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Inattention and distraction in fatal road crashes – Results from in-depth crash investigations in Norway

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ABSTRACT

Distraction and inattention pose a considerable threat to road safety, not only for car drivers, but also for vulnerable road users. Previous studies show that inattention and distraction are more often contributing factors in severe crashes, compared to less severe crashes. The correlation with severity appears to vary with the type of inattention. The aim of the present study was to conduct a comprehensive mapping of the types of inattention that contribute to fatal road crashes. This was done by exploring data from in-depth investigations of all fatal road crashes in Norway between 2011 and 2015 conducted by crash investigation teams of the Norwegian Public Roads Administration. Crash reports were selected for screening, based on codes indicating inattention as a possible contributing factor. Inattention among at-fault drivers of motor vehicles was found to contribute to almost one out of three fatal road crashes between 2011 and 2015. About one-third of inattention-related crashes involved pedestrians who were hit by motor vehicles, where the driver typically detected the pedestrian too late. Failure to check for information in blind spots or behind other sight obstructions is a typical form of inattention. Distraction by use of mobile phones contributed to between two and four percent of all fatal crashes, while other sources of distraction, within or outside of the vehicle, contributed to about ten percent. Driver inattention may be preventable by a system-oriented approach including a combination of vehicle technology, road and road environment improvements, appropriate signs and markings, education and information, as well as legal measures and enforcement regarding use of mobile phones, in-vehicle sight obstructions, and involvement in other secondary tasks during driving.

1. Introduction

Driver distraction is defined as “the diversion of attention from activities critical for safe driving to a competing activity”, and driver inattention is described as “mismatches between the driver’s current resource allocation and that demanded by activities critical for safe driving” (Engström et al., 2013).

Distraction can be classified by modality. A common distinction is between visual, auditory, manual, and cognitive distraction. Taking distraction by using a mobile phone while driving as an example, visual distraction would be looking at the display, auditory distraction listening to a conversation partner, manual distraction dialling or texting, and cognitive distraction thinking about the contents of the conversation. Both visual distraction (e.g., looking away from the road and traffic) and other types of distraction may contribute to fatal crashes.

For example, some studies show that cognitive distraction, such as daydreaming, resulting in a failure to concentrate on traffic (Chan and Singhal, 2013; He et al., 2011), is a contributing factor in several crashes (e.g. Berthie et al., 2015; Galera et al., 2012; Sagberg, 2016).

Some studies have shown that two seconds is a critical limit for looking away from the roadway, before the risk of safety-critical events increases substantially. However, looking ahead does not guarantee that the driver is attentive. It has been demonstrated that “looked but failed to see” is a common factor in road crashes (Beanland et al., 2013; Clabaux et al., 2012). Various aspects of mental work load resulting from cognitive distraction may explain this phenomenon (Brown, 2005).

When discussing distraction and possible countermeasures it is important to consider the source of distraction. One distinction is whether it is external or internal with reference to the vehicle. Another relevant distinction is between “top-down” (proactive or feedforward) and “bottom-up” (reactive or feedback) control of attention and distraction (Engström, 2011; Lee et al., 2009). *Proactive control* means searching actively for information or actively engaging in some distracting activity like making a phone call or turning around to fetch something in the backseat. *Reactive control* means that attention involuntarily or

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automatically is drawn toward some source of distraction, like a loud sound, a blinking light, or an advertising board. This distinction has important implications for finding effective countermeasures against driver distraction and inattention. Presumably, proactive distraction in the form of conscious decisions to engage in secondary tasks during driving can be influenced by awareness campaigns and information or by enforcement and sanctions, whereas reactive (involuntary) distraction by events or objects automatically attracting the driver's attention are less likely to be influenced by such measures. On the other hand, reactive distraction may be influenced by designing the road system to comply as far as possible with driver information needs, and to avoid conspicuous but irrelevant information in the road environment.

