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Analysis of rear-end collisions, blind spot crashes and crashes where the heavy goods vehicle driver was not wearing a seatbelt

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Summary

Background

This report follows on from the study into the characteristics of road crashes involving heavy goods vehicles (HGVs) by Temmerman et al. (2016). This study contains a summary of the literature, an analysis of the available crash data and the results of a survey conducted among HGV drivers. The results show that the number of crashes involving injuries per kilometre driven is lower for HGVs than for other vehicles, but that crashes involving heavy goods vehicles more frequently have a fatal outcome. Two types of crash occurred the most frequently in this study:

- rear-end collisions;
- blind spot crashes involving a vulnerable road-user;

Another noteworthy feature affecting the seriousness of crashes was the wearing of seatbelts. For this reason, in this study we also examined crashes in which the HGV driver was not wearing a safety belt.

As a result, it was decided to examine these three types of crash in more detail in a follow-up study and by doing so to supplement any gaps in our knowledge about these types of crash. The three types of crash were studied by way of in-depth research, although the source of the data for each part of the research was different.

Rear-end collisions

Rear-end collisions involving heavy good vehicles were studied using road crash reports, which were selected initially from the official database of crashes involving injuries. The selection criteria were: (1) rear-end collisions occurring in 2014, 2015 or 2016, (2) in which at least one HGV was involved, and (3) resulting in a death or serious injury. These cases were then retrieved from the courts with jurisdiction after approval from the College of Principal Public Prosecutors. But due to difficulties in obtaining the crash report numbers, it was only possible to obtain and analyse 53 crash reports. This means that the results cannot be generalised, although they do indicate a number of points worthy of attention.

The majority of the rear-end collisions occurred during the week, during daytime and on a dry motorway. Rear-end collisions also occurred frequently on regional roads. In most cases, crashes also occurred on the open road. Only a few crashes occurred at a (four-way) crossroads. One striking finding was that in one-third of the crashes analysed, there were roadworks in progress at the location of the crash. Generally, queues of traffic were caused by the roadworks, after which an HGV drove into the back of the queue of vehicles. In a number of crashes, the HGV involved in the crash was the last vehicle in the queue; which means that this vehicle was driven into by another vehicle (and therefore was involved passively in the crash).

In many cases, rear-end collisions occurred between heavy goods vehicles, private cars and light commercial vehicles. The drivers were usually male. The HGV was not always the vehicle causing the collision: 55% of the HGVs were driven into by another vehicle. More than half of the HGV drivers were not injured in the crash. When we break down the ages of all the drivers involved, we can see that the category for 40-49-year olds is the largest.

Excessive or inappropriate speed played a somewhat limited role in rear-end crashes occurring: 'only' 7% of drivers were driving at an inappropriate or excessive speed; for 3% of the drivers, there was a strong suspicion of excessive speed. Alcohol also played a very limited role in this type of crash: 105 drivers (out of a total of 138) were tested for alcohol, of whom just three blew a positive test. 13% of passengers were not wearing a seatbelt at the time of the crash.

For each crash, we determined who the 'initiator' was. This does not mean 'guilty', but rather the driver whose particular action or behaviour led to the crash. In doing so, we made a distinction between:

- primary active road-users (the person causing the events)
- secondary active road-users (who did not contribute towards solving the problem, for example because they took no action to change a situation)
- reactive road-users (who had no information to prevent the crash from happening), and
- passive road-users (who had a passive involvement in the crash, for example they were in the vehicle following).

The vehicle colliding with the other is not always the "primary active" road-user, so it is not by definition the vehicle causing the crash. Sometimes it is the party being hit that is responsible for the collision. Approximately half of the drivers involved did not commit a functional error; those were all vehicles that were collided with (i.e. driven into). They were simply in the wrong place at the wrong time.

The functional error was also determined for each road-user based on the information in the crash report. We made a distinction between observation, processing, prediction, decision, execution and general errors. No functional error was recorded for half of the drivers, while a quarter of the functional errors were related to observation. Drivers didn't see/notice another vehicle and then drove into the back of that vehicle. Often there was a general error on the part of the driver of the vehicle colliding with the other; this included falling asleep while driving and driving under the influence of alcohol.

