TRACE Project. Deliverable 3.4. Driving Task-Related Factors

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Project No. 027763 – TRACE

Deliverable 3.4

Driving Task-Related Factors

Contractual Date of Delivery to the CEC: April 2008

Actual Date of Delivery to the CEC: June 2008

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Work Package: 3

Est. person months: 18

Validated by task Leader: Claire Naing (VSRC)

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Validated by external reviewer:

Validated by TRACE Coordinator:

Security: PU

Nature: Report

Version: V2

Total number of pages: 80

Abstract:

Driving task-related factors by definition are 'directly and causally contributing to the accident occurrence, very specific and detailed, are short-term lasting or dynamic in nature, and refer to the actual conditions of the components'.

The aim was to analyse specific driving task-related factors to investigate how these type of factors affect the driver undertaking their tasks within driving. A selection of driving task-related factors were chosen and analysed using two types of analysis; by a statistical method and by an in-depth methodology developed in TRACE.

Typical characteristics of these accidents were identified, and for a number of factors, typical failure generating scenarios were also identified. From this, a list of possible countermeasures were defined with the aim of preventing such accidents occurring. These included driver education, in-vehicle technologies and design issues.

Finally, benefits and limitations of the analysis undertaken are given, with recommendation for future work on driving task-related factors.

Keyword list: driving task level, accident causation, contributing factors, attention, speed, sudden health problems, mobile phone use, sudden technical defects, dazzling sunshine, logistic regression, TRACE Work Package 5 methodology.

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1 Executive Summary

An objective of TRACE is to view accident causation from a number of different angles. In Work Package 3, different Types of Factors are identified to analyse whether they are associated with typical accidents. In Work Package 3, Task 3.1 was concerned with examining causation and risk factors that occur in accidents, and results from that task were used to define the key factors to be researched in each of the following tasks. In that way, Task 3.2 went on to examine Social and Cultural Factors, Task 3.3 examined Trip Related Factors and the current report presents findings from Task 3.4 to examine Driving Task-related Factors. A final deliverable from Work Package 3 will be the Summary Report (D3.5) making a synthesis of all four preceding tasks.

Driving task-related factors defined to be 'directly and causally contributing to the accident occurrence, very specific and detailed, are short-term lasting or dynamic in nature, and refer to the actual conditions of the components'. The aim of the analysis in Task 3.4 was to analyse specific driving task-related factors to learn further how these types of factor affect the driver undertaking their tasks within driving. Factors typical to the driving task were identified from previous research and accident studies investigated in TRACE Task 3.1. A selection of driving task-related factors were chosen, ensuring that driving task-related factors from all three components in the driving system (Human, Vehicle and Environment) were included in the analysis.

The main factors selected were:

- Attention
- Sudden health problems
- Mobile phone use
- Speed (including 'inappropriate speeding' and 'illegal speeding')
- Sudden technical defects
- Dazzling sunshine

Two main methods of analysis were used in this analysis, statistical and an in-depth case by case examination.

Firstly, the so-called 'statistical method' of analysing accidents aimed to make a comparison between accidents where the above driving task-related factors were contributory against accidents where they were not contributory. The analyses deployed bivariate and logistic regression methods. Depending on the source databases, different variables were available to the analysts. The databases used for the analysis were the ones available to the Work Package 3 partners BASt (German GIDAS), CIDAUT (Spanish DIANA), LMU (TUG/Austrian ZEDATU) and the VSRC (UK OTS). The factors 'attention', 'sudden health problems', 'mobile phone use', 'speed', 'sudden technical defects', and 'dazzling sunshine', were analysed using this method.

Secondly, the in-depth method of analysing accident cases from a human functional failure approach was deployed, as developed by Work Package 5, as introduced to TRACE within Work Package 5. In Task 5.3, typical failure generating scenarios are presented showing that combinations of conflicts, tasks and explanatory elements go along with typical functional failures and with typical accident situations. This in-depth approach gives important insight to underlying causes for accidents, and therefore solutions to drivers' needs and prevention measures. Much of this Work Package 5 methodology was already in use and developed by INRETS (French EDA-INRETS), and then applied while the methodology was applied by the VSRC for the first time using their source database (UK OTS).

The two types of statistical methodology described above were deployed to explore the data as thoroughly as possible before going on to make a comparison of explanatory variables across data available for six European countries. That comparison involved requesting accident causation data relating to each driving task-related factors from eight TRACE partners (over six countries). Those partners were able to supply data to Work Package 3 analysts via the standard Work Package 8 data

request process. For each driving task-related factor, data regarding the frequency of numerous explanatory variables regarding the accident were requested, such as road user characteristics, vehicle type, accident/impact type, location and time of day.

The results enabled, for each driving factor, a pattern of accident characteristics to be established in terms of explanatory variables, which could distinguish and therefore define types of accidents, supplemented, where possible, by the main causes of failure in the situations identified.

For analysis of the driving task-related factor 'attention', a cross-tabulation and logistic regression analysis was undertaken by CIDAUT using Spanish data from the DIANA database and an in-depth analysis using TRACE Work Package 5 methodology was undertaken by INRETS using EDA-INRETS data. In addition, aggregated data was made available from 5 European countries (6 databases).

The driving task-related factor 'attention' was found to be a complex factor which involved a variety of road users at various locations and times in a variety of situations. However, attention (or lack of) was found to have the greatest effect at non-intersections (i.e. monotonous situations), when a road user was undertaking an illegal manoeuvre or the road user's vehicle had an active safety system. It was also found that inadequate attention more often led to failures in detection (perception), although failures in diagnosis were also frequent during inattention and distraction failures frequent during distraction.

For analysis of the driving task-related factor' speed', a cross-tabulation and logistic regression analysis was undertaken by CIDAUT using the Spanish DIANA data and by TUG using the Austrian ZEDATU data. Also, a separate analysis of the contributory factors 'inappropriate speed' and 'illegal speed' was undertaken of UK OTS data by VSRC using both the method of 'statistical overview' and secondly using the TRACE Work Package 5 methodology. In addition, aggregated data was made available from European 5 countries (7 databases).

Speed, although less complex than attention, was found to be a considerable issue in many accidents across the available European data sources. Typical characteristics of speeding accidents were male drivers of cars/vans and riders of motorcycles up to the age of 45 years being most prevalent, and involving non-major roads on bends at night. However, motorcycles (of less than 6 years old) and bends were found to have the strongest link. Inappropriate speeding in particular was more likely during degraded road and weather conditions on high speed roads, and involved a greater number of failures in detection (perception) in situations where an encounter was not expected (so drivers did not search for 'danger'). Illegal speeding differed in that it occurred on low speed roads and more often involved a greater number of failures in diagnosis, in particular when correctly diagnosing the road layout (e.g. a bend).

For the analysis of the driving task-related factor 'sudden health problems' a cross-tabulation and logistic regression analysis was undertaken using German GIDAS data by BASt. In addition, aggregated data was made available from 3 European countries (3 databases).

Sudden health problems were mainly found to be a cause in accidents where the road user was over the age of 65 years, where the road user had a pre-existing medical condition, in urban locations but also on motorways during daylight conditions. Cyclists were also found to be prevalent.

For the analysis of the driving task-related factor 'sudden technical defects', a cross-tabulation and logistic regression analysis was undertaken using German GIDAS data by BASt. In addition, aggregated data was made available from 3 European countries (3 databases).

Sudden technical defects were most prevalent in male, young-middle aged truck drivers (25-44 years old) on high speed rural roads during both day and night conditions, where tyre defects were present, which resulted in the vehicle leaving the road.