A recent literature review showed that driver inattention contributes to a considerable share of road crashes (both fatal and non-fatal), with a minimum estimate at 12% of crashes (Sagberg and Sundfør, 2016). Important explanations include too long glances away from the road during driving, and cognitive load resulting in impaired processing of visual information ("looked but failed to see"). Texting on a mobile phone is associated with a very high risk, but causes relatively few crashes, since the prevalence is low. In comparison, adjusting radios or music players contributes to more crashes. A survey among approximately 4100 drivers in Norway largely confirmed the results of the literature review. In addition, it showed that cognitive distraction (daydreaming etc.) is one of the most prevalent types of driver inattention, both in driving generally and immediately preceding a crash (Sagberg and Sundfør, 2016).

Some studies have investigated the relationship between distraction and fatal crashes (e.g. Stevens and Minton, 2001; Zhang et al., 2015), only few studies have estimated the proportion fatal crashes in which inattention has been a contributing factor. A study from the USA found a share of inattention of 299% in fatal crashes (Bunn et al., 2005). Another study reported a share as high as 33% (Peng and Boyle, 2012). However, the latter study includes only single vehicle (SV) crashes. Most studies report smaller proportions, which may partly be due to the inclusion of less severe crashes in addition to fatal crashes. Some studies report that inattention far more often contributes to fatal crashes than to less severe crashes (Stevens and Minton, 2001; Stimpson et al., 2013; Zhang et al., 2015). Reported differences between proportions of crashes related to distraction may partly be due to differences in types of inattention that were studied, and in how distraction is defined. For example, in-vehicle distractions seem to be associated with more severe crashes, compared to external-to-vehicle distractions or cognitive distraction.

By looking at previous studies on inattention and distraction we find inattention to be a more frequent contributing factor in more severe crashes. However, the correlation with severity varies with the kind of inattention. The aim of the present study is to identify the types of inattention that contribute to most fatal crashes. The concepts of inattention and distraction as used in this study imply that distraction is one of several factors that can contribute to a person being inattentive.

2. Method

In Norway, all fatal road crashes are examined by the Norwegian Public Roads Administration. For each crash, a crash investigation team carries out an in-depth study and produces a crash report with detailed information about road user behaviour, vehicles, road and environment conditions, etc. In addition, a large selection of variables are coded into a database with predefined categories.

The present study includes an analysis of the fatal crash database, and a subsequent detailed examination of reports from crashes where inattention was considered a possible contributing factor based on codes used in the database.

Potential inattention-related crashes were identified in the database, based on the following variables:

- Insufficient information collection
- Party driving
- Mobile phone
- Music player
- In-vehicle distraction
- Roadside distraction
- Radio tuning
- Sight obstruction
- Cluttered road environment
- Complex traffic situation.

We considered the codes in the database only as suggestive of possible inattention as a contributing factor, since the original coding was not based on clear definitions or a theoretically founded framework for analysing inattention. Having selected crash reports based on these suggestive codes, we looked carefully through each report and made our own independent judgement about the presence and type of inattention, using our own coding scheme as described below. In several crash reports we did not find any clear indication of the presence of inattention. On the other hand, some inattention-related crashes may have gone undetected if none of the codes above were used. Since the codes that were used for selecting reports covered a wide range of possible types of inattention, the number of undetected inattention-related crashes is not likely to be large.

All reports from crashes in 2011–2015 with the mentioned codes were investigated. Crashes involving impaired drivers under the influence of alcohol or other substances were not included in the analyses. Crashes in which the at-fault driver had not been inattentive according to our judgement of information in the crash report (despite the selected code in the database), or in which distraction had not contributed to crash occurrence, were excluded as well. Based on information in the crash report, the at-fault driver was defined as the driver or rider whose action triggered the crash. Thus, being at-fault in our study is often, but not necessarily, the same as being held legally responsible. Information about who has been held legally responsible for the crashes is not available in the crash reports. In crashes involving both a motorised vehicle and a bicyclist or pedestrian, the presence of inattention was coded only for the driver/rider of the motorised vehicle. These vehicles were counted among the at-fault traffic units in our analyses. All drivers/riders in single-vehicle crashes were considered to be at fault.

