Why do road traffic accidents happen?
Why do road traffic accidents happen?
Why do road traffic accidents happen?
The purpose of the work of the AIB is to obtain more knowledge about road traffic accidents. This new knowledge is to be used to improve road safety.

The AIB consists of a multi-disciplinary group that makes in-depth analyses of frequent and serious accident types to create a more accurate picture of the factors contributing to accidents and recurring problems. The in-depth analyses make it easier to target the preventive measures than if the efforts were only based on accident statistics. The analyses conducted by the AIB are based on a comprehensive collection of data and information.

The AIB investigates the vehicles involved and the accident scene and conducts interviews with involved in the accident and any witnesses. The AIB's own material is supplemented with material from the police, vehicle inspectors, road administrations, hospitals/casualty departments and forensic institutes.

The results of the AIB's studies are to help ensure that the responsible institutions and the authorities can improve the work to prevent road traffic accidents. The purpose is not to blame in the legal sense, and the investigations of the AIB may not be used for criminal prosecution.

So far, the AIB has studied the following themes and published reports on:

- Single vehicle accidents involving drivers under the age of 25 (2002)
- Road traffic accidents on motorways (2004)
- Road traffic accidents with vans (2005)
- Road traffic accidents involving lorries turning right and cyclists travelling straight on (2006)
- Accidents between cyclists and motor vehicles at road junctions (2008)
- Motorcycle accidents (2009)
- Road traffic accidents on primary roads (2011)
- Excessive speed limit infringements (2011)
- Road traffic accidents involving elderly people (2012)
- Safety equipment for children in cars (2012)
- Accidents involving pedestrians (2013)
## CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preface</td>
<td>4</td>
</tr>
<tr>
<td>Summary</td>
<td>6</td>
</tr>
<tr>
<td>Purpose and background</td>
<td>9</td>
</tr>
<tr>
<td>Purpose</td>
<td>9</td>
</tr>
<tr>
<td>Data basis</td>
<td>10</td>
</tr>
<tr>
<td>Accident and injury factors</td>
<td>12</td>
</tr>
<tr>
<td>Road users, vehicles and roads: accident factors in AIB's analyses</td>
<td>13</td>
</tr>
<tr>
<td>The most common causes of road traffic accidents</td>
<td>16</td>
</tr>
<tr>
<td>Speed</td>
<td>17</td>
</tr>
<tr>
<td>Orientation</td>
<td>23</td>
</tr>
<tr>
<td>Attention and alertness</td>
<td>27</td>
</tr>
<tr>
<td>Interpretation and assessment</td>
<td>32</td>
</tr>
<tr>
<td>Maneuvering</td>
<td>36</td>
</tr>
<tr>
<td>Alcohol, drugs and medicine</td>
<td>40</td>
</tr>
<tr>
<td>Seat belts</td>
<td>44</td>
</tr>
<tr>
<td>Road and environment</td>
<td>46</td>
</tr>
<tr>
<td>Vehicles</td>
<td>47</td>
</tr>
<tr>
<td>Are the AIB accidents representative?</td>
<td>51</td>
</tr>
<tr>
<td>Annex</td>
<td>59</td>
</tr>
<tr>
<td>Brief information about AIB and the AIB's working method</td>
<td>59</td>
</tr>
</tbody>
</table>
Why do road traffic accidents happen?
Since 2001, the Danish Road Traffic Accident Investigation Board (AIB) has conducted in-depth analyses of frequent types of road traffic accidents with serious injuries to study why the accidents occur so that efforts can be made to prevent them.

In 2009, the AIB conducted an analysis of the 207 accidents, which was analysed in-depth in the first six thematic studies to provide a comprehensive picture of why road accidents typically happen. This analysis is an update of the study from 2009, now based on 291 accidents.

Although the update includes accidents from three very different thematic studies (accidents on primary roads, accidents involving elderly drivers and accidents involving pedestrians), this does not change the general picture of the most common reasons for the accidents. This indicates that the overall message is robust, in spite of the fact that the total accident material originates from nine different themes.
With this report, the AIB confirms the fact that road user actions contribute in the majority of the cases to the accidents, and that work is still needed in the traditional priority areas such as speeding, alcohol and lack of seatbelt use. Focus must also be on road users’ minor mistakes and on lack of routine which are usually the cause of insufficient orientation, inattention, misinterpretation and misjudgement, inadequate driving skills and inadequate maneuvering.

Through a joint effort of all players in the road safety area, we have come a long way preventing road traffic accidents. During the 13 years the AIB has existed, the number of people killed and injured in road traffic accidents has more than halved.

Also in the continued efforts to prevent accidents, it is important to focus on the joint effort to be made by the authorities and road users. Only by substantiating the direct influence on the road users with continued efforts to create safe roads and developing safe cars with advanced technology, we will be able to significantly reduce road users’ mistakes in traffic and minimise their implications.

I am grateful for the support that the AIB has received from the Danish National Police, the Danish Road Directorate, Danish Transport Authority, Odense University Hospital, DTU Transport, the Danish Road Safety Council and the Danish Road Safety Commission, and not least everyone, who has contributed to the studies of the AIB. Road safety is a shared responsibility, and together, we can obtain more knowledge and can achieve better results and thus fewer people will be killed and injured in road traffic accidents.

Sven Krarup Nielsen
Chairman of the Danish Road Traffic Accident Investigation Board
**SUMMARY**

Why do still too many road traffic accidents happen in Denmark where people are killed or seriously injured? Poor orientation and speeding are the most frequent explanations of why road traffic accidents occur. This is the conclusion of the overall analysis of the 291 serious road traffic accidents which the AIB have analysed in depth over the past 13 years. High speed and orientation mistakes each contribute to up to half of the investigated accidents.

Speed may exceed the speed limit but may also be too high for the conditions, e.g. if it is foggy or slippery. When vehicles drive too fast, drivers are typically less aware of the risk involved whereas exceeding the speed limit often indicates that the driver accepts the increased risk.

