs to take the differences in information sources into account.

4.3. Consumers and car sellers

Many sellers do not have the necessary time, education, materials and other resources to use during customer contact and to investigate ADAS themselves. Consequently, almost a fifth of sellers rarely or never give ADAS information (5% for OBD and 29% for ICD). This is consistent with the finding from our consumer survey in which a quarter of the consumers indicated that they did not receive ADAS information. Although we cannot state causality, it may be that the lack of ADAS information for consumers is influenced by car sellers not receiving sufficient information. Car sellers indicated that their main methods to inform consumers are verbal explanations, referring to the owner's manual and explaining the functions during a test drive. This last method is inconsistent with the finding in our consumer survey as only a very small amount of consumers were able to test the functions during a test drive. Most car sellers expected ADAS information from the car manufacturers, importers and a stakeholder organization (in this case BOVAG). Furthermore, they preferred receiving ADAS information through digital brochures that targets them as sales personal. They would also like digital materials to use directly for the consumers during the sale and delivery of a car. These preferred information types should be considered in the development of standardized information to increase its acceptance and usage in daily operations.

4.4. Limitations

Some limitation need to be considered for this study. First, participants of the consumer survey were more than averagely interested in (automotive) technology. Also, participants signed themselves up on

the website denkmeemetdeanwb.nl to be included in traffic related studies. It is therefore possible that a self-selection bias was present (Bethlehem, 2008; Rasmussen, 2016). On the one hand, participants may have been more inclined to asking ADAS related questions, evoking information from the car sellers. On the other hand, participants might have been more prone to decline information when they already had knowledge about ADAS. However, this does not seem very likely as only 2.9% indicated to have dismissed information because they had prior experience with, or knowledge about, ADAS. Therefore, if there was a self-selection bias, the 'actual' percentage of consumers that receives information of their car seller would be even lower than presented in this study. A second limitation is that the study was conducted exclusively in The Netherlands. Based on our results, we expect that consumers are less likely to be informed about ADAS in countries where used cars and independent car dealers dominate the automotive market. Still, our results may not be directly transferable to countries in which the structure of the automotive retail is significantly different. Especially considering the differences in automotive regulations across countries. Replication of our study is encouraged for countries with significantly different car retail structures. Therefore all surveys and data are freely available.

5. Conclusions

This study shows some important gaps in the current way of informing both consumers and car sellers about ADAS. A considerable amount of consumers does not receive any or insufficient ADAS information, with a specific lack of practice with the systems. For car sellers, it appears that especially independent car dealers, struggle to receive standardized, updated and practical information about ADAS. Several options may address these issues. First, physical practice with ADAS may be necessary for both for consumers and car sellers as these may increase the understanding and safe use of ADAS (Panou et al., 2010; Payre et al., 2017; Payre et al., 2015). Especially as theoretical information solely may not be sufficient for drivers to fully comprehend and safely use the systems (Boelhouwer et al., 2019). The customer contact during sales and delivery can be an opportunity to include practical training and information. However, it is very important that car sellers are supported in this as a lot of car sellers already lack the time and resources to inform customers about ADAS. The different preferred sources of information need to be taken into account for both the consumers and car sellers (Abraham et al., 2018).

In conclusion, major steps are required in the ADAS information provision for both consumers and car sellers. Especially as the automated systems that are introduced into commercial cars are expected to increase in complexity rapidly. Still, feasible opportunities for improvement and standardization were identified that may be implemented by either industry, stakeholder organizations and/or the government.

Data availability

The data collected during the study are freely available at [10.17605/OSF.IO/JQ37Y](https://doi.org/10.17605/OSF.IO/JQ37Y)

Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Appendix A. Consumer survey

1. Did you buy or lease a new car in the last two years?

Yes, I bought a new car.

Yes, I started leasing a new car.

Yes, I bought a second hand car.

No .

2. By what car brand is the car you bought/leased?

▼ Drop down menu

3. What car model did you buy/lease? (Example: Audi A4 Avant 2.0 2017) If you are not sure which exact model you have, please fill in as much as you do know about the model.

4. In what year was your car built?

▼ Drop down menu

5. How was the car delivered to you?

Delivery at home or at work without any personal help of a sales person.

Delivery at home or at work with personal help of a sales person.

I got it myself at the car dealer or lease company.

I got it myself at the car manufacturer. (For example through the 'Factory Delivery Experience' by Volvo in Torslanda Sweden, and the 'Pick up experience' by Volkswagen in Wolfsburg Germany).

Other, ...

6. Which of the following automated car systems does your car have? (Multiple answers possible.)

Cruise Control (CC). This system maintains a set speed.

Adaptive Cruise Control (ACC). This system maintains a set speed and a set distance to the car in front simultaneously.

Lane Keeping. This system keeps the car within the lane. The car steers itself to keep between the lane markings.

Automated Lane Change. The car changes lane by steering itself if the driver turns on the indicator.

Automated Parking. The car parks itself. In most systems, only the steering is automated and the driver still has to press the gas and brake pedals.

None of these systems.

I do not know.

Other, ...