For every road-user the factors were recorded that played a role in the crash, or which had an effect on the seriousness of the crash. In this instance, we made a distinction between behaviour, vehicle, infrastructure and environment. Rear-end collisions were mainly the result of the behaviour of the drivers involved. Drivers were not paying enough attention or were distracted. Other causes included involvement in secondary tasks (distraction), tiredness, excessive or inappropriate speed and taking risks. Naturally the focus on behaviour is also determined by the source. The aim of a crash report is to provide sufficient information about the crash so that the courts can make a ruling based on the facts and particularly about any (legal) blame/guilt. With that in mind, the courts look, in particular, at the behaviour of the people involved.

Only 4 vehicle-related factors were recorded; these were three drivers who had a problem with their blind spot and one driver who had a sudden mechanical defect. The 5 infrastructure-related factors were to do with roadworks that affected the road layout, tyre grip on the road surface and the profile of the road (such as a steep descent). Environmental factors also regularly played a role in rear-end crashes. Busy traffic and traffic queues were important factors. The weather only had an occasional influence.

We divided the rear-end crashes into 7 frequently occurring crash profiles (plus one 'other' category that included 4 crashes). The profile in which a vehicle collides with the tail of a traffic queue (20 crashes – 38%) was the most frequent, followed by a vehicle that collides with another vehicle driving normally (9 crashes – 17%) and a vehicle driving into a slow-moving or stationary vehicle (7 crashes – 13%). A variation of this latter profile is a crash in which a vehicle collides with an impact attenuator (5 crashes – 9%). Together, these three profiles represented almost 80% of rear-end collisions.

Based on the findings, the following recommendations can be made.

- *To fleet managers*: make sure there are driver assistance systems incorporated into the car when choosing and buying a vehicle. In particular, Forward Collision Warning (FCW), which warns the driver before a rear-end collision, and Autonomous Emergency Braking (AEB), in which the vehicle itself brakes when there is a threat of a rear-end collision happening, are both suitable systems for preventing this type of crash.

- *To drivers*: when in a traffic queue, using your hazard indicators can help warn the traffic coming up behind you of suddenly slowing traffic. Keeping a safe distance from the vehicle in front is also important, especially when the traffic is heavy or if there is a traffic jam.

- *To road authorities*: it is best to control the speed of road-users in the area before the start of roadworks. This is because complex manoeuvres may need to take place prior to the roadworks zone and this may cause traffic queues. Dynamic traffic management needs to be implemented systematically. Any information given needs to be understandable for all drivers, including foreigners. This can be done, for example, by using pictograms that are easy to understand. To reduce the relatively high number of crashes occurring with crash barriers, a crash-safe warning could be installed upstream of the location, such as by installing a moveable/mobile 'rumble strip' system.

- *To vehicle manufacturers*: ongoing technological innovation is needed to prevent rear-end collisions in the future.

- *The lawmakers* can support research into technical tools and devices and, where appropriate, make their use compulsory. One major step in this area has already been taken by making the use of adaptive cruise control and emergency braking assistance mandatory for all new vehicles. Other tools, such as fatigue detection, could also contribute towards this. Awareness raising and enforcing minimum safe distances between vehicles can make a major contribution towards preventing rear-end crashes. It is also recommended that the issue of rear-end collisions involving HGVs should be monitored further.

Blind spot crashes with HGVs and vulnerable road-users

The second type of crash that was investigated in the study involves blind spot crashes between HGVs and vulnerable road-users. The blind spot is the area around the HGV where the driver has no direct view (i.e. everything that the driver can see directly through the windscreen and windows) or indirect view (i.e. things that the driver can see indirectly by using tools and equipment such as mirrors and cameras). There is a blind spot to the left and right of the HGV, as well as to the front and rear of the vehicle. Research shows that in almost half of crashes involving HGVs and vulnerable road-users at crossroads, the vehicle's blind spot is the main factor for the crash. Also, the level of severity of these crashes is often high (European Commission, 2007).

