Reliability and automation. The role of information about device-specific features in ADAS acceptability
Abstract

As for many innovative devices that require a novel user-technology interaction, the question of future consumer acceptance is central for the correct utilization of the ADAS device. But since acceptance can be determined only after the direct use of the device, information that aims to promote the use of the safety device should work on improving initial acceptability before use. Acceptability is the attitude towards a new device before its use, and it can be influenced by information gathered about the device. The aim of the present work is to explore the influence of the quality of information about the device on the acceptability of ADAS. In particular, how information about reliability and levels of automation of a collision warning system (CWS) affects initial acceptability in naïve potential future buyers of cars equipped with these systems.

527 novice drivers (males and females) rated a CWS presented as fully automated with auto-brake or partially-automated and with vs. without explicit mention to its use limitations. Results show that the quantity and quality of information pertaining to device-specific features can systematically change the initial acceptability towards the safety device. Pleasantness of use and perceived benefits for safety were found to be the most important to the novice drivers.

Keywords: ADAS; acceptability; automation; reliability; novice drivers.
1. Introduction

At the present time Advanced Driver Assistance Systems (ADAS) do not represent standard equipment on vehicles in the automotive market of many countries. As for many innovative devices that require a novel user-technology interaction, the question of future user acceptance becomes central for the correct utilization of the device. Without a user’s full acceptance, safety devices could reduce their potential benefits because of incorrect use, or could generate adversity to their use (Lindgren & Chen, 2007).

ADAS acceptance has been analyzed through user tests that investigate a driver’s evaluation and performance after direct driving experience in ADAS equipped vehicles (Brookhuis, De Waard, & Janssen, 2001).

However, a consumer’s evaluation about the possibility to buy or utilize a car equipped with new safety devices happens also before any actual direct driving experience with the device itself. That is why a precise definition of device acceptability is becoming crucial to determine a positive process towards the decision to employ a new safety device. According to Vlassenroot et al. (2011), it is possible to define ADAS acceptability as the attitude towards the new device before its use. While acceptance can be determined after a direct use of the device, acceptability is also determined by attitudes and beliefs prior to use of the device that are influenced by: information gathered about the device’s features, its working modality, features, and how its implementation could benefit the user experience. The quality and quantity of information available to the user of a new device are then crucial to determine the potential intention to use the new safety device (Davis et al., 1989). If acceptability can mediate the actual use of the device, then negative attitudes toward a new device could prevent the use of ADAS that could be potentially useful to improve road safety. Focus of the present work is to explore the influence of the quality of information on the acceptability of ADAS. In particular, we investigated how information about device-specific features of a collision warning system affect its initial acceptability in naïve novice drivers.

1.1 Reliability and level of automation: what relationship with acceptability of a collision warning device?
Many studies have analyzed user acceptance of information technology. Substantial theoretical and empirical data have supported the Technology Acceptance Model (TAM) (Davis 1989), which theorizes that a user’s attitude and intention to use a system are determined by two main variables: perceived usefulness of using the system to improve the performance, and perceived ease of use.

TAM was developed by Davis to explain computer-usage behavior supposed to increase job performance and theorized that system characteristics can mediate acceptability. When referring to ADAS use, it must be noted that advanced drivers systems do not only represent a new technology that improve the driving performance but can also impact the relationship of the driver with the driving task itself. When the driver chooses to use the device, he/she is no longer the only one in charge of “driving” the car but could become a “supervisor” of the device. Especially in the case of an emergency, when the risk of potential damage is involved and the advanced system takes over the vehicle control, the driver must interact with the new technology interface and also adapt to the new role of supervising ADAS performance instead of acting independently as the driver. For this reason, it is crucial for efficient and effective use of the device, to understand how device-specific features could influence the user acceptability of the device itself and of his/her partially new role within the relationship with the vehicle and the driving task.