For the analysis of the driving task-related factor 'dazzling sunshine', a cross-tabulation and logistic regression analysis was undertaken using German GIDAS data by BASt. In addition, aggregated data was made available from 3 European countries (4 databases).

Dazzling sun was found to most likely occur as a problem when car drivers were female (>44 years old), at an intersection with a sight obstruction and resulting in impacts with vulnerable road users.

A variety of countermeasures were recommended to prevent accidents in which these factors are contributory, including stricter enforcement of speed at 'high risk' locations and driver education to:

- increase awareness of the dangers of poor driving habits related to different types of attention;
- highlight the dangers of both illegal speeding and inappropriate speeding;
- increase awareness of the importance of regular vehicle maintenance, in particular for tyres;
- raise public awareness towards the problem to increase driver attention in these situations;
- highlight the importance of regular health checks for elderly drivers and those with relevant pre-existing medical conditions.

Prevention methods by in-vehicle active safety measures and vehicle design were also highlighted, such as Collision Warning, Collision Avoidance, Intelligent Speed Adaptation, Lane Keeping Assistance, Electronic Stability Control, Brake Assistance, ABS, Active Cruise Control, Night Vision Tyre Pressure Monitoring and Warning Systems, Other 'Vehicle Condition' warning systems, 'Anti-dazzle' on windscreens, 'Vulnerable Road Users Protection' systems.

Finally suggestion for prevention in terms of road design were also highlighted, including improved road design (i.e. 'self explaining' roads) to reduce competition for attention, clear roadside signage to warn drivers of impending bends in the road and to advise on safe travel speeds and intersections designed to improve visibility.

A number of conclusions were made about the analysis of driving task-related factors and the methods applied.

Overall, when driving task-related factors are a cause in an accidents, it appears that road users are caught by surprise by the sudden change in events and are unable to deal with the situation in hand. In most of the situations analysed, it appears to be the driving task-related factor itself that is the main factor leading to the deterioration in the situation. By preventing factors at a trip or social/cultural level, it might also be possible to prevent the factors at a driving task level.

By using the two main types of analysis in this study, it was possible to identify not only the most 'typical' characteristics of accidents where driving task-related factors are involved, but also to identify the main reasons for what went wrong in these accidents. The results of each type of analysis was found to complement the other and give a more detailed view than from just using one method alone.

The link found between factors at a driving level and other levels being investigated in Work Package 3 (trip, social/cultural) shows that it could be of future interest to take each specific driving task factor (e.g. speed) and analyse it's effects throughout all three levels investigated in this Work Package. However, for this to be possible, data harmonisation issues would have to be further overcome.

Difficulties were found in attempting to harmonise the results from the various data sources in this study. However, despite these limitations, this was successfully managed to a certain point. This has highlighted that analysing accident causation at a 'harmonised' level, especially when only aggregated data are available for use, is not always possible. However, studies that are gathering new cases, rather than retrospective data, and to a European wide protocol (e.g. SafetyNet), will overcome the harmonisation issues highlighted in this report to enable a more overall view of Europe as a whole to be achieved.

The benefits of the TRACE Work Package 5 methodology were also highlighted, in particular showing the need for a common accident causation methodology such as this, in particular for undertaking analysis of newly investigated accident cases as opposed to existing cases.

The analysis covered in this study is discussed further in TRACE Deliverable D3.5, where the analysis is brought together with the analysis of factors at a trip and social/cultural level to give an overall view of analysing accidents from a factors point of view.

2 Introduction

One of the objectives of TRACE is to try to view accident causation from three different angles. Work Package 1 focuses on different road users, WP2 on different situations and in WP3, the viewpoint is taken from the contributory factors and risk factors. Each Work Package analyses accidents from these viewpoints, with WP3 trying to gain knowledge on typical accidents or patterns of factors contributing to these typical accidents.

In WP3, different types of factors are identified to analyse whether they are associated to typical accidents. Within WP3 of the TRACE project, Task 3.1 was concerned with researching the types and frequency of causation and risk factors that occur in accidents. This Deliverable 3.4 demonstrates the work performed for Task 3.4 "driving task-associated factors". The factors analysed for this task have been chosen according to the results of Task 3.1.

Driving task-related factors were previously defined in Task 1 of WP3 (TRACE D3.1) as being 'directly and causally contributing to the accident occurrence, very specific and detailed, are short-term lasting or dynamic in nature, and refer to the actual conditions of the components'. Therefore, they may not necessarily be present throughout the whole of the trip, and when they are present, they will only affect the road user when they are undertaking a certain part of the driving task. Examples of driving task-related factors include speed, weather conditions and driver behaviour. They are often thought to be effects of the trip related factors (e.g. alcohol impairment, road geometry, vehicle maintenance – discussed further in D3.3), which are in turn often effects of the 'background factors' (i.e. pre-existing factors that are sometimes sociological such as education, income residence etc – discussed further in D3.2).

By literature review and database analysis the most relevant factors on a driving task level were identified, as outlined in D3.1.

At a HUMAN level, driving task associated factors were found to have a high prevalence in accidents or a high risk in literature included 'loss of consciousness', 'acute medical condition', 'falling asleep', 'inattention', 'distraction', 'cell phone use', 'emotion', 'careless/reckless/thoughtless', 'mood' and 'aggressive driving'.

At a VEHICLE level, the high risk and/or high frequency driving task associated factors included 'speed', 'acute technical failure' and 'tyre blow-out'.

Finally, at an ENVIRONMENT-level, the high risk and/or high frequency driving task associated factors included 'traffic density', 'traffic flow', 'slippery road conditions', 'temporary obstacles' and 'adverse weather conditions'.

Two main methods of analysis have been used in Task 3.4. The first involved the analyst using their existing database and preparing it for a statistical method to compare accidents in which certain factors contributed to their occurrence with accidents where this factor didn't contribute. The results gained from this enabled a pattern of accident characteristics in terms of explanatory variables which could distinguish and therefore define types of accidents.

The second method of analysis involved the analyst using their in-house accident cases and applying the methodology presented by Work Package 5 in the TRACE-Project, to analyse certain accidents with a certain driving task-associated factor with the human functional failure analysis leading to prototypical scenarios.

In addition to the analysis of data from databases available to WP3 partners using these two methods, data was also collated from databases from 8 TRACE partners (from 6 countries), which was made available via a WP8 data request (see D8.1 for further details of this process). By analysing the available data from this data request and supporting findings from the in-depth analysis undertaken by each WP3 partner, the aim was to go some way to giving a general European overview of the characteristics of accidents where driving task-related factors are contributory.

Separate internal sub-reports were produced by each WP3 partner involved in Task 3.4. Each report outlined the analysis (either using the statistical method or WP5 methodology) undertaken on one or two of the driving task-associated factors selected from those identified in D3.1. This report gives a detailed overview of all of the analyses undertaken using accident data from sources of in-depth databases available to each WP3 partner (either France, Great Britain, Germany, Austria or Spain), with the aim of identifying the characteristics of accidents and typical situations when certain types of driving task associated factors are present and/or are causative.

Section 3 outlines the specific driving task associated factors that were included in the analysis, along with the sources of accident data used in the analysis and finally describes the two main methods used to analyse the available accident data and also the WP8 data request process. In section 4, the results of this analysis are presented per driving task associated factor and per analysis method. Section 5 discusses the findings of the analysis and the issues associated with these results. Finally, section 6 gives conclusions for this work and an outlook for the future.

