

## Blind spot crashes

### Summary

Crashes involving lorries turning right and cyclists going straight ahead usually have serious consequences for the cyclist. The cyclist, who has right of way, is often overlooked by the lorry driver. For his part the cyclist is often unaware that the lorry driver has not seen him or that the driver wants to turn right. Despite a variety of measures, blind spot crashes continue to occur. Each year they still cause approximately fifteen fatalities. This number could be reduced in the long term by banning heavy goods vehicles from town centres. In the short term the number of crashes will need to be reduced, for example, by infrastructural measures at junctions and by permanent public information on a code of behaviour for cyclists.

### Background

Due to the size of a lorry the driver has poor vision around the vehicle and encounters difficulty in manoeuvring in the town/city. The size of the vehicle also means that if a crash occurs the crash opponent usually is severely injured. More information about lorries in traffic can be found in SWOV fact sheet [Lorries and vans](#). Many crashes involving lorries happen when the lorry wants to turn right in an urban area and cyclists are located to the right or in front of the vehicle. Legally speaking, the cyclists have the right of way but they are overlooked by the driver. Because blind spot crashes appear to be avoidable and the consequences for the casualties are very severe, this type of crash attracts considerable media attention.

### Where is the blind spot of a lorry?

The blind spot is the area around the lorry over which the driver lacks a direct or indirect view. A direct view exists if the driver can see the area through one of the vehicle windows. An indirect view is what the driver has via mirrors or cameras. Therefore, the size and position of the blind spot depends on the type of lorry, including the height of the cab and the presence of mirrors or cameras. *Figure 1* shows the areas that must be visible to the driver according to current EU Directives. Lorries marketed since 2007 are equipped with a front view mirror, a convex kerb mirror and a convex wide angle mirror (also see *Figure 4*). These mirrors can cover a larger area than the blind spot mirror dating from 2003 and thus render it superfluous.

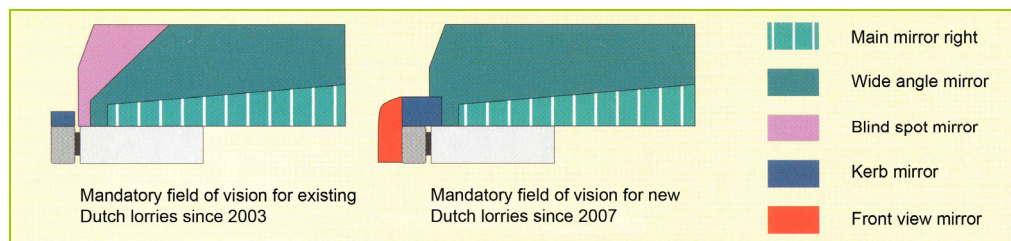


Figure 1. *Top view of the required field of vision for lorries. On the left is the field of vision that the Netherlands made mandatory for all lorries in 2003 and on the right the EU requirements for new lorries in 2007. The front view mirror is new (MoT, 2006).*

A lorry driver who has adjusted his mirrors correctly will have the field of vision shown in *Figure 1*. The blind spot relevant to lorries turning right is located on the right hand side just in front of the cab on vehicles built up to and including 2006. This spot is not visible through the side window, or through the blind spot or wide angle mirror. While the spot to the right alongside the lorry is partially visible through the kerb mirror, the driver does not use this mirror very often. What is more, the area in front of and to the right alongside the cab (outside the range of the front view mirror and kerb mirror) is only partially visible on lorries with a high windscreen and side window. The cab of these vehicles is high up because they have such a large engine below the cab, with the bottom of the window typically at a

height of 1.80 to 2 metres. This gives the driver a very limited direct view of the area in front of and to the right of his cab. A driver with a lightweight lorry has better direct vision of the area around the cab.

Another blind spot occurs because the direct vision diagonally to the front is obstructed, left and right, by the various mirrors and by the windscreen frames. Less important blind spots in relation to the issue of lorries turning right are located behind and to the left of the lorry. The blind spot to the left of the lorry is smaller than the one to the right because the driver sits closer to the left-hand side window and thus has greater direct vision.

### How big is the problem?

Between 2004 and 2007, fatalities among cyclists due to crashes involving lorries averaged 34 per year. In addition, there is an average number of 71 casualties each year. Of these, 15 fatalities and 22 hospital admissions were a result of crashes where a lorry wanted to turn right and the cyclist wanted to go straight ahead - the typical blind spot crash. A crash has more serious consequences for a cyclist when the crash opponent is a lorry than when the cyclist collides with a different type of crash opponent. Serious crashes involving cyclists and lorries are fatal for 32% of the casualties (68% are admitted to hospital with injuries). For blind spot crashes the fatality rate is 41%, showing that relatively speaking blind spot crashes are extra severe.