Different collision warning systems can be endowed with or without an auto-brake function. In addition, they can be effective in any use condition or have use limitations such as not working in low visibility conditions or at a certain distance. According to TAM these two main features could influence driver acceptability before use and affect future use of the device.

The perceived device reliability represents the information available about the use limitations of the device. New technologies that promise positive benefits tend to generate high expectations on the device’s reliability (Faulkner, 1998; Hoque & Lohse, 1999). However if the device can’t achieve consistent levels of reliability and present several use limitations, it could generate a perception of uncertainty which reduces trust and the intention to adopt the new system (Wickens & McCarley, 2008). If user’s expectations about reliability are biased, then the trust towards the
device will be undermined even when the actual device performance is reliable during driving trials (Lee & See, 2004). That is why actual reliability and even direct use experience does not always lead to acceptance of the device, since the users’ initial beliefs on reliability could still mediate for acceptance (Beggiato & Krems, 2013).

The level of automation featured in the collision warning device is the second central feature that differentiate CWS. As previously seen, some devices can just provide warning information to the driver regarding the external environment, while other devices can actually take over the vehicle control and autonomously respond to external stimuli without any input from the driver (collision warning systems with auto-brake). When the automated function concerns the avoidance of a deadly event like an imminent collision, then automated systems are usually seen as more reliable than partially human-controlled systems (Madhavan & Weigmann, 2007). At the same time automated systems could be seen as a deprivation of vehicle control function, leading drivers to prefer partially-automated devices. Moreover, partially-automated systems that just provide warning are often perceived as potentially more demanding and distracting, thus lowering the levels of acceptance of the device. On the other hand, blind trust to fully automated device could generate automation bias (Dzindolet et. al, 2003; Parasuraman & Manzey, 2010) that impacts on user’s performance and could be potentially dangerous in real-life driving conditions (Ruscio, Ciceri, & Biassoni, 2015).

Several studies analyzed the influence of reliability and levels of automation of devices on the acceptance after direct use. Vlassenroot et al. (2010) reviewed a series of studies and identified the social aspects that could lead to positive or negative public acceptability of a device. Those studies have demonstrated that acceptability could affect trust and acceptance of the device and that the communication given to the public has to reach a delicate balance between information and advertising when presenting the device, especially to naïve potential users. We know from study on acceptance that the more potentially critical situations turn up during the preliminary use of a device, the lower trust and acceptance levels of the system will be. Similarly, initial omissions on reliability levels determine over trust and misplaced acceptance of the system in preliminary use.
(Beggiato, & Krems, 2013). Meanwhile, more attention towards the automated features of the device could generate over reliance on the system, while emphasis on lower degrees of automation could generate low levels of acceptance and perception of higher demand for cognitive resources.

Based on these findings on acceptability and initial acceptance, effective communication for road safety should take into account the way the device is presented, and how this could impact the user’s initial attitudes. A scientific approach to the question must be considered, as quality and quantity of information could potentially facilitate or discourage the intention to use the safety system and so affect road safety. Even more, communication could facilitate the intention to buy while promoting a less informed use, or could promote a more informed use while discouraging the intention to use the safety system. Therefore it is important to understand how information impacts the several aspects of optimal acceptability.

1.2 Measuring ADAS acceptability

Acceptability describes the prospective judgment, without experience, based on attitudes and beliefs about a measure, to be introduced in the future, while acceptance ex-post can be defined as an individual’s direct attitude and behavioral attitudes towards the system that evolve after an actual use of the device (Beggiato & Krems, 2013). Analyzing ex-ante acceptability is then necessary to measure drivers’ attitudes towards the possible use of the safety system. According to the Theory of Reasoned Action and to the Theory of Planned Behaviour, the best predictor of a person's behavior is the behavioral intention, which depends on the person's attitude about the behavior. The operationalization of constructs central for the Theory of Reasoned Action was developed from a long history of attitude measurement theory rooted in the concept that an attitude (toward an object or an action) is determined by expectations or beliefs concerning attributes of the object or action and evaluations of those attributes (Montaño & Kasprzyk, 2008).