To allow more detailed coding compared to what was available in the database, a coding scheme was developed, partly based on previous research. The items in the coding scheme are presented in Table 1. Codes for type of inattention were adapted from Engström et al. (2013) and Regan and Strayer (2014). Sources of distraction and the presence of sight obstructions were coded based on the crash reports. Finally, for mobile phones, handheld vs. hands-free mobile phone as well as type of usage were coded. The coding scheme was applied to all crashes where some type of inattention was assumed to be a contributing factor. The coding was done by a researcher with extensive experience in the field of driver distraction and inattention. Information from the reports was used to determine to what degree inattention had contributed to the crash, which types of inattention were involved, and how likely it is that the factor had contributed (possibly vs. probably or certainly). For some crashes, the reports did not contain sufficient evidence to indicate any role of inattention; those were not coded as related to inattention.

After analysing the crash reports, we identified 163 out of the 374 crashes as possibly, probably or certainly related to inattention. Three of these involved only cyclists (and a pedestrian), whereas the remaining 160 crashes involved at least one motor vehicle.

Since 160 out of the 544 crashes were identified as related to an inattentive at-fault driver, 384 crashes remained that were not inattention-related. Database information from those crashes was included for comparison in some of the analyses. For each factor the probability of having contributed to the crash was coded as probably/

Table 1
Coding scheme items and description.

Items		Description
Mobile phone	Type	Handsfree/handheld
	Method of use	Conversation, dialling, keying, SMS, handling, etc.
Sight obstruction	Blind spot in front of vehicle	
	Blind spot behind vehicle	
	Blind spot on vehicle side	
	Window column or mirror	
	Object inside vehicle	
	Other sight obstruction	
Inattention	Inattention not specified	
Subcategories adapted from taxonomies of Engström et al. (2013) and Regan and Strayer (2014)	Misprioritised attention	
	Failed to look	The driver failed to look or scan for potentially safety-critical information
	Looked but failed to see	
	Insufficient attentional effort	Low concentration on traffic, including cognitive distraction
Distraction along the road	Construction work	
	Event/activity/animal in road side	
	Other road users	
Distraction inside vehicle	Locating object	
	Music player or radio	
	Eating/drinking	
	Information and communications technology (ICT) – systems	
	Passenger-related	Child passenger, adult passenger, pets
	Other distraction	

For the years 2011–2015, there was a total of 704 crashes in the database. After excluding crashes with drivers/riders influenced by alcohol or drugs, 544 crashes remained. Using the listed codes from the database, we selected 374 crash reports for analysis regarding the presence and type of inattention.

certainly or possibly.

3. Analysis and results

3.1. Share of accidents

The share of inattention-related at-fault crashes for the years 2011–2015 are presented in Fig. 1. Crashes with drivers/riders influenced by alcohol or drugs are excluded. Over all, inattention contributes to 29.4 per cent of all the fatal accidents in the period (N = 544).

3.2. Vehicle type

The share of inattention-related at-fault crashes varies between the different types of vehicles (Table 2). For each crash, inattention was coded for the at-fault drivers of motor vehicles. In crashes with more than one motor vehicle, inattention was coded for the driver who was assumed to be at fault for the crash.

One or more indicators of attention were identified as contributing

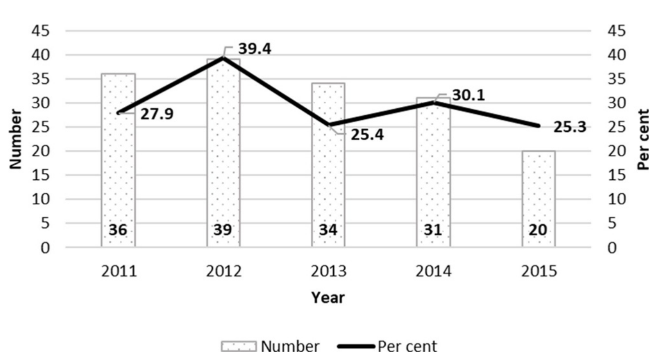

Fig. 1. Fatal accidents where inattention by drivers of motor vehicles has probably been a contributing factor, by year (2011–2015). Number and percent of all accidents (except crashes with drivers/riders influenced by alcohol or drugs).

Table 2
Inattention by the driver of a motor vehicle in fatal crashes (crashes with drivers/riders influenced by alcohol or drugs are excluded) (2011–2015), by traffic unit; numbers and percentages.

