"That bollard could have been a child".

On traffic safety and human behaviour in traffic[1].

Inaugural speech

Short version has been spoken on October 21st, 2015
at the occasion of her acceptance of the
position of full professor of 'Traffic Safety'
at the Faculty of Civil Engineering and Geosciences
of Delft University of Technology

by

Prof.dr. M.P. Hagenzieker

[1] *The inaugural address was recorded and can be viewed via this link: https://collegerama.tudelft.nl/Mediasite/Presentation/67e9a72b94b2448190f4a387aa23cf6c1d*

Mijnheer de Rector Magnificus,
Leden van het College van Bestuur,
Collegae Hoogleraren en andere leden van de universitaire gemeenschap,
Zeer gewaardeerde toehoorders,
Dames en heren,

A warm welcome to everybody! And a special welcome to all non-Dutch speakers. Because as you probably know my speech will be in Dutch. The slides are in English though, so I hope that will help. I will now switch to Dutch.

Today, I will take you on a journey into the world of traffic safety, or perhaps more accurately traffic unsafety, and research into it.

"That bollard could have been a child". The title of my inaugural address is a phrase actually used in the law courts and was intended to explain the need for imposing a fine or other criminal measure on people who have caused an accident or damage (Vleggeert, 2015). The seemingly innocent phrase "It was only a bollard" suddenly changes its meaning: in different circumstances, a simple mistake can have drastic consequences.

This explanation is intended to ensure that drivers drive more safely in future. It may lead them to pay more attention to bollards and drive more slowly in their vicinity. They may also not only be more vigilant when it comes to bollards, but also other things or people that you can drive into. When people change their behaviour in this way, certain accidents can potentially be prevented. But it could equally result in drivers simply paying the fine and complaining slightly less about it. Perhaps, rather than attempting to change drivers, we should be trying to change his or her environment? Should that bollard actually have been there or should it perhaps have been more visible?

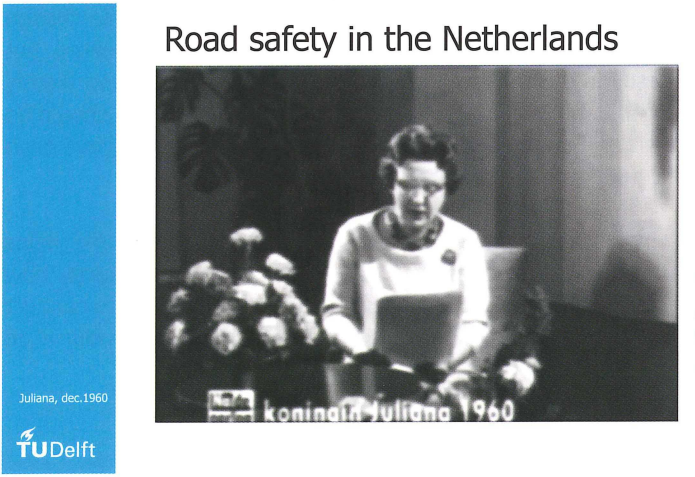
The secret lies in discovering how we can prevent accidents. What helps and what does not? It is only possible to do this, if you know exactly how accidents happen and understand the causes. That means you need to conduct research. In this speech, I will demonstrate that research into behaviour is an indispensable part of this.

Scope of the problem

Every year, more than 1.5 million people are killed in traffic on the roads every year (WHO, 2015). In Europe, that figure is approximately 26,000 (Adminaite

et al., 2015) and in the Netherlands it was 570 last year (Statistics Netherlands/ CBS, 2015). The number of serious traffic injuries is many times higher: tens of millions worldwide (WHO, 2015) and around 19,000 in the Netherlands every year (Institute for Road Safety Research/SWOV, 2015).

Figure 1. Scope of the problem.



"...the Netherlands does not belong to Europe's best."

Figure 2. In 1960, Queen Juliana referred to the danger of traffic in her Christmas address.

Since 1947, a total of 107,812 traffic fatalities have been recorded in the Netherlands – and the actual figure is even higher. To give you some idea of the magnitude: this figure amounts to more than all of the inhabitants in the municipality of Delft. Or take this lecture room – it can accommodate more than 1000 people, so that makes 100 full lecture rooms.

Traffic accidents have been happening ever since traffic existed. The number of fatalities grew enormously in the 1950s and 1960s. Juliana, the Dutch Queen at the time, even referred to it in her Christmas address in 1960. It would be difficult to imagine that happening today. The number of road traffic fatalities peaked at the start of the 1970s: more than 3,000 every year. This was largely the result of the increase in motorised traffic.

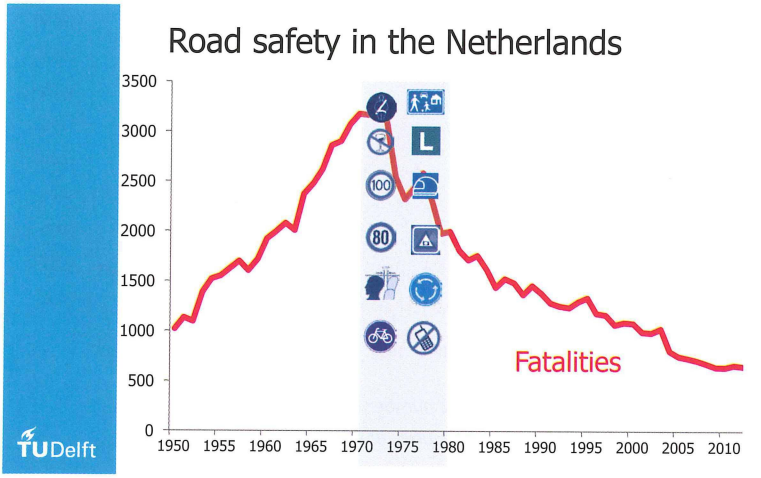


Figure 3. Traffic safety trends in the Netherlands.