A further development of the Theory of Reasoned Action is the Technology Acceptance Model that explains individual’s behavioral intention to use a technological device according to an evaluation about two main features: perceived usefulness, defined as the extent to which a person
believes that using the system will enhance his/her performance; and perceived ease of use, that is the extent to which a person believes that using the system will be free of effort (Davis, 1989).

To assess the effect of different information on device-specific features on perceived usefulness and perceived ease of use of CWS, two different instruments have been built: 1) four videos that manipulate the information available about CWS reliability and levels of automation; and 2) a questionnaire adapted from Vlassenroot et al. (2010) to measure acceptability before use. More precisely, an identical CWS device was presented to naïve drivers in four different videos that differentiated the following: the reported levels of reliability of the device (device presented with use limitation vs. device without explicit mention of use limitations) and the level of automation of the device (device presented as fully automated (with auto-brake) vs. partially-automated (without auto-brake)).

For the levels of acceptability of the CWS, a questionnaire was built considering the work of Vlassenroot et al. (2010) on an Intelligent Transport System (ITS). Vlassenroot and colleagues systematically analyzed the instruments used in literature to assess acceptance and acceptability, and found 14 indicators that directly or indirectly influenced acceptability, divided into general indicators (such as: personality characteristics, social norms, problem perceptions … ) and device-specific indicators (such as: perceived efficiency, perceived usability, perceived usefulness).

Using the TAM model with the device-specific indicators of CWS, the following variables were considered to measure the levels of acceptability (see Fig. 1):

![Diagram showing ADAS Acceptability before use and ADAS Acceptance after use.](attachment:image.png)
1) Trust in the device: Trust proved a predictor of acceptability (Kazi et al., 2007) and in particular the more trust in the device, the more useful it was considered and the more acceptance was found (Wickens and McCarley, 2008). Since CWS efficiency involves reaction to potentially dangerous situations, it is important to examine how much the user thinks he/she can trust the specific device after having seen its initial video presentation.

2) Perceived sense of control: The sense of control the users perceive to potentially have when driving a CWS equipped car is another important element in driver attitude. Devices that can be controlled by the driver are perceived more useful by drivers and more accepted (Jimenez et al., 2012).

3) Perceived effort of use: In addition to the sense of control, Comte, Wardman, and Whelan (2000) found a positive correlation between the cognitive affordability of the device and overall acceptance of a technology. Different CWS could generate different initial perceptions about the effort required or fatigue that potentially affect the driver.

4) Perceived distraction: Ease of use is also related to the perceived potential workload and distraction caused by the system, or by its difficulty of utilization. Driver’s perceived distraction caused by the device did not always match actual distraction caused by the device during use (Birrell and Young, 2011). A user could rate a CWS as more or less distracting depending on the different device-specific features.

5) Perceived safety: Perceived usefulness of a device is also dependent on the potential benefits for driving that the use of a device would provide. Different CWS can be considered different by different drivers as an improvement for their personal safety, or a potential threat to their safety (Vlassenroot et al., 2010).

6) Effectiveness in reducing accident rates: A device that is supposed to be effective in reducing accident rates could be perceived as more useful by users, than a device perceived as less able to impact on road safety. However not all the different advanced driver assistance device are
perceived by drivers as effective in reducing the accident rate if they would be implemented on a
generic larger scale (Huth & Gelau, 2013).

7) Willingness to use the safety device is considered related to the perceived usefulness of the
device (Kotler, Armstrong, & Wong, 2005). Even if the willingness to use does not represent the
final intention to use, which depends on other external constructs, it represents nevertheless a
general initial attitude towards the device. It is influenced mostly by the driver’s direct subjective
and hedonic experience while assessing the system (Adell, 2007).

8) For this reason we included also a hedonic measure to assess user’s perception on the
device’s pleasantness of use while driving. That is, how pleasant the experience of driving a car
with the CWS presented could be for the potential user.

