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The future of driver training and driver instructor education in Norway with increasing ADAS technology in cars

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ABSTRACT: On average, more than two people are killed or severely injured every day in Norway in road traffic. Hence, elements that benefit a decrease in this number will be welcomed, such as "Advanced Driver-Assist System" (ADAS) technology. However, increasing technology in cars might require new driving skills compared to those taught today and the transition to more and new technology could potentially increase the accident rate. In the safety industry, it is well known that training for new and more automated technology is important. This raises a question: How does the transition to new, more complex and more automated technology affect driver training and the education of driver instructors? At the present time, there are no clear answers to this question. However, it seems that there is a need for a discussion and potentially a redefinition on which driver skills should be required, and how to implement these skills. This is what we attempt to discuss in this paper.

1 INTRODUCTION

In 2016, there were 135 road deaths in Norway. The number for 2015 was 117, and for 2014 it was 147. However, if you include the number of accidents resulting in severe injuries, the number was 791 in 2016, 810 in 2015, and 821 in 2014 (SSB 2018a). This means that, on average, more than two people are killed or severely injured every day due to traffic accidents in Norway. Compared to any other high-risk sector, the number is high, but the trend over the past decades is that the number is decreasing. The Norwegian government bases the National Transport Plan (NTP) on a vision of zero. This vision means zero dead and zero severely injured in road traffic. The objective for this period of NTP (2014–2023) is to halve the number of road deaths and severe injuries, and that, in 2020, there should be no more than 775 killed and severely injured in road traffic in Norway, that is about two people per day on average. Strategies to achieve this objective in Norway are, for instance, to design safer roads, to encourage safer behaviour from road users, and to encourage the development of technology to produce safer vehicles (NTP 2014–2023). Norway is not alone in such objectives as this is also in accordance with the EU objective, which is to halve the number of people killed in road traffic during the period 2010–2020 (European Commission 2015a). In order to achieve this, the EU has developed seven strategies: (1) improve education and training of road users, (2) Increase enforcement of road rules, (3) safer road infrastructure, (4) safer vehicles, (5) promote the use of modern technology to increase road safety, (6) improve emergency and post-injuries service, and (7) protect vulnerable road users (European Commission 2010). Technological innovation is one of the seven strategies, in addition to improving education and training of road users. However, what we know from other industries regarding humans interrelating with increased automation (e.g., Lee 2006; Sætren and Laumann 2015), it is not a certainty that the numbers of killed and severely injured will continue to decrease with an increase in technological solutions. Reasons such as lack of standardisation in technological solutions, mode confusion, lack of situational awareness, overreliance, complacency and so forth, could all be reasons why the interrelation between humans and technology have a possibility of not going according to plan (Young and Stanton 2007). One of the reasons is a lack of focus on training for automation (Sætren and Laumann 2015). Regarding the technological development in cars, new technology is implemented at a fast tempo, but little attention is given to training in using the technology to new and existing drivers. Research shows for instance that only 24% of buyers were given instructions from the car dealer when cars with an "Advanced Driver-Assist System" (ADAS) were bought in The Netherlands (Harms and Dekker, 2017). Even less attention seems to be placed on teaching driver instructors how to teach driving skills with this vast variety of technology. In addition, we have found no literature on this topic from a pedagogy aspect. For this reason, we would like to look at training for automation when it comes to driving cars.

How will ADAS technology in cars potentially affect driver training and driver instructor education, and which new skills might be needed for a driver?

In order to answer this, the driver training program and the driver instructor education in Norway will be presented first, before we present issues regarding automation and training. After this we discuss ADAS technology in cars and how it would affect driver training and driver instructor education. Next, we look at which new skills a driver might need. Then, we present our conclusion.