Orientation mistakes sometimes occur because drivers are distracted by something that does not relate to driving – sometimes because other matters in traffic require too much attention. And sometimes, drivers do not pay too much attention due to too little sleep or lack of attention for other reasons. The reason may also be a pedestrian or cyclist who does not carefully look in both directions before crossing a road.

Inattention, misjudgement, incorrect reaction and alcohol are also often the triggering factors of road traffic accidents. These conditions each contribute to between one third and one fifth of the investigated accidents.

Virtually all of the investigated accidents could have been avoided if road users had not made mistakes. Often, it is a combination of several factors that result in an accident.

This does not mean that road safety can best be improved only by influencing road users directly. Through better design and layout of roads and vehicles, it is often possible to prevent or minimise the implications of the mistakes made by the road users.

Not only road users contribute to the accidents. Road deterioration / environment contribute to approximately one third of the investigated accidents, and vehicle deteriorations contribute to approximately one fifth.

The AIB has also studied the factors that most commonly worsen personal injuries. Two of the most common conditions are lack of seatbelt use and trees along the roadside. Lack of seatbelt use worsen injuries in more than one fifth of the investigated accidents, and roadside trees,
steep ditches and other hazardous road design increases the injuries in every fourth investigated accident.

The AIB’s investigations have focused on a theme, and the conditions contributing to the accidents also differ for each investigation. But together, the AIB accidents are, however, roughly representative of accidents in Denmark in general.

In each chapter, a fictional accident is described, where the course and circumstances are typical of the relevant type of accident. The accidents are based on the knowledge obtained by the AIB through its accident analyses.
PURPOSE AND BACKGROUND

Purpose
The AIB conducts thorough analyses of accidents within a chosen theme, e.g. accidents on motorways or accidents involving motorcyclists. In one theme, 25-40 accidents are normally investigated. In the in-depth analyses, the AIB points out the major accident factors contributing to the individual accidents. The in-depth analysis provides detailed knowledge and understanding of the individual types of accidents, so that the work to prevent accidents can be further targeted. The strength of the AIB's analyses is therefore qualitative knowledge of accidents.

The purpose of this combined analysis of all 291 accidents investigated by the AIB, is further to utilise the knowledge of these accidents, which AIB has collected throughout the years. Even though the studies of the AIB have a qualitative purpose and have been carried out within defined and different themes, a number of common characteristics can be seen, and this may be useful contribution to further accident prevention work.

In this analysis, certain comparisons are made with the Danish accident statistics to assess whether the accidents analysed in depth by the AIB are approximately representative of the accidents in Denmark in general.
Data basis

This analysis is based on data from a total of 291 accidents investigated in 9 of the 11 different thematic studies carried out by the AIB.

Theme 1: Single vehicle accidents involving drivers under the age of 25 (2002) (32 accidents)
Theme 2: Road traffic accidents on motorways (39 accidents)
Theme 3: Road traffic accidents with vans (40 accidents)
Theme 4: Road traffic accidents involving lorries turning right and cyclists travelling straight on (25 accidents)
Theme 5: Accidents between cyclists and motor vehicles at road junctions (30 accidents)
Theme 6: Motorcycle accidents (41 accidents)
Theme 7: Road traffic accidents on primary roads (30 accidents)
Theme 8: Excessive speed limit infringements (not comparable analysis)
Theme 9: Road traffic accidents involving elderly people (32 accidents, of which 5 repeats from theme 7)
Theme 10: Safety equipment for children in cars (not comparable analysis)
Theme 11: Accidents involving pedestrians (27 accidents)

Theme 8 and theme 10 were investigated with a different purpose, and a different method was used to analyse these themes, and therefore they are not part of this analysis.

When the accident factors are described in the following, it must be seen in the light of the fact that the individual themes involve different road user groups, vehicles, roads or accident situations. An accident feature can thus be very frequent within one theme and not very frequent within another. As an example, this analysis has shown that the accident factor "insufficient orientation" was found in most accidents involving vulnerable road users. However, it only involved few or none of the accidents in the first three themes which almost only involved passenger cars and vans.
The 291 investigated accidents covered a total of 522 involved: 423 motor vehicles of which 316 were passenger cars and vans, 52 motorcycles and 54 heavy goods vehicles. 65 bicycles or mopeds, 32 pedestrians and one flow-loader and one tractor were involved. In addition, a hit-and-run-driver was involved, probably driving a passenger car.

Of the 291 accidents, 84 were categorised as single accidents, 29 as head-on collisions, 36 were rear-end collisions, and 108 were intersection accidents. 88 accidents occurred in the dark or twilight, 75 in wet weather or wet conditions and 18 in slippery conditions.

A total of 113 individuals were killed in the 291 accidents and 353 were injured. 41 drivers were found to be under the influence of alcohol exceeding the legal limit.

**Accident facts in Denmark**
The 291 analysed accidents occurred over a period of more than 10 years. During these years, the number of road users killed and seriously injured in traffic has been more than halved. Although the exact cause of this significant reduction is not known, there is hardly any doubt that development in vehicle technology has had a significant impact on the reduction of accidents. In 2012, DTU Transport showed that improvements in both active and passive safety have reduced the number of personal injuries during the period. This is confirmed by the increasing use of e.g. airbags and anti-skid technology (ESC), which are among the technologies known to reduce the risk of personal injury. Also the roads have generally become safer because the work to remove black spots (an accident-prone intersection or an accident-prone section on the road network) and the work to increase the general road standards has continued throughout the period.

![Figure 1](image-url)
And while it is generally difficult to demonstrate changes in road users' risk behaviour, it is found, however, that the proportion of accidents involving alcohol has fallen during the period and that the use of seatbelts by the motorists has also improved.

Traffic volumes have not decreased during the period, quite the contrary, so the lower number of people killed and seriously injured means that it has become safer for individuals to move around in traffic. It is documented by DTU Transport that there is not much difference in how much safety has improved for the different types of road users. This means that there are no signs of major shifts in risk conditions during the period.

