

Advanced driver support systems and screen interfaces in car

How do they affect driver behaviour?


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Advanced driver support systems and other new technology in cars, such as integrated touchscreens, bring with them both advantages and disadvantages for driving safety, but there is still much we do not know about these relationships.

New cars are equipped with a number of both passive and active safety systems, including advanced driver assistance systems (ADAS) that can facilitate and partially take over certain parts of the driving task. In addition, mechanical buttons and switches for adjusting the car's functions have been replaced with digital buttons or completely digital control surfaces that are operated via a screen on many car models. What effect ADAS and the use of integrated screens in cars have on the driver has not yet been well studied in research, and there is a great need for knowledge to build future legislation and recommendations.

The purpose of the project was to obtain knowledge about how driver support systems that exist on the market today, and integrated screen interfaces in vehicles, affect road user behaviour. This was done using three different approaches:

- 1) **Literature review:** A literature search of studies that deal with technology and functionality found in cars today was carried out, limited to studies published in the period 2010-2022. In short, the studies show that:
 - There are no clear answers as to whether ADAS has an impact on safe driving.
 - Advantages of ADAS: contribute to smoother speed, safer distance to the car in front, improved situational awareness, as well as reduced mental strain in certain contexts.
 - Disadvantages: increased chance of doing secondary tasks while driving, and thus reduced focus on driving; increased reaction time or lack of or wrong reaction in critical situations, for example because the driver takes a less active part in driving, or has excessive trust in the system; possible impairment of manual driving skills with prolonged use.
 - Factors that may be related to ADAS and safety while driving, are age, driving experience, degree of familiarity with ADAS and training in its safe use, and screen

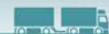


interface. Larger screens with less visual stimuli, placed closer to the view of the road ahead, appear to be more beneficial.

- 2) **Interviews** to survey experiences and reflections among key players in the car industry. We examined thoughts about issues related to ADAS and integrated screens, interest in traffic safety effects, feedback from customers and end users, as well as how any problem situations related to these forms of technology are dealt with. Some of the findings were:
 - Few work systematically with issues related to advanced driver support systems and integrated screen interfaces.
 - No one collects specific information about incidents or accidents that can be linked to the use of ADAS systems or touch screens.
 - Inquiries actors receive from customers and members, indicate that some experience challenges with advanced driver support systems and lack insight into which systems the car is equipped with, and how the systems work. Lane keeping is the technology the actors received the most inquiries about.
 - In general, little training about the driver assistance systems found in the cars is given to customers, both at car dealers and rental services.
- 3) **Field study on a driving track**, where we investigated how the use of an integrated screen affects driver behaviour. Participants wore eye-tracking glasses while performing various relevant tasks on the car's screen.
 - The study is a successful example of how the connection between the use of an integrated screen in a car and driver behavior can be studied.
 - The results provide examples of situations where the use of a screen reduces visual attention on the road.

Based on the literature in this report, we have identified several areas that should be further researched. This includes: older drivers, use and design of head-up display (HUD), and knowledge of and use of ADAS functions in the car. The latter has not been researched in Norway and is interesting with regards to mapping possible behavioral adaptations and challenges that are particularly linked to Norwegian conditions. For example, use of ADAS functions such as ACC and LKA, but also combination systems such as Tesla autopilot or similar systems.

More functions and solutions have been developed gradually to reduce distraction from the screen, including HUD and voice control. However, the research that exists is both limited and wide-ranging. It may appear that HUD contributes to drivers looking more at the road, but at the same time the research suggests that it can be more mentally taxing. It is also found that older drivers scored higher on mental stress than younger drivers when they used the HUD. However, it is difficult to say whether increased mental load can be linked exclusively to the use of the HUD, or whether it is linked to the user interface itself and the amount of information presented. More research is needed to gain a deeper understanding of the interaction between these mechanisms. Voice control is a function found in many of today's car models, which is intended to reduce the need to operate functions in the car via a screen. There are several car manufacturers and organizations that recommend voice control, including Norwegian Automobile Federation (NAF, 2023). The research that exists on voice control is still quite limited. Existing studies indicate that voice control can increase mental load, even if it seems to contribute to less visual distraction. It is important to gain more



knowledge about voice control for different user groups, and in which situations it should be used.

We know little about older drivers with regards to how ADAS and screen interfaces affect their driver behavior. Certain types of ADAS appear to be able to contribute to increased safety for older drivers, particularly alerts such as collision warning systems, and cross-traffic alerts that can warn of conditions in traffic that the driver must be aware of. However, most of the studies are simulator studies, where these functions are tested under relatively controlled conditions. It is important to gain more knowledge about how such systems affect driving behavior among older users in more realistic settings. The available literature on ADAS such as ACC and LKA is relatively small, and we find no empirical studies that examine the effect of combination systems such as Tesla autopilot or similar systems. In other words, there is a need for more knowledge about how the elderly handle combination systems, as well as how it affects situational awareness, mental load and attention, for example by measuring gaze behaviour. It will also be relevant to gain more knowledge about how older car owners with ADAS functions in their cars use the ADAS systems, and any behavioral adjustments that are made. Another area in which it is important to gain more knowledge about challenges older drivers experience with operating functions via screen interfaces in cars.

A majority of the identified studies investigating the use of ADAS and screen interfaces, have focused on the extent to which ADAS is distracting, and the extent to which drivers perform secondary activities on the screen when ADAS is activated. One area where more knowledge is needed is how mentally demanding and distracting it is for drivers to switch driver assistance systems on and off while driving. Although it is recommended to stop the car when you have to make such adjustments, it is nevertheless a scenario that can occur quite often. Lane assist is an example of a driver support system that can be found in most new car models that is activated from the start. Research shows that many find this system annoying, and want to turn it off. It could thus be interesting to examine how different user groups solve such a task while driving, for example by examining eye movements, reaction times and mental load.

Furthermore, more research is needed on training ADAS functions/screen interfaces, as well as research on how drivers handle the transition between different car models with different interfaces. The results in this study also indicate that it will be relevant to take a closer look at whether - and possibly in what way - driver training should be adapted, so that new drivers will gain sufficient competence in the safe use of ADAS and screen interfaces.

Design of screen interfaces is another area where research is lacking. It is particularly important to study how these can be developed so that they are user friendly and pose as little distraction as possible. Authorities and industry actors should work towards standardization of screen interfaces, and in particular the menu system, icons, screen placement and orientation, etc. This will help to avoid interfaces that are distracting and difficult to operate, and make the driving environment as predictable and universal as possible across car models.