In the middle of the 1970s, the numbers began to fall and that trend has continued to the present day. Since the middle of the 1970s, the number of traffic fatalities has fallen spectacularly – by a factor of four! I am firmly convinced that this fall is partly thanks to effective research. That combined, of course, with the results of many different measures. For example, it became compulsory to wear a safety belt in the 1970s; the legal blood alcohol level for drivers was set at 0.05%; speed limits were introduced for roads outside built-up areas; headrests started to appear on front car seats; separate cycle tracks were widely introduced; residential areas were given special low traffic status; and training standards were introduced for driving instructors – to name just

a few examples. Many more measures have been introduced in the meantime. Over the same period, we have all become much more experienced in our new and increased mobility and are better able to manage it safely. For many years, the Netherlands was one of the world leaders in traffic safety, but has been overtaken more recently by such countries as Norway, Denmark and Ireland (Adminaite et al., 2015). This means that we cannot rest on our laurels. 570 road traffic fatalities per year is the equivalent of two large passenger aircraft at full capacity! What is especially worrying is the fact that the number of serious traffic injuries shows a rising rather than falling trend (Weijermars et al., 2014).

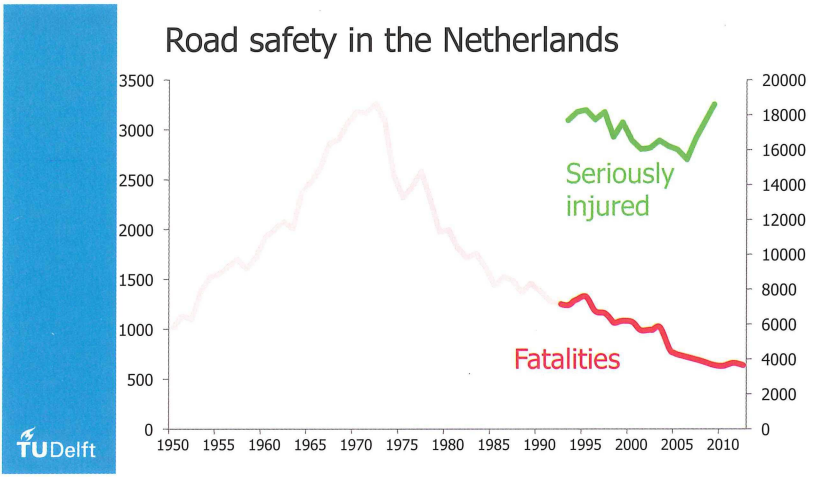


Figure 4. Trend in the number of traffic fatalities and serious traffic injuries in the Netherlands.

Danger on the roads is not only associated with an enormous amount of human suffering, but also significant costs to the economy. In motorised countries, it amounts to approximately 2% of the gross national product. In the Netherlands, that means slightly over 12.5 billion euro every year.

By way of comparison: the annual costs of congestion are between 2.3 and 3.0 billion euro; the environmental costs of traffic are between 2.0 and 8.5 billion euro (SWOV, 2014). And if you ask citizens for their opinion, they will say that their experience of traffic safety or lack of it matters a lot in terms of their well-being (RIVM, 2004). So how can we bring about a further fall in the number of victims and the associated costs? And what research will be needed to achieve this? I will return to these questions later.

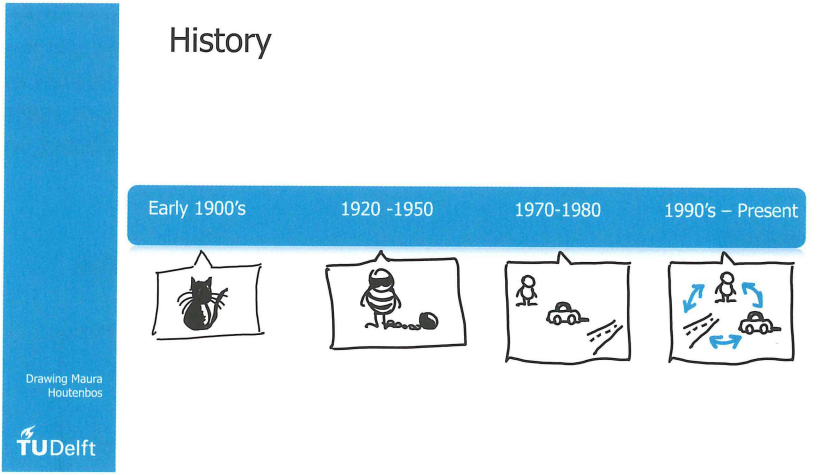


Figure 5. History: views on traffic safety in various periods.

History

But first, let us go back in time. We can clearly see that views on traffic safety have changed a lot over the years. Around a century ago, accidents were actually regarded in Western, motorised countries as a matter of bad luck – fate – and therefore inevitable. Indeed, the Dutch term for 'accident' roughly translates as 'bad luck'. Besides, in many countries of the world, deeply-rooted cultural and/or religious convictions mean that traffic safety or lack of it continue to be seen as a question of fate (Nordfjærn et al., 2014).

As we move further forward to the 1920–1950 period, much of the blame was placed on reckless drivers – a small group of motorists thought to be the cause of the bulk of all accidents. If we could only find out who these people were and ban them from the roads, the problem would be solved, was the thinking. But that proved unsuccessful. Research revealed that the reckless drivers of the past were usually not the reckless drivers of the future. And vice-versa. In the ensuing period, people assumed that traffic accidents were caused by factors related to humans, the vehicle or the road, then a combination of these factors and this ultimately resulted in the 'system approach'. In the last decade, based on the view that accidents are caused by a combination of different factors, the so-called system approach has been on the rise. One of the basic principles of the system approach is that all parts of the traffic system must be taken into account in order to successfully improve traffic safety (Accident Analysis and

Prevention, 2015). This system approach is actually used in increasing numbers of countries, for example as the basis for traffic safety policy. Sweden and the Netherlands are well known examples. Here in the Netherlands, it is known as Sustainable Safety (Duurzaam Veilig, Wegman et al., 2008). The various views on what causes accidents have been reflected in the research conducted on traffic safety over the years.