Figure 2 shows how the number of blind spot crashes developed from 1997 to 2007. There was a prominent decrease in the number of fatalities in 2002 and 2003. We will return to this matter later in this fact sheet.

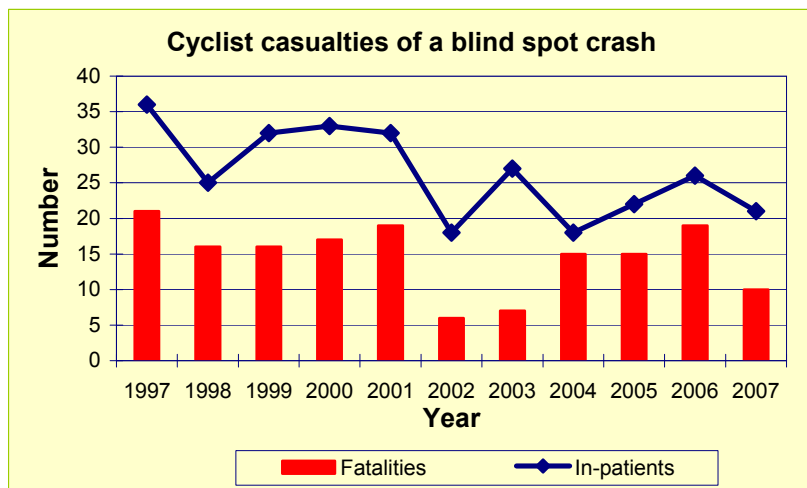


Figure 2. Number of casualties (fatalities and in-patients) among cyclists involved in a blind spot crash in the Netherlands from 1997 to 2007 inclusive.

### Where do most crashes involving lorries turning right happen?

Many blind spot crashes occur at junctions in urban areas when a lorry wants to turn right from stationary and a cyclist riding to the right of or diagonally in front of the vehicle wants to go straight ahead (see Figure 3A). This frequently happens at junctions with traffic lights where cyclists get the green light simultaneously with other traffic. In principle the cyclist has the right of way, but is overlooked by the lorry driver. As long as the lorry driver can continue driving and does not need to accelerate from stationary he has a better overview of the presence or absence of cyclists (Schoon, Doumen & De Bruin 2008). In many cases the lorry driver does notice the cyclists waiting at the lights because he has seen them approach. However, the problem is often caused by a cyclist who has approached from the rear and wants to continue just ahead of the lorry (BVOM, 2008).

A separate category of blind spot crashes concerns a lorry that approaches a priority road and crosses a priority cycle path, especially if the cycle path has two-way traffic (Figure 3B). The lorry driver often overlooks the cyclists coming from the right because he apparently does not expect them.

Both of these types of blind spot crashes also happen on roundabouts where cyclists have right of way (Figure 3C).

Most crashes involving lorries turning right concern vehicles with a high windscreen. In 98% of such

crashes in recent years the windscreen was higher than 1.50 to 1.60 metres, while 70% of the lorries driving at those locations were found to have a high windscreen. Lorries with a high windscreen are thus involved relatively often in blind spot crashes (Schoon, Doumen & De Bruin, 2008).