**Accident and injury factors**

In the work of mapping out why the individual accidents happen, what increases personal injuries, and how accidents and injuries can be prevented, the AIB finds accident factors for the individual accidents. Accident factors are the circumstances of decisive importance for the occurrence of the accident. A typical accident factor is “too high speed”. Injury factors worsen the extent of personal injuries, and a typical injury factor is “lack of seatbelt use”. The AIB's catalogue of factors has developed over the years, but it has proved that the factors, which are most frequently involved when analysing across the accidents, have been used in all nine themes.

This analysis shows that the most frequent factors are linked to road users and their behaviour. These factors concern the choice made by the road user (e.g. choice of speed or use of seatbelt) or other actions (such as insufficient orientation, misinterpretation, incorrect maneuvering, driving skills). To elaborate on accident and injury factors, a number of "underlying" factors are used such as psychological/mental states (risk-taking, risk blindness, inattention, lack of experience) and physiological conditions (alcohol, drugs, physical illness, fatigue) or other (passenger distraction).
The analysis also includes factors not relating to the road users but to:
• The vehicle, such as design of the vehicle, its condition (lights, brakes, tires) and use (e.g. loading condition)
• The road, e.g. its design, its maintenance condition (e.g. reduced friction) or its environment (ditches and steep slopes)
• Weather, light conditions and road conditions (fog, strong winds, darkness, glaring sun, slippery roads)

Road users, vehicles and roads: accident factors in AIB's analyses

As part of the analysis, it has been calculated how often the AIB has found accident factors for road user, road/environment and vehicle in the 291 accidents analysed. The breakdown by these factor types is shown in the figure.

The figure indicates, among other things, that at least one accident factor is linked to one road user for almost all accidents.

This means that the accidents could have been avoided with a more appropriate behaviour.

100% in the figure corresponds to all of the 291 accidents investigated by the AIB. The columns show how many of the accidents involve road user factors, road and environment factors and vehicle factors.
Why do road traffic accidents happen?

The figure above shows how often factor types are found in the individual accidents. There might be several factors of the same type (i.e. road user factors, vehicle factors or road/environment factors) in each accident. This does not appear from the figure. As an example, alcohol and high speed are road user factors which both appear in some accidents. A total of 886 road user factors have been established for the 291 accidents, in other words, on average of about three road user factors in every accident. Several road or vehicle factors may also be involved in the same accident.

In all 291 accidents, except one, road user factors have been established as contributing to the accident. The road or the environment were a factor in almost every third accident (89 of the 291), and vehicle defects were a factor in every fifth accident (58 of the 291). In slightly more than half of the accidents (160), only road user factors were found.

Figure 3: Amount of accidents with road user, vehicle, road/environment factors

The figure above shows how often factor types are found in the individual accidents.
The fact that road user factors were found in almost all accidents, shows that AIB has for each individual accident assessed that the accident could have been avoided with more appropriate road user behaviour – within the limits of what could reasonably be expected in traffic.

The identified accident factors provide important knowledge about the cause, mechanisms and contexts that lead to accidents, and they are not at least a valuable tool to assess how the serious road traffic accidents can be prevented. If, for example, “poor visibility on the roads” is identified as an accident factor, an improvement of visibility on the roads will also prevent such accidents.

However, it is far from always the case, that the correlation between factors and measures is clear. As an example, “high speed” is one of the most common accident factors and choice of speed by road users may to some degree be influenced with campaigns, tickets and other measures aimed at road users. But often, it is at least as effective to work with the road design and in that way influence road users to choose an appropriate speed. A vehicle factor such as “incorrect tire pressure” may be influenced by campaigns and checks to make motorists check tire pressure – i.e. road user measures.
AIB’s use of the different factors has developed over time, but the use of human-related factors – the road user factors – has been fairly consistent. Therefore, it is possible to make an accurate comparison of the contribution of road user factors in all the analysed accidents.

### The most common causes for accidents

<table>
<thead>
<tr>
<th>Road user factors related to</th>
<th>Accident factors</th>
<th>Injury factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>123</td>
<td>30</td>
</tr>
<tr>
<td>Orientation</td>
<td>145</td>
<td>1</td>
</tr>
<tr>
<td>Attention and alertness</td>
<td>129</td>
<td>0</td>
</tr>
<tr>
<td>Interpretation and assessment</td>
<td>87</td>
<td>0</td>
</tr>
<tr>
<td>Maneuvering</td>
<td>83</td>
<td>7</td>
</tr>
<tr>
<td>Alcohol, drug and medicine</td>
<td>64</td>
<td>2</td>
</tr>
<tr>
<td>Seat belts</td>
<td>0</td>
<td>63</td>
</tr>
<tr>
<td>Others</td>
<td>255</td>
<td>20</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>886</strong></td>
<td><strong>123</strong></td>
</tr>
</tbody>
</table>

High speed and inadequate orientation top the list of factors – they were both involved in up to half of all accidents investigated in the nine AIB themes. Inattention and misinterpretation/misjudgement were involved in around one third of the investigated accidents, and the same applies to incorrect maneuvering, including poor driving skills and incorrect avoidance manoeuvre or position.

The involvement of the factors and their mutual ranking reflect the fact that the nine studies carried out by the AIB include various road user groups, vehicles, roads or accident situations. A factor can thus be very frequent within one theme and not very frequent within another. If the themes studied had been different, the picture of the overall involvement of the factors would likewise have been different.

Risk blindness, risk-taking, physical/mental state (including fatigue and being busy) lack of experience and distractors are some of the other frequent accident factors linked to road users which should be mentioned.