Moreover the stream of research about technology acceptance has been very active in the last
twenty years and has suggested also the possible impact of gender on acceptance (Gefen & Straub,
1997). Some studies have examined gender differences in the specific context of IT diffusion,
showing that men have a relative tendency to feel more at ease with computers (Frankel, 1990;
Gilroy & Desai, 1986), but when it comes to safety devices, Carsten et al. (2008), in a work about
speed limiting systems, noted that young male drivers deactivated the system more than female
drivers, who seemed to be more sensitive to road safety (Gwyther, & Holland, 2012).

1.3 The present study

Objective of the present research is to assess the influence of information on the initial
acceptability of a collision warning system (CWS). In particular the present study aims to explore
how presenting or omitting information about device-specific CWS features lead to different
attitudes towards the safety system, in a group of male and female novice drivers.

More precisely we expect that:

H1) The information about the device reliability would affect users’ initial acceptability of the
collision warning system. More information about the device working modality should make the
driver more aware about the use limitations of a CWS, but at the same time could present the device
as more complex and so less useful. More initial acceptability should be declared when the device is
presented without explicit use limitations and always reliable, as the device could be perceived as more useful.

H2) Since the automation applies to an action intended to avoid a collision, we expect that the more the system is presented as fully automated to a group of novice drivers, the higher the levels of initial acceptability will be declared by potential users. In particular, we expect that fully the automated device will be perceived as more acceptable because it is perceived as more easy to use.

H3) An interaction effect is expected between information about reliability and level of automation on the device acceptability, with an increase of perceived usefulness and ease of use when the device is presented as fully automated and without mention of any use limitations.

H4) We expect gender differences in CWS acceptability. Males should be more accepting of new technologies, but at the same time females should show more positive attitudes towards road safety devices. We aim then to explore the effect of gender on H1, H2, H3.

2. Method

2.1. Design and variables

To test the role of information on initial acceptability, two independent variables between groups were manipulated: (1) information about CWS level of automation (CWS fully automated with auto-brake vs. partially automated without auto-brake); (2) information about CWS reliability (CWS presented without any mention of use limitations vs. CWS presented mentioning also the use limitations).

The third independent variable considered was the gender of novice drivers.

User’s initial acceptability of the CWS was measured with a survey which recorded the rate on the eight indicators considered (each type of CWS presentation made in the different experimental groups).

2.2. Instruments

2.2.1. Experimental informative videos

To test the influence of the independent variables on CWS initial acceptability, four video clips were created. The videos were promotional presentations of the working modality of a
collision warning system (Volvo City Safety), never before aired in Italy, where the sample of naïve drivers was recruited. Videos were manipulated for the purpose of the present research with Italian dubbing and video editing work in order to create four original video presentations of the same exact device (see Figure 2).

Two videos presented the CWS as fully automated, two videos as partially automated; at the same time one of the two videos presented the CWS mentioning the use limitations, while the other video did not mentioned any CWS use limitations.

The fully automated videos presented an emergency braking activated by the CWS with auto brake without any direct input from the driver on the brake. The partially automated videos presented the same emergency braking situation with the CWS without the auto-brake, describing the device only as alert system that leaves the braking task to the driver.

The videos that mentioned the use limitations of the device included a list of technical descriptions of the device’s working modality in emergency situations, including specific mentions of the condition under which it would not be effective. The videos that did not mentioned the use limitations of the device presented the CWS as always reliable, without any explicit mention of the eventual condition under which it would not be effective.

The four resulting video stimuli defined the four experimental conditions in which each participant was randomly assigned: (A) CWS presented as fully-automated with use limitations; (B) CWS presented as fully-automated without use limitations; (C) CWS presented as partially-automated with use limitations; and (D) CWS presented as partially-automated without use limitations.