Because in the official database recording crashes involving injuries it is not possible to select blind spot crashes unequivocally and free of bias, the reconstruction reports of 29 crashes between an HGV and a cyclist or pedestrian in Antwerp were used. In 2010, the local Antwerp police began a project to raise the level of professionalism for investigating road crashes. As part of this, a team was set up that went on-site when there was a crash with fatalities or where one or more of the victims sustained life-threatening injuries. The results of their research were then set out in a technical report based on which the courts were able to rule on (criminal) liability. The project ran until 2016. During that period, the team reconstructed more than 250 serious crashes. In total, 29 of these crashes were blind spot crashes.

A typical blind spot crash happens on a weekday, between 7.00 am and 5.00 pm (with a definite spike between 1.00 pm and 2.00 pm), in daylight, at a four-way crossroads controlled by traffic lights where there is a freestanding or raised cycle path. In 10 crashes, a pedestrian was involved, while in 19 there was a cyclist. Blind spot crashes involving pedestrians more frequently had a fatal outcome than blind spot crashes involving cyclists.

An important conclusion from this analysis is that it is not just the blind spot at front right that poses a significant safety risk for vulnerable road-users, but the blind spot directly in front of the HGV also appears to pose a major risk for vulnerable road-users who are crossing the road.

Interestingly, the pedestrians involved in the blind spot crashes investigated had quite a high age, whereas with cyclists, a higher proportion involved young road-users. We also looked at the age of the vulnerable road-users involved based on the type of blind spot crash. In crashes that were the result of the blind spot at the front of the vehicle, the high age of the people involved was striking. The opposite was true with 'classic' blind spot crashes in which an HGV was turning right. The vulnerable road-users involved in these 'classic' blind spot crashes were relatively young.

Based on the reconstruction reports, we then checked to see whether the vulnerable road-user was visible for the HGV driver at the time he began his manoeuvre. In more than half of blind spot crashes, the vulnerable road-user was directly or indirectly visible for the HGV driver. Yet despite that, there was still a crash. This indicates that an appreciable proportion of the crashes where we thought the vulnerable road-user was not visible was in fact attributable to the complexity of the HGV driver's driving task, rather than a pure lack of physical visibility.

Among the various factors that contribute to crashes, not paying attention, temporary situational pressure caused by making a manoeuvre, and focusing too closely on specific aspects of the driving task, leading to the driver completely overlooking something important on the road, all played a significant role. For the vulnerable road-user, crashes involved making mistakes when assessing the danger, followed by not paying attention, committing an offence and a form of temporary or permanent disorder. Among HGV drivers, vehicle-related factors played a very important role in this type of crash, in particular with both unavoidable and avoidable vision obstacles. Infrastructure-related factors and circumstances played a fairly limited role in blind spot crashes.

Based on the blind spot crashes investigated, the following recommendations can be made:

- *To road authorities*: The majority of blind spot crashes happen at crossroads/crossing points, mainly at crossroads that are controlled by traffic lights. The design of crossroads has a major influence on the safety of cyclists. Consequently, an important recommendation when designing these crossroads is to give priority to the safety of vulnerable road-users. In doing so, the number of conflict situations between cyclists or pedestrians and heavy good vehicles could be minimised – and preferably avoided altogether by creating a conflict-free layout. In addition to minimising the number of conflicts, unbundling (in other words spreading in space) could also contribute towards improved safety. Uniformity in the design and signage of these crossroads can help enhance the safety of vulnerable road-users.

- *To fleet managers*: make sure there are driver assistance systems incorporated when choosing and buying a vehicle. A blind spot warning system detects whether there are other road-users close to the vehicle and if there are, this is shown by a warning light that is displayed in the window pillar or outside mirror. An important precondition is that the performance and reliability of the blind spot warning system should be sufficiently high. Camera systems can also help in identifying vulnerable road-users better and more quickly close to the HGV. The idea then would be to replace all mirrors with cameras so that HGV drivers would only have to keep an eye on their camera display and not worry about looking at three or more different mirrors at the same time.
  It may also make sense to equip an existing fleet (vehicles registered before 2007) with a front mirror and a pavement mirror. Mirror systems are only effective if they are installed correctly, adjusted properly and are clean. The driver also needs to know how to use them. Make provision for a mirror adjustment location.
  You also need to make sure that HGV drivers do not restrict their field of view from their cab by festooning the front windscreen with decorative items or stacking things on the dashboard. Fleet managers can draw up practical guidelines to show drivers how they can organise and personalise their cab safely and efficiently.