As the involvement of the various road user factors differ in the various accident themes, it is of interest to look at the involvement of the relevant factor types separately for the themes. This is shown in a figure for each factor.
**Speed**

The most common road user factor in all accidents analysed is also the most common of all the factors: i.e. speed. In more than two in five of the analysed accidents, speeding was a contributing factor to the accident, and for a further one in ten, the personal injuries got worse due to too high speed. Thus, speeding was a contributing factor to the accident or increased the personal injuries in about half of the accidents analysed.
The dark blue colour in figure 4, indicates the share of the accidents where the speed limit had been exceeded, while the light blue colour indicates where the speed was too high for the conditions – typically poor visibility or slippery roads.

The impact of speed in the various themes studied differs significantly. Speed was a factor in most single accidents involving young drivers (theme 1) and in the majority of motorway accidents (theme 2) and motorcycle accidents (theme 6). In bicycle accidents with right-turning lorries (theme 4), speed was, however, rarely a contributing factor to the accident. In themes with many single accidents, speed was relatively often a factor.

**Two types of speed violations**

The analyses distinguish between whether speeding was a case of exceeding the speed limit or a case of too high speed in relation to the conditions, such as precipitation, slippery conditions, fog or darkness.

Motorists driving too fast under good conditions and exceeding the speed limit are often considered as risk-takers. The speed in these cases was typically a deliberate choice on the part of the driver.
However, motorists driving too fast in relation to the conditions in precipitation, fog and in darkness, often do not see the risk. This means that road users do not deliberately choose or seek out risk, but just do what they would normally do, because it tends to go well. Under wet or slippery conditions or when it is dark or visibility is reduced, the road users do not lack knowledge but rather lack understanding of how much speed needs to be reduced relatively to the normal speed. Typically, the choice of speed is not very deliberate.

As an example, in single accidents involving young drivers (theme 1), speed limit was exceeded in most accidents. In the motorway accidents (theme 2), speed was also an accident factor but in these cases, the problem was too high speed in relatively to the conditions – typically fog or darkness.
The accident occurs on a motorway on a Friday afternoon in November. The speed limit is 110 km/h. Søren and Niels are driving two trucks with semi-trailers northwards in dense fog. Visibility is around 60 metres. Niels’ friend Lise is sitting on the passenger seat in the truck. Søren overtakes Niels at 90 km/h. Niels is driving 80 km/h, and after Søren has overtaken, the lanes ahead are apparently clear. Søren does not see any traffic ahead and discovers too late that there are wrecked cars further ahead on the motorway. Søren makes an avoidance manoeuvre to the right and onto the grass verge where the lorry stops with its front into the steep slope and the rear end of the trailer partly in the first lane.

Niels is driving at 85 km/h and sees Søren’s semi-trailer at a distance of 60 metres. He brakes and immediately tries – unsuccessfully – to make an avoidance manoeuvre to the left of the trailer, which he hits with great force. Niels brings the lorry to a halt between lane 1 and lane 2. Lise is not wearing a seatbelt and is thrown against the corner post in the driver’s cab and is severely injured.

Factors include: Too high speed in fog and non-use of seatbelt.
Why do road traffic accidents happen?
Why do road traffic accidents happen?
Orientation

In about half of all the accidents analysed, it has been assessed that the accident would not have occurred if the people involved had oriented better and looked around. In other words, insufficient orientation was a factor in these accidents. The factor was particularly found in connection with a planned manoeuvre, such as a turn.

Figure 5 shows that this factor can be found in very varying degrees in all the themes. It occurs only in accidents with several involved, and mainly where one involved was less visible in traffic than a car. In the four theme studies, which deals with pedestrians, bicycles and motorcyclists, the factor insufficient orientation was involved in all or most of the accidents, while it was involved in fewer of the accidents in the other themes. In the investigation of motorway accidents (theme 2), no accidents were caused by the fact that one road user did not orient him- or herself nor was this the case in the study of single accidents involving young drivers (theme 1).

An obvious example of insufficient orientation as an accident factor is a right-turning truck hitting a straight ahead going cyclist. In all the investigated accidents of this type (theme 4), it was a factor that the turning driver had not checked out the conditions properly. This does not mean that the cyclists had no chance of avoiding the accident, but it means that the right-turning driver would have avoided the accident by using correct orientation. Another common example is pedestrians crossing a road without looking to both sides.

Figure 5
Why do road traffic accidents happen?
The accident happened in a four-leg, signal-controlled intersection on a Tuesday at noon. The weather is dry, visibility is good and it is daylight. Ole is approaching the intersection in his truck. He needs to turn right. On his way towards the intersection, Ole orients himself to the right and ahead for pedestrians and cyclists. He also looks at his GPS for directions, because he does not know the area. Ole stops for red light about one metre from the curb in the right-turn lane.

While Ole waits for green light, he does not look in his right side mirrors. If he did, he would have seen Hanne coming from behind on a bicycle. When the traffic light signal changes to green, Ole drives into the intersection, looks in the side mirror and then turns right. Hanne comes on her bicycle from behind and rides up along the waiting cars. When she has almost stopped, the light turns green and she rides her bike ahead simultaneously with the truck a little in front of her. Ole does not see Hanne as she is hidden behind the shelf, which Ole has placed on the instrument panel. Hanne is pushed around the front corner of the truck when she is in front of the truck, she falls over and gets under the truck. A pedestrian shouts at Ole, and he stops before the truck runs Hanne down.

Factors include: Insufficient orientation and poor visibility from the driver’s seat in the truck.
Why do road traffic accidents happen?
Attention and alertness

In nearly half of all the analysed accidents, it has been assessed that insufficient attention or alertness on the part of at least one of the road users involved contributed to the accidents. It might be the case of completely lack of attention (drowsiness, lost in own thoughts), attention not being directed towards what is most important in traffic or attention being directed at something not relevant for the traffic (distraction). Lack of alertness means that road users did not increase his attention in the situation, even though it was clear that the situation required it.

These factors were involved in between one and three out of four of the accidents in each theme.

Inattention and lack of alertness were very common in accidents in towns and cities with both vehicles and vulnerable road users. Lack of alertness in particular pedestrian crossings was critical.