The videos were tested prior to the main experiment with a pilot sample of 20 novice drivers in order to determine if the communication was clear in all the four experimental conditions. The four videos were rated on a 7-point Likert scale (1: absolutely unbelievable, 7: completely credible). All the videos were rated as believable (M= 4.30, SD =1.44), with no statistical differences on the ratings between the four of them (F (4,20) = 1.278, p = .372).
2.2.2. Questionnaire

The acceptability questionnaire was designed to test the effect of information on the main variables that impact ADAS acceptability, as found in the literature. Vlassenroot et al. (2010) tested 250 possible questions derived from the literature about acceptance and acceptability models. Fourteen relevant indicators were divided into general indicators (related to persons’ psyches, social values and norms) and device-specific indications (factors that are directly related to the device itself). Through the use of factor analysis, relevant items on a 5-point Likert-scale were found, and they were divided between items that proved to be directly correlated to the acceptability of ITS and others that influence acceptability more indirectly. Starting from the items that describe only the features of the device with a good direct correlation with acceptability of ITS, a translation into the Italian language was made to build the questionnaire. An eight-item, 7-point Likert scale was built, that included questions about: (1) trust in the CWS presented in the video, (2) perceived difficulty of use, (3) perceived safety while driving a CWS equipped car, (4) perceived sense of control, (5) perceived potential distraction while using CWS, (6) perceived effectiveness of CWS in reducing accidents, (7) perceived pleasantness of driving while using a CWS equipped car, (8) willingness to use the device in the future.
Exploratory factor analysis of these items confirmed the single dimension for the Vlassenroot et al. (2010) indicators, accounting for 48% of the variance, with item loadings from 0.372 to 0.855.

2.3. Sample

Participants were 527 students from four different undergraduate programs: Psychology, Engineering, Economy, Sport Science. Application was voluntary, and participants were recruited on two different Italian University campuses.

To meet the requirements of the study, all participants had to be uninformed about ADAS, both theoretically (i.e., they declared to have no knowledge about ADAS) and practically (i.e., they declared that they never drove an ADAS-equipped car). Note that at the time the data were collected, there were no commercial advertisements about CWS (with or without auto brake) in Italy and that such technology was very uncommon on cars sold in the Italian car market.

Moreover young adults and university students are the potential future buyers of ADAS equipped cars, and thus represent an interesting sample of naïve drivers to study the initial acceptability of an assistance device.

Stratification sampling method for gender was used to control the participants’ distribution in the experimental conditions. The mean age of the participants was 20 years (M = 20.57, SD = 2.22). 57% of the subjects were women (N = 300). All of the subjects were novice drivers who have had their driving license for no more than 5 years (M = 2.27, SD = 2.26).

2.4. Procedure

Participants were randomly assigned to the four experimental conditions, with the variable gender controlled to balance the distribution of male and female drivers in any of the different experimental conditions.

The experimental session took place in apposite classrooms, scheduling the participants of each day into small groups, with a maximum of 30 subjects per session. After informed consent was given, each small group was shown the video corresponding to one of the four experimental conditions assigned by the experimenter. After watching the video twice, participants were asked to fill in the acceptability questionnaire. After the questionnaire was completed, a debriefing session
was held: the experimenters explained the goals of the research and led a guided peer discussion about the device they had just seen, in order to gain a deeper understanding of the opinions expressed in the subjects’ answers.

2.5 Calculation

The impacts of different information on acceptability were analyzed using the General Linear Model. A 3-way factorial ANOVA (2 x 2 x 2: reliability (with vs. without mention of use limitations) x level of automation (fully vs. partial) x gender of the driver (male, female)) was conducted to measure the main and interaction effects of independent variables measured on the Likert scale on ADAS acceptability.

3. Results

Table 1 shows means and standard deviations of the dependent variables for gender, level of automation and level of reliability.