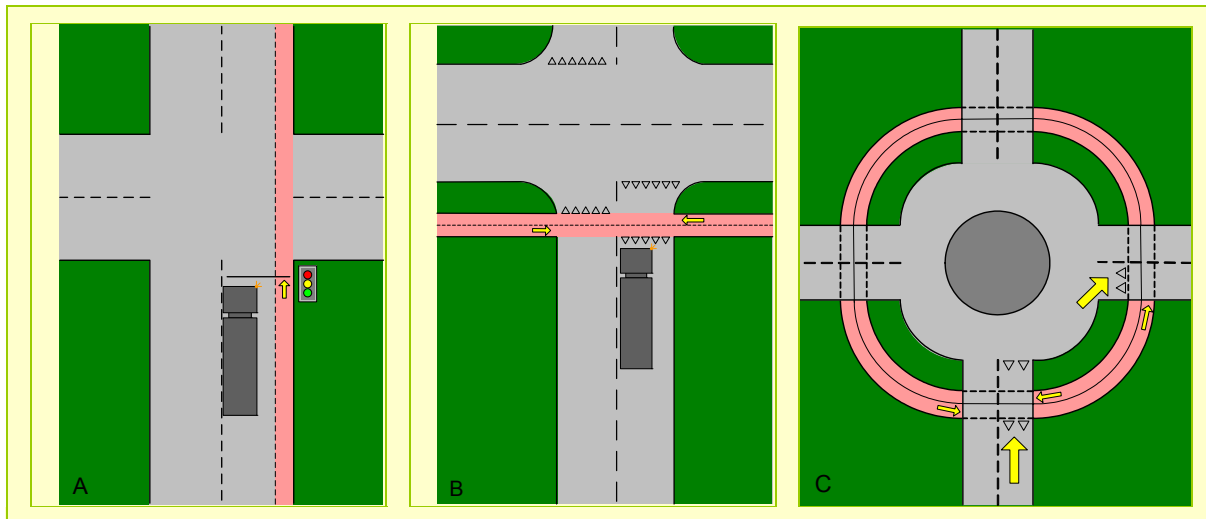


Figure 3. Three frequently occurring situations where conflicts arise between lorries and cyclists. A. At a junction (with traffic lights) the lorry accelerates from stationary and turns right; the cyclist rides straight ahead. B. The lorry approaches a priority road with a separate cycle track (two-way traffic). C. Driving on to and off a roundabout where cyclists have the right of way. When a lorry drives on to the roundabout, the situation corresponds with situation B, or with situation A when the lorry leaves the roundabout.

### How do crashes involving lorries turning right and cyclists arise?

It is not easy to summarize the events leading up to crashes between lorries turning right and cyclists. Various factors influence the behaviour of the cyclist and the lorry driver. In a situation where a lorry wants to turn right and a cyclist wants to ride straight ahead on the same road, the cyclist has the right of way, in principle. The problem stems from the fact that while the lorry driver is generally aware that the cyclist has the right of way, he often sees the cyclist too late if at all. For his part the cyclist is insufficiently aware of the size and position of the blind spot. A survey among crash casualties involving lorries turning right revealed that cyclists were frequently unaware that the lorry wanted to turn right (Schoon, Doumen & De Bruin, 2008). Moreover, cyclists tend to take the right of way without looking first to see whether they are actually being given it.

### What measures have already been taken?

#### Lorry

A kerb mirror has been mandatory for lorries since the 1980s (*Figure 4*). This mirror gives a lorry driver a top view of the area immediately to the right alongside his cab. In 1995 side underrun protection was made mandatory for lorries. This makes it less easy for a cyclist or pedestrian to end up under the lorry if hit by its side. This reduces the severity of the casualty's injuries. However, a recent crash analysis showed that many casualties of lorries turning right are hit by the front right-hand corner of the vehicle. So this measure cannot have much effect on the severity of blind spot crashes of this kind.

The blind spot mirror was introduced in the Netherlands in 2002. All Dutch lorries had to be fitted with this mirror by January 2003. The mirror extends the field of vision of the normal mirror to the right alongside the lorry. *Figure 1* (left-hand figure) shows a top view of the mandatory field of vision. The introduction of this mirror was accompanied at the time by a major public information campaign. In 2002 and 2003 this contributed to a sharp reduction of the number of fatal crashes. However, in 2004 the number of fatalities caused by blind spot crashes returned to the pre-2002 level. It cannot be ruled out that the reduction was due to the extra attention and publicity crashes of this kind received and that, when this attention decreased, the number of crashes rose again (Schoon, 2006). While introduction of the blind spot mirror may have improved the lorry driver's vision, this is ultimately not reflected in the crash statistics.

Since January 2007 it has been mandatory for all new lorries in Europe to be fitted with a front view mirror. This mirror gives the driver a top view of the area to the right of and in front of his cab. This EU measure is intended mainly to give the driver a view of crossing pedestrians in front of his lorry. But SWOV research indicates that such a mirror can also be useful when lorries turn right. The life expectancy of a lorry is 10 to 15 years, so it will be many years yet before all lorries are fitted with such a front view mirror.

EU requirements allow a lorry to use a camera instead of a front view mirror. Research conducted for the Ministry of Transport revealed that drivers preferred a front view camera to a front view mirror (Buck Consultants, 2007). Such a camera is used more frequently than the mirror when turning right from stationary at traffic lights. *Figure 4* shows the mirrors described in this factsheet.