In accidents which occurred on motorways and primary roads, inattention and lack of alertness were not a common accident factor.
Alertness as a factor is only used from theme 4 onwards. It cannot be excluded that there might be accidents in the first themes, where a new analysis would show that the lack of alertness played a role.

An example of insufficient attention could be a motorist driving on a straight two-lane road looking for a small side road on the left hand side. The motorist drives at reduced speed and is aware of a small queue behind. In the opposite direction, a cyclist approaches and is in the driver's field of vision all the time. The motorist finds the side road and turns but is not aware of the oncoming cyclist, who is hit.

The motorist is aware of both the position of the side road and of the traffic behind, but not on the possible traffic conflict of the turning manoeuvre. The motorist directs all his attention to some traffic conditions, and thereby ignores others.

An example of insufficient alertness could be a boy walking on the right pavement with an adult. The boy makes vigorous movements, as if he wants to escape from the adult. A motorist is driving at the sign-posted speed and sees the two pedestrians. She does not react to the boy's behaviour by reducing the speed or pulling away from the pavement. The boy breaks loose, gets on to the road and is hit by the car. The motorist does not have the time to brake nor avoid the boy. She is not inattentive but she does not take into account an obvious risk.
Why do road traffic accidents happen?
77-year-old Erling is on his way home from the barber shop. He reaches a major primary road, where he has the duty to give way. Here, he needs to turn left on the major road. Erling stops at the give way line and looks to both sides. He sees a car coming from the left. It drives in the right-turn lane and has to turn down the road on which Erling is waiting.

To the right, there is a high hedge which takes part of the view. He therefore looks a second time to the right to make sure that the road is clear before he drives into the intersection.
Nikolaj, a 33-year-old technician, is on his way home from work. Nikolaj is driving at 100 km/h. The speed limit is 80 km/h. He knows the place well and is able to see traffic from the side roads. The car ahead indicates a right turn and pulls into the right-turn lane. Further ahead he sees a car at the side road waiting to turn left. Suddenly the car drives into the intersection right in front of Nikolaj. He brakes and turns to the left, but due to his high speed he is unable to avoid the accident.

Nikolaj’s car hits Erling’s car on the left side just around the front door. The airbag in Nikolaj’s 7 years old car deploys, and he escapes with minor scratches on his hands from the glass of the broken windscreen. The side airbag and curtain airbag in Erling’s 4 years old car also deploy. It minimises Erling’s injuries but he is still severely injured. His injuries include a broken hip.

Factors include: Insufficient orientation and attention and exceeding the speed limit and lack of alertness.
Interpretation and assessment

In just over one fourth of the accidents investigated, the road user misinterpreted something in the traffic situation.

The road users may have misunderstood signs or road markings or the intentions of another road user. It may also have been a simple misjudgement of the speed of another car or of whether there was enough space to overtake.

This type of road-user mistakes particularly occurred in the themes where accidents happened on roads with high speeds. This includes single accidents involving young drivers (theme 1) and motorway accidents (theme 2). It is assumed that misinterpretation and misjudgement most commonly occur with inexperienced road users, which is supported by the fact that this factor was most commonly seen in accidents involving young drivers (theme 1), and most rarely in the study on elderly drivers (theme 9).
Why do road traffic accidents happen?
It is Thursday afternoon. 47-year-old Svend is on his way home from work. The weather is fine – and he has therefore decided to take his motorcycle, a Suzuki SV 1000. Part of the trip is a long straight section on the main road. It is a bit boring, but it allows him to gain speed. 63-year-old Palle has had the last working day before his holiday. His workplace is located at some distance from the main road which he is now about to enter. He stops at the give way line and waits for a couple of crossing cars from the left. Svend is driving on the main road and sees a car on the side road from left – it waits at the give way line. He therefore looks further ahead on a truck which is driving somewhat further ahead on the main road. He starts thinking about his possibilities of overtaking it. When the two cars from the left have passed, Palle looks to both sides and then turns left onto the main road. Svend suddenly discovers that the car from the side road drives out in front him. He brakes and tries to pull to the right, but hits the rear of the car. He is thrown over the car and into a ditch. He hits a concrete edge at the end of the ditch. Svend was driving with full safety equipment and a good helmet but dies as a result of the accident.

Factors include: Misinterpretation of MC speed due to the size and relatively weak head lights as well as the injury factor: design of the ditch.
Why do road traffic accidents happen?
Maneuvering

A standard example of an incorrect maneuvering is excessive adjustment after inadvertently having one pair of wheels on the edge. The excessive adjustment means loss of control or that the car gets into the opposite side of the road and collides with oncoming traffic or drives off the road. Often, it will be an instinctive reaction which may occur although the road user knows that it is not a correct reaction. If it is established that a motorist with standard driving skills would have reacted more calmly and controlled and thus would have retained control of the vehicle, then this is a situation where incorrect maneuvering was a factor.

Incorrect or inadequate maneuvering was an accident factor in around one fourth of the accidents investigated but with variable occurrence between the themes. The factor was observed in all investigated themes, and most often in single accidents with young drivers (theme 1).

![Share of accidents with incorrect reaction as a factor](image)

*Figure 8*
Why do road traffic accidents happen?
Frederik is 21 years and works night shifts in Aarhus. The accident occurs an early Friday morning in August on the way home from Aarhus. Frederik is driving in his friend’s car southbound on the motorway where speed limit is 110 km/h. He is wearing seatbelt. Frederik is tired after his night shift and has been driving for about an hour. Frederik is inexperienced and he is driving a car that has a bigger engine than his own car. There is little traffic, and he is driving 125 km/h in the fast lane. Frederik overtakes another vehicle driving at 120 km/h, and he is about to overtake another car. He speeds up to 145 km/h. He drives onto the central median because he is tired and not paying attention. As a reflex, he overreacts by pulling the steering wheel to the right. Frederik is driving across the carriageway and behind the car he wanted to overtake. Frederik ends up in the fields where the car rolls over.