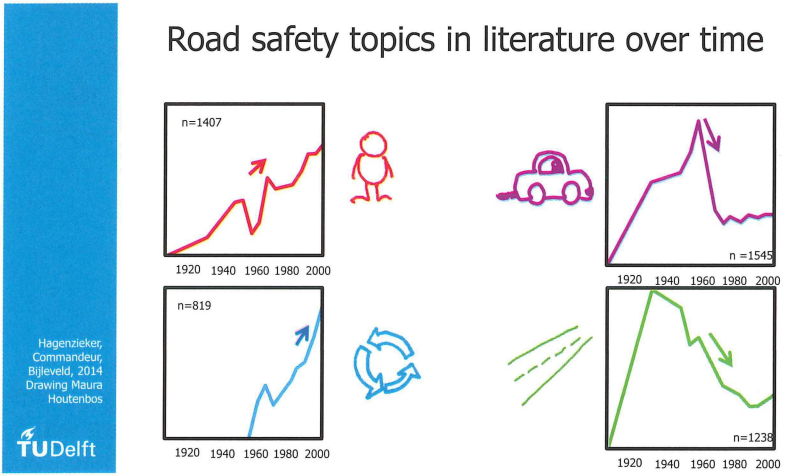


Figure 6. Focus on different traffic safety topics over various time periods (based on Hagenzieker et al., 2014).

Here, we can see the number of academic publications on topics relating to traffic safety. There is clearly an increasing focus on 'human behaviour' and the 'traffic system'. On the other hand, the subjects 'vehicle' and 'road' both peaked in a much earlier period. This was revealed by a quantitative analysis of research into traffic safety published in academic journals (Hagenzieker et al., 2014). We looked at the subject of all of that research, sorted it into subjects and topics and counted them.

Behaviour

The focus on behavioural research in my specialist field is increasing. There is good reason for this: behaviour is a key factor. Knowing about traffic behaviour is essential in order to make substantial and structural improvements to traffic safety, especially measures that involve infrastructure, vehicles or technical solutions. For example, the way you design a road is a great way of influencing road users.

I aim to demonstrate that the behavioural sciences have a great deal to offer on this point. I have chosen three topics on which to focus at TU Delft in the period ahead: the first two of these are traffic safety in the city and automated driving, two very current themes that clearly bring together technology and behaviour. My third topic will be: behaviour in traffic safety models. I will return to that point later.

Figure 7. Three topics

The city

We will start with the city. How can we make traffic safer in modern urban environments? Urbanisation is increasing worldwide, including in the Netherlands. More than half of all people now live in urban environments and their numbers continue to increase. It ranges from 82% of the population in North America to 40% in Africa. In Europe, city-dwellers account for 73% of the population (Economist, 2015).

In the Netherlands, walking and cycling are relatively important modes of transport within the built environment (Netherlands Institute for Transport Policy Analysis/KiM, 2014). Cycling and walking are also healthy modes of transport. In cities, they can often save time, are good for the environment and help combat congestion. This is why cycling is becoming increasingly popular not only in the Netherlands, but also in other European countries and worldwide (ITF, 2013). However, the downside of this is that these modes of transport are also relatively vulnerable and these types of road users account for relatively

large and increasing numbers of victims. These groups have benefited less than other groups of road users, such as car drivers, from the overall reduction in risk achieved.

In the Netherlands, road traffic accidents involving cyclists tend to be concentrated in built-up areas and on local roads (Weijermars et al., 2014). Around half of all traffic fatalities in the country's urban provinces (e.g. Utrecht, Zuid-Holland) are in built-up areas; in rural provinces (e.g. Groningen, Drenthe), that figure is a quarter. In urban provinces, there are relatively more serious traffic injuries in built-up areas than in more rural provinces (Eenink & Vlakveld, 2013). Cyclists receive the most serious injuries and there has been a significant increase in these since around 2007–2008. This includes a lot of elderly people who are increasingly taking to two wheels, partly due to the introduction of electric bicycles.

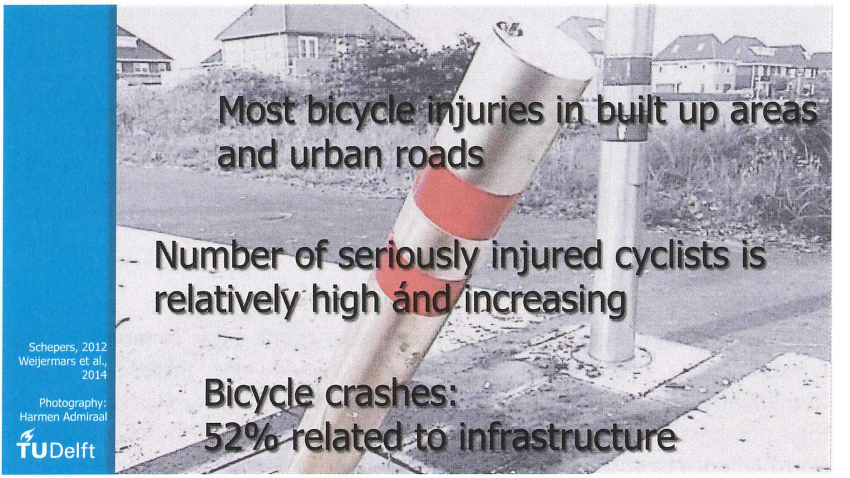


Figure 8. Cyclists are mainly involved in road traffic accidents in built-up areas and on local roads in the Netherlands, and many bicycle accidents are related to infrastructure.

Let me briefly return to the bollard in the title. Most, indeed more than half (52%) of all bicycle accidents in the Netherlands are related to infrastructure. This frequently involves bollards on cycle tracks. But these are not the only obstacles that cyclists encounter. Cities are growing in complexity as they become busier and more and more different types of vehicles use the roads. There are increasing numbers and different types of fast and electric bicycles, all kinds of often extraordinary vehicles – including motorised and foot-

operated scooters and the Segway – alongside cars, buses, trams, commercial vans, lorries and... pedestrians. A mixture of lighter and heavier, larger and smaller, and faster and slower vehicles is emerging. All of these need to interact in traffic. If we fail to take action now, the urban road infrastructure will be outpaced by these developments. We will need to modify this infrastructure in order to prevent the increase in the number of trips and different modes of transport resulting in more traffic victims (Weijermars et al., 2014).