		Inattention contributed	
At-fault unit	All crashes	N	%
Bus	14	8	57 %
Lorry	62	24	39 %
Other type of vehicle	32	12	38 %
Car	377	108	28 %
MC/moped	59	8	15 %
Total	544	160	29 %

factor in 29% of all fatal crashes included in the analysis (crashes with drivers/riders influenced by alcohol or drugs are excluded). The prevalence of inattention may be underestimated since inattention may have contributed to some of the crashes that were excluded from analysis in the coding procedure due to insufficient evidence in the crash reports, amounting to 12% of all crashes (N = 544).

3.3. Crash opponents

Fig. 2 shows the distribution of crashes by type of unit for inattentive (N = 160) and not inattentive at-fault drivers (N = 384) in the period 2011–2015. The figure also shows the distribution of crash opponents for each group and type of traffic unit. Crashes without motor vehicles involved are excluded.

As expected (given the volume of traffic), a passenger car is the at-fault unit in the vast majority of inattention-related crashes (68%), followed by heavy vehicles (20%). When it comes to crash opponents, it is interesting to note that collisions with pedestrians is by far the most frequent type of fatal crash where a driver has been inattentive. In 51 out of the 160 crashes with an inattentive motor vehicle driver, i.e. 32%, a pedestrian was killed. By comparison, in the same period there were 24 pedestrian crashes in which the at-fault driver was not considered as inattentive. This means that inattention by drivers of motor

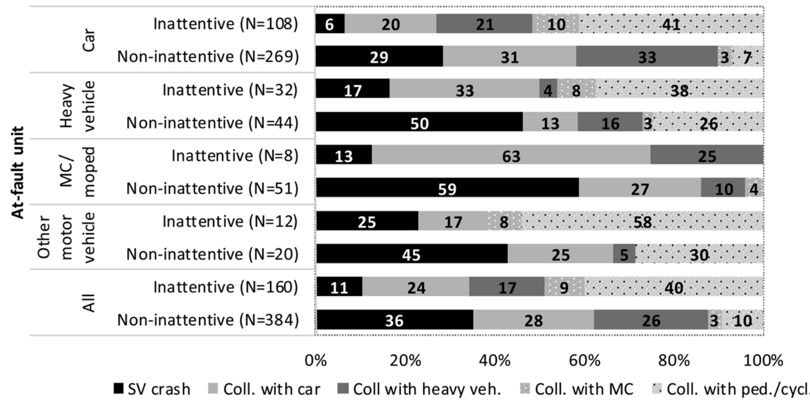

Fig. 2. Distribution of crash type (single vehicle, SV / collision) and collision partner for different groups of attentive and inattentive at-fault drivers (2011–2015).

vehicles occurred in 51 out of 75 pedestrian crashes, i.e. 68%.

3.4. Driver demographics

The proportion of female drivers is 18% among inattentive and 22% among non-inattentive drivers. The difference is not statistically significant. The average age is also similar in both groups, with 45.3 years among inattentive and 45.2 years among non-inattentive drivers.

However, some differences emerged when looking at the age of the individual road user groups. Among drivers of heavy vehicles, the average age is lower among inattentive drivers (35 years) than among the non-inattentive drivers (46 years). The difference is statistically significant ($t = 3.72$; $df = 60$; $p < 0.001$). This means that heavy-vehicle drivers involved in fatal crashes while inattentive, are younger - and thus probably less experienced - than heavy vehicle drivers in other fatal crashes. For other road user groups, there are no significant age differences.

3.5. Crash types

Fatal crashes (in total and related to inattention) by crash type and combination of traffic units are presented in Table 3. In crashes with different types of traffic units, the at-fault unit is listed first.

The results in Table 3 show that percentage of crashes with inattention is higher among intersection, pedestrian, and same direction crashes (changing lanes, overtaking, rear-end collisions, etc.) than among other crashes. Inattention contributes more frequently in crashes where a heavy vehicle is the at-fault unit than in crashes where a car is the at-fault unit. In head-on collisions inattention occurs less often than in other types of crashes. However, for these crashes the proportion of inattention is higher for heavy trucks (38.9%) than for cars (13.7%) ($\chi2 = 7.79$; $df = 1$; $p = 0.005$).