Factors include: Incorrect maneuvering.
Why do road traffic accidents happen?
Alcohol, drugs and medicine

It is a well-known fact that driving under the influence of alcohol results in accidents. The same applies to drugs and many types of medicine. When the AIB has concluded that alcohol, drugs and medicine have contributed to the accident, this is stated as a factor. It is not important whether the influence is above or below current limit values. Out of the 291 investigated accidents, influence was an accident factor in more than every fifth accident.

As shown in figure 9, alcohol, drugs and medicine was involved in one of five accidents in most accident themes. Only theme 1, which is single accidents involving young drivers, had significantly more, and only accidents between cyclists and motor vehicles (themes 4 and 5) had significantly fewer – there were none.

Driving under the influence of alcohol is well documented in terms of both occurrence, risk and preventive measures. This is not the case with drugs and medicine. Tests of whether a driver has drugs in the blood have so far been costly, and this has limited the use of such tests in both Denmark and abroad. In a significant part of the accidents investigated by the AIB, the extent of the influence of drugs and medicine is therefore unknown. Only in a few themes, has the AIB been able to analyse (screen) the blood samples for drugs, and only in the cases where the police have chosen to take blood samples, which is only done to a certain extent. Therefore, it cannot be excluded that more cases exist where the involved was under the influence of drugs and medicine than shown by the figures.

An example where alcohol is a factor, could be a motorist driving under the influence of alcohol through a curve on a small primary road. The speed and the curve involve risk elements. It is the duty of the driver to assess the road course correctly, react in sufficient time and drive the car accurately. Alcohol reduces the capacity in all three disciplines. The driver is significantly influenced when he crashes, and there are no other circumstances, which are in themselves enough to result in the accident. As a result, it can be concluded that that alcohol was a factor.
43 Why do road traffic accidents happen?

<table>
<thead>
<tr>
<th>Description</th>
<th>Share of Accidents (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Single accident</td>
<td>50%</td>
</tr>
<tr>
<td>2. Motorway</td>
<td>25%</td>
</tr>
<tr>
<td>3. Big car</td>
<td>75%</td>
</tr>
<tr>
<td>4. Bicycles, lanes turning</td>
<td>0%</td>
</tr>
<tr>
<td>5. Bicycles in intersections</td>
<td>100%</td>
</tr>
<tr>
<td>6. Motorbikes</td>
<td>100%</td>
</tr>
<tr>
<td>7. Primary roads</td>
<td>75%</td>
</tr>
<tr>
<td>8. Pedestrians</td>
<td>50%</td>
</tr>
<tr>
<td>9. Elderly drivers</td>
<td>25%</td>
</tr>
<tr>
<td>11. Pedestrians</td>
<td>0%</td>
</tr>
</tbody>
</table>

Figure 9
It is a Friday past midnight. 26-year-old Peter is on his way home after dinner with a friend. They have eaten good steaks and have had several beers. Peter is feeling guilty towards his girlfriend Katrine. He promised that they should spend time together this evening, and Katrine has called him a couple of times during the evening to ask when he would be home. It has been a tough week with much overtime work. The weather is dry, but it was raining earlier in the evening. Peter knows the road well and knows that the trip home takes just over an hour. There are no other cars on the road, so Peter drives a little faster to get home faster. He is driving about 110 km/h in his old car, which does not have ESC. The speed limit is 80 km/h. Peter is under the influence of alcohol, and suddenly he thinks that he sees something moving on the right side of the road. Maybe it is an animal? Instinctively he pulls the steering wheel to avoid it. He loses control of the car which continues into the ditch and onto the field behind. Peter survives the accident but suffers a pelvic fracture and injuries to his back and neck. He can not continue to work as carpenter due to the injuries.

Factors include: Exceeding speed limit, driving under the influence of alcohol and incorrect maneuvering.
Why do road traffic accidents happen?
Seatbelts

An injury factor is a circumstance which worsens the extent of the personal injuries but which do not have an influence on the occurrence of the accident. For example, failure to use seatbelts may increase personal injuries, but the use of seatbelts is irrelevant for the occurrence of the accident.

Lack of seatbelts use is the most common injury factor. In 63 of the 291 accidents, lack of seatbelt use had a crucial importance for how much a person was injured in an accident. The use of seatbelts did not increase the injuries in any of the accidents.

In the five themes, which mainly include accidents involving passenger cars and vans, lack of seatbelts use was an injury factor in a significant part of the accidents. However, as expected, the use of seatbelts had almost no influence in the theme studies dealing with accidents involving pedestrians, cyclists and motorcyclists.

It should be noted that more than 10 years have passed from the occurrence of the accidents in theme 1 to the accidents of theme 11. During this period, the proportion of motorists who do not use a seatbelt has been more than halved (from a little less than 20% to 6-8%). This is probably one of the explanations why there were more accidents where failure to use seatbelts was an injury factor in the first themes (themes 1-3) than in the most recent (themes 7 and 9).
When both involved contribute to the accident

Of the 291 accidents analysed, more than two thirds of the accidents, i.e. 207, involved several road users. The rest were single accidents. In 97 of the 207 accidents involving more than one involved, the AIB has established that both involved made mistakes contributing to accident.

If just one of the involved road users had avoided making mistakes in these accidents, the accidents would not have happened.
Road factors have been identified when significant conditions have been found which can be considered as defects in the road facility, including the road surroundings. Accident factors were linked to the road in one third of all the accidents investigated and injury factors were linked to the road in about every fourth accident.

Road and environment factors were found to some extent in all themes studies but with great variations between the themes. In single accidents involving young drivers (theme 1), this type of factor was found as both accident and injury factor in the majority of the accidents. Overall, low road friction was the most common accident factor and fixed objects the most common injury factor.

The road was also both an accident and injury factor in more than one third of the motorway accidents (theme 2): in these cases, the most common accident factor was edge defects; and the most common injury factor was ditches and slopes.