3 Material and Methods

3.1 Selected driving task-associated factors

Based on the findings of WP3 Task 1 (see D3.1), it was decided that analysis on selected driving task - elated factors from all 3 components in the driving system (Human, Vehicle, Environment) would be undertaken.

From the factors previously outlined in section 2, a number of driving task-associated factors were selected to be analysed in Task 3.4. Each WP3 analyst undertook analysis using data from their own country, these data sources being outlined in sections 3.2 and 3.3 and each analyst undertook analysis on up to two of the identified driving task associated factors, these factors being chosen by the quality and quantity of data in the respective databases.

3.1.1 Human-related factors

From the HUMAN component, the factors 'distraction' and 'inattention' were both found to be frequent contributing factors in the D3.1 work. Factors which result in acute low levels of consciousness or alertness were also found to be contributory in many accident data sources. Therefore, the factors 'attention', 'sudden health problems', and 'mobile phone use' were selected for analysis.

'Attention' refers to when the driver has declared they were distracted by undertaking another task different from the driving one and this was thought to have contributed to an accident (also see section 3.3 for further specific definitions of attention used in the WP5 methodology analysis)..

'Sudden health problems' refers to all states concerning 'sudden physical incapability' of the road user which contributed to an accident (sudden failures in health which are not expected at the start of the trip, e.g. heart attack, stroke, epileptic fit, asthma attack).

'Mobile phone use' refers to all states where the driver was speaking on the phone, handling with the communication equipment or using a hands free speaking device and it was thought to have contributed to an accident.

3.1.2 Vehicle-related factors

In D3.1, 'speed' was regarded as being a component of the vehicle, even though it is the road user that decides on the speed of the vehicle and in most European databases, 'speed' is part of the human component. Therefore, for continuity in WP3, speed will also be regarded as a component of the vehicle in Task 3.4. The factor 'speed' was found to be both a frequent contributory factor and risk factor in D3.1 and therefore speed was selected from the VEHICLE component.

As previously mentioned in D3.3 and D3.1, apart from 'speed' (which is also closely linked to the HUMAN component), pure vehicle-related factors were seen to contribute much less to accidents in the accident material provided for Task 3.1. However, to show that all three components had been considered fully in this study, it was decided that at least one pure vehicle-related factor would be included in the analysis. Therefore, from the VEHICLE component, the factor 'sudden technical defects' was also selected.

'Speed' refers to when the road user is travelling above the speed limit or special condition limit (e.g. in road works or related to vehicle type, such as mopeds or Heavy Goods Vehicles (HGVs) or when travelling too fast for the road surface conditions (e.g. wet/icy road) and it contributed to an accident.

'Sudden technical defects' refers to all states concerning the vehicle that contributed to an accident occurrence (acute failures which are not known about or expected when starting the journey, e.g. tyre-blow out, brake failure, loss of engine power).

3.1.3 Environment-related factors

It was decided that because the majority of environment-related factors which were identified in D3.1 were factors that were already being studied in TRACE Task 2.4 ('Degradation' factors such as road surface condition, weather condition, lighting conditions, obstacles in the road). Therefore, to avoid repeating the analysis being undertaken in Task 2.4 and, as with the vehicle components, to show that all three components had been considered in this study, it was decided that one environment-related factor would be included in the analysis. Therefore, from the ENVIRONMENT component, the factor 'dazzling sunshine' was selected.

'Dazzling sunshine' refers to all states concerning the environment that contributed to an accident occurrence (when the road user's visibility of the road ahead is affected by, for example, low sun, sun reflection, sun glare on wet road).

3.2 'Statistical method' and databases used

The aim of using a 'statistical method' of analysing accidents was to enable a comparison to be undertaken of accidents where the above driving task-related factors were contributory with accidents where they were not. In other words, do the characteristics of accidents differ when these contributory factors are present compared with when they are not?

These differences can be described by explanatory variables which comprise of road user characteristics and their participation in traffic, crash types, vehicle characteristics, manoeuvres, situations, locations, times, scenarios, and other characteristics describing or being connected to an accident.

Initially, for each source database used in this study and each factor analysed, two samples of cases were identified. The first sample comprised of cases where the factor was recorded as being contributory to the accident. The second sample comprised of cases where the factors were not recorded as being contributory.

The two samples of accidents are then compared with the help of explanatory variables (e.g. by cross-tabulation) to see if noticeable associations exist between a contributory factor and an explanatory variable. The selection of explanatory variables were in the first instance decided either by method of 'mutual information' (i.e. common variables between source databases) or where this was not possible, by the limited number of available variables in a data source, or by expert knowledge.

From this initial analysis, the explanatory variables which showed associations and were not in correlation with each other (inter-correlation of explanatory variables) were further analysed using a logistic regression model.

The remaining variables in this logistical regression analysis for accidents with the contributing factor of interest compared to accidents without this contributing factor, describe a certain pattern that goes along with this type of accident, but not for accidents, where this factor was not contributing.

Depending on the source databases, different variables were available for analysis for each analyst.

The databases used for the analysis are the ones available to the WP3 partners BASt (GIDAS), CIDAUT (DIANA), LMU (ZEDATU, via sub-contractor TUG) and the VSRC (OTS):

- The analysis of BASt comprised the factors 'sudden health problems', 'mobile phone use', 'sudden technical defects' and 'dazzling sunshine'.
- The analysis of CIDAUT comprised the factors 'attention' and 'speed'.

- The analysis of LMU (TUG) comprised the factor 'speed'.
- The analysis of VSRC remained at a cross-tab level and comprised the factors 'inappropriate speeding' and 'illegal speeding'. The majority of VSRC's analysis involved using the WP5 methodology.

3.3 TRACE WP5 methodology and databases used

The method introduced by WP5 is an in-depth method of analysing cases from a human functional failure approach. In Task 5.3 typical failure generating scenarios are presented showing that combinations of conflicts, tasks and explanatory elements go along with typical functional failures and with typical accident situations. This in-depth approach gives important insight to underlying causes for accidents, and therefore answers to drivers' needs and prevention measures.

Human functional failures can happen due to psycho-physiological and cognitive restrictions on the stages perception, diagnosis, prognosis, decision and execution of an action or on an overall level.

This analysis was in use by INRETS, and contributed to the analysis of the driving task-related factor 'attention'. 'Attention' refers to all states (not actual and dynamic conditions) concerning the human's level of focus of their mind on a task that contributed to an accident occurrence. Three main types of attention are defined in INRETS' study: inattention (e.g. being 'lost in thought'), distraction (focusing on a task not linked to the driving task, e.g. using mobile phone) and competition for attention (focusing on one part of driving task, e.g. searching for road signs). Attention is distinctly different from vigilance, which is investigated in D3.3, because vigilance is defined as the psychophysiological support behind attention (e.g. sleep/arousal disorders, fatigue, monotonous/stressful driving situations, driving time). It is possible for someone to be vigilant but not attentive. The cases in the in-depth analysis of EDA cases using WP5 methodology included at least one of the following attention-related elements as a cause:

- Low level of attention (allocating attention resources to the general driving task),
- Internal distraction (internal thoughts),
- Driving in "automatic" mode: low level of attention related to a long experience with the itinerary and/or its monotony,
- Driving in "automatic" mode: low level of attention related to a long experience with the manoeuvre,
- External distraction (external to the driver: inside or outside the vehicle),
- Performing a side task with no direct link to driving,
- Directional problem (navigation),
- Identifying a potential risk in a certain component of the situation = focus.