Other road and crash characteristics that were found to be related to the prevalence of inattention, are curvature, intersections, light conditions, weekday/weekend, and speed limit (not shown in Table 3). On straight road sections, inattention contributes to a larger share of crashes than in curves (42% vs. 18%) ($\chi^2 = 35.7$; $df = 1$; $p < 0.0001$). Furthermore, inattention contributes more frequently to crashes in intersections and private entrance roads (63%) than in other crashes ($\chi^2 > 50$; $df = 1$; $p < 0.002$). The proportion of inattention-related crashes is highest in darkness on lit roads (42%) and lowest in darkness on unlit roads (14%) ($\chi^2 = 8.1$; $df = 1$; $p = 0.005$). The proportion of inattention crashes is lower during weekends (Friday – Sunday) than on weekdays ($\chi2 = 5.55$; $df = 1$; $p = 0.019$), which means that other contributing factors are more prevalent during weekends. The proportion of inattention-related crashes is larger on roads with a speed limit of 50 km/h or lower, compared to roads with a speed limit above 50 km/h ($\chi^2 = 31.2$; $df = 1$; $p < 0.0001$). In accordance with this, the prevalence of inattention is higher in urban (55%) than in rural (22%) areas ($\chi^2 = 50.9$; $df = 1$; $p < 0.0001$). No statistically significant relationships were found between inattention and season, weather and road conditions, number of lanes, or presence of a median.

Table 3
Fatal crashes 2011–2015 by crash type, combination of traffic units, and contribution of inattention; numbers and percentages.[a]

		Inattention-related	
	All crashes (N)	N	%
Pedestrian crashes	75	51	68 %
Heavy vehicle - pedestrian	18	12	67 %
Car - pedestrian	49	34	69 %
Intersection crashes	59	42	71 %
Car - car	9	8	89 %
Car - heavy vehicle	13	9	69 %
Car - MC	12	9	75 %
Car - bicycle	7	4	57 %
Heavy vehicle - car	4	4	100 %
MC - car	4	3	75 %
Same direction crashes	21	13	62 %
Head-on collisions	219	34	16 %
Heavy vehicle at-fault	18	7	39 %
Car at-fault	183	25	14 %
Run-off-road crashes	146	16	11 %
Other crashes	21	3	14 %
All	544	160	29 %

[a] Combinations (of different traffic units) with less than 4 crashes are not presented.

3.6. Types of inattention

Fig. 3 shows the inattention categories in descending order by frequency and whether it had probably/certainly or possibly contributed to the crash.

Unspecified inattention (no clear evidence of *the type* of inattention, but clear that inattention was involved) was the most frequent category.

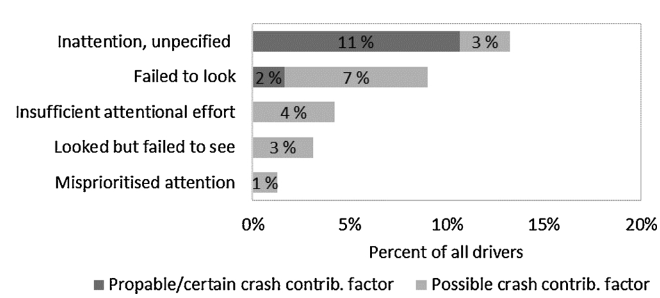

Fig. 3. Prevalence of different types of inattention among at-fault drivers in fatal crashes (in the period 2011–2015). N = 544.

The most frequent *specific* category was failure to look (found in 50 inattention-related crashes). The second most frequent categories were insufficient attentional effort (24 out of 160 inattention-related crashes), followed by looked but failed to see (19 out of 160 inattention-related crashes). These types of inattention mainly concern *proactive attention mechanisms*, i.e. the extent to which the driver is actively searching for information.

Typical crashes in which failure to look contributed, include situations where an at-fault driver did not see the other road user due to a failure to check blind spots, mirrors, or possibly a backing camera screen. A large share of these crashes involved a cyclist or pedestrian being hit while in the vehicle's blind spot. There were 36 crashes with sight obstruction or blind spots in the study (7% of all crashes). Vulnerable road users were also involved in many of the other types of crashes where an at-fault driver was judged to have been inattentive. In one-third of inattention related crashes, a pedestrian was killed.

The main difference between passenger vehicles and heavy vehicles as at-fault unit, is the proportion of "failed to see". The proportion is significantly larger for heavy vehicles (19%) compared to passenger cars (7%). This is possibly related to higher incidence of blind spots and obstructions on heavy vehicles than passenger vehicles.

3.7. Types of in-vehicle distraction

Fig. 4 shows prevalence of different sources of in-vehicle distraction among at-fault drivers in fatal crashes, related to inattention.

Among specific sources of in-vehicle distraction, use of mobile phones is the most frequent category (2–4% of all fatal crashes; 7–14% of inattention-related fatal crashes). Five crashes (out of a total of 22 mobile phone-related crashes) occurred during reading or sending text messages. A handheld mobile phone (which is explicitly forbidden during driving in Norway) was used in 16 out of the 22 crashes. The remaining sources of distraction were use of ICT systems in the vehicle (GPS, laptop or tablet computer, video camera, backing camera, etc.) and interaction with passengers. In-vehicle distractions other than mobile phones contributed to 8% of all fatal crashes. In 39 out of 44 crashes with an in-vehicle type of distraction, the distracted driver was a passenger car driver.

3.8. Pedestrians and cyclists as at-fault unit

For all crashes, we encoded any inattention (or culpable negligence) by the other party in the crash. Hence, we could explore inattention among cyclists or pedestrians in collisions with a motor vehicle, but at a less detailed level than for the drivers of the motor vehicles. In several crashes between a motor vehicle and a vulnerable road user, inattention or carelessness on the part of the cyclist or pedestrian had contributed to the crash. This was the case for at least 27% of crashes between a motor vehicle and a bicycle, and at least 12% of crashes between a motor vehicle and a pedestrian.

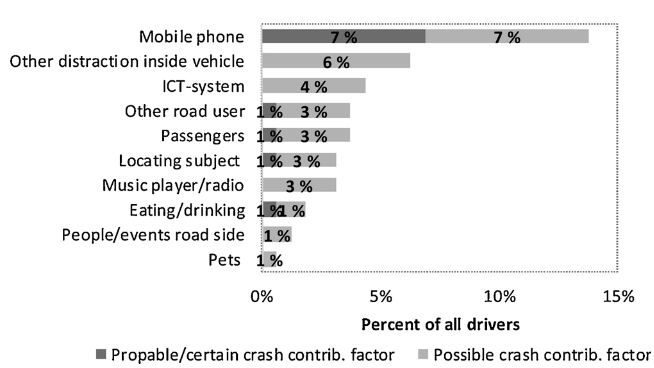

Fig. 4. Prevalence of different sources of in-vehicle distraction among at-fault drivers in fatal inattention-related crashes (2011–2015; N = 160).

4. Discussion

A comprehensive mapping of data from in-depth crash investigations of all fatal crashes in Norway showed that inattention among motor vehicle drivers contributed to almost one out of three (29%) fatal crashes between 2011 and 2015. About one-third of inattention-related crashes involved pedestrians who were hit by a motor vehicle, typically because the driver detected the pedestrian too late.

In the existing literature, available estimates of the prevalence of inattention vary a lot, but most from comparable studies are roughly in the same order of magnitude as ours (Beanland et al., 2013; Bunn et al., 2005; Peng and Boyle, 2012). Most other studies report somewhat lower proportions than what we find (Ascone et al., 2009; Donmez and Liu, 2015), which may partly be due to the inclusion of less severe crashes in addition to fatal crashes. Another explanation may be different definitions of inattention. The fact that we included insufficient check of blind spots and other sight obstructions as a type of inattention may have contributed to higher estimates than in some other studies. On the other hand, some studies have included fatigue-related inattention, which is excluded in our study (Bunn et al., 2005).

The 36 crashes with sight obstruction or blind zones in our study make up 7% of all potential intention related fatal crashes, so even without including these crashes, the share of inattention related crashed would be above 20%. An alternative explanation for some of the crashes coded as inattention (especially unspecified, failed to look, and look but failed to see) might be dynamic occlusion (another road-user). We cannot rule out that some of the cases are events with an attentive driver, who is just looking for a reason why the crash happened. On the other hand, the information from the reports is not merely based on interviews of the at-fault driver, but also witness observations and investigation of the vehicle and the surroundings.