When studying all themes the edge (slope, high edge or softness) and the road surfacing friction properties were among the most common accident factors. Verge conditions were a factor in every third accident in single accidents involving young drivers (theme 1) and in every fourth accident in motorway accidents (theme 2), but were uncommon in the other themes. Road friction was a factor in one third of the accidents in single accidents involving young drivers (theme 1) and in a few motorway accidents (theme 2) and not otherwise.
A special group of environment factors is the weather, road conditions and light conditions. These factors contributed to a total of 21 accidents, of which six involved vans (theme 3) and four involved elderly drivers (theme 9). Such environment factors were not involved in connection with single accidents involving young drivers (theme 1), bicycle accidents (themes 4 and 5) or accidents involving pedestrians (theme 11).

Animals and lost objects contributed to six accidents, of which four were on motorways (theme 2).

Large variation is seen between themes in terms of the road factors. None of the two bicycle themes involved any road factors whereas the majority of single accidents involving young drivers (theme 1) had a road factor. The road side design (ditch, slope) increased the injuries in 28 accidents, trees in 18 accidents and other fixed objects in 26 accidents increased the injuries. In some accidents, the road/environment involved more than one injury factor. A total 58 of the 291 accidents resulted in more serious injury due to the conditions on the road and its environment.

**Vehicle factors**

In every fifth of the accidents investigated, vehicle factors contributed to the accidents (accident factor), and in every eighth accident, special circumstances relating to the vehicles made the personal injuries worse than they would have been (injury factor).

The analyses of the vehicle's influence have shown that most of the injury factors were related to the design and equipment. This was the case for 14 motorway accidents and 14 accidents involving vans – i.e. more than one third of the accidents in both themes.

On the other hand, accident factors were particularly related to maintenance and other matters on which the motorist had an influence such as loading, tire type, tire wear, tire pressure and mirror adjustment. Tire failure was an accident factor in 14 accidents, of which six were motorway accidents (theme 2) and four accidents on primary roads (theme 7). Poor maintenance and incorrect loading contributed to 14 accidents, of which five were motorway accidents. Misalignment of mirrors contributed to eight accidents, of which seven was in the theme involving right-turning trucks and cyclists (theme 4).
Among the 291 accidents, brake failure only contributed to the accident in six cases of which four involved cyclists with defective brakes. Steering system failure was not involved as a factor in any accident.

No accidents occurred where vehicle failure alone caused an accident. In all accidents, where vehicle failure played a part, the road user also contributed to the accident.

There has been significant safety development of the vehicles during the approximately 12 years, which have passed from the accidents in theme 1 to the accidents in theme 11. Electronic stability control (ESC) was only found in very few of the cars in 2001, while all cars sold after 2009 have this equipment. The ESC has proved to have a great effect on the number of road accidents. Seatbelt alarms, seatbelt tensioners and airbags have also become far more widespread during these years, and collision safety in the car cabins has been further developed; technical features which have not prevented accidents but have reduced the personal injuries.

Together, these elements have contributed to the general significant reduction in the number of injured drivers during the period.
Why do road traffic accidents happen?
Why do road traffic accidents happen?
ARE THE AIB ACCIDENTS REPRESENTATIVE?

So far the AIB has completed in-depth studies of 291 accidents broken down by 9 specific themes. The main purpose of the studies has been to find new knowledge, which can be used in the work to prevent accidents in the future. The studies had a qualitative focus and were not intended to produce statistical material.

The purpose of the analyses of the AIB was to show what generally characterises road traffic accidents in Denmark. However, many conclusions of the AIB have been perceived and quoted by the media as applicable to road traffic accidents in general. This is also the way in which the conclusions have in several cases been used by the authorities and professional players.

In principle, it is not correct to use in-depth analyses of a limited number of accidents which include some pre-defined themes to describe general road traffic accidents in Denmark. However, since it has proved difficult to avoid, the AIB has decided to look at how well the material of the AIB is suited to describe some general conditions of the serious road traffic accidents which occur in Denmark.

This is done by comparing the 291 accidents which was analysed in-depth by the AIB with the 5999 accidents with serious personal injury which were recorded throughout the country in the years 2011, 2012 and 2013. Both time, place, accident type, vehicle and the road users involved were compared. It has also been studied how well the so far completed themes actually cover all the serious road traffic accidents which occur in Denmark.

The comparisons, which will be reviewed on the following pages, show that the AIB accidents in many ways are representative of the nationwide accidents. However, some significant differences have been found.

The conclusion is that large parts of the picture presented by the in-depth analyses of the 291 accidents would also apply to the accidents in Denmark in general. But it will not be possible to establish exactly what parts of the picture do not match. The comparisons, which are mentioned below in this section, may, however, provide some indication.
Who was involved?

**Vehicles/road user groups**

A statement of the involved road user groups shows that the AIB accidents are not representative to all accidents. While passenger cars represent the largest group of both the AIB accidents (43%) and accidents at a national level (51%), there are roughly speaking too many motorcycles, vans and trucks and too few mopeds in the AIB accidents. This is due to the fact that specific thematic studies have been carried out for precisely these road users. For cyclists and pedestrians, it is noted that despite the fact that two themes have specifically studied bicycle accidents and one theme has studied pedestrian accidents, these two road user groups are still slightly under-represented in the overall picture. For mopeds, it can be established that with less than 1% of the AIB accidents and more than 8% of the nationwide accident statistics of the Danish Road Directorate, they are under-represented in AIB.

522 road users were involved in the 291 AIB accidents; on average 1.8 road users per accident. By comparison, 11,249 road users were involved in the 5,999 accidents throughout Denmark, i.e. 1.9 road users per accident. In this case, the difference is small.
Age
The AIB accidents include many young drivers compared to the number at national level. In turn, the 45-74-year-olds are slightly under-represented. The difference is most significant with regard to 18-24-year-olds, which should be seen in the light of the fact that one study theme deals particularly with young drivers (theme 1). On the other hand, there was also a theme particularly about elderly drivers, and as the figure shows, this has not resulted in an over-representation of elderly drivers in the AIB accidents.
Even though the age groups are not exactly represented, there are no age groups, which are very disproportionately represented.