The adjustment of the mirrors is very important, but difficult to perform if the lorry driver is alone in the vehicle. At various places in the Netherlands special mirror adjustment stations have been set up where lorry drivers are able to adjust their mirrors in accordance with guidelines.

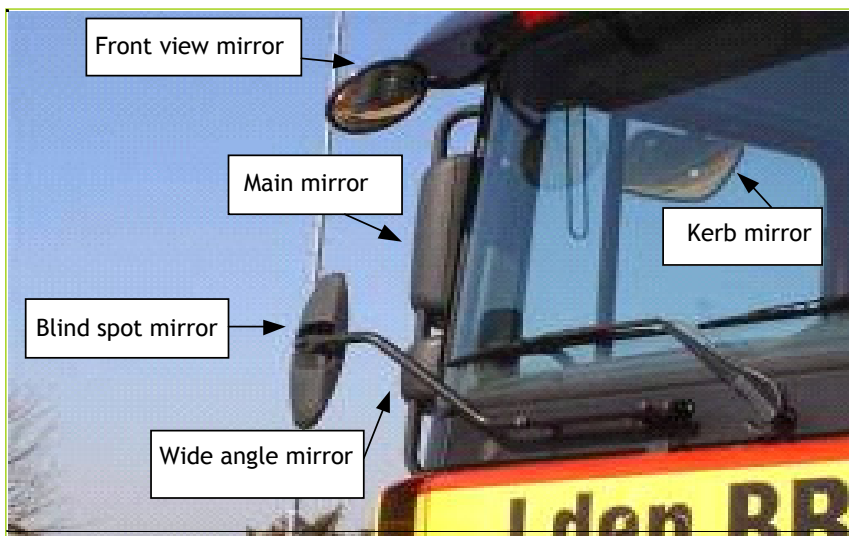


Figure 4. The mirrors fitted on the front right-hand side of a lorry. The blind spot mirror may be omitted if the wide angle mirror and the pavement mirror satisfy the EU requirements applicable since 2007 (Buck Consultants, 2006).

### Safety culture

For some time now road hauliers have been encouraged to cultivate a safety culture among their employees. This means that the employer makes clear to the drivers that safety has high priority. Among other things the company must get drivers to comply with prescribed driving and rest times, use the mirror adjustment stations and refrain from placing any objects in front of the windscreen in the cab. From September 2009 periodic further training will be mandatory for all European lorry drivers (under EU Directive 2003/59/EU). It will be mandatory for a driver to receive 35 hours of further training within a period of five years. This kind of training has been available in the Netherlands since 1 March 2009.

### Cyclists

Measures for cyclists have been mainly in the field of public information and education. There are various educational projects for primary schools to make children aware of the issue. In one of the projects lorry drivers visit primary schools with their lorry.

### Why do blind spot crashes still occur despite the current measures?

Despite measures to improve the lorry driver's field of vision, there is still an area around the vehicle that he is unable to see through the windows or with the help of mirrors and/or cameras. Moreover, the mirrors may not always be adjusted properly, which (unnecessarily) increases the area not visible to the driver. On top of this, a lorry driver has to contend with a heavy mental burden when he wants to turn right: he must keep an eye on all the traffic at the junction by looking through the windows and in all his mirrors. Not all of the mirrors are in the same direction of view, so it takes time to switch between the mirrors. This may give rise to a situation where a cyclist is overlooked.

Despite education and public information for cyclists, most cyclists do not seem to know where the

blind spot is located and how exactly they must act when in the proximity of a lorry. This too can lead to blind spot crashes.

### **What additional measures are possible?**

#### *Long-term measures*

According to the Sustainable Safety principles, a mix of fast and slow traffic is safe provided that the speed of motorized traffic is low (30 km/h). However, this does not apply to lorries, where far lower speeds can easily end in a fatality if a cyclist goes under the wheels. What is more, heavy goods vehicles have a limited view of other road users. Therefore, the objective should be to separate heavy goods vehicles and cyclists, making it impossible for them to encounter each other. One such far-reaching measure is to ban heavy goods vehicles from towns and villages. However, this would necessitate placing distribution centres, accessible via the national road network, outside the urban area. Heavy goods vehicles could deliver goods to these centres. Lighter goods vehicles could drive out from the distribution centres over the secondary road network. Such a measure would obviously not be easy to introduce. Research is necessary to identify the pros and cons of various solutions and SWOV has offered to conduct such a study. But there are some conceivable short-term measures to increase the safety of the transportation of goods by heavy goods vehicles in the urban area. SWOV recently drew up a number of recommendations for the short-term (Schoon, Doumen & De Bruin, 2008).