Table 1. Novice drivers’ overall initial perceived acceptability of the CWS

<table>
<thead>
<tr>
<th>Experimental Condition</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Trust in the device</td>
<td>2.77</td>
<td>1.15</td>
<td>4.29</td>
<td>1.14</td>
</tr>
<tr>
<td>Sense of control</td>
<td>3.23</td>
<td>1.36</td>
<td>3.62</td>
<td>1.39</td>
</tr>
<tr>
<td>Effort of use</td>
<td>3.75</td>
<td>1.39</td>
<td>3.84</td>
<td>1.43</td>
</tr>
<tr>
<td>Distraction</td>
<td>3.50</td>
<td>1.36</td>
<td>3.26</td>
<td>1.22</td>
</tr>
<tr>
<td>Benefits for safety</td>
<td>3.30</td>
<td>1.58</td>
<td>4.49</td>
<td>1.53</td>
</tr>
<tr>
<td>Reducing accident rate</td>
<td>3.87</td>
<td>1.55</td>
<td>3.15</td>
<td>1.52</td>
</tr>
<tr>
<td>Willingness to use</td>
<td>2.59</td>
<td>1.50</td>
<td>3.60</td>
<td>1.77</td>
</tr>
<tr>
<td>Perceived pleasantness</td>
<td>3.24</td>
<td>1.43</td>
<td>3.63</td>
<td>1.50</td>
</tr>
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</table>


3.2 Information about the device reliability

The main effect of the information about CWS reliability on acceptability was significant (F (7,504) = 32.083, p < .001, η² = .030). In particular, when the device was presented without mentioning use limitations the significantly relevant aspects were an increase in the perceived
safety ($F(1,504) = 26.236, p < .001$), an increase in perceived pleasantness of use while driving ($F(1,504) = 10.304, p = .001$), and an increase in perceived effectiveness in reducing possible accidents ($F(1,504) = 13.209, p < .001$). The willingness to use the CWS was significantly higher when no use limitation was mentioned than when the device was presented with use limitations ($F(1,504) = 30.266, p < .001$). All the other aspects measured were not significantly impacted by the information about device reliability: trust in the device, sense of control, and perceived distraction.

### 3.3 Information about level of automation

The main effect of the information about level of automation on acceptability was significant ($F(7,504) = 22.519, p < .001, \eta^2 = .021$). In particular, when the device was presented as fully automated, driving was perceived as less demanding ($F(1,504) = 16.687, p < .001$), less distracting ($F(1,504) = 10.725, p = .001$), with more perceived safety ($F(1,504) = 15.259, p < .001$), and more perceived pleasantness to use ($F(1,504) = 54.448, p < .001$).

However no differences were assessed in participants’ perception of sense of control ($F(1,504) = 27.13, p = .100$), nor in the perceived effectiveness in reducing accidents’ rate ($F(1,504) = 25.51, p = .111$) when the device was presented fully or partially automated. The overall acceptability measured as the willingness to use the CWS was significantly higher when the device was presented as fully automated than when as partially automated ($F(1,504) = 45.810, p < .001$).

### 3.4 Reliability and level of automation effect

The interaction effect of information about reliability x level of automation was statistically significant ($F(7,504) = 16.777, p < .001, \eta^2 = .016$). In particular, when the device was presented fully automated and without mention of use limitations, the interaction effect was statistically significant for trust in the device ($F(1,504) = 49.112, p < .001$), perceived safety ($F(1,504) = 24.830, p < .001$), and effectiveness in reducing accident rates ($F(1,504) = 25.201, p < .001$). No significant interaction effect was found for the perceived sense of control ($F(1,504) = 14.23, p = .223$), nor the perceived potential distraction ($F(1,504) = 24.27, p = .120$).
Figure 3. *Interaction effect of reliability and levels of automation on perceived pleasantness and perceived benefits for driver’s safety.*

### 3.5 Gender

The main effect for gender on acceptability proved significant (\(F(7,504) = 4.084, p = .002, \eta^2 = .004\)). In particular female drivers rated the devices overall as safer compared to the ratings of male drivers (\(F(1,504) = 4.007, p = .046\)), and as more pleasant (\(F(1,504) = 5.516, p = .019\)), for all the experimental conditions. Females declared to be significantly more prone to use the device then males, regardless of the quality and quantity of information received (\(F(1,504) = 5.623, p = .018\)). However no interaction effect with any level of automation or reliability information proved to be significant.