7. How often do you use the following systems?

	Never	Sometimes	Regularly	Every time I drive	I do not know	Not applicable
Cruise Control (CC). This system maintains a set speed.						
Adaptive Cruise Control (ACC). This system maintains a set speed and a set distance to the car in front simultaneously.						
Lane Keeping. This system keeps the car within the lane. The car steers itself to keep between the lane markings.						
Automated Lane Change. The car changes lane by steering itself if the driver turns on the indicator.						
Automated Parking. The car parks itself. In most systems, only the steering is automated and the driver still has to press the gas and brake pedals.						

8. About which of these systems did you get information from the car dealer? (Multiple answers possible.)

- Cruise Control (CC). This system maintains a set speed.
- Adaptive Cruise Control (ACC). This system maintains a set speed and a set distance to the car in front simultaneously.
- Lane Keeping. This system keeps the car within the lane. The car steers itself to keep between the lane markings.
- Automated Lane Change. The car changes lane by steering itself if the driver turns on the indicator.
- Automated Parking. The car parks itself. In most systems, only the steering is automated and the driver still has to press the gas and brake pedals.
- I did not get information about any of these systems.
- I turned down any information myself.
- I do not know.
- Other, ...

8a. Why did you turn down the information?

9. When did you receive information about any of the prior mentioned systems from the car dealer?

- During the purchase contact.
- During the delivery of the car.
- Both during the purchase contact and the delivery of the car.
- I did not get information about any of these systems.
- I turned down any information myself.

10. How did you get information about any of the prior mentioned systems from the car dealer? (Multiple answers possible.)

- Verbal explanation by the car seller.
- Through (referral to) a brochure or information file.
- Through videos of the systems (shown by the seller).
- Through the owner's manual.
- Through (referral to) a website.
- By trying out the systems on the road together with the seller.
- Through an official training of one or multiple sessions.
- Other,...

11a. If you had an official training, what parts did this training consist of?

- Theoretical training.
- Practical training.
- A combination of theory and practical training.
- I don't know.

11b. Can you further describe the process of the training?

12. To what extent did the information cover the following topics?

	Not at all	Little	Not extensive/not little	Extensive	Very extensive
The functionalities of the system. [What the system can do]					
Operating/handling the system.					
The capabilities and limitations of the system. [In what situations does the system work or not]					
The hardware and technical functioning of the equipment like sensors and cameras.					

13. After getting the information:

	Totally disagree	Disagree	Neutral	Agree	Totally agree
I know which automated systems are in my car.					
I understand the functionalities of the automated systems.					
I understand how to operate/handle the systems.					
I understand the capabilities and limitations of the system. [In what situations does the system work or not]					
I understand the equipment that the systems consist of and how these work.					

14. How satisfied were you with the way that you were provided with information about the automated systems?

- Very dissatisfied.
- Dissatisfied.
- Neutral.
- Satisfied.
- Very satisfied .

15. What where you satisfied about?

16. What where you dissatisfied about?

17. Where do you look for information about the automated systems in your car in case you have any questions?

(Multiple answers possible.)

- In the paper owner’s manual.
- In the digital owner’s manual.
- At friends, family or colleagues.
- At a car dealer or lease company.
- On the internet.
- I never look up information about this.

18. What websites do you mainly use for looking up information about the automated systems in your car in case you have any questions? (Multiple answers possible.)

Search engine like Google.com.

The car manufacturer's website.

The ANWB website.

A car news website such as Autoweek.nl, Topgear.nl of autowereld.nl.

A video sharing website like youtube.com or vimeo.com.

I don't know.

Other, ...

19. What is your gender?

Male.

Female.

20. What is your age?

21. What is your highest education level?

None or primary education.

Secondary education.

Associate's degree.

Bachelor's degree.

Master's degree or higher.

22. I mainly travel:

More by public transport than by car.

More by car/motorcycle than by public transport.

Just as much by car/motorcycle as by public transport.

I (almost) never travel by car/motorcycle or public transport.

23. I am interested in new technology (for example gadgets and apps).

Totally disagree.

Disagree.

Neutral.

Agree.

Totally Agree.

24. I am interested in the latest developments in car technology.

Totally disagree.

Disagree.

Neutral.

Agree.

Totally Agree.

Appendix A. Car seller survey

1. Does your company sell passenger cars?

Yes.

No/almost never.

2. Which car brands do you sell? (Multiple answers possible.)

▼ Drop down menu

3. Do you sell cars that are built after 2012?

Yes, (almost) always.

Yes, regularly.

Yes, sometimes.

No, I primarily sell cars that were built before 2012.

4. Which of the following systems are present in the cars that you sell? (Multiple answers possible.)

Adaptive Cruise Control (ACC). Adjusts its speed to the traffic.

Lane Keeping. The car follows the lane by detecting the road lines.

Automated Lane Change. The car automatically changes lane if the driver turns on the indicator.

Automated Parking. The car parks by itself. In most cases, only the steering is automated, the driver still needs to brake and accelerate.

Emergency brake. The car brakes automatically in case to avoid an imminent crash.

Live navigation system (TMC live).

Parking sensors and/or cameras.