Some studies report that inattention far more often contributes to fatal crashes than to less severe crashes (Bunn et al., 2005; Zhu and Srinivasan, 2011). However, this seems to depend on the type of inattention. For example, in-vehicle distraction seems to be associated with more severe crashes than distraction outside the vehicle or cognitive distraction (Donmez and Liu, 2015). Since our study includes only fatal crashes, we have not been able to do comparable analyses of differences in outcome probabilities between various types of inattention.

The main challenge in our study was the coding process. In many cases, it was difficult to assess the type of inattention being present in a crash. Thus, the coding is based on hypotheses about possible contributing factors to inattention. It would have been difficult to use coding schemes from previous research where more detailed information about drivers' behaviour prior to the crash was available.

The lack of an inter-rater reliability assessment is a possible source of bias in the results. However, over all we do not believe coding by another person would have changed the results regarding total prevalence of inattention in crashes, only the distribution across types of inattention.

Another limitation is that information about pre-crash driver behaviour may be insufficient for drawing firm conclusion. Thus, data from crash investigations may be a useful supplement to e.g., naturalistic driver observations, which provide very detailed information about driver behaviour in normal driving and some safety-critical events, but on the other hand include very few real and severe crashes.

Most detailed information is often found where the driver of the at-fault vehicle has survived (e.g. witness statement to the police or interviewers). In these cases, it is sometimes possible to estimate the specific type of inattention with reasonably high degree of certainty. It may also be difficult to distinguish inattention / distraction from other possible explanations in cases where there is no first-hand information from the driver or from witnesses in the vehicle. The most relevant alternative explanations for many crashes with suspected inattention is illness, falling asleep, or suicide. The judgement of whether or not a driver or rider had been inattentive was made by the coder, based on a detailed consideration of all evidence presented in the crash reports. However, for some crashes information was not sufficient for a definite judgement, which implied that the contribution of inattention was coded as 'possible' rather than 'probable or certain'. These limitations are important to take into consideration when interpreting the results of our analyses.

It could be argued that in some crashes expectancy violations could be an alternative to inattention as a probable contributing factor. Some current models of driver inattention include expectancy among the factors that determine attention. For example, Regan and Strayer (2014) describe "driver neglected attention" as a result of "faulty expectations about the driving situation" (p. 6). In our study, expectancy violations are classified as "failed to look".

Concerning countermeasures against inattention among motor vehicle drivers, vehicle-related measures are probably most effective (Høye et al., 2012). Examples include:

- Driver assistance systems that facilitate the perception of safety-critical information (such as collision warning)
- Blind spot warnings on heavy vehicles
- Mobile phones with a "driving mode", which e.g. blocks text messaging
- Pedestrian collision avoidance systems
- Improved viewing conditions by vehicle design (e.g. a thinner or transparent A column and improved seating position).

Improved roads and road environments may also contribute to preventing inattention. Sufficient sight distances, absence of distracting elements (such as conspicuous advertising boards) along the road, clear and unambiguous signs and markings, as well as clear information about right of way are important measures. Right-of-way regulations should be consistent with the visual design of the road (major vs. minor roads) (Høye et al., 2012).

Finally, some studies indicate that measures addressing road user behaviour, such as education and information, can contribute to preventing specific types of inattention (e.g. Lawrence, 2015; Roge et al., 2015). Such measures are probably most effective when combined with police enforcement, for example of the use of mobile phones and sight obstructions in vehicles (Phillips et al., 2011).

5. Conclusions

The results show that inattention among motor vehicle drivers contributed to almost one out of three fatal road crashes between 2011 and 2015 in Norway. About one-third of inattention-related crashes involved pedestrians who were hit by a motor vehicle, typically because the driver detected the pedestrian too late. Failure to check for information in blind spots or behind other sight obstructions is a typical form of inattention. Distraction by use of mobile phones contributed to between two and four percent of all fatal crashes, while other sources of distraction, within or outside the vehicle, contributed to about ten percent of all fatal crashes. Road user inattention may be preventable by a system-oriented approach including a combination of vehicle technology, road and road environment improvements, appropriate signs and markings, education and information, and legal measures and enforcement regarding use of mobile phones and other secondary task involvement during driving.

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