### 4. Discussion

The present work aimed to explore the way the quality and quantity of information influence the acceptability of ADAS before use. In particular how information about the device-specific features can affect acceptability in naïve potential future users of the system.

Results show that omitting information about reliability and levels of automation can systematically change the initial acceptability of a collision warning system (CWS). Analysis of variance showed that two main factors influence CWS initial acceptability most: the perceived benefits for road safety, and the perceived device’s ease of use while driving. That means
that, to increase the overall initial acceptability, the device information should communicate an increase in perceived benefits for personal safety and should be perceived as pleasant to use.

Perceived safety and perceived pleasantness are influenced by the information about reliability and levels of automation of the safety device. Consistent with H1, when the CWS was presented without mentioning any limitations, then an increase in device’s perceived safety and pleasantness of use were registered. However, when use limitations were presented, naïve drivers saw the same CWS as less safe, less pleasant, and also less able to reduce road accidents, leading to a decrease in overall acceptability. Nevertheless, it must be considered that omitting information about the device reliability, though increasing the acceptability degree, may cause an inaccurate representation of the system, leading the driver to underestimate the device limitations and exposing the novice driver to actual potential incorrect uses of the safety device.

Consistent with H2, when the device was presented as fully automated initial acceptance increased. The device was perceived as more useful, safer, more pleasant, as well as less demanding and less distracting, therefore easier to use.

The interaction effect between fully automated and no mention of use limitations was significant, with higher levels of trust and perceived safety. Devices that required a driver response were perceived as less safe to use especially when presented with use limitations: they were seen as more annoying and consequently less acceptable to use while driving. At the same time, fully automated devices were perceived as more pleasant regardless of reliability, and they were considered to autonomously prevent and elude risky situations, without the need for the driver to intervene.

In addition, results showed that information on reliability and level of automation does not always influence the perception of use in an objective way. For instance, presenting the same CWS as fully automated or partially automated did not influence the perception of the sense of control: the sample of novice drivers used in this research estimated a similar sense of control even if the fully automated device was shown to actually take over control during a critical driving situation. It appears that fully automated devices make the driver feel safe, even when they don’t have control,
suggesting that they could delegate the control of risky situations to the device: drivers feel safer with the fully automated device compared to the partially-automated device. This discrepancy however proved to be consistent with the fact that novice drivers feel less in control while driving than experienced drivers, and in accordance with other studies that have examined correlations between a high level of automation and device acceptance. Devices with high levels of automation, in fact, tend to be overestimated and perceived in a favorable way. Lee and See (2004) showed that when individuals believe that a generic automated system performs well, they are more likely to develop trust and acceptance with the device compared to situations where an automated system is presented as not fully reliable or its working modality is not transparent. Harms and colleagues (2007), Hultkrantz & Lindberg (2003) and Reagan & Bliss (2014) also found that automated systems are judged as more pleasant than partially automated devices.

Another result that wasn’t consistent with our hypotheses (H2 and H3) was that presenting a CWS with some explicit use limitations (e.g., it does not work with pedestrians, or under certain weather conditions) did not have any significant effect on the user’s awareness on the perceived of fatigue or potential distraction implied while driving a CWS equipped car. It has been proven that a partially automated device which provides audio visual warnings cause visual, auditory and cognitive interferences (Ranney et al., 2000), but maybe the scant levels of driving experience of the novice drivers used in this study did not make them realize that additional information from the device could be a potential cause of distraction or overload for their attentional resources while driving (Fernandes et al., 2010).