The WP5 methodology was applied by the VSRC for the first time using their source database (OTS). The factors 'inappropriate speeding' and 'illegal speeding' were analysed. However, due to the in-depth recoding that was required, it was only possible to undertake this analysis on a sample of approximately 20 cases for each driving task-associated factor.

'Inappropriate speeding' was defined as when the road user was travelling too fast for the road surface conditions (e.g. wet/icy road) and it contributed to the accident.

'Illegal speeding' was defined as when the road user was travelling above the speed limit or special condition limit (e.g. in road works or related to vehicle type, such as mopeds or HGVs) and it was contributory (whether or not it was also 'inappropriate').

3.4 WP8 data request

The data request to WP8 aimed at screening for certain associations between contributing factors and explanatory variables. Therefore cross tabulations of the selected contributing factors with a selection of explanatory variables with suggested parameter values was requested.

Requests for data were only made to data providers (i.e. TRACE partners) who were able to provide at least a small number of the suggested contributory factors and those who were able to perform this cross tabulation on a database structure level where only one participant (in one vehicle) for one factor in one accident can be selected per accident without major effort in database preparation. According to the WP3 point of view the data request was not restricted to certain road users or situations, further the data was taken from accidents occurring in 2004, where possible.

The selected contributing factors were "attention", "sudden health problems", "speed", "sudden technical defects", and "dazzling sunshine" from the driving task level.

The selected explanatory variables and the suggested parameter values were as follows:

a) person characteristics:

- Gender (male/female)
- Age group (<25/25-44/45-64/>65)
- occupation (worker, employee/student/pensioner/unemployed/other)

b) traffic participation

- Vehicle group (Car, Van <3.5t/truck >3.5t/PTW/pedestrian/bicycle/Other)

c) accident characteristics

- impact type multiple vehicle collision (frontal/side/rear/Other)
- crash type single vehicle (running off the road/hitting object (immobile)/hitting object (mobile -e.g. animal)/rollover)
- manoeuvre (going straight/overtaking/turning/crossing/merging/other)

d) site characteristics

- Location (Rural/Urban)
- Road type (Autobahn, National road/Country road/Other roads)
- Speed limit zone (<50/50-100/>100 km/h)

e) time characteristics

- light conditions (dark/dusk, dawn/day)
- time of day (0-7:59/8-15:59/16-23:59)

The method of the data request is comparable to the first step of the statistical method applied by the WP3 Partners except that the explanatory variables are not selected by statistical methods or expert knowledge, but are requested.

For harmonization reasons only these variables were requested, as it was possible for most databases to be able to provide this information. Due to the restriction to aggregated data the cross-tabs request was requested on the first stage comparable to the in-depth request performed by the WP3 Partners in the induced exposure mode, but it was not possible to request logistic regression or case analysis.

Where possible, data was made available from the following countries/TRACE partners (see TRACE D8.1 for further details):

- Czech Republic (national –" Czech National Road Accidents Database" provided by CDV),
- France (in-depth – “EDA-INRETS” data provided by INRETS and LAB data by LAB),
- Germany (national – “OGPAS” data provided by BASt;, in-depth – "GIDAS" data by MUH),
- United Kingdom (in-depth – "OTS" data provided by VSRC),
- Italy (in-depth - “SISS” data provided by ELASIS),
- Spain (in-depth – "DIANA" data provided by CIDAUT).

4 Analysis of Driving Task Associated Factors

This section overviews the main results and provides discussion and overall conclusions of the in-depth analysis undertaken on the six driving task associated factors outlined in the previous section.

4.1 Attention

Accident data where attention was recorded as being contributory was made available from two countries, from Spain (CIDAUT) and from France (INRETS). A cross-tabulation and logistic regression analysis was undertaken using all car accidents from the Spanish data source where attention was a causation factor. Using the French data source, an in-depth analysis using TRACE WP5 methodology was undertaken on all cases where attention was contributory to identity the typical failure generating scenarios in accidents. In addition, results from the bivariate analysis of the requested data via WP8 is also given.

4.1.1 Results of WP3 partners' analysis of the contributing factor 'attention'

4.1.1.1 Spain (CIDAUT)

From the sample of 250 drivers involved in 154 accidents in the available Spanish DIANA database, **attention** was a contributory factor for 66 of the drivers. From the results of the cross-tabulation analysis, which aimed to identity explanatory variables which were 'significantly' more likely to be present when the contributory factors 'attention' was present, two explanatory variables were identified, these being:

- **Manoeuvre.** In the relation between manoeuvre and attention, the category "driver was committing an infraction" is the one more associated with the presence of attention as a contributing factor.
- **Active safety system.** In the relation between active safety system and attention, the category "active safety system" is the one more associated with the presence of attention as a contributing factor.

There were 17 variables where a 'significant' link with the factor 'attention' was not found (i.e. $p>0.05$), which were 'intersection', 'traffic density', 'age', 'gender', 'nationality', 'driver type', 'employment', 'vehicle type', 'vehicle colour', 'vehicle age', 'vehicle power', 'day of week', 'time of accident', 'road alignment', 'road type', 'luminosity' and 'speed limit'.

The results of this analysis outlines the relationship between each explanatory variable and the contributing factor (in this case, attention), without considering interactions between explanatory variables, which are necessary to reach a fit model. That is the reason why in the following **logistic regression analysis** every explanatory variable is included.

In addition to the two explanatory variables which showed a relationship with the factor 'attention' in the cross-tabulation results (manoeuvre and active safety system) the variable 'intersection' was also included in the logistic regression model, mainly owing to its close links with these two variables.

The way these 3 variables are related to accidents where attention is contributory is in the following way:

- **Intersection.** The category "absence of intersection" is the one most associated one with the presence of attention as a contributing factor.
- **Manoeuvre.** The category "driver was committing an infraction" is the one most associated with the presence of attention as a contributing factor.
- **Active safety system.** The category "vehicle with active safety system" is the one most associated with the presence of attention as a contributing factor.

With regards to the significant result found when active safety systems are present, this result should be considered cautiously, taking into account that active safety systems were created to prevent accidents and it was not possible to compare the results found here with the number of accidents these systems avoid, as data could not be sourced.

4.1.1.2 France (INRETS)

Within the French EDA data, 443 drivers who were involved in accidents had attention-related problems. These drivers had at least one of the 8 explanatory elements related to attention which were divided into 3 categories as previously outlined in section 3.3, these being inattention, distraction, and competition for attention.

While 64.6% of the failures related to a vigilance problem occurring when the driving task is limited to guiding the vehicle along the carriageway (cf. TRACE report D3.3), attention failures were found to be evenly divided between stabilised situations (driving on a straight road, going around a bend) and in intersections and when performing a manoeuvre (changing directions or overtaking). Moreover, these accidents occurred equally in the countryside and in urban areas.

Figure 4-1 shows the distribution of failure categories among drivers with attention problems.