2 DRIVER LEARNING PROGRAM AND DRIVER INSTRUCTOR EDUCATION IN NORWAY

The Norwegian driver education model is very comprehensive and systematic (Rismark and Sølvberg 2007) and it normally takes about two years to become a driver with the program which contains detailed curricula for content, progression, and teaching methods (NPRA 2013). This two-year education is a module based training program consisting of four modules that include both individual and group tutorials that are both theoretical and practical. In addition, accompanied driving with someone who has had their driving license for a minimum of five years is highly recommended and thus it is common, from the age of sixteen to drive with a parent as a passenger.

Driver instructor education in Norway is also an extensive education as it is a two-year university education with an emphasis on traffic pedagogy, road traffic law, and traffic psychology in addition to physics and technology (Nord universitet 2017). This two-year education includes both theory and practice and emphasises operational, tactical and strategic driving skills (Michon 1985), and the GDE framework (Peräaho, et al. 2003). However, in the future we might see a reduced need for an extensive focus on these elements, which until now have been viewed as basic. As future in-car technology might replace some of the information retrieval, assessments and decisions previously made by the driver, we might see a shift in which are the knowledge and skills that are important for driving instructors to develop.

3 AUTOMATION AND TRAINING

There are a number of different systems, ranging from basics such as automatic windscreen wipers to more advanced technology such as lane departure tracking, automatic braking systems and even more enhanced levels of automated driving functionality. Such systems are for instance autopilot (Tesla), distronic plus steering assist (Mercedes), and intellisafe (Volvo).

Increased automation in cars will probably lead to an eventual decrease in the numbers of accidents (Elvik and Høye 2015; Wilmink et al. 2008). Some reports indicate that traffic fatalities could be reduced by as much as 90% (Bertanocelli and Wee 2015). Further, levels of automation in cars will most probably increase as a result of the increased digitalisation of the transport sector, and brands such as Volvo, BMW, and Tesla, all popular brands in Norway, expect to have self-driving cars on the roads within the next five years (TechEmergence 2017). However, it is expected that the leap from where we are today to all cars being self-driven, is remote, and that semi-automation with in-built ADAS technology seems to be a reality for some time to come, considering that age of the motor vehicle population in Norway in 2016 was, on average, 10.6 years (SSB 2018b). The number for Europe is 10.7 years (ACEA 2017).

There are several different taxonomies trying to capture the essence of the development of advanced technology in cars, and the most common seems to be the SAE's levels of automation (SAE 2014). This approach is based on six levels of automation ranging from "No automation" (level 0) to full automation (level 5). In levels 0–3 the human driver has the responsibility for the driving, and in levels 4–5 the car takes on this responsibility. Examples of technology at each level, according to Banks et al. (2017) are for instance level 1: Adaptive Cruise Control (ACC), level 2: Tesla Autopilot, level 3: Audi A7 prototype, level 4: Toyota Highway Teammate, and level 5: Google self driving car. Today, most ADAS technology equipped cars are at level 1. Furthermore, seen from a drivers perspective (Banks and Stanton 2017), there are different roles for the driver within automated systems. As an example, a Driver Driving (DD) is defined as an operator responsible for completing basic operational, tactical, and strategic tasks (Michon 1985). However, the Driver Not Driving (DND) would expect an automated system to have full control of these tasks. That being said, the transition is not straightforward, and during the middle phases of automation, Driver Monitoring (DM) should be assumed. A challenge is that in level 2 the driver operates the vehicle, which assumes a transition between DD and DM and in level 3 the driver, to a larger degree, supervises the vehicle but needs to intervene if needed assuming a transition between DM and DND (Banks and Stanton 2017). The cars with the most advanced driver assist systems will be additional to the many cars that have less advanced technological equipment on the roads. However, this middle phase is, according to human factors and safety research, a phase where the human interference is relied upon, but the human is not very reliable (Wickens et al. 2016; Son and Park 2017). Human interrelationship with semi-automated technology is known to potentially result in serious unwanted incidents in a wide range of sectors such as petroleum (Sætren and Laumann 2015), aviation (Billings 1997; Parasuraman and Byrne 2003), and road transport (NTSB 2017). Research has found there are several causes for this, for instance the issue of trust, overreliance, or complacency (Sætren and Laumann 2015; NTSB 2017), situational awareness (Kaber and Endsley 2007), mode confusion (NTSB 2014), or lack of optimal training (Salas et al. 2006; Sætren and Laumann, 2015). Additionally, news items concerning ADAS technology in cars seems to share a common misperception that when more automation is introduced, human error will disappear (e.g. NRK 2017). This gives rise to the idea that training is not necessarily needed. Human factors research advises against not training for the use of new complex technology (Lee 2006; Salas et al. 2006; Sætren and Laumann 2015), as there will always be a human in the technology loop, for instance in use, maintenance or design.

It might even be an issue that increased automation might increase the level of competence required for the operator, as an operator must know both how to handle the system more or less manually, for instance if the sensors in a car turn off due to bad weather, and additionally know how to handle and supervise the advanced technology.

So, as driving skills decrease, the need for potentially taking over the car will occur in more difficult scenarios such as in bad weather conditions like slippery roads, heavy snow, and so forth, because such conditions could be difficult for ADAS technology to handle. One example is Adaptive Cruise Control (ACC). A driver who uses ACC, that works most of the time, does not get much training in driving without it. Then, when it is time for the driver to take over control, for instance because the weather conditions are too harsh for the system to operate, the driver might lack optimal skills to handle the driving. Research has indicated that ACC technology leads to a reduction in mental workload and thus problems with regaining control of the vehicle in failure scenarios (Stanton and Young 1998). ACC is one of the technologies that might be turned off in, for instance, heavy rain without advance warning, implying in that the driver must be skilled in handling bad weather conditions while driving, and be able to take control of the car straight away.

During a transition period where there will be cars on the roads with very little to no ADAS technology in combination with cars with a large variety of ADAS technology. There is the important question of which skills should be taught in a driver training program and in driver instructor education. The introduction of more automation in cars will lead to a change in the skills needed for the driver, and hence will bring about a need for a change in the competence of the driver instructor. This, in turn, will probably affect driver instructor education.

4 AUTOMATED AND ADVANCED NEW TECHNOLOGY IN CARS IN REGARD TO DRIVER TRAINING AND DRIVER INSTRUCTOR EDUCATION

There are some obvious strengths regarding more automation in cars as opposed to fully manual cars. First of all, the workload will decrease for the human driver. With more technology taking over tasks such as changing gears, keeping the speed stable, avoiding collisions with pre-crash systems, navigation, and so forth, the driver can pay attention to other aspects. However, it is commonly known that when humans supervise a system as opposed to being an active participant, attention seem to fall (e.g. Yerkes and Dodson 1908). Even though there are many benefits such as the probability of a lower accident rate, there are also several concerns regarding automation. Most of these concerns are about when the driver needs to take over a vehicle, for instance in critical conditions (Son and Park 2017) or intention to use/user resistance (Kyriakidis, et al. 2015; König and Neymar 2017). When technology takes over many of the tasks, and works most of the time, driver skills will decrease. This is because maintaining skills without practice is probably not possible. However, very little information exists on driver training in regard to how to learn to drive with new technology as a new driver, or driving cars with new technology as an experienced driver (Harms and Dekker 2017). The topic of learning to use the technology is not even mentioned when opportunities and barriers on a societal level are considered (Fagnant and Kockelman 2015). However, the use of the technology on the market today, such as, for instance, lane assist and Adaptive Cruise Control (ACC) should perhaps be taught after proper driver skills are acquired. For instance, technical driving using lane assist could be perceived as uncomfortable as the technical reaction of the car is generally slower compared to a driver. When turning, for instance, the car is often too far out the curve before the turn is performed and this can be repeated several times during the turn. If this was the behaviour of a learner driver during a lesson, the instructor would not have considered the technical driving skills to be adequate. This means that the driver must be skilled in order to understand that the car's behaviour is not adequate, and respond accordingly. The driver requires both good driver skills and an understanding of how the technology works, together with its advantages and limitations. On the other hand, technology such as lane assist could probably be of support in the event that an unexpected incident occurs and the driver loses control of the car. As single vehicle off the road together with head-on accidents are the most frequent accidents with the highest death rate in Norway for the past decades (SSB 2018a), this technology could potentially save lives. However, perhaps, it should not be trusted for use on a regular basis. In driver instructor education today, the teaching is that when driver assistance systems take over, the driving is not optimal. Thus, the systems could be there as a backup, but not trustworthy enough to be used regularly. The driver should drive the car. Furthermore, if such systems are to be used while driving, there are other considerations involved. For instance, regarding ACC, it is a technological system that perhaps works better in some driving conditions than in others. As an example, on icy roads, or in higher density traffic in a more complex driving environment, it might be a better solution to control speed manually. Making the correct decisions on when to use, and when not to use, technology while driving requires good driving skills.

Regarding driver instructor education and driver training, it seems that the introduction of ADAS technology requires that elements are added to the education and training rather than removed. Additionally, operating these technologies should perhaps be a larger part of driver training, driver testing, and hence driver instructor education.

Technology has always had an impact on the content of the Norwegian driver education curricula. For instance, driving on slippery roads has been a mandatory part of driver training in Norway since 1975. In the early days, the learner drivers were trained to manually adjust the brake pedal in different ways to minimise the braking distance, on ice and snow, as much as possible. After the ABS braking system was introduced and became common in most cars, the content of driver training on slippery roads changed and focused more on letting the learner drivers experience that the ABS system enabled them to brake as hard as they could and to simultaneously use the steering wheel to control the car (NPRA 1995; NPRA 2005). However, the main difference between the ABS brakes transition and the present technological transition, is that ABS brakes became common in many cars and used the same way of braking in all brands of car. The driver needed to change how to move the foot while braking, but the brakes were in the same place, the basic movement was the same, and most brands of car had the same system. Nowadays, new technological solutions such as ACC, are different in different makes of car where some brands for instance have a switch on the right side of the steering wheel, while others have a button on the front or on the left side of the steering wheel. This lack of standardisation could be confusing and hence could distract the driver. All kinds of different solutions such as these, and different software solutions in touchscreens in new cars may have as a result that it may not be as easy as previously to drive a car that the driver has not driven before, due to a wide variety of technological solutions. It could be difficult to know which technological solutions are included in the car, and difficult to know how to use the technology. Currently, distractions for the driver are about to increase due to in-vehicle devices. This runs counter to the necessity of keeping an eye on road (Wickens et al. 2004).

There is a possibility that the answer to this is to have differentiated driving licenses and not a standardised license such as we are used to today, because technology in cars is too varied and unstandardised. It should be a matter for discussion as to when cars are so different from each other that a standardised driving license is no longer good enough.

Increased technology has affected the training situation for a long time, and, in Norway, one example of an aspect that is in a transitional phase, is the trend that new cars are not equipped with manual gears. There are two important aspects to this situation. First, we see that the educational system does not keep up with the speed of technological development. Toyota for instance, sold more than 99% of new cars equipped with automatic gears so far in 2017, in Norway (Korsvoll 2017). Thus, the driver will not need to learn how to use manual gears as automatic gears will most probably become the new normal. However, in Norway, driver training is based on manual gears, and the education of driver instructors is based on vehicles equipped with manual gears. Perhaps the driver instructor program should focus instead on other tasks rather than teaching new drivers how to drive with manual gears. If a technology as basic as gears is hard to keep up with regarding a transition from manual to more automation, it could be a challenge when now even more technologically equipped cars enter the market.