How many bollards are there in urban environments anyway? What purpose do they serve? Is it possible to introduce greater or improved separation of road users and vehicles of different speeds and sizes? Perhaps even fast and slow cyclists? Or possibly share the space more effectively? But do road users want that? In addition, what speeds are safe and under what circumstances? Should we have users of fast bicycles take a driving test, as we do with moped riders? And if we do, will it actually make traffic safer? Is it desirable to ban certain vehicles from city centres, such as lorries in busy high streets? Which trends in mobility and choices of mode of transport are set to continue? What combination of measures would be most effective in improving traffic safety? These are just a few of the numerous questions to which the answers are not exactly obvious (Twisk et al., 2013).

Figure 9. There are more and more different types of road users.

For cities and urban areas, a great deal of thought is currently being devoted to the future, often under the term 'smart cities'. How can quality of life be improved

in cities and cities made more attractive? In my view, traffic safety should play a very specific role in this from the outset. Of course, this is often already the case. But it can and must be much better. We need to aim to achieve health benefits, for example by enabling more people to cycle, but without the dreaded side-effects of the dangers involved. This is, in fact, possible if you come up with suitable measures. At present, however, there are no ready-made solutions. Research is required to help identify them. This research is already underway and, in the years ahead, I intend to help ensure that traffic safety becomes a key focus of attention there and remains so. Before we immediately seize on all kinds of assumed or apparently obvious solutions, let us first explore what the potential consequences will be for traffic safety and how we can prevent potentially negative consequences.

Automated driving

The second topical theme that I would like to focus on in the period ahead is automated driving. First, let us return to the bollard that could have been a child. This explanation when issuing a fine may soon be completely outdated if intelligent vehicles are driving around on a major scale. Bollard or child, the intelligent vehicle will see it and simply avoid it. In the ultimate version of the intelligent vehicle, the fully automated, autonomous or self-driving vehicle, the human driver will play hardly any role at all. There will be even fewer traffic offences.

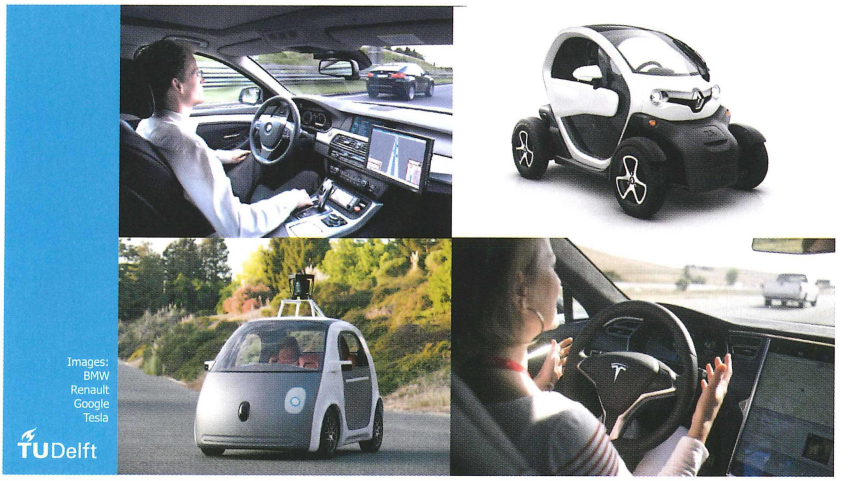


Figure 10. Various types of vehicles automated to a greater or lesser extent.

In other words, the traffic safety issue will soon be solved with the arrival of the automated car. Or perhaps not? The self-driving vehicle. This is a subject that attracts a lot of attention from the media, industry and the world of science and academia. A new report seems to appear on the subject every other week. In the wider debate, it is also clear that there are still many uncertainties about various possible scenarios. In addition, there is not just a single type, but all types of automated driving under development at all different levels.

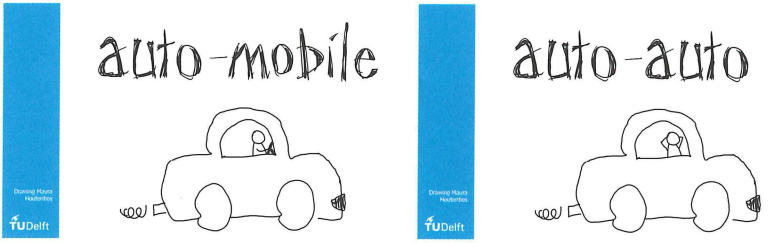


Figure 11. The auto-mobile becomes auto-automobile.

I will refer to this here as the "auto-automobile". Because the automobile, which also means "self-moving" – from the Greek word auto: "self" and the Latin mobile: "moving" – already exists (https://nl.wikipedia.org/wiki/Auto). Many traffic benefits are expected from the auto-automobile. In my view, this is expecting too much in the short term, since it is based on rather optimistic assumptions (ex-ante estimates: see, for example, Fagnant & Kockelman, 2015). It is more realistic to assume positive safety effects in the longer term (Milakis et al., 2015).

I therefore do not assume that, in the near future, auto-automobiles will be able to operate on a large scale and completely independently in mixed traffic, such as in cities. The human driver will continue to play an important role for many years to come, as the research literature in the behavioural sciences clearly shows (Jamson et al., 2013). I cannot envisage a self-driving vehicle that will take you from door to door, driving around everywhere on public roads at least for the next few decades. Before that can happen, there will be a long transitional period in which various different types of fully or partially-automated vehicles will operate.

More and more parts of the task of driving will be completely or partially automated, but many tasks will still be left to the driver, at least in the early stages. It is also possible that this transitional period, the intervening stages,

will cause so many problems that we will be better advised to switch straight to the completely self-driving vehicle, which will then, for example, only drive along specially designated routes.