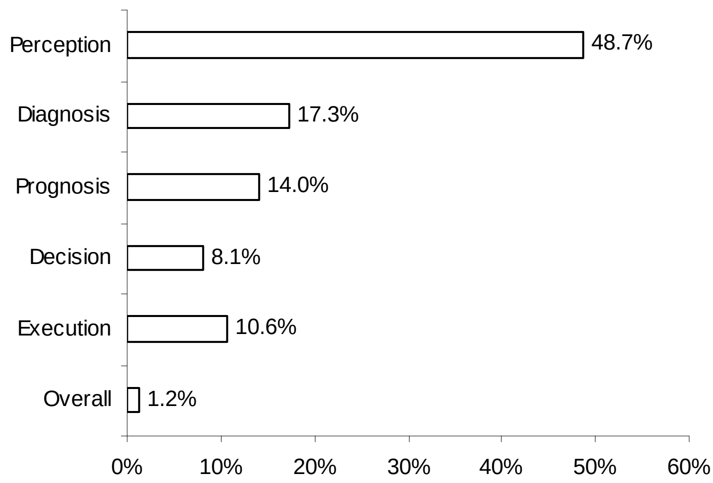

Figure 4-1 Distribution of failure categories for drivers with attention problems (n=443 involved*)*

Grouping accidents together by categories of failures induced by attention problems shows a very high proportion of perception (detection) failures (48.7%), but also a large proportion of failures in the processing stages (diagnosis and prognosis) (31.3% in total)..

A more detailed analysis shows that 3 main perception failures affect nearly 40% of the sample:

- **P2: Focalised acquisition of information** (17.3%)
- **P3: Cursory information acquisition** (11.4%)
- **P5: Neglecting information acquisition demands** (9.6%)

Also observed were failures at the information processing stage:

- **T1: Incorrect evaluation of a road difficulty** (8.1%)

Attention problems among drivers may also be at the origin of failures in the motor command execution stages:

- **E2: Guidance problems** (6.6%)

The most common elements for explaining failures are elements of inattention and, to a lesser degree, elements of distraction and competition for attention.

Among the 443 drivers with attention problems, some only had problems of inattention, competition for attention, or distraction, while others had a combination of these attention problems.

4.1.1.2.1 Inattention

Inattention is in question in 79.4% of the cases in our attention sample, accounting for 28.3% of the detailed database of 1,244 drivers. In 17.4% of cases, inattention is accompanied by a problem of distraction or competition for attention, but in 62% of cases, inattention alone is in question.

It was found that the failures related to driver inattention occur in a wide variety of driving situations, from the most simple (e.g. guiding the vehicle along a straight road or bend) to the most complex (e.g. crossing intersections).

Many of the failures caused by driver inattention were related to the detection or perception of another vehicle or road user. The most frequent 3 failures, which were each involved in more than 10% of the cases in the sample, were:

- P3 failure (14.4%), observed in cases where information acquisition is cursory and/or hasty.
- P5 failure (13.1%) typically appears when drivers are "thinking about something else".
- T1 failure (11.5%) corresponds to a poor evaluation of a temporary difficulty relative to infrastructure.

Typical scenarios

The most frequent prototypical scenario for P3 failures was found to be P3b "Cursory search for information when crossing an intersection" (54.4% of P3 failures).

The most frequent prototypical scenarios for P5 failures were found to be P5a "Late detection of the vehicle ahead slowing down" (50.7% of P5 failures) and P5b "Late detection of a user without right-of-way entering an intersection" (40.7% of P5 failures).

The most frequent prototypical scenario for a T1 failure was found to be T1b "Underestimating the difficulty of known bend" (61.9% of T1 failures).

4.1.1.2.2 Competition for Attention

Competition for attention deals with a competition for attention resources between several sources of information relevant to the driving task.

The failures among drivers in competition for attention were found to mainly manifest themselves in complex situations such as: changing directions with interference by another vehicle on the road (20%), crossing an intersection without right-of-way with interference by another vehicle on a road with right-of-way (19.1%) or approaching an intersection without right-of-way (10.6%).

In nearly 80% of cases, competition for attention leads to the appearance of perceptive failures. One specific perceptive failure affected more than two-thirds of the "competition for attention" sample (71.8%), this being P2: "Focalised acquisition of information". This refers to the focusing of the driver's attention on a partial aspect of the situation to the detriment of other relevant information.

Typical scenarios

3 prototypical accident scenarios for P2 failures emerged:

- P2d Focalisation on an identified source of danger (30.2%)
- P2c Focalisation on a source of information regarding the high level of traffic flow (26.6%)
- P2a Focalisation on a directional problem (22.6%)

4.1.1.2.3 Distraction

The failures related to a distraction problem mainly occur in stabilised traffic situations (72.9%) and principally on straight roads with no other demands than guiding the vehicle (31.3%). On the other hand, they are less common when crossing an intersection (9.5%) or when performing a specific manoeuvre (e.g. changing directions (11.1%) or overtaking (6.7%)). Thus, simple driving situations allow drivers to become distracted and/or to perform another task at the same time. Under these conditions, the distracted driver may lose control of his vehicle or may not detect an interfering vehicle.

The study of failure categories shows that distracted drivers mainly have perceptive failures (45.1%) or failures in the execution of their action (31%).

An in-depth analysis of this sample shows that the E2 failure, "guidance problem" (28.3%) and P4 failure "temporary interruption in information acquisition" (24.6%) make up the majority of failures whose occurrence can be explained by driver distraction.

Typical scenarios

The most frequent prototypical scenario for E2 failures was found to be E2a "Interruption of guidance after turning attention toward a side task" (84.3% of E2 failures).

The most frequent prototypical scenario for P4 failures was found to be P4a "Non-detection of approaching the vehicle ahead" (66.4% of P4 failures)

4.1.2 Results of in-depth data request to all TRACE data providers

From the WP8 data request to TRACE partners, Table 4-1 shows the statistically significant results for the types of characteristics more likely when attention was a contributory factor. As can be seen from this table, 6 partners in TRACE were able to provide data for attention-related accidents, from 5 European countries.

Significant parameters for attention	Czech national	GIDAS (Germany in-depth)	OTS (GB in-depth)	INRETS (France in-depth)	LAB (France in-depth)	CIDAUT (Spain in-depth)
Female ↑	Czech		OTS			
Male ↑					LAB	
<25 ↑			OTS			
45-64 ↑	Czech	GIDAS				CIDAUT
Bicycle ↑	Czech					
Pedestrian ↑		GIDAS	OTS			
Car, Van, <3.5t ↑						CIDAUT
Frontal ↑		GIDAS	OTS			
Frontal ↓						CIDAUT
Rear ↓				INRETS		
Other impact type↑	Czech					
running off the road ↑		GIDAS				
hitting object (immobile) ↑	Czech					
going straight ↑			OTS			CIDAUT
crossing ↑		GIDAS				
overtaking ↓					LAB	
Rural ↑	Czech					
Urban ↑			OTS			
Autobahn, National road ↑	Czech		OTS			
Country road ↓		GIDAS				
<50 ↑		GIDAS				
50-100 km/h ↓			OTS			
>100 ↑						CIDAUT
Dark ↑	Czech				LAB	CIDAUT
Dark ↓		GIDAS				
Day ↑			OTS			
0-7:59 ↑	Czech					
8-15:59 ↑		GIDAS				

Table 4-1 Results from the data request 3B calculations - parameter values showing associations for attention related accidents (not multivariate)

What Table 4-1 shows is that the road user who was inattentive in the accident was found to be more often female in the Czech and GB data, but was more often male in the French data.

In terms of age, the GB data found that the road user was more likely to be less than 25 years old, whereas in the Czech, German and Spanish databases, the age of the road user was more likely to be between 45 and 64 years old.

In the Czech data, the inattentive road user was more likely to be a cyclist, in Germany and GB a pedestrian, and in Spain, a car or a small goods vehicle.

In terms of impact type, frontal impacts were more likely in Germany and GB, but were less likely in the Spanish data. Rear impacts were less likely in the French data.

In terms of accident type, the vehicle of the inattentive road user was more likely to run off the road in the German data, whereas in the Czech data, the vehicle was more likely to hit an immobile object.