Lane departure warning. Warns the driver when the car is (almost) crossing the road lines. For example by sound, light, symbols and/or a vibrating steering wheel.

Blind spot detection. Warns the driver if an object is in the blind spot.

Distance alert.

Intelligent Speed Adapt. A system that helps the driver to keep to the speed limit.

Traffic sign recognition.

Driver fatigue recognition.

None of these systems.

I do not know.

5. In general, do you think that you get enough information (from car manufacturers, importers, your car dealership, holding, a nearby dealer or wholesaler) to provide customers with information about ADAS?

Yes, I get sufficient information.

No, I get insufficient information.

No, I get no information.

6. Who provides you with information about ADAS? (Multiple answers possible.)

Car manufacturers/importers.

My location or holding.

A nearby car dealer.

An education company (i.e. Innovam).

My garage brand.

My wholesaler.

I receive (almost) no information.

I look up the information myself.

I do not know.

Other, ...

7. What is your most important reason to look up ADAS information yourself?

I do not receive (enough) information from car manufacturers, importers, my location or holding, nearby dealers, my garage brand, my wholesaler or an education company.

I do not receive the correct information from car manufacturers, importers, my location or holding, nearby dealers, my garage brand, my wholesaler or an education company.

The information i receive is confusing or difficult to understand.

I think it is interesting.

8. Where do you (on your own initiative) look for information about ADAS? (Multiple answers possible.)

I contact a stakeholder organization such as BOVAG.

In the paper owner's manual.

In the digital owner's manual.

By asking colleagues.

On video websites such as youtube.com.

On an internet forum.

On different websites.

On an app.

Other,...

9. How do you receive information about ADAS?

A colleague explains it to me.

I am referred to the owner's manual.

I am referred to a website.

Through an app.

Through an information brochure.

By trying out the functions on the road.

Through a training that deals with ADAS by the car manufacturers, importers or my garage brand. (For example an information meeting or practical training.)

Through a training from that deals with ADAS my location or holding. (For example an information meeting or practical training.)

I receive (almost) no information.

I look up the information on my own.

Other,...

9a. To what app or website are you referred?

10a. Complete the following sentence with (1) very good, (2) good, 3 (sufficient), 4 (poor) 5(very poor).

The availability of the provided trainings is ...

10b. Complete the following sentence with (1) very good, (2) good, 3 (sufficient), 4 (poor) 5(very poor).

The capacity of the provided trainings is ...

10c. Complete the following sentence with (1) very well, (2) well, 3 (sufficient), 4 (poorly) 5(very poorly).

The content of the provided trainings suits my daily sales tasks ...

11. Describe what the provided trainings you receive consist of.

12. How often do you receive a general ADAS training?

Once.

Once every three months.

Once every year.

Less than once per year.

13. Do the model specific trainings that you receive discuss ADAS?

Always.

Sometimes.

No.

N/A.

14. From whom do you wish to receive ADAS information?

The car manufacturer/importer.

My location or holding.

A nearby dealer.

My garage brand.

My wholesaler.

The government.

The BOVAG (A Dutch stakeholder organization).

The RAI (A Dutch stakeholder organization).

The ANWB ((A Dutch stakeholder organization).

I do not want any ADAS information.

Other,...

15. What information do you expect to support you in providing information about ADAS to customers?

Digital education materials that are aimed at car sellers.

Paper education materials that are aimed at car sellers.

Digital education materials aimed at the customer that can be used directly during the customer contact.

Paper education materials aimed at the customer that can be used directly during the customer contact.

A training for car sellers.

16. Rate the following statements from 1 (Strongly Disagree) to 5 (Strongly Agree).

In order to give complete and correct information about ADAS to customers I:

I do not have enough time during the customer contact moments.

I lack the right education.

I lack the right materials.

I do not get enough time or resources to investigate ADAS myself.

17. When u are talking to customers about a car they are interested in, how often do you give them information about ADAS?

Never.

Rarely.

Sometimes.

Often.

(Almost) Always.

17b. You indicate that you only sometimes or rarely provide ADAS information to customers. Which statement applies most to your situation?

I usually start informing the consumers about ADAS on my own initiative.

I usually only give ADAS information when the customer asks me about it.

18. When do you give information to customers about ADAS?

When the customer is first looking for a new car. (The orientation phase)

During the definitive sale meeting with the customer.

When the car is delivered to the customer.

After the car is delivered to the customer (for example during a maintenance appointment).

19a. How do you inform customers about ADAS information? (Multiple answers possible.)

By a verbal explanation.

By referring them to a website.

By referring them to the owner's manual.

Through an information brochure.

Through an app.

During a test drive where I (the car seller) drive and show the different systems.

During a test drive where the customer is drives and tests out the different system.

Through an instruction system in the car itself (a tutorial).

We (our location or holding) provide our own training to customers.

We provide trainings through an importer.

We provide trainings through another party (other than importers, for example a driving school).

19b. To which websites or apps do you refer customers to look up information about ADAS?

19c. Describe the ADAS training that you or another party provides for the customer.

20. What is your gender?

Male.

Female.

21. What is your age?

22. What is your job description?

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