However, the driver's tasks will change. The driver will no longer need to keep a continuous eye on the traffic, but actually only in order to intervene effectively and quickly if the system fails for whatever reason. We will change from operators to supervisors.

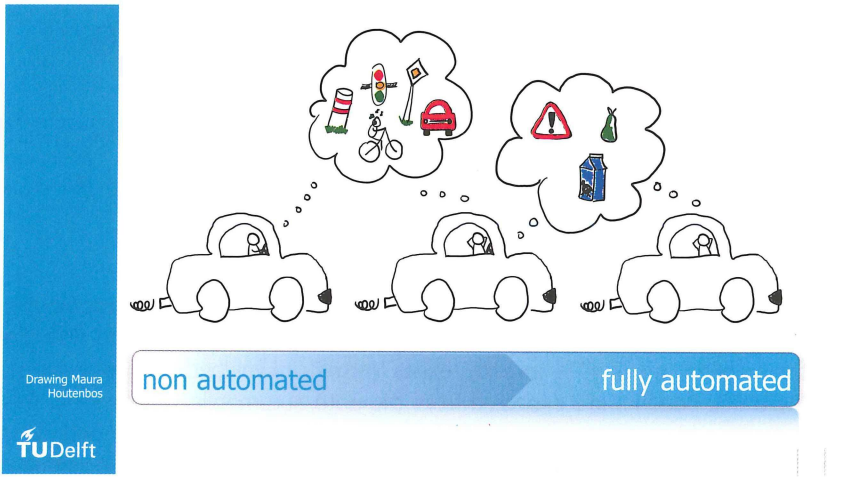


Figure 12. During the transitional period, car drivers will need to do more than they do now: driving and maintaining supervision of the system's operation.

And that is not a role that suits us particularly well (see De Winter et al., 2014 for an overview). If more and more tasks become automated, controlling the car takes less effort: the workload decreases. As a result, we have a tendency to start doing other things or lose focus, which means that we no longer properly observe what is going on around us. The question then arises as to how long it will take for us to be completely on-task again when we need to take over the wheel. This will occasionally be necessary, because even highly-automated systems sometimes encounter situations that they are unable to deal with, can make mistakes or break down.

Behavioural research in driving simulators into what are referred to as 'authority transitions' has revealed that this can lead to accidents and near-accidents (De Winter et al., 2014). In addition, it appears that the higher the level of

automation, the more time drivers need in order to resume driving effectively. Furthermore, too much and sometimes unjustified trust in automated systems can result in a lack of focus on the supervisory task and failure to intervene effectively when necessary. All of this means that, although the automation of driving prevents human error on the one hand, new types of error are introduced, both in the vehicle and in the human driver. These can then again lead to unsafe situations. The role of human drivers in what is expected to be a long transitional period is one of the most important challenges in research into automated vehicles.

In fact, you need drivers who are capable of more than existing drivers: you not only need to be able to control the vehicle, as you do now, but also effectively monitor and supervise the operation of the system. In the near future, I think it will be necessary to teach people both of these tasks. They will also need to practice switching from one to the other. One consequence of this will therefore be a need for changes in how people learn to drive. Another extremely important challenge in the period when only some vehicles will be automated to a greater or lesser extent is the interaction between automated vehicles and non-automated traffic, especially from the perspective of cyclists and pedestrians. How will they respond to automated vehicles? How will they know what to expect of them?

Bollard or child: the vehicle will see it and avoid it. Yes, that is possible. But how fail-proof will the vehicle actually be? And what happens if children – and other pedestrians and cyclists – almost blindly assume that it will stop for them? Will they stop paying attention when crossing the road? Or will they try to test out the intelligent vehicle? And how will pedestrians and cyclists know if they are dealing with an intelligent or automated vehicle? How can they communicate and cooperate with each other? Eye contact with car drivers to check if they have seen you does not work so well if the driver is not actually the person driving and deciding when to brake. If pedestrians and cyclists do not know whether they are dealing with smart vehicles that drive automatically or 'conventional', manually-controlled vehicles, some will behave hesitantly, but some will actually be more certain, albeit unsafe. From the perspective of the auto-automobile, it will then be more difficult to predict the intended behaviour of pedestrians and cyclists. This is because robots are not good at dealing with inconsistent behaviour. If we want robots, in this case an auto-automobile, to take over our tasks, they need to be able to cooperate with us. And in order to cooperate with us, they need to understand us (Evers, 2015; see also e.g. Hoff & Bashir, 2015).

If the behaviour of car drivers on a motorway is difficult to understand and not always predictable, the behaviour of cyclists and pedestrians in an urban environment is a completely different challenge. Research from the perspective of this vulnerable, unprotected group of road users will need to increase our understanding of the factors that influence safe cooperation between cyclists and pedestrians on the one hand and self-driving vehicles on the other.

Figure 13. Who will the auto-automobile listen to?

Finally – what do people themselves actually want? Ultimately, it will be people who need to use the automatic systems. Do they really want that? Are auto-automobiles really so attractive if you still need to stay seated with your hands on the wheel? Wouldn't it be boring? Opinions about what people really want are divided. There is a group of enthusiasts who cannot wait until they can spend their journey doing something useful, for example working. Or those who want to get from A to B independently by car while sleeping or even under the influence. Or elderly people or those with visual disabilities for whom an auto-automobile offers new opportunities for independent mobility. There is another a group of people who would prefer to drive themselves, maintain control and keep their hands on the wheel (Kyriakidis et al., 2015). Of course, there is also a large group in the middle who sometimes want one and sometimes want the other. The size of these different groups varies depending on the study.

There is much more to say about this important topic. Here, I have explained only a few aspects that I consider to be important areas for research. Do not misunderstand me. I am extremely enthusiastic about the possibilities that

intelligent, self-driving vehicles offer for increasing traffic safety. However, we need to realise that this will not happen overnight or automatically. This is why my argument includes so many questions.