Compared with other manoeuvres, the vehicle was more likely to be going straight ahead in the GB and Spanish data, more likely to be crossing an intersection in the German data and less likely to be overtaking in the French data.

In terms of the accident location, major rural roads were more prevalent in the Czech data, whereas major urban roads were more prevalent in the GB data. Less major roads were less prevalent in the German data.

Accidents involving a problem with attention were found to be more likely on lower speed roads in Germany, but on high speed roads in Spain. Mid-speed roads were less likely in GB.

Accidents at night were more likely in the Czech (0000-0800), French and Spanish data, but less likely in the German results, where accidents between the hours of 0800-1500 were more likely. Daytime accidents were more likely in GB.

4.1.3 Summary, Discussion and Conclusions of the Analysis of the Factor 'Attention'

In this accident analysis, attention as a contributing factor referred to all states concerning the road user's level of focus of their mind on a task that contributed to an accident occurrence.

As outlined in the previous section, an in-depth analysis using the method of logistic regression was undertaken by the WP3 partner CIDAUT using Spanish data (DIANA). The results revealed that when attention was contributory, the accident was also more likely to involve an 'infraction' (i.e. illegal manoeuvre) and/or not occur at an intersection. This implies that road users are less attentive when not at in intersection, which could be expected, as negotiating an intersection involves a higher level of thinking than just driving along a road. This also implies that road users are also less attentive when undertaking a manoeuvre which contravenes the rules of the road. On one hand this is somewhat worrying because it suggests that road users are undertaking an illegal (and possibly risky) manoeuvre without thinking about it. However, it also suggests that road users are undertaking the illegal manoeuvre due to the lack of attention, in particular if it involves running a red traffic light or overshooting a junction.

Interestingly, from the analysis of 'attention'-related accidents undertaken by CIDAUT, as well as the explanatory variables 'not at intersection' and 'illegal manoeuvre', the presence of active safety systems was also found to be present significantly more often than when attention was not a factor. It was not possible to identify the specific type of active safety systems present in the vehicles in these accidents and therefore it was difficult to suggest reasons for this result. One possibility could be that the type of active safety system involved may only assist the road user in undertaking their manoeuvre. Therefore, if the road user's level of attention is already low, then over-expectancies of how the safety system will assist them when needed. Therefore, this means the road user becomes even less attentive than they usually would be, because they are relying on the active safety system too much. Therefore, when faced with a possible accident situation, even with the presence of the safety system, they are still unable to avoid a collision. This highlights that, until safety systems are fully automated, the level of attention of the road user is still just as important in terms of road safety as it would be if active safety system were not present at all.

The analysis of French EDA data by INRETS using the TRACE WP5 human factors methodology revealed that a low level of attention leads to the production of perceptive failures which can occur in many different driving situations, from the simplest (driving along a straightaway) to the most complex (intersections). In particular, failures related to the 'focalised acquisition of information' were most prevalent. Unlike Vigilance (TRACE D3.3), for which relative elements alone often suffice to explain the failure, attention problems are often accompanied by other non-attention explanatory elements related to external events (other users, traffic condition, vehicle) or internal conditions in performing the task (risky behaviour, excessive speed). On average, 3.54 explanatory elements are needed to explain failures. It should be pointed out that an insufficient level of attention or attention divided among several tasks leads to a failure in driving situations when really, the attention effort should be enhanced.

<u>Problems of inattention</u> were by far the most common. These problems may be directly at the origin of the accident, but in many cases they are combined with another attention problem (competition for attention or distraction). Looking at the analyses, it appears that a driver's inattention makes them more vulnerable to the occurrence of failures which are characteristic of distraction or competition for attention problems. Thus, inattention makes drivers sensitive to external distractions. Likewise, an inattentive driver will have difficulties when encountering complex driving situations which can cause an overload of the information processing system.

Typically, inattention causes perception failures, and 3 prototypical scenarios were found to be most frequent for these failures:

"Cursory search for information when crossing an intersection" (P3B) - In these scenarios, the driver's failure when seeking information can be explained by habitually making the manoeuvre that leads to a reduction of attention resources allocated to the task, combined with a particular traffic or infrastructure element.

"Late detection of the vehicle ahead slowing down" (P5A) - In these scenarios, the driver's inattention, whatever the reason (personal or professional concerns), is such that he is unable to detect an event occurring directly in his field of vision, this late detection of the difficulty making the situation irretrievable.

"Late detection of a user without right-of-way entering an intersection" (P5B) – Here, the extra driving experience combined with good knowledge of the location (some drive this itinerary every day) and a strong feeling of having the right-of-way cause a major decrease in the attention applied to the driving task and the inability to detect a possible disturbance.

In summary, these perception failures keep drivers from detecting interference due to excessive summary and/or hasty information gathering, or simply because the level of attention is so low that it does not make it possible to process visual information even if it is located directly in the field of vision. In other words, accidents related to inattention problems illustrate the consequences of some of the effects largely described in the literature under the term "driving without attention mode" and cover some of the "looked but failed to see" accidents.

Furthermore, it is interesting to observe here that, beyond the perception problems posed by a lack of attention, inattention also explains the occurrence of diagnosis failures (T1), the most frequent prototypical scenario being **"Underestimating the difficulty of known bend" (T1B).** In this scenario, the road users drive this route, which they know very well (home-work, daily professional travel) in automatic mode and without really paying attention to what they are doing. But on the day of the accident, for various reasons (concerns, irritation, in a hurry to get home at the end of the day, etc.), they drive faster than usual or do not adjust their speed to a new traffic situation (wet carriageway, lighter trailer load than usual). Thus, they are surprised by a difficulty and lose control.

This point nicely illustrates the fact that a sufficient level of attention is required for all functional steps.

<u>Problems of competition for attention</u> were by far the most complex. Of course, competition between two driving tasks most commonly leads to perceptive failures, but this failure is just the result of a failure at a higher level leading to a focusing of information gathering. Indeed, when the driver is

confronted with a complex situation (intersection, dense or rapid traffic) and also has to orient himself, a large amount of information must be processed. The driver's experience will then condition information gathering, focusing attention on certain components of the situation while neglecting other information. This negligence can then lead to a poor interpretation of the situation and erroneous decision-making. The failure in this case is indeed a perceptive failure, since the person involved does not detect the other user who interferes with him, but this failure originates in system overload and a poor information-seeking strategy.

Three prototypical accident scenarios for P2 failures emerged:

- P2d Focalisation on an identified source of danger (30.2%)
- P2c Focalisation on a source of information regarding the high level of traffic flow (26.6%)
- P2a Focalisation on a directional problem (22.6%)

Distraction was the least common attention problem in this sample, but appears to have more serious repercussions than in accidents related to the other attention problems[1]. Two main prototypical scenarios were identified from the analysis, both typical of distraction problems:

"Interruption of guidance after turning attention toward a side task" (E2A)

"Non-detection of approaching the vehicle ahead" (P4A)

Distraction problems mainly cause failures in execution; they are moreover the only attention problems which cause this type of failure in such a large proportion. On a known and/or monotonous itinerary, drivers tend to give in to distractions or to performing other tasks which entail abandoning the visual scene, often taking at least one hand off the steering wheel.

In non-urban areas, distraction is usually caused by an event or a discussion with a passenger in the car. The momentary interruption of vehicle guiding leads to a drift by the vehicle which is usually perceived too late. A recovery manoeuvre is then impossible or poorly adapted to the situation. These accidents are often serious because it is not possible to adapt speed before the distraction. Moreover, it appears that inattention encourages driver distraction. The failure in execution is accompanied by a perceptive failure in 86% of the cases.