- *To HGV drivers*: do not restrict your field of view by placing decorative items and other objects on the front and side windows and dashboard. Allow the driving assistance systems to do as much of the work as possible. Adjust the mirrors correctly whenever someone else has driven the HGV before you. Notify the fleet manager of any defects to the vehicle or any equipment that may be missing. Be aware that it's not just the 'classic' blind spot to the right that is a risk, but also that in an urban environment the blind spot to the front of the vehicle can also be a major safety risk.

- *To cyclists and pedestrians*: make sure that you are clearly visible. This can be achieved by wearing light-coloured clothing or reflective accessories and by making sure that everything is working properly on your bike. It is important to keep out of the blind spots of HGVs as much as possible. Particular points and situations you should pay attention to are crossing in front of a stationary HGV or being behind an HGV that is manoeuvring (especially if the vulnerable road-user is not very quick-footed or mobile), and crossing the road at points that are controlled by traffic lights. Before crossing in front of an HGV, it is advisable to make eye contact with the driver so that you can be sure that s/he has seen that the vulnerable road-user is going to cross.

- *To vehicle manufacturers*: it is important to invest in the development of reliable technological equipment that is designed to prevent blind spot crashes. In doing so, the focus should not only be on the 'classic' blind spot at front right, but work should also be done on the other blind spots. When designing new HGVs, as much attention as possible should be paid to visibility and direct sight must be maximised. Direct views can be increased substantially by making a number of adjustments to the vehicle cab, such as designing a lower windscreen, having narrower A-pillars, including an extra viewing window at the bottom of the doors and so on.

- *To the lawmakers*: support research into technical tools and equipment and, where necessary, make them compulsory. Awareness raising and enforcing the proper adjustment of mirrors and keeping the cab free of avoidable obstacles such as items left on the dashboard. Various governments could also consider providing subsidies for retrofitting and/or purchasing safety systems as an option for HGVs. The Flemish Government already offers a subsidy for this. It is also recommended to keep monitoring the issue of blind spot crashes.

Crashes where the HGV driver was not wearing a safety belt

Finally, we examined crashes in which the HGV driver was not wearing a seatbelt. Research has already shown that not wearing a safety belt is a defining factor in the seriousness of HGV crashes. Surveys among Belgian HGV drivers have also shown that they wear a seatbelt less often and that a higher percentage of drivers find it acceptable not to wear a belt, compared with the drivers of other types of vehicle.

This analysis used the international IGLAD database. 252 crashes from European countries were selected in which HGVs were involved. A restriction of this study is that the number of HGV passengers not wearing a seatbelt or not wearing it correctly and the number of HGVs equipped with a seatbelt reminder function is very limited. The large amount of missing data relating to the wearing of seatbelts also makes it difficult to arrive at reliable results. The IGLAD database features the details of crashes from 7 European countries, but not from Belgium. Given that many HGVs operate internationally, the country where the crash occurred is not necessarily the country of origin of either the driver or the HGV.

One point of interest in the crashes recorded in the IGLAD dataset since 2011 is the rise in seatbelt usage by people travelling in HGVs. Among crashes occurring on the motorway, it is known that over 6 out of 10 HGV drivers were wearing their seatbelt. On lower category roads, the figure was just under half. With 3%, the number of drivers definitely not wearing their seatbelt was the smallest on motorways.

This study confirms the importance of passengers wearing seatbelts in reducing the severity of injuries sustained in crashes. In particular, the risk of a serious or fatal injury is reduced when a seatbelt is worn.

Based on the data examined, the following recommendations can be made:

It is recommended to continue making HGV drivers aware of the importance of wearing a seatbelt. It is also recommended to encourage the installation of seatbelt reminders.

- *To vehicle manufacturers*: include seatbelt reminder systems as standard equipment for HGVs.
- *To fleet managers*: opt for vehicles that are equipped as standard with a seatbelt reminder system, or choose it as an option. For vehicles that are already on the road, consider having a seatbelt reminder fitted.
- *To HGV drivers*: always wear your seatbelt and make sure that any passengers do so as well. Do not override the seatbelt reminder.

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