Whatever happens, people will continue to play an important role. This even applies to vehicles that drive completely automatically. Auto-automobiles will not make journeys themselves. Even if I instruct it to drive me to Schiphol airport, I am still ultimately "the driver". Just imagine: If I am sitting in the car arguing with my partner on where to go, who will the car listen to? Of course, it is a pretty ridiculous example. I use it simply to demonstrate that there ultimately needs to be a single person to decide where to go, a driver who – possibly remotely – presses the button to issue instructions to the auto-automobile.

Models

Let me now move on to the third topic I would like to look at: models. Models are one of the most important instruments for traffic safety research. I believe that we can create much better traffic safety models if we have a better understanding of behaviour in traffic and the underlying mechanisms – especially, what is it that triggers a certain behaviour? And if we can integrate the resulting behavioural models with traffic models. These integrated models will then enable us to give better forecasts of traffic behaviour in changing circumstances. They will also increase our understanding of the short and longer term trends in terms of the number of accidents. We will then be able to use that as a basis for developing appropriate measures. I would very much like to make a contribution to that.

Of course, that is easier said than done. Traffic models and behavioural models originate from different research traditions and differ in nature partly for that reason. Behavioural models, for example, are strong on concepts, but not adequately formulated from a quantitative perspective. Traffic models are strong in terms of quantity, but largely based on very general assumptions about behaviour, often more at macro- than micro-level. In the world of traffic models, also clear need has developed for behaviour to be effectively taken into account (Hoogendoorn et al., 2014). If we wish to model lack of traffic safety, behaviour will play an important role in that. But improving the models not only involves more accurately incorporating the safety effects of specific behavioural choices: such as, for example, mode of transport, speed, maintaining distance, deciding whether or not to cross the road, or using belts or helmets. It also involves, perhaps even more so, understanding and modelling factors that in turn form the basis for

these behavioural choices. The slide shows this in broad outline. Our behaviour is in turn influenced by many different factors. Modelling just a single aspect of behaviour, such as maintaining distance between vehicles on motorways, is therefore already extremely complicated (Saifuzzaman & Zheng, 2014). It becomes even more complex if we wish to incorporate in a model other behaviours, under different circumstances, in different environments and of other road users, such as cyclists and pedestrians.

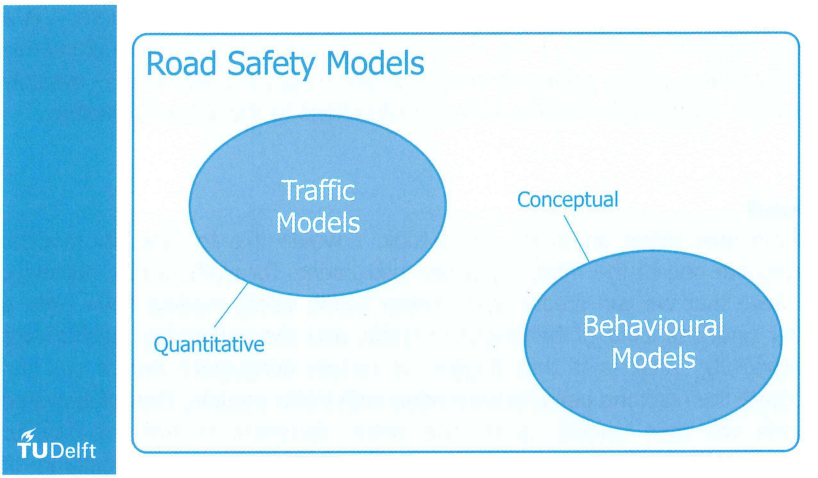


Figure 14. Differences between traffic and behavioural models.

This makes modelling extra difficult, because by no means can all of the factors that influence behaviour be easily observed and quantified. Think, for example of less rational, more emotional factors, such as feelings, attitudes and motivation. All kinds of higher cognitive skills, such as the ability to recognise danger in traffic, play an important role as well (Vlakveld, 2011).

In addition, we need to take account of the expectations of road users. Behavioural and psychological research tells us that expectations play an important role in determining our traffic behaviour. Expectations are important in our ability to anticipate traffic situations. For example, give-way rules create patterns of expectation as to how others will behave in traffic (Houtenbos, 2008). Having the right expectations also ensures that we make fewer mistakes. Relevant information, such as traffic signs, traffic signals and fellow road users are more likely to be seen if they are where we expect them to be and less likely if that information is in a place we do not expect (Theeuwes & Hagenzieker, 1993).

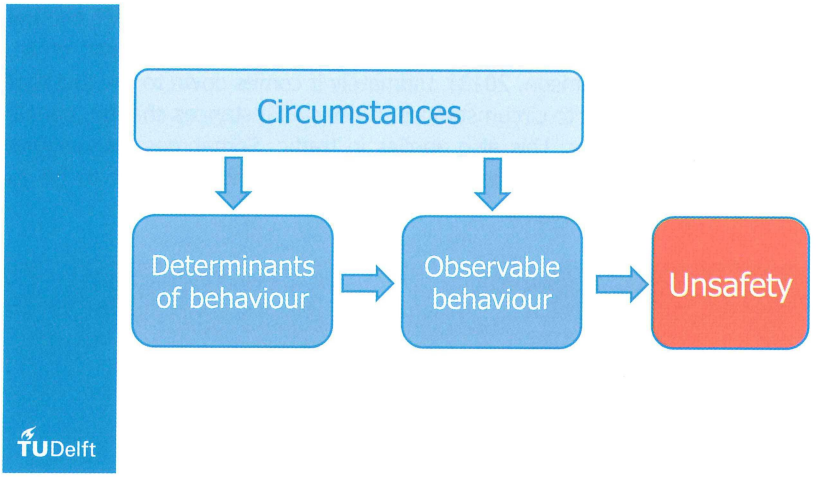


Figure 15. Sketch showing the effects of behaviour, behavioural determinants and circumstances on lack of traffic safety.

In addition, different road users vary enormously. Moreover, the performance of an individual road user also varies depending on the extent to which he or she feels fit, ill or tired. All of this would need to be incorporated in your model. How to achieve that is far from clear. Incorporating these kinds of influences as moderating variables in models is very much in its early stages (per contra, see Chorus, 2014; Vaa, 2014). But this is actually essential. Ultimately, behaviour in traffic is not always rational. The non-rational, more intuitive or emotional aspects of behaviour also need to be accounted for if we want to model traffic behaviour. All of this combined creates a certain level of traffic (un)safety.