In urban areas, the profusion of available information is such that the driver takes his eye off the road scene to focus his attention on an event or piece of information outside the vehicle. The driver is no longer able to detect the slowdown of the vehicles ahead of him. When the driver becomes aware of the situation, it is too late to avoid collision.

Attention problems in traffic accidents are closely linked to the notion of driving experience. It appears quite clearly in the results and in the literature (see Bailly and Chapon, 2006) that inexperienced drivers are more sensitive to the phenomenon of competition for attention and distraction, as many driving tasks are not yet automatic and their perceptive strategy is not yet fully in place. Driving experience makes it possible to liberate attention resources by making certain tasks automatic and also conditioning the visual search effectively in relation to the experience of the situation. On the other hand, we can see that too much experience in driving over an itinerary or of a manoeuvre can also lead to attention problems by encouraging the driver's introspection and the diversion of attention resources from the driving scene (i.e. inattention).

Attention problems in accident studies are diverse and it is important to consider them in their many aspects to define their characteristics precisely (pre-accident situations, functional failures, related

[1] As a comparison in the sample:

Distraction: 204 people are involved in these accidents, including: 3.4% killed, 8.8% seriously injured, 42.6% slightly injured and 45.1% unharmed.

Inattention: 753 people are involved in these accidents, including: 1.4% killed, 6.7% seriously injured, 34.8% slightly injured and 56.9% unharmed.

Competition for attention overall concerns 99 drivers at the origin of accidents. A total of 266 people were involved in these accidents, including: 0.4% killed, 11.2% seriously injured, 31.2% slightly injured and 57.1% unharmed.

factors, risk populations, etc.) for each attention problem. This study once again demonstrates the importance of not confusing vigilance problems and attention problems at the wheel, which clearly present very different accident features.

Table 4-2 gives an overview of the results obtained by the two WP3 partners who analysed the causation factor 'Attention' using their own database. In addition, suggestions for potential solutions based on the findings are also given.

Factor	Partner	Method	Main question	Result	Potential Solution
Attention	INRETS (France)	WP5 methodology	▪ Defining operationally the notion of Attention ▪ Understanding the different facets of the corresponding driving problems ▪ Attention problems in accident studies are diverse (Inattention, Competition for attention, Distraction) and are considered here in their many aspects to define their characteristics precisely	▪ Attention problems contribute to the production of 61% of the accidents studied ▪ The perception step is the most vulnerable to attention problems which directly or indirectly contributes to the breakdown of the situation. ▪ Inattention and competition for attention altered perception step but for different reasons. Distraction induces mainly execution and perception defaults. ▪ Attentional failure, contexts and factors that pre-condition the accident are determinant to identify adequate scenarios.	▪ The results can be used to identity the type of safety systems which focus on drivers' specific needs and the safety benefits of those systems in terms of preventing problems in attention ▪ Focussing on the right population and conditions of accidents according to the specific attention difficulties highlighted in the results is important to identify adequate countermeasures (e.g. collision warning, driver assistance systems)
Attention	CIDAUT (Spain)	Crosstabs & logistic regression	▪ Environmental and other characteristics associated with 'attention'-related accidents	▪ 'Not at intersection' ▪ Driver committing an 'infraction' (i.e. illegal manoeuvre) ▪ Presence of active safety system	▪ Driver education for greater awareness of the dangers of poor driving habits related to attention, in particular in monotonous and dangerous situations (which may lead to unintentional illegal manoeuvres) ▪ Caution should be noted about the potential for increased distraction, information overload (competition for attention) and overreliance on technologies

Table 4-2 HUMAN Driving Task-Related Factor: Attention

In addition to this analysis undertaken by WP3 partners, the bivariate analysis undertaken of the data from 8 databases (6 countries) supplied from the WP8 data request revealed a variation in statistically significant results across the various countries and databases. However, links with the results of the in-depth analysis undertaken by the WP3 partners CIDUAUT and INRETS were also found.

The results implied that road users involved in accidents where attention-related problems were contributory vary in their gender and their age, although elderly drivers (>64 years) were found not to be significantly involved. These results are similar to those found in the analysis undertaken by

INRETS. In terms of the type of road user, all types apart from motorcyclists and the drivers of large or heavy goods vehicles were found to be significantly more often in 'attention' accidents.

In terms of the 'mechanics' of the accident, the vehicle was found to be more often going straight ahead or crossing an intersection, but less likely to be overtaking, more often resulting in either the vehicle running off the road or impacting an immobile object. The results of the in-depth analysis undertaken by CIDAUT using Spanish data found attention-related accidents to occur significantly more often when the driver was 'going ahead' (i.e. not at an intersection), but in addition, also found that drivers 'committing an infraction' ('illegal' manoeuvres not further specified in the analysis) were significantly related to these type of accidents. In the bivariate analysis, impacts to the front of the vehicle were the only impact type found to be significantly related to attention-related accidents.

The accident itself occurred more often on both rural and urban roads, and were generally more often major roads. The cases included in the INRETS in-depth analysis were also found to be a mix of rural and urban locations. Both low and high speed roads were found to be more prevalent. Accidents in darkness, in particular between midnight and 8am, were more prevalent, as were daytime accidents, in particular between 8am and 3pm. Daytime accidents were also more frequent in their in-depth analysis.

From all the analysis undertaken, a number of main conclusions can be drawn out:

- Overall, type of road user, road environment and characteristics in attention-related accidents were found to vary greatly, implying accidents involving problems with attention are no more likely in one driving situation than another and not one type of road user appears to be more vulnerable to attention-related problems than another.
- The results further implied that drivers' attention on the road is reduced in monotonous situations. It also implies that inattention leads to a greater likelihood of a driver undertaking an illegal manoeuvre. Most interesting, the results also suggest that the presence of active safety systems can affect the driver's level of attention, increasing the likelihood of an accident. However, without further information of the type of active safety systems in these accidents, it is difficult to discuss in any detail this result.
- It was shown that attention is a complex problem that can lead to many different failures in the road user's functioning. However, failures in perception were most prevalent, but by examining inattention, competition for attention and distraction separately, a variation in the type of specific scenarios where each of these attention factors were involved could be identified.
- In order to provide potential solutions to attention-related accidents, each specific type of attention needs to be considered separately. Educating drivers on the complexities of attention related problems would be one benefit, but also supporting drivers with systems to overcome attention issues (without creating new issues) may also help. For example, where there is a risk of different parts of the driving task being in competition for the driver's attention, in-vehicle automated systems could take over some tasks, leaving the driver to concentrate on the main driving task.

4.2 Sudden health problems

Accident data where 'sudden health problems' was recorded as being contributory was made available from Germany (BASt). A cross-tabulation and logistic regression analysis was undertaken using all car accidents from the German data source where 'sudden health problems' was a causation factor. In addition, results from the bivariate analysis of the requested data via WP8 is also given.

4.2.1 Results of WP3 partners' analysis of the contributing factor 'sudden health problems'

4.2.1.1 Germany (BASt)

The factor 'sudden health problems' was analysed statistically using available cases from the German in-depth data source 'GIDAS'. All accidents where 'sudden physical incapability' is specified are considered as accidents where the factor sudden health problems was present. From the 6621 passenger car accidents in the GIDAS database from 1999-2005, 119 accidents were found to have had 'sudden health problems' as a contributory factor.