**Gender**

Nationwide, women accounted for 30.4% of the road users – i.e. pedestrians, cyclists and drivers of the vehicles involved in the serious road traffic accidents. In the AIB accidents, women only accounted for 24% of the road users involved. In the study of single accidents with young drivers (theme 1), only 9% (3 in 32) were women, while pedestrian accidents (theme 11) had the most balanced distribution of gender with 39% women (including the involved drivers). The difference may thus be seen as an expression of the major differences in gender of the specific study themes. The majority of the themes studied by AIB was therefore characterised by involving relatively few women.

**How did the accident happen?**

The accident statistics operate with a standardised classification of what is known as accident situations, depending on how the involved in an accident hit each other. The statement shows that the in-depth analysed accidents do not differ much from the serious accidents in all of Denmark.

![Figure 14](image-url)

*Figure 14*
The greatest difference is that intersection accidents with involved road users coming from the same direction account for a larger number of the AIB accidents than at the national level. The reason for this difference is that the AIB had a theme with this specific group of accidents: right-turn accidents with cyclists going straight ahead (theme 4). No accident types lack representation or are strongly over-represented in the AIB accidents.

**When did the accident happen?**

**Season variation in Denmark**

A relatively large proportion of AIB accidents occurred in September and other autumn months, while the proportion of AIB accidents is smaller during the winter months than accidents in Denmark in general. The AIB accidents can therefore not be said to be representative in terms of the season.

**Light / darkness**

The distribution of accidents between light and darkness is exactly the same in the AIB accidents as the accidents in Denmark in general. The AIB is currently analysing accidents which happen at night to see what characterises these accidents.
How typical and comprehensive are the studied themes?

When AIB completed the first few theme studies, the accidents investigated were obviously not representative, but they helped clarify the specific subjects chosen. But now, the AIB has in-depth analysed nine themes, thus making it more interesting to see how well the nine themes together cover the total amount of serious accidents happening in Denmark.

In figure 17, the blue columns show how many of the AIB accidents are within the chosen themes. The red columns show the proportion of the relevant accident type which represents the serious accidents throughout Denmark. When the accidents within the nine themes so far studied are combined, and it is taken into account that many accidents occur in several themes, then it can be calculated that the AIB themes together represent slightly more than half of the serious accidents in Denmark. (Based of the accident data of the Danish Road Directorate for 2011-2013, this is 54%).

Most of the study themes each represents around 5-10% of the serious accidents in Denmark. The most significant exception is bicycle accidents with right-turning lorries (theme 4), which only account for approximately 0.7% of the nationwide total number of serious accidents. It is interesting to compare with theme 5, which deals with general intersection accidents involving cyclists – they account for more than 10% of the nationwide serious accidents.

Pedestrian accidents are another exception. With 15% of all serious accidents in Denmark, this theme represents most serious accidents.
Why do road traffic accidents happen?

Figure 17

Typical accidents

Figure 17
Why do road traffic accidents happen?
About the AIB and its working method

The purpose of the work of the AIB is to obtain more knowledge of road traffic accidents so that more targeted efforts can be made to prevent them. The AIB consists of a multi-disciplinary group that make in-depth analyses of frequent and serious accident types. In order to get a more accurate picture of why accidents happen, the circumstances of the individual accidents must be studied into more detail.

The analyses conducted by the AIB are based on a comprehensive collection of data and information. The AIB investigates the vehicles involved and the accident scene and conducts interviews with involved in the accident and any witnesses. The AIB’s own material is supplemented with material from the police, vehicle inspectors, road administrations, hospitals/casualty departments and forensic institutes.

AIB working method

The AIB’s analysis of individual accidents aims to study the factors that caused the accident. Focus is not on blame and offenses. The analysis is conducted on the basis of fixed methodology, the main features of which have remained unchanged since the AIB’s first theme analysis.

The first element in the analysis of an accident is to establish the course of events based on the collected material. The AIB always establishes the course of events with the participation of all groups involved (road engineer, psychologist, vehicle inspector, the police and medical doctor). In the process, the AIB relies on reconstructions of the accident, and the tools "PC-Crash" and "PC-Rect" are used for the reconstructions.

Then an analysis is made of the road users' information processing in the seconds immediately before collision. Was the information necessary available, and was it recognised and interpreted correctly by the road users?

The next step is a study of the impact of the elements: The AIB generally considers accidents as a failure in the interaction between the road users, the vehicles and the road/environment. A general assessment is therefore made of the impact of these elements on the accidents. This could, for example, be road design conditions or the behaviour or state of the involved or any vehicle defects. The impact of speed is also considered.
Then, it is determined which factors caused the accident (accident factors) and which factors have had an impact on the extent of the injuries (injury factors). The AIB operates with a defined number of possible factors. The list of the factors and their relationship with the information processing can be seen on the AIB's website.

**Accident factor**
An accident factor is essential for the occurrence of an accident. Often several accident factors contribute to an accident. As an example, both too high speed and insufficient orientation may be decisive for the occurrence of an accident. If just one of the accident factors had not been there, then the accident would not have taken place.

**Injury factor**
An injury factor worsens personal injuries, but they have no impact on whether the accident occurs. For example, failure to use seatbelts may increase personal injuries, but the use of seatbelts is irrelevant for the occurrence of the accident.

**Underlying factor**
Whenever possible, based on the data available about the accident, the AIB also determines what is behind or explains the accident factors. For example, distraction or busyness may be the reason why a road user does not orient himself sufficiently, or alcohol may be an underlying factor of too high speed. An underlying factor explains and elaborates an accident factor. An underlying factor may, like an accident factor, be linked to the road user, the vehicle, the road and environment, but it may also be linked to what could be known as the system, e.g. the working conditions of drivers or inadequate road planning.

See www.hvu.dk for a more detailed description of the AIB’s method and any other AIB reports.
Why do road traffic accidents happen?