SWOV
INSTITUTE FOR
ROAD SAFETY RESEARCH

Automated vehicles in traffic

How will pedestrians and cyclists react

Automated vehicles are being developed at a rapid pace and automated driving systems are becoming more and more advanced. Before long automated vehicles will be a common mode of transport on our roads. There will, however, be a transition period during which a mixture of manually driven, partially automated and fully automated vehicles will be participating in traffic. The recently published SWOV report *Safe interaction between cyclists, pedestrians and automated vehicles* investigates what is known about the interactions between (partially) automated vehicles and vulnerable road users and does this from the perspective of pedestrians and cyclists.

Vulnerable road users

Pedestrians and cyclists are vulnerable road users because they do not have a protective shell and are therefore easily (fatally) injured. This is particularly the case in crashes with heavier, faster vehicles such as cars, delivery vehicles and trucks. In addition, the behaviour of pedestrians and cyclists is often unsystematic and unpredictable. Crash statistics show that most of the pedestrian and cyclist road deaths occur in crashes with motorised vehicles, mainly in urban areas.

Perspective

The interaction between pedestrians and cyclists and motorised vehicles is important for road safety, especially for that of the vulnerable road users. Current interaction patterns and strategies of pedestrians and cyclists cannot be automatically transferred 'as such' to a situation with automated vehicles or to a situation with vehicles with different levels of automation. The behaviour of pedestrians and cyclists may very well be different in their interaction with automated vehicles. The research that has been done on the interaction between automated vehicles and pedestrians and cyclists, has seldom used the perspective of pedestrians and cyclists. It is therefore difficult to estimate the safety effects of (a transition towards) automated vehicles for this category of road users and, consequently, to know what must be done to prevent crashes between these road user categories or to minimize their severity. SWOV therefore set out to provide an overview of current knowledge about the interaction of pedestrians and cyclists with (partially) automated vehicles, from the perspective of pedestrians and cyclists; decision making and behavioural aspects as well as potential road safety consequences were investigated. The findings are used to identify knowledge gaps: what we need to know to ensure that the safety of pedestrians and cyclists is not affected by an automated driving system and or by the transition period towards such a system.

Findings

Some of the problems that have been identified in the SWOV literature study are presented below.

Road deaths

Worldwide, pedestrians and cyclists account for just over 25% of all road deaths, in the European Union for almost 30% and in

the Netherlands for almost 40%. Whereas both worldwide and in Europe, the share of pedestrian road deaths is substantially higher than the share of cyclist fatalities, this is the other way around in the Netherlands: 30% of all Dutch road deaths are cyclists and 9% pedestrians. It is sometimes suggested that automated vehicles can reduce these percentages. Is this indeed the case?

Non-verbal communication

The interactions between road users are essentially based on formal rules and regulations. However, personal characteristics such as skills and experience, knowledge, motivation, state-of-mind, as well as age and gender may, either consciously or unconsciously, influence the correct application of these rules. In addition, expectations, the presence and behaviour of other pedestrians or cyclists, as well as feelings of safety or insecurity affect the way the interactions develop. Communication between road users, generally non-verbal communication such as nodding or a hand gesture, helps to clarify their intentions. This type of communication is impossible in automated vehicles.

Predicting intentions and behaviour

So far, technology has mainly focused on the detection and recognition of pedestrians and cyclists and good progress has been made. Safe interaction, however, also requires technology that can reliably predict the intentions and behaviour of pedestrians and cyclists, so that the vehicle can choose the right course of action. Automated vehicles stick to the traffic rules and regulations, do not exceed the speed limit, and do not make errors due to being distracted, fatigued, or being under the influence. Road users, on the other hand, do make errors and commit violations, and may look and/or behave in a way the automated vehicle cannot detect or recognize. Making the correct predictions requires further research.

Cautious attitude

The limited research carried out so far has found that pedestrians and cyclists generally have a conservative, rather cautious attitude towards automated cars. Pedestrians and cyclists do not seem to fully trust the behaviour of automated vehicles when they share the road or interact. And, whereas pedestrians/cyclists say that

they know and appreciate that automated vehicles use an auditory or visual signal to indicate that they have been spotted and/or to show the intentions of the vehicle, they tend not to change the way in which they cross the road.

Attentiveness

The human driver is expected to play a role until the very last level of full automation. However, this role will change from being actively in command to that of monitoring the situation as a supervisor. However, people are known to be unfit for this supervising role, because they are unable to remain attentive for a longer period of time when they are merely supposed to monitor the environment. Therefore, remaining attentive and taking over control adequately and in time when they are required to do so is a major problem.

Knowledge gaps and answers

In addition to the problems identified in the previous section, many questions remain; questions that need to be answered in order to ensure that further developments towards automated driving will not result in a traffic system that is even less safe for pedestrians and cyclists.

Many relevant questions such as *"Will cyclists and pedestrians change their crossing decisions or their red light compliance?"* concern the behaviour of pedestrians and cyclists when interacting with automated vehicles and the underlying psychological processes. Other questions concern the likely transition period from completely manually-driven vehicles to fully automated vehicles, or measures to help pedestrians and cyclists to interact safely with automated vehicles.

Answers to these questions need to be shared with those who need them most: road authorities, car manufacturers and software developers.

More information

You can find all the details of this SWOV-study and information the problems and knowledge gaps that were identified in SWOV-report R-2016-16 *Safe interaction between cyclists, pedestrians and automated vehicles; What do we know and what do we need to know?*

Much information can also be found under the project description on the SWOV-website:
S17.05 Safe interaction between cyclists, pedestrians and autonomous vehicles