Second, the gearing system is an example where different technological equipment in cars requires different types of license for the driver. In Norway, as in the EU, you are allowed to drive an automatic car if your license is for manual gears, but not the other way around. You are not allowed to drive a car with manual gears if your license is for automatic driving (FOR 2017). For this reason, many driving schools only have manual gears in their cars, as for instance learner drivers know that they will probably buy a cheaper car with manual gears when they have their license. A solution such as this might also include more ADAS technology in the years to come. There could be different licenses based on the technology in the car you drive.

The rapid speed of introducing new technology seems to be happening faster than the changes in the educational system. Furthermore, if you have received your class B driving license, there is no re-testing or system to update your driving skills, so there is a question as to how these drivers should learn how to operate new technology properly. Additionally, for driver instructors who are already authorised, there are no mandatory courses for updating their competence, so another question could be how they should get the necessary skills to teach new and existing learner drivers. If the two-year university education to become a driver instructor in Norway adjusts today, the market will not change completely for many years. Nevertheless, the rapid speed of technological progress will continue.

5 NEW DRIVER SKILLS REQUIREMENTS

In order to know which skills a driver must have, we need to know how the car works. For example, the GDE matrix has been the basic understanding of the driving skills that is necessary for a driver to have and thus, one of the central elements in the driver instructor education. The GDE-matrix consists of five levels, where the lowest level is vehicle manoeuvring, the second level is mastering traffic situations, the third level is goals and context of driving, the fourth level is goals for life and skills for living (Keskinen 1996 in Hatakka et al. 2002), and the fifth level is social skills (Keskinen 2014; Keskinen et al. 2010). However, the situation regarding new technology in the car is also changing the skills needed for a driver. It seems to be time to redefine which competence a driver must hold, and the GDE matrix may not be the optimal way to define the necessary skills in the future. If cars become more or less self-driving and automated, perhaps the lower stages of the GDE matrix might not correspond with the actual skills that are needed to drive a car.

Another example is the driving process, which might be explained using a basic information processing model (e.g. Wickens and Carswell 2006). This model assumes that information is *perceived*, then *processed* before *decisions* are made based on how the information is processed and *action* is then taken. In regard to the driving process, the question is who is collecting the information and who is responsible for collecting which information, the car or the human? As an example, when driving with ACC, the driver needs to monitor the environment and collect information on driving conditions as the car does not collect information, for instance, on the road conditions such as rain or ice or dry asphalt. Furthermore, the system does not correspond with any other systems in the car, so, for instance, if the car skids and the traction gets the car back on track, the ACC does not take the slippery road condition into consideration, and will only work to get the car back to the required speed or distance from the car in front. This assumes Driver Driving and Driver Monitoring with this technology (Banks and Stanton 2017). Regarding another technology, lane assist, the same aspect occurs as, for instance, lane assist will not work without proper road markings. Therefore the driver must pay attention to whether the road is properly marked or not. This is information a driver normally would not need to pay that much attention to if driving the car, as the driver would most likely hold the steering wheel and stay on her/his side of the road regardless of the quality of the road marks. The technology could thus make the driver pay attention to the road closer to the vehicle rather than paying attention to the road traffic environment further ahead. Additionally, regarding decision making, it could be questioned as to whether it is the car or the driver that makes the decisions. For instance, with ACC, if the car does not collect information on the road conditions, it cannot be responsible for making decisions in this regard. The driver must monitor and make decisions based on the information gathered and processed. Finally, the question is who takes action based on the information and decisions? If the car does not make decisions or gather relevant information, it probably cannot take appropriate action, meaning this would be the driver's responsibility.

So, what do we hand over to the car and what is left to the driver? The question will have different answers for different technologies. If, for instance, using the same scenario as with the ADAS technology, adaptive lighting, there is a different situation. Here the car gathers information on for instance the light conditions in the environment, and oncoming cars, and makes decisions based on the information gathered and takes action to turn lights on or off or chooses the degree of brightness. Thus, the driver will not need to use as much cognitive capacity for this operation.