The main effect for gender (H4) was significant, but not the interaction with the device-specific feature: whether or not the device was presented as fully automated or not, fully reliable or not, female drivers evaluate the device as safer and more pleasant and their declared willingness to use the device was higher. The lack of an interaction effect for gender with other variables seems to suggest that the acceptability for female drivers is more related to the absolute presence of a device that could improve the driving task than to its actual features.
The present study presents some limitations. We used a self-report measure to assess initial acceptability of a device presented to participants with four different videos. A 7-point Likert scales was employed within a questionnaire that is intended as a survey to record the attitudes about the device after watching a video presentation of the device. Different scales could have been used to control the effect of social norms and personality attitudes towards new technology along with our survey, but the size and the controlled features of the sample may have helped to mitigate the distribution of the sample according to those variables. In future research the role of social norms and pressure and of personality attitudes may be controlled, as well as the different emotional impacts of the videos used as stimuli on initial acceptability.

In conclusion, the data collected verify the main direction of presented hypothesis. The declared degree of the device acceptability proved to be proportional to the information about level of automation and the omission of information about use limitations.

These results suggest that to increase CWS acceptance the initial informative communication should be able to impact two specific psychological variables that novice drivers use to analyze and judge a new safety device: benefits for safety and pleasantness. At the same time such acceptability seems to be more related to uncritical acceptance of the new supervising role created by an automated device, rather than to evaluate its specific driving-related features like: potential distraction caused by use, fatigue and the potential implications of delegating vehicle control. Thus, suggesting that the role of information about a safety device could affect not only acceptability but also potentially impact road safety.

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5. References


Huth, V., Gelau, C., 2013. Predicting the acceptance of advanced rider assistance systems. *Accident Analysis and Prevention, 50*, 51–58. doi:http://dx.doi.org/10.1016/j. aap.2012.03.010 ISSN 0001-4575


Regan, I., & Bliss, J. (2013). Perceived mental workload, trust, and acceptance resulting from exposure to advisory and incentive based intelligent speed adaptation systems.


http://doi.org/10.1016/j.aap.2015.01.018


Annex: Questionnaire
Caro partecipante, l’Unità di Ricerca in Psicologia del Traffico dell’Università Cattolica di Milano sta conducendo una ricerca sul rapporto uomo-veicolo. Ti chiediamo cortesemente la disponibilità a partecipare compilando il presente questionario. Le risposte che vorrai fornirci, totalmente anonime, saranno utilizzate unicamente a scopo di ricerca. Grazie per la collaborazione!

Data: ____ / ____ / _______                  Età:_______                  M☐
F☐

Da quanti anni hai la patente? _______
1. Quanto è credibile il video che hai appena visto?
Dai una valutazione da 1 (per niente) a 7 (moltissimo).

2. Quanto è affidabile, a tuo parere, il dispositivo presentato nel video che hai appena visto?
Dai una valutazione da 1 (per niente) a 7 (moltissimo).

3. Secondo te guidare un’auto munita di questo dispositivo è più facile o più faticoso?
Dai una valutazione da 1 (più facile) a 7 (più faticoso).

4. Ti sentiresti più sicuro alla guida di un’auto munita di questo dispositivo?
Dai una valutazione da 1 (per niente) a 7 (moltissimo).

5. Quanto sentiresti di avere il controllo di un’auto munita di questo dispositivo?
Dai una valutazione da 1 (per niente) a 7 (moltissimo).
6. Pensi che saresti più distratto o più attento alla guida di un’auto munita di questo dispositivo?
   Dai una valutazione da 1 (più distratto) a 7 (più attento).

7. Quanto pensi che sarebbe piacevole guidare un’auto munita di questo dispositivo?
   Dai una valutazione da 1 (per niente) a 7 (moltissimo).

8. Pensi che, se tutte le auto fossero munite di questo dispositivo, gli incidenti aumenterebbero o diminuirebbero?
   Dai una valutazione da 1 (diminuirebbero) a 7 (aumenterebbero).

9. Quanto saresti interessato a installare questo dispositivo sull’auto che guidi?
   Dai una valutazione da 1 (per niente) a 7 (moltissimo).