[20 seconds of music is played]

So this much is clear, but how do we encapsulate it in a model? Music influences our mood and our behaviour. For example, the tempo of the music you are listening to affects the speed at which you drive (Ünal, 2013). If you are in a hurry, you will drive more quickly (Rendon-Vélez, 2014), and the same applies if you are angry (Mesken et al., 2007). And a high driving speed has an influence both on the likelihood of an accident and its seriousness (Aarts & van Schagen, 2006). There are far too many of these types of influences to elaborate on all of them. However, I would like to mention the following. The phenomenon of behavioural adaptation is of major importance (OECD, 1990). Models of traffic

behaviour and traffic safety also need to take account of this. Behavioural adaptation is a complex phenomenon (see for example Dragutinovic et al., 2005; Rudin-Brown & Jamson, 2013). Ultimately it comes down to the fact that people continually adapt to circumstances. If the circumstances change, people start behaving differently. This also applies in traffic. Sometimes, behavioural adaptation can mean that traffic safety measures do not turn out to be as positive as originally envisaged.

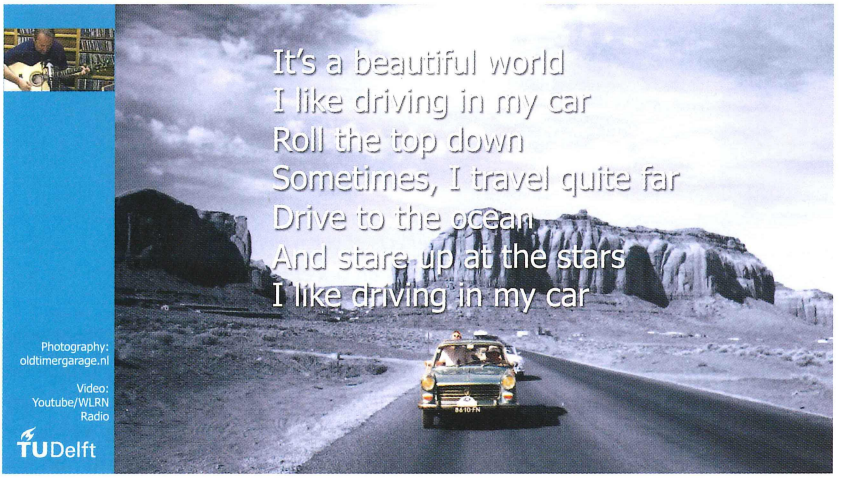


Figure 16. Music influences traffic behaviour.

A well-known, although not completely uncontested, example of this is the introduction of ABS, which had less of an effect on safety than expected, possibly because drivers started taking more risks in other areas (Aschenbrenner & Biehl, 1994). No doubt you encounter them on a regular basis. The person driving slowly in front of you who turns out to be on the phone when you overtake him or her. In itself, driving more slowly is an adaptation in a safer direction, but that is insufficient to cancel out the increased risk caused by the distraction of talking on the phone. This is because the driver is also more likely to swerve, brake more abruptly and ignore all kinds of things. The net result is that talking on the phone is more dangerous than not doing so (for an overview, see Stelling & Hagenzieker, 2012).What makes modelling behavioural adaptation so complicated is the fact that it is difficult to predict in advance whether and to what extent, and even in what direction, it will occur. You might imagine that cyclists listening to music on earphones would observe what is going on around them more carefully to compensate for the fact that they

cannot hear the ambient sound. But this does not happen at all, or at least not with everyone. This was recently shown in a study involving young cyclists listening to music or not. They cycled a familiar route twice: once with and once without music. With the help of equipment that monitors eye movements, we were able to measure how often they looked around and at what (Stelling et al., 2015). The cyclists did not start observing what was going on around them more when they listen to music at all. In some cases, they did so less. This could ultimately lead to this cyclist colliding with a bollard. Or possibly even a child...

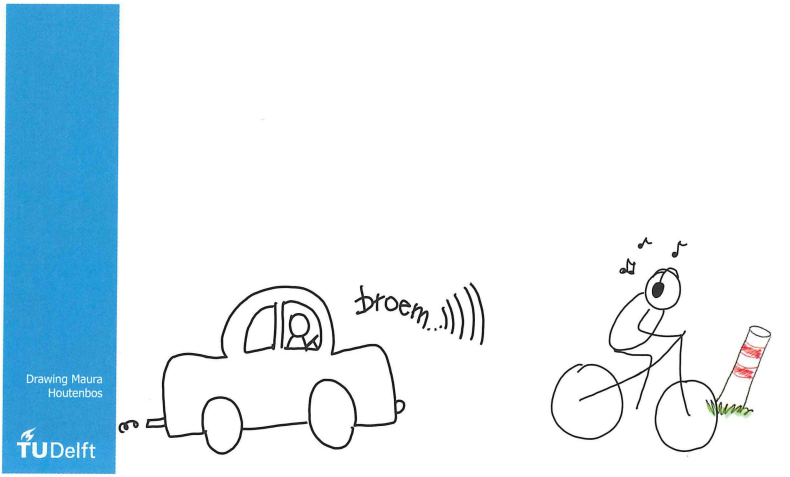


Figure 17. Illustration of behavioural adaptation by a cyclist listening to music (see text for explanation).

Research methods

It should be clear by now that there is a great deal that we still do not know when it comes to traffic behaviour, the factors that underlie it and how all this relates to accidents. Fortunately, partly as a result of advances in technology, there are increasing opportunities to conduct focused research into this and study behaviour in much greater detail and in more realistic circumstances. Driving simulators are becoming ever more advanced and can be used in combination with virtual-reality simulations of the environment in order to study the interaction between people, technology and the environment in detail. Only very recently, bicycle simulators have started to be developed, including at TU Delft. But a bicycle simulator of this kind is not easy to develop and will take a lot of effort. Cars and bicycles fitted with all kinds of measuring equipment

also make it possible to study actual behaviour in controlled circumstances. In addition, there are increasing possibilities for studying behaviour in non-controlled and therefore more realistic conditions, including in what are described as naturalistic driving or cycling studies. Special techniques from modern brain research that visualise the brain's activity can also be used in our field. For example, they can be used to study how the brain activity of road users changes when they are distracted.

Figure 18. Research methods for studying traffic behaviour are becoming increasingly more advanced.

If applied appropriately, these advanced new methods and techniques are set to make an important contribution to more and better data about traffic behaviour, partly because they are more precise and comprehensive than was previously the case. In order, ultimately, to incorporate traffic safety in models, all sorts of these kinds of behavioural data need to be linked to accident data.

This will give us a better understanding of which behaviour relates to which type of accident and what will be necessary in order to prevent these accidents in the future. Incidentally, one point for concern is the fact that accident and exposure data is far from complete and much of it is unavailable. For example, we do not keep good records of how much people cycle and where, and have no precise understanding of the number of kilometres covered by different types of road users and how. However, here too, sophisticated methods and technique models are being developed to address all of this (Bijleveld, 2008).

Summary

Let me conclude by summarising and returning to one of the arguments from the start of this speech: Yes, it is important for road users to know how to behave safely. But above all, it is important not to attempt to change road users, but to change the environment in which they operate: roads, vehicles, the entire traffic system. So we should get rid of bollards and find another way of ensuring that only cyclists go onto the cycle track or path. Design cities to ensure that users do what is safe and also tailor self-driving vehicles to fit what people want and are capable of.I also think that traffic safety models can significantly improve if better and more evidence-based account is taken of the complex and partly less rational and emotional behaviour of road users. The opportunities for achieving this are increasing all the time, but patience is nevertheless required.

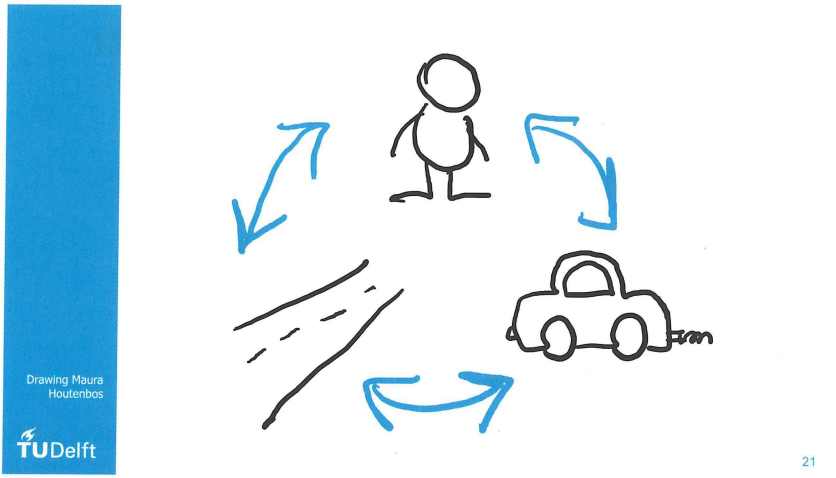


Figure 19. Summary: It is especially important not to focus on attempting to change road users, but to change the environment in which they operate.

Teaching

The questions and issues that I have discussed today also arise in my teaching. I hope that students remember and take on board the knowledge about traffic safety and the role of behaviour in it, whatever their ultimate career path. Conducting research into traffic safety is both multidisciplinary and interdisciplinary and encompasses the specialist fields of behavioural scientists, engineers, statisticians and policy experts. This is essential and highly inspiring and something I try to put across in my teaching.

Collaboration

It is relatively unusual that TU Delft has this chair in traffic safety in the Faculty of Civil Engineering and Geosciences. In many countries, there are no professors in this specific specialist field. As this speech demonstrates, traffic safety constitutes an important problem in society. Equally, the research and quest for greater traffic safety can also bring about wonderful new scientific ideas. I have mentioned some of these today.

Figure 20. Collaboration is essential.

I intend to use this chair to help ensure that the specialist field of traffic safety becomes firmly embedded within academic research at TU Delft. To achieve this, I will make use of all the knowledge and experience I have acquired over the last 25 years. But of course, cooperation will be essential in this and I hope to achieve this in several different ways.

First of all, I also work at the Institute for Road Safety Research (SWOV), which makes it easier to conduct joint research projects. I also see plenty of opportunities to pursue and develop research plans.

And in close cooperation with many different university parties – both within and outside of TU Delft – as well as all kinds of public and private parties, both in the Netherlands and internationally to set to work on some of the research questions I have highlighted today.

A word of thanks

I am absolutely delighted with this chair, made possible by TU Delft, SWOV and the Ministry of Infrastructure and the Environment. TU Delft is a leading university and I feel honoured to be able to take on this position. I would not have been able to speak to you here today without the inspiration, cooperation and help of a great many people, whom I would like to thank.

Figure 21. Thanks to...

First of all, the doctoral candidates that I have had the honour to supervise in recent years – I have always relished the opportunity to work with you. My colleagues at SWOV – without you I would not be here today. My colleagues in Transport & Logistics in the faculty of Technology, Politics and Management, where I started out at TU Delft seven years ago. And, of course, my colleagues in Traffic & Planning in the faculty of Civil Engineering and Geosciences, who made me feel so welcome from the very first day. Plus, of course, those who inspired me in the early days, who during my studies infected me with their drive and enthusiasm for scientific research.

Finally, my friends and family, my husband, son and daughter.

Many of you are here today. Thank you for coming along. My daughter Sophie is not here; she is in Taiwan, as part of her studies. Especially for her, the university has organised a live stream of this event, so, hopefully, she is now watching.

I have now reached the end of this inaugural speech and would like to conclude by expressing the wish that scientific research in the years ahead will result in the very necessary answers to the questions I have outlined, in order to ensure that crashes with bollards, and even more importantly with children and other road users, quickly become a thing of the past.

I have said my piece!

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