Another issue that complicates which driving skills are needed is the lack of standardisation between the car manufacturers on how the new technology should interact with the driver. For instance, there are several different solutions to touchscreen software in cars. So, the skills of the driver need to correspond to the actual car the driver will be driving, the technological solutions in the car and how the technological solutions interact with the driver.

It seems that training needs adjustment in order to meet the new digitalisation of the future. However, in order to change what we teach to the learner drivers, we probably need to start with the educational institutions who educate the driver instructors. In addition, there is the question of if and how to re-educate driver instructors who are already certified as driver instructors for traditional driving. In Norway alone, there are more than 1,000 driving schools, and providing courses for the instructors in all of these schools will take time and effort. This time does not seem to be available at the speed at which changes are happening today.

One solution could be that the manufacturers are responsible for the specific technological training for drivers, and license drivers for their technology. A solution such as this also requires consideration as to what training and testing for such a license should involve, in addition to who is responsible for the training and testing. Today it is the National Road Authorities in Norway who conduct the testing of learner drivers in order for them to qualify for a driving license. Therefore, to maintain the driver skills requirements, the testing could be the responsibility of the authorities. This testing could include drivers ability to drive and supervise the systems in addition to how to respond to alarms and warnings. Therefore, one could think of driver education that comes in two levels. In that case, a standard learner driver could learn how to handle a manual car as level one in a standard driving school, but also learn how to operate and supervise a car of the future as level two. How to drive a car with technological solutions could, with this system, be up to the manufacturers to teach properly to all drivers, and be tested by the road authorities.

We see in aviation, for instance, that pilots are trained in simulators in order to uphold the required skill level to fly an aircraft. This is partly because flying with a high level of automation decreases flying skills. This could be a solution for drivers as well. In order to keep their driving license, drivers could be required to have a certain amount of simulator training in order to uphold driving skills because their cars have ADAS technology. However, this will require an increase in simulators for one, and in Norway today there are between 5–10 simulators for driving license B. Furthermore, retraining to uphold skills requires a system where everyone holding a driving license in Norway has training. A system will also be needed to deal with the bureaucratic aspects. Thus, there are some obvious obstacles to such a solution in regard to costs and resources in addition to the issue of how society would respond to it and if there will be public acceptance for such a system, and the political will to implement it.

6 CONCLUDING REMARKS

How will ADAS technology in cars potentially affect driver training and driver instructor education and which new skills might be needed for a driver? This was the question we wanted to examine closely in this paper.

We must be honest and admit that today, we do not know how to provide general training for more technology equipped cars, or even for self-driving cars. To be able to assess a good training program, it is essential that we know what we are training for. Today, however, with the vast variety of technological solutions on the roads, the lack of standardisation of the software and devices in cars, in addition to a future which seems to have new technological solutions happening quickly, it seems difficult for the driver instructor industry to prepare and come up with an optimal solution in the short run.

Hence, we recommend that the content of driver training and driver instructor education should preferably be increased, not decreased, as good driving skills are still needed in addition to good understanding on how to operate the technology. This is because, as of today, ADAS technology in cars seems to result in more rather than less work for the driver.

REFERENCES

ACEA, 2017. Average vehicle age. ACEA European Automobile Manufacturers Associations. http://www.acea.be/statistics/tag/category/average-vehicle-age.

Banks, V & Stanton, N. 2017. Analysis of driver roles: Modelling the changing role of the driver in automated driving systems using EAST, *Theoretical Issues in Ergonomics Science.* doi.org/10.1080/1463922X.2017.1305465.

Banks, V. et al. 2017. Is partially automated driving a bad idea? Observations from an on road study. *Applied Ergonomics, 68,* 138–145.

Bertanocelli, M. & Wee, D. 2015. *Ten ways autonomous driving could redefine the automotive world.* McKinsey and Company. Downloaded November 25th from https://www.mckinsey.com/industries/automotive-

and-assembly/our-insights/ten-ways-autonomous-driving-could-redefine-the-automotive-world.
Billings, C. 1997 *Aviation automation: The search for a human-centered approach.* Englewood Cliffs, NJ: Erlbaum.
Elvik, R. and Høye, A. 2015. *Hvor mye kan drepte og hardt skadde i trafikken reduseres?* (English translation: How much can the number of those killed and severely injured in road traffic be reduced?) Transportøkonomisk Institutt: TOI Report 1417/2015.
European Commission 2010. *Communication from the commission to the European parliament, the council, the European economic and social committee and the committee of the regions. Towards a European road safety area: policy orientations on road safety 2011–2020.*
Fagnant, D. J. & Kockelman, K. 2015. Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations. *Transportation Research Part A, 77,* 167–181.
Forskrift om trafikkopplæring (FOR) 2017. https://lovdata.no/dokument/SF/forskrift/2004-10-01-1339?q=trafikkopplæringsforskrift [Norwegian Regulations for traffic education] The Norwegian Ministry of Transport.
Harms, I.M & Dekker, G-M. 2017. ADAS: from owner to user. Insight in the conditions for a breakthrough of Advanced Driver Assistance Systems. *Connecting Mobility NL.*
Hatakka, M. et al. 2002. Goals for driver development, published in EU MERIT Project (2004). *Driving instructors' education in Europe: A long-term vision*, Working Paper for Workshop 1, (21 January, 2005).
Hatakka, M. et al. 2002. From control of the vehicle to personal self-control; broadening the perspectives to driver education. *Transport Research Part F, 5,* 201–215.
Kaber, D. B. & Endsley, M. R. 2007. The effects of level of automation and adaptive automation on human performance, situation awareness and workload in a dynamic control task. *Theoretical Issues in Ergonomic Science, 5,* 113–153.
Keskinen, E. 2014. Education for older drivers in the future. *IATSS Research, 38,* 14–21. doi.org/10.1016/j.iatssr.2014.03.003.
Keskinen, E. et al. 2010 *GDE-5PRO and GDE-5SOC: Goals for driver education in a wider context–professional and private drivers in their environment* Unveröffentlichtes Manuskript, Universität Turku, Finland.
König, M. & Neymar, L. 2017. Users' resistance towards radical innovations: The case of self-driving cars. *Transportation Research Part F, 44,* 42–52.
Korsvoll, R. 2017. Nå forsvinner det manuelle giret. (Now the manual gear disappears. Our translation) *Motor:* Downloaded December 12th from https://www.motor.no/artikler/2017/oktober/na-forsvinner-det-manuelle-giret/.
Kyriakidis, M. et al. 2015. Public opinion on automated driving: Results of an international questionnaire among 5000 respondents. *Transportation Research Part F, 32,* 127–140.
Lee, J.D. 2006. Human factors and ergonomics in automation design. In G. Salvendy (Ed.) *Handbook of human factors and engineering* (3rd ed.). Hoboken, NJ: John Wiley and Sons.
Michon, J. A. 1985. A critical view of driver behaviour models: What do we know, what should we do? In L. Evans and R. C. Schwing (Eds.), *Human behavior and traffic safety*, pp. 485–502. New York: Plenum Press.
NTP 2014–2023 Stortingsmelding 26 *Nasjonal Transportplan* Det Kongelige Norske Samferdelsdepartment.
NRK 30.04.2017 https://www.nrk.no/norge/null-omkomne-i-fire-fylker_-forerlose-biler-kan-halvere-ulykkene-1.13494298
NTSB 2014. *Descent below visual glidepath and impact with Seawall, Asiana Airlines Flight 214, Boeing 777-200ER, HL7742, San Francisco, California July 6, 2013.* Washington, DC: Author. Retrieved November 25th from https://www.ntsb.gov/investigations/AccidentReports/Reports/AAR1401.pdf
NTSB 2017. *Driver errors, overreliance on automation, lack of safeguards, led to fatal Tesla crash.* National Transportation Safety Board. Retrieved November 20th 2017 from https://www.ntsb.gov/news/press-releases/Pages/PR20170619.aspx
Nord universitet 2017. Studieplan for Trafikklærer, høgskolekandidatstudium. (English translation: Driving Instructor Education for License B. Nord University.) Received December 15th 2017 from: https://www.nord.no/no/studier/trafikklarer-hogskolekandidatstudium#.
Norwegian Public Road Administration (NPRA) 1995. Curricullum for driver training category B, BE and code B 96.
Norwegian Public Road Administration (NPRA) 2005. Curricullum for driver training category B, BE and code B 96.
Norwegian Public Road Administration (NPRA) 2013. Curricullum for driver training category B, BE and code B 96. www.vegvesen.no.
Parasuraman, R., and Byrne, E. A. 2003. Automation and human performance in aviation. In P. Tsang and M. Vidulich (Eds.), *Principles of aviation psychology* (pp. 123–155). Lanham, MD: Rowmand Littlefield.
Peräaho, M, Keskinen, E, Hatakka, M. 2003. Driver competence in a hierarchical perspective; implications for driver training. University of Turku, Traffic research Rismark, M., and Sølvberg, A.M. 2007. Effective dialogue in driver education. *Accident Analysis and Prevention, 39,* 600–605.
Rismark, M., and Sølvberg, A.M. 2007. Effecive dialogues in driver education. *Accident Analysis and Prevention, 39,* 600–605.
SAE 2014. *Automated driving levels*, SAE International Standard J3016.
Salas, E. et al. 2006. Design, delivery, and evaluation of training systems. In G. Salvendy (Ed.) *Handbook of human factors and engineering* (3rd ed.). Hoboken, NJ: John Wiley and Sons.
Sætren, G. B. & Laumann, K. 2015. Effects of trust in high-risk organizations during technological changes. *Cognition, Technology and Work, 17,* 131–144.
Son, J. & Park, M. 2017. Situation awareness and transition in highly automated driving: A framework and mini review. *Journal of Ergonomics 7*, DOI: 10.4172/2165-7556.1000212.
SSB.no 2018a. Veitrafikkulykker med personskade (Road traffic accidents involving personal injury).
SSB.no 2018b. Personbiler alder (Passenger cars, age).
Stanton, N. and Young, M.S. (1998). Vehicle automation and driving performance. *Ergonomics, 41*(7), 1014–1028.

SVV 2017. Statens Vegvesen (Norwegian Road Authorities) https://www.vegvesen.no/

TechEmergence.com 2017. The self-driving car timeline—predictions from the top 11 global automakers. Consulted on November 5th, 2017 at: https://www.techemergence.com/self-driving-car-timeline-themselves-top-11-automakers/

Young, M.S. & Stanton, N. A. 2007. What's skill got to do with it? Vehicle automation and driver mental workload*, Ergonomics*, 50:8, 1324–1339, DOI: 10.1080/00140130701318855.

Wickens, C.D. & Carswell, C.M 2006. Information processing. In G. Salvendy (Ed.) *Handbook of human factors and engineering* (3rd ed.).Hoboken, NJ: John Wiley and Sons.

Wickens, C.D. et al. 2016. *Engineering psychology and human performance* (4th ed.). New York: Routledge

Wickens, C.D., . et al. 2004. *An introduction to human factors engineering* (2nd ed). New Jersey: Pearson Prentice Hall.

Wilmink I. et al. 2008. *Impact assessment of intelligent vehicle safety systems*. eIMPACT Deliverable D4. Version 1.0.

Yerkes, R.M., and Dodson, J.D. 1908. The relation of strength of stimulus to rapidity of habit formation. *Journal of Comparative Neurology & Psychology,* 18, 459–482. doi.org/10.1002/cne.920180503.