For a number of explanatory variables, a 'mutual information' and bivariate analysis was undertaken to identity specific explanatory variables which are statistically more frequent in accidents involving sudden health problems than others.

MI-values for the factor sudden health problems for some explanatory variables are shown in Figure 4-2. Only variables with a value higher than 2% are included, which are possible interesting candidates for further analysis.

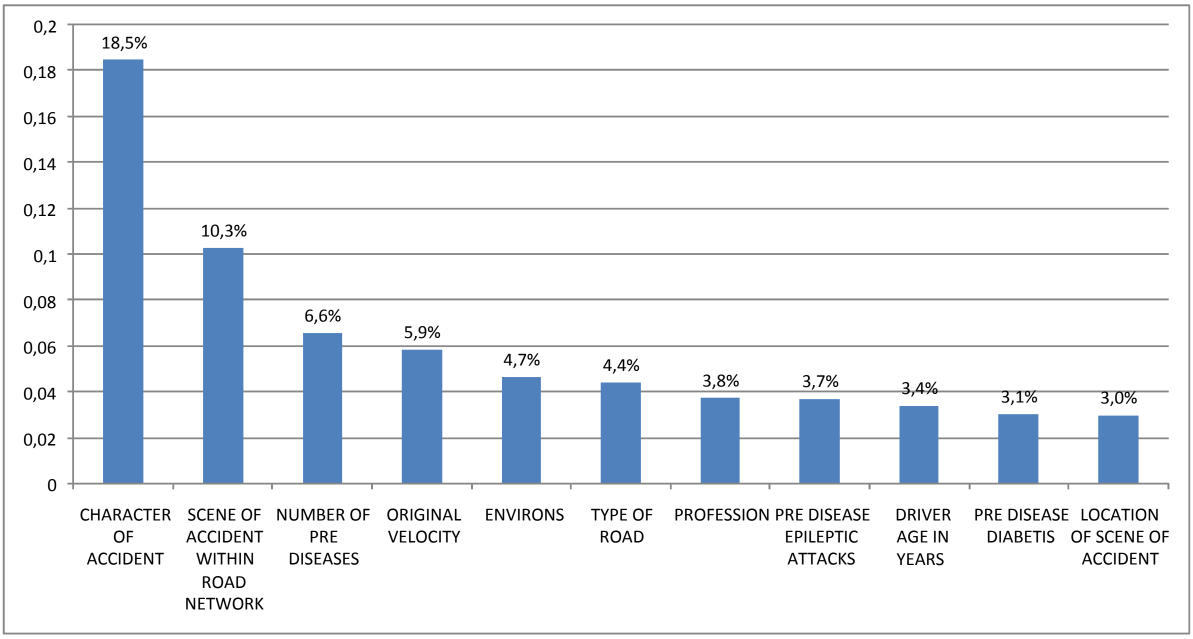

Figure 4-2 Results from mutual information analysis for the factor sudden health problems

The explanatory variable with the highest value is 'character of accident' (18.5%). 'Leaving the road' accidents are highly overrepresented in the group of accidents where the factor 'sudden health problems' was involved whereas collisions with crossing or turning vehicles are underrepresented.

The results correlate with the results provided by analysis of the variables 'scene of accident within road network', which also has a high MI-value. The results revealed that accidents related to sudden health problems mainly happened at straight parts and not at traffic nodes.

Accidents where sudden health problems were a contributing factor mainly happen at high original vehicle velocities (higher than 60 km/h). Low velocities (lower 30 km/h) are underrepresented in accidents related to sudden health problems. A reason could be that in low speed situations the driver experience an acute health problem can still manage to stop his vehicle without causing a serious accident.

The distribution of the next variable 'type of road' could be directly related to this speed issue. Federal motorways (Autobahn) were found to be highly overrepresented in accidents related to sudden health problems while urban roads are significantly underrepresented.

The results of the variable 'location of scene of accident' further confirm this result. Accidents where the factor 'sudden health problems' was involved happen mostly outside built-up areas. Trees, field, sound barriers and other undeveloped surroundings are overrepresented in accidents related to sudden health problems while city surroundings are significantly underrepresented.

Also some variables of the human component are significantly different between accidents where the factor 'sudden health problems' was contributory and accidents where it was not involved. As expected, the age groups above 65 years are significantly overrepresented in accidents related to sudden health problems.

These findings correlate with the results provided by bivariate analysis of the variable profession, which shows that pensioners are significantly overrepresented in accidents related to health problems. A reason might be that elderly people in general have more health related problems than younger people.

A correlation between number of pre-diseases and the accident factor 'sudden health problems' was also found. People with 2 or more pre-diseases were significantly overrepresented in accidents where sudden health problems were a factor.

The pre-disease 'epileptic attacks' is overrepresented in the accidents related to sudden health problems. The same is true for the pre-disease diabetes.

Table 4-3 shows the final selection of explanatory variables. Some categories were aggregated to reduce the complexity of the logistic regression model. The variable profession was not used in the model as the information is already included in the variable age. Also the variable environs was not included in the model as it correlates with location of accident.

Variable	Aggregated category 1	Aggregated category 2	Aggregated category 3
Character of accident	Leaving road	Crossing or turning	Others
Number of pre-diseases	0	>0	-
Original velocity	<= 60 km/h	>60 km/h	-
Type of road	Federal motorways	Urban roads	Others
Age	<= 65 years	> 65 years	-
Location	Urban	Rural	-

Table 4-3 Final Selection of explanatory variables for logistic regression analysis of factor sudden health problems.

Results of logistic regression analysis

Table 4-4 shows the results of the logistic regression analysis. Most results show a significant p-value on 5%-level. Also most findings from bivariate analysis are confirmed by logistic regression analysis.

The results of the variable character of accident confirms on highly significant level that 'leaving road' accidents are significantly overrepresented in accidents where the factor 'sudden health problems' was involved. Delogarithmization of the model using the estimate of 2.20 indicates that 'leaving road accidents' are highly overrepresented by a factor of almost 9 in health related accidents compared to the reference group, which are other kinds of accidents according to Table 4-3. However, crossing or turning accidents do not give results on significant level in the logistic regression analysis.

The increased number of pre-diseases found in bivariate analysis is confirmed by logistic regression analysis as accidents with no pre-disease of the road user at fault is underrepresented in health problem related accidents by a factor of 2.7 compared to more than on pre-disease.

	Estimate	Std. Error	Pr(>|z|)
(Intercept)	-3,93	0,32	< 0,01
Character of accident crossing or turning	-17,03	581,83	0,98
Character of accident leaving road	2,20	0,24	< 0,01
Number of pre_diseases 0	-1,01	0,20	< 0,01
Original velocity >60 kph	-0,83	0,25	< 0,01
Type of road federal motorways	0,89	0,27	< 0,01
Type of road urban roads	-0,35	0,28	0,22
Age >65	1,15	0,24	< 0,01
Location urban	0,23	0,28	0,40

Table 4-4 Results of logistic regression analysis for factor sudden health problems.

The health problem related accidents with an original vehicle velocity higher than 60 km/h are surprisingly underrepresented compared to accident with a lower velocity based on the results of the logistic regression analysis. This is contradictory to the results found in the bivariate analysis. An explanation was not found so far. It is even more surprising as the road type 'federal motorways' is found to be overrepresented in accidents were 'sudden health problems' were a factor. This was also found in the bivariate analysis and expected to be correlating to the high velocity. The results for road type urban were not significant.

The logistic regression analysis shows that high age groups (higher than 65 years) are overrepresented in accidents related to sudