Defining Driver Distraction

Michael Pettitt1*, Gary Burnett1, Alan Stevens2
1. School of Computer Science and Information Technology, University of Nottingham, Nottingham, United Kingdom, NG8 1BB, +44 (0)1159 514226, map@cs.nott.ac.uk
2. Transport Research Laboratory, United Kingdom

ABSTRACT

This paper discusses the various issues concerned with the precise definition of the term driver distraction. There has been growing interest in driver distraction in the research community due to the development of information and communication technologies for concurrent use whilst driving. Concern has been raised that such technologies may lead to an increase in accidents. In order to reliably monitor the driver distraction problem it is essential that cross study comparisons can be made. This is made difficult due to the lack of a comprehensive definition of the term. This paper reviews those definitions available in the literature and examines the necessary components of a reliable definition with support from accident statistics in a database of work-related road traffic accidents in the Midlands area of the UK. It is found that driver distraction should be discussed in terms of four components: the difference between distraction and inattention; the recognition that distraction can be internal and external to the vehicle; that distraction can be categorised into four types; and, the effect of distraction on the driving task. Finally, a proposed, comprehensive definition for driver distraction is provided along with other conclusions.

KEYWORDS
Distraction, Inattention

INTRODUCTION

The introduction of new information and communication technologies, for example navigation systems, mobile telephones, in-car internet [1], within vehicles has led to research on the effects of driver distraction on driving performance. The assumption is made that the variety of systems available to drivers may lead to an increase in accidents caused by driver distraction [1]. Research efforts can be categorised into pre and post-crash analysis. Pre-crash analysis involves the development of predictive methods for assessing the potential distraction of an interface or device, such as the visual occlusion method [2]. It has also focussed on the effect of different levels of distraction on driver performance in order to inform interface design [3]. Post-crash analysis has sought to assess the actual prevalence of distraction, in particular distraction from technology, amongst accident statistics [1]. In England and Wales, evidence suggests that in-vehicle distraction is a contributing factor in about 2% of fatal accidents, although this figure is felt to be a conservative estimate [1]. Studies in other countries have reported much higher levels of distraction related accidents, reporting values of 9%, 8.2% and above [1]. Whilst post-crash analysis and pre-crash studies provide useful data in isolation, comparisons can be difficult to make across the body of
research [1; 3]. One factor is the seeming lack of a valid and reliable definition for what is meant by the term ‘driver distraction’ [1].

An agreed definition would help to focus clarity within future research, making cross-study comparisons easier. Such a definition may be particularly useful for accident researchers seeking to categorise cases, allowing for comparisons between statistics from different areas, regions, countries etc. This paper summarises the issues in defining driver distraction, drawing on previous research and new statistics from a database of work related accidents in the Midlands area of the UK. There will be particular focus on distraction related accidents that are as a result of a driver’s interaction with some form of technology, however all distraction related accidents are examined to support the recommended definition.

WORK-RELATED ROAD TRAFFIC ACCIDENT DATABASE

This paper includes statistics from a database of work-related road traffic accidents that occurred between the years 1996 and 2004 inclusive in the Midlands region of the United Kingdom. The database contains information on 2114 accidents over the period. Each record is generated from police road accident files of accidents involving drivers and others using the roads in connection with their work [4]. Depending on the severity of the accident and any subsequent legal proceedings, the information within each file varies. The minimum amount of information for each accident includes the time, date, location, weather conditions, a brief accident account and other items [4]. Files are categorised as being ‘A’ or ‘B’ class. ‘A’ class files are the most detailed, and contain a range of further items, such as maps and interviews with witnesses, that help ‘fill out the often complex circumstances of the accident’ [4].

The data is reasonably specific and no formal attempt will be made to generalise the results to the whole driving population of the United Kingdom. All accidents in the database involve at least one work-related vehicle, although fault or blame does not necessarily lie with the work-related driver. Work-related road traffic accidents are of interest for research into driver distraction for several reasons. Drivers on work-related activities may potentially be exposed to more in-vehicle technology than the overall driving population, with communication devices such as CB and taxi radios prevalent in addition to mobile phones. Furthermore, such drivers may be motivated to use these devices due to work pressures. With regards to distraction from technology-based sources, work-related accidents may give an indication of future trends as in-vehicle technology becomes more ubiquitous. In separate research involving the same database of accidents it was concluded that ‘work-related accidents are not fundamentally different in their causal structure to any other road accidents’ [4: 40] and that the errors and violations made by drivers in the database were not significantly different from those made by the general driving population; though work-related drivers have more opportunity to make them [4].

CURRENT DEFINITIONS

Investigations of the effects of distraction on driving have employed varying definitions. It is not uncommon, though, for studies to make no specific definition of the term. This could be related to the common nature of the word ‘distraction’. Distraction is an everyday term. Consequently, its meaning has become somewhat abstract, lacking the precision necessary for scientific purposes. Defined in the Oxford dictionary as ‘Something that distracts the...
attention and prevents concentration’ [5], the generally understood meaning of distraction
does not cater for the complexities of the term when related to driving.

Definitions currently used in the literature are either from official bodies or organisations, or
are less formal. The International Standards Organisation (ISO) defines distraction as being
‘attention given to a non-driving related activity, typically to the detriment of driving
performance’ [2: 10]; this definition is concise and highlights the impact of distraction on the
driving task. In order to be distracting there should be some form of measurable change in
driving task as a result of a driver’s engagement in a secondary task or activity. However, the
definition is not comprehensive and further definitions are required. For example, the draft
occlusion standard separately defines visual distraction as: ‘diversion of visual attention from
the road scene’ [2: 10]. In the Indiana Tri-Level Study of the Causes of Traffic Accidents, a
specific definition is given of internal distraction, which is said to occur when attention is
given to a ‘competing event, activity, or object inside the vehicle’ [6: 2]. The use of the word
‘competing’ in this definition highlights the pull on the driver’s attention of the event, activity
or object, from the driving task.

Possibly the most comprehensive definition of distraction comes from the American
Automobile Association Foundation for Traffic Safety (AAAFS). It states that distraction
occurs when ‘a driver is delayed in the recognition of information needed to safely
accomplish the driving task because some event, activity, object or person within or outside
the vehicle compelled or tended to induce the driver’s shifting attention away from the driving
task’ [3: 2]. Omitted from this definition is any mention of the various types of distraction.
Other definitions have discussed distraction in terms of four types: visual, cognitive,
biochemical and auditory [7]. These types are used to discuss the specific impact of the
distraction on the driver.

Comparisons of the available definitions in the literature suggests that a comprehensive
definition of driver distraction must take into account the following key components: the
difference between distraction and inattention; the recognition that distraction can be internal
or external to the vehicle; that distraction can be categorised into four types; and, the effect of
distraction on the driving task. These components are discussed in detail below with reference
to definitions used in the literature and data from the work-related accident database.

Distraction and Inattention

Definitions of distraction must consider the presence of an event or occurrence that causes a
driver to allocate attention, which might otherwise be focussed on the driving task, to a
separate activity. Where this has been achieved, caveats used have discussed an ‘event,
activity, object or person within or outside the vehicle [which] compelled or tended to induce
the driver’s shifting attention away from the driving task’ [3: 2], or physical events, actions or
conditions, in or on the vehicle that divert attention from driving [1]. The key consideration is
that the result of distraction is inattentive driving; however inattention is not always caused by
distraction.

Distraction is listed as a primary or contributory factor in 109 accidents in the work-related
road traffic accident database. Of these, two are cases where the distracted party was a
pedestrian, and are therefore excluded from analysis. Therefore, 5.1% of accidents in the
database list distraction as a primary or contributory factor. Closer inspection of the individual
accident reports suggests that up to 29 of these accidents are more likely due to inattention, e.g. daydreaming, fatigue, rather than distraction specifically. This leads to a revised figure of 3.7% of accidents caused in some part by distraction. Misleading classification of accidents can be conducive to inaccurate statistics regarding accident causation, which is potentially harmful for research incentives and legislative bodies. It is important that the prevalence and severity of distraction related accidents is accurately monitored in tandem with pre-crash research in order to ensure that developments in vehicle technology are beneficial for the safety and comfort of drivers. The work-related accident database contains reports on accidents that are categorised as being primarily or partially caused by distraction, however there is no indication of the event or occurrence that precipitates the distraction. The prose accounts of these accidents generally suggest that the drivers were momentarily ‘distracted’ by thoughts of events in their lives other than the driving task at hand. The lack of a definable event or occurrence in these situations leads to the assertion that these accidents are more reasonably categorised as inattention. Efforts should be made within accident reporting to differentiate between distraction and inattention more clearly in order to assist in post-crash analysis of accident causation.

The importance of differentiating between distraction and inattention accidents is made even clearer when the accidents are analysed by severity. Within the database, accidents are categorised as ‘slight’, ‘severe’ or ‘fatal’. Slight accidents involve vehicle damage, which can be substantial, but no serious injury that requires hospitalisation. Often, accidents of this type involve at least one vehicle being written off. Severe accidents usually involve substantial damage to vehicles and some degree of injury to victims involving hospitalisation. Accidents are categorised as fatal when a death occurs as a result of the accident. The distribution of accident severity amongst all accidents is shown in figure 1, amongst all distraction related accidents in figure 2, and amongst distraction related accidents, eliminating those considered due to inattention, in figure 3.

![Figure 1 – All accidents (n=2114)](image-url)
As can be seen in the figures, removing inattention accidents makes an important difference in the data. Across all accidents, 83% are slight in severity. For those accidents categorised as due in part to distraction, 76% are slight. A higher proportion of distraction related accidents appear to be either serious or fatal (24%) than across all accidents (17%). Removing those accidents felt to be due to inattention and not distraction reduces these differences. The proportions of slight, serious and fatal accidents are now much closer to those of all accidents (see figures 1 and 3). This is further evident if we examine the proportion of distraction related accidents in each category of severity (see figures 4 and 5).
Initially, distraction is accountable for 4.6% of all slight accidents, 6.8% of serious accidents and 8.8% of fatal accidents (figure 4). This is very concerning, as it suggests that distraction plays a larger role the more severe the accident. However, removing those accidents considered more likely to be due to inattention, the figures change to 3.6% for slight accidents, 5.2% for serious accidents and 2.9% for fatal accidents. The increase from slight to severe accidents may in part be due to the high number of large vehicles, such as HGVs and buses, in the database, as these have the potential to cause more damage than if the same accident were to occur with two cars.

**Internal and External Distraction**

Sources of distraction can be both internal and external to the vehicle. Where a definition encompasses both internal and external distraction, it takes into account distractions that are initiated by the driver and also non-driver initiated, examples of which include ‘acute situations that demand a quick response from the driver’ [8: 416]. Internal distractions can be categorised as both driver initiated, e.g. making a mobile phone call, or non-driver initiated, e.g. the unpredictable actions of a passenger. It has been suggested that all forms of external distraction could be said to belong to be non-driver initiated, e.g. the unpredictable behaviour of a drunk pedestrian [8].

Figure 6 shows the distribution of distraction sources in the accident database. Internal distraction, both from technology sources and non-technology sources, play the greatest role. However, external distraction is also prominent. The results suggest that it may be inaccurate to claim all forms of external distraction are non-driver initiated. The prose accounts of accidents given in the database suggests that many external distraction related accidents are the result of drivers who are lost or unfamiliar with their location, or searching for visual cues such as road signs and street names at the time of the collision. When a driver is distracted from the primary driving task because they are lost, looking for street signs or buildings, and so on, it could be suggested that they have
given priority to their route finding task at the expense of the safe control of their vehicle.

Other instances of external distraction fit more easily with the classification non-driver initiated, and include drivers being distracted by other road events and failing to properly attend to the forward view as a result. Examples of other external distractions include: cyclists, police vehicles, events off road and parked vehicles. The distracting effect of searching for road and street signs in unfamiliar environments may be overrepresented in the database as it covers work-related accidents, and drivers on work-related business may drive in unfamiliar locations more regularly than the driving population as a whole.

![Diagram showing distraction sources](image)

**Figure 6 – Distraction sources (n=107)**

The various sources of distraction are summarised in table 1. The data has been ranked to show the greatest contributors. Worryingly, mobile phones are the second greatest contributor of internal distraction with 7 accidents. One fatal accident in the database involved a driver using a hands-free mobile. The work-related accident database covers accidents between 1996 and 2004, and is therefore more up-to-date than sources used in other post-crash analysis [1; 6]. As mobile phone ownership has increased since the work of previous studies, the potential safety risks of using a mobile phone whilst driving may be demonstrated in this data. The greatest source of internal distraction is passengers. In several cases the passengers in question were children, who can be unpredictable in behaviour, lack appreciation of the stress a driver is under and who may also place high demands on the driver.

<table>
<thead>
<tr>
<th>Distraction sources</th>
<th>No.</th>
<th>Distraction sources</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>External source</strong></td>
<td></td>
<td><strong>Internal source (technology based)</strong></td>
<td></td>
</tr>
<tr>
<td>Another vehicle</td>
<td>9</td>
<td>Mobile phones</td>
<td>7</td>
</tr>
<tr>
<td>Unknown</td>
<td>27%</td>
<td>Passengers</td>
<td>9</td>
</tr>
<tr>
<td>Internal (technology)</td>
<td>15%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal (non-technology</td>
<td>28%</td>
<td></td>
<td></td>
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<td>based)</td>
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</table>

**Table 1 – Sources of distraction in work-related accidents**
It was suggested above that internal distractions can be either controlled or initiated by the driver or non-driver initiated. This is supported by the results from analysis of the database. Whilst a driver has some control over whether or not they answer or make a mobile phone call, use their taxi radio, smokes, eats or drinks etc., they do not have complete control over the behaviour of passengers, in particular children, or, for example, the movement of items in their vehicle, such as luggage. Distractions from sources such as these can be unpredictable and may coincide with driving situations that are particularly demanding.

Types of Distraction

In order to better understand the nature of driver distraction, the term has been divided into four types of distraction that are commonly referred to in the literature. These types are: visual, cognitive, biomechanical, and auditory [7; 3]. Whilst the four types are useful, it is important to recognise that these distinct types of distraction are not mutually exclusive [3]. Whilst a device may be particularly distracting visually, it is also likely to incorporate elements of, for example, biomechanical distraction, e.g. manipulation of controls.

Within the work-related accident database, it can be difficult to determine the exact type(s) of distraction for each accident. The records do not specifically categorise accidents in this manner. It is sometimes possible to make judgements on the nature of the distraction. For example, where a driver is distracted by searching for road signs when lost it is reasonable to assume the distraction is visual and cognitive in nature, and unlikely to be biomechanical or auditory. However, in situations where a driver is distracted by passengers it is not clear whether this is visual, i.e. the driver turned to face their passenger and therefore was not observing the road, or auditory, i.e. the driver was startled or taken by surprise by a comment from their passenger, or cognitive, i.e. the conversation was mentally taxing and impinged on the driver’s concentration.

<table>
<thead>
<tr>
<th>Types of Distraction</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road signs</td>
<td>3</td>
</tr>
<tr>
<td>Taxi/CB radio</td>
<td>3</td>
</tr>
<tr>
<td>Reaching for a dropped/falling item</td>
<td>5</td>
</tr>
<tr>
<td>Looking for buildings</td>
<td>3</td>
</tr>
<tr>
<td>Adjusting controls</td>
<td>2</td>
</tr>
<tr>
<td>Paper maps</td>
<td>3</td>
</tr>
<tr>
<td>Pedestrians</td>
<td>3</td>
</tr>
<tr>
<td>CD/stereo</td>
<td>1</td>
</tr>
<tr>
<td>Illness/pain</td>
<td>2</td>
</tr>
<tr>
<td>Lost/unfamiliar</td>
<td>3</td>
</tr>
<tr>
<td>surroundings</td>
<td>1</td>
</tr>
<tr>
<td>Pager</td>
<td>1</td>
</tr>
<tr>
<td>Unknown</td>
<td>2</td>
</tr>
<tr>
<td>Unknown</td>
<td>3</td>
</tr>
<tr>
<td>Instrument panel</td>
<td>1</td>
</tr>
<tr>
<td>Smoking</td>
<td>2</td>
</tr>
<tr>
<td>Events in rear view</td>
<td>2</td>
</tr>
<tr>
<td>mirror</td>
<td></td>
</tr>
<tr>
<td>Rubbing eyes</td>
<td>2</td>
</tr>
<tr>
<td>Off-road events</td>
<td>2</td>
</tr>
<tr>
<td>Securing a seatbelt</td>
<td>1</td>
</tr>
<tr>
<td>Cyclists</td>
<td>2</td>
</tr>
<tr>
<td>Door not shut properly</td>
<td>1</td>
</tr>
<tr>
<td>Events in right-hand</td>
<td>1</td>
</tr>
<tr>
<td>road scene</td>
<td></td>
</tr>
<tr>
<td>Possible vehicle fault</td>
<td>1</td>
</tr>
<tr>
<td>Looking for turn-cues</td>
<td>1</td>
</tr>
<tr>
<td>Work-boots lodged</td>
<td>1</td>
</tr>
<tr>
<td>and brake pedal</td>
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</table>
It is unlikely that accident reports would be able to accurately report on the exact type of distraction. However, the types are useful for pre-crash research, which can be carefully controlled and recorded to assess the different demands on drivers whilst performing secondary tasks whilst driving. For example, researchers can evaluate the visual demand of a system using the occlusion technique [2], and therefore make a judgement on the potential visual distraction of a device, or assess cognitive distraction through the use of workload questionnaires.

**Distraction and the Driving Task**

As earlier stated, ISO defines distraction as ‘attention given to a non-driving related activity, typically to the detriment of driving performance’ [2]. By emphasising the ‘detriment of driving performance’ the definition demonstrates the effect of a distracting activity on the primary task – driving. Consequently, in order to be classified as distracting, a secondary task must have some measurable impact on driving performance, and a definition of driver distraction should cater for this fact. A criticism could be levelled at the definition for referring to ‘non-driving related’ activities. It can be argued that route finding, which may involve distracting activities such as using a navigation system or reading a map, is related to the driving task, as the driver has the goal of travelling from one location to another. Research has suggested that drivers are likely to prioritise those tasks that are deemed of relevance to driving, accepting greater detriments in driving performance in order to ensure successful completion of the secondary task [9]. Table 1 showed the various sources of internal and external distraction. If all the sources involved with route finding are grouped together (paper maps, looking for buildings, looking for streets signs, lost/unfamiliar surroundings and looking for turn cues), this new category becomes the largest single source of distraction. As noted earlier, it is likely that the category is overrepresented in terms of the general driving population, as those driving on work-related activities are more likely to be travelling to unfamiliar destinations. However, the evidence provides support for the notion that a secondary task deemed of high importance to the overall driving goal, that is, to travel from one location to another in the most efficient manner, may place more of a demand on the driver’s attention than a task perceived to be of less importance.

Analysis of the work-related accident database shows that distraction related accidents differ in type to all accidents. 80% of distraction related accidents are either of the form rear end shunt or right of way violation (ROWV). Of these, rear end shunt is the greater category, at 44% (see figure 7). In contrast, across all accidents, these types of accidents account for just 58%, with rear end shunts only 26% (see figure 8).
The differences between the types of accidents caused by distraction and all accidents provide researchers with some useful information. It is possible that, if distraction becomes a more significant cause of accidents, there will be an impact on the distribution of all accident types. This has implications for vehicle safety research, and may lead to increased development of safety systems that mitigate the effects of rear end shunt type collisions. For pre-crash analysis, the results provide support for the use of particular measures when assessing distraction. In simulator studies, measures of reaction times to a braking lead vehicle could be used with greater confidence, as a measure of distraction when engaging in a secondary task.

**FINAL DEFINITION**

This paper has discussed the various issues surrounding the definition of driver distraction for the purposes of research, both pre and post-crash. It is argued that an
agreed, comprehensive definition is necessary to enable better cross-study comparisons and to assist in the categorisation process in accident reporting. A review of currently used definitions shows that four aspects must be covered in a comprehensive definition: the difference between distraction and inattention; the recognition that distraction can be internal or external to the vehicle; that distraction can be categorised into four types; and, the effect of distraction on the driving task.

This paper suggests that a reasonable, comprehensive definition of distraction is comprised of four components: impact, agent, mechanism and type. The proposed definition is as follows:

**Driver distraction:**
- *Delay by the driver in the recognition of information necessary to safely maintain the lateral and longitudinal control of the vehicle (the driving task) (Impact)*
- *Due to some event, activity, object or person, within or outside the vehicle (Agent)*
- *That compels or tends to induce the driver’s shifting attention away from fundamental driving tasks (Mechanism)*
- *By compromising the driver’s auditory, biomechanical, cognitive or visual faculties, or combinations thereof (Type).*

This definition is based primarily on that provided by the AAAFTS (3). Additions include clarification of what is termed the driving task and a recognition of the four types of distraction.

**CONCLUSIONS**

The key conclusions of this paper are as follows:
- An agreed definition is vital for the accurate recording of accidents, in particular to discriminate between distraction and inattention. With an agreed definition the prevalence of distraction as a cause of accidents can be measured over time with greater confidence;
- Distraction is found to be a factor in about 3.7% of work-related accidents, and there is a tendency for these accidents to be either rear end shunt or ROWV in nature;
- Distraction comes from multiple sources, both internal and external. Passengers and mobile phones are the greatest sources of internal distraction in work-related accidents. Other vehicles are the greatest source of external distraction;
- Activities linked to route finding, both internal and external, are the greatest source of distraction. This may be linked to the priority placed on the route finding task by the driver;
- Distraction has been discussed in terms of four different types: auditory, biomechanical, cognitive and visual. Accident files do not generally use these four types in their reporting. This would inevitably be complicated and involve the judgement of the person reporting the accident. The types are useful for pre-
crash research into the impact of various different configurations of systems on driving performance.

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