#### *Short-term measures: education*

Driving lessons for lorry drivers (including periodic training) should pay attention to anticipatory driving and to the use of mirrors. An example of anticipatory driving is that if a driver must stop at a junction he should do so a few metres before the junction so as to get a direct view of cyclists. There is also a need for extra training in the correct use of mirrors during driving courses. This includes a final check using the front view mirror just as the lorry starts to turn and is about to cross the path of the cyclist. Instruction vehicles should be equipped with front view mirrors for this purpose.

#### *Short-term measures: infrastructure*

Infrastructural measures may help to reduce the number of crashes involving lorries turning right. This includes the repositioning of stop lines and give way lines for motorized traffic to make vehicles line up well behind cyclists, like an expanded bicycle streaming lane (EBSL). This will give a lorry driver a direct view of stationary cyclists. If possible a separate green light can be given to cyclists.

#### *Short-term measures: lorry*

Possible modifications to the lorry include fitting high vehicles built before 2007 with a front view system. It is advisable to fit extra signalling if the lorry's direction indicator is not readily visible to cyclists (in many cases the indicator is located too far back). Additionally, the lorry driver must be made aware that objects placed in front of the windscreen can seriously impede the view.

#### *Short-term measures: cyclists*

Cyclists should be targeted with public information about the danger of riding through red lights. A code of behaviour should be agreed making it clear to cyclists what to do if they find themselves alongside a lorry on its right-hand side. If they are already next to or in front of the lorry, they should keep in front of the lorry when the lights turn green. Cyclists approaching from behind should stay behind the lorry. Public information on this code of behaviour should be of a permanent nature.

#### *Additional measures*

In addition to the possibilities mentioned above, there are a few extra measures for increasing safety. They include measures like introducing 'allowed delivery times' within which heavy lorry traffic is allowed to enter towns/cities (when few cyclists are on the roads) and setting out routes for lorry traffic within towns/cities so that it encounters few cyclists. For other additional measures we refer to the report of Schoon, Doumen & De Bruin (2008).

### **Are there any technical facilities to aid a driver while turning right?**

A few systems have been developed to aid lorry drivers when turning right. However, there are still some difficulties in the practical use of these systems. The most promising is the Lexguard system. This system detects the presence of cyclists in the blind spot and gives the lorry driver an audio warning signal. However, if the system detects cyclists always and everywhere, it will bombard the

lorry driver with signals and he will stop responding to them. Therefore, the system should only work at the time that the driver actually wants to turn.

A system like LISA, which warns cyclists when they are located in the blind spot of a lorry, seems less desirable to SWOV for the time being. One of the objections is that the lorry driver does not know what cyclists will do with this information.

### **Which measures will be implemented?**

In a letter to parliament on 28 November 2008, the Dutch Minister of Transport set out the measures that he wants to implement to reduce the number of blind spot crashes. For the most part the measures correspond with the SWOV recommendations. In the long term there will be an examination of the possibilities for organizing the infrastructure in conformity with the Sustainable Safety vision. Together with the Dutch Cyclists' Union, the Ministry of Transport has drawn up a code of behaviour for cyclists. It is being brought to the attention of cyclists by means of public information campaigns. There have also been discussions in the National Mobility Council about repositioning stop lines and give way lines. The Ministry has started a study into paying attention to anticipatory driving and the final check during driving lessons and periodic training of lorry drivers. The Ministry will further examine the possibilities of detection systems that might be able to aid the lorry driver. A national Blind Spot Platform will be set up to bundle expertise in this field.

### **Conclusion**

Crashes involving lorries turning rights and cyclists usually have very serious consequences for the cyclist. The cyclist riding straight on has the right of way over the lorry turning right. However, lorry drivers regularly overlook the cyclist. For his part the cyclist is often unaware that the lorry driver is unable to see him or that the driver wants to turn right. Collisions between lorries turning right and cyclists continue to happen despite various measures to enlarge the lorry driver's field of vision and to increase the awareness of cyclists by means of public information campaigns. The number of casualties of crashes of this kind could be reduced by creating a separate infrastructure for lorries. However, this far-reaching measure still requires research. In the meantime it will be necessary to reduce the number of crashes by means of other measures, such as infrastructural measures at junctions and permanent public information about a code of behaviour for cyclists. Other possible new developments for reducing the number of blind spot crashes include technical facilities to aid the lorry driver.

### **Publications and sources (SWOV reports in Dutch have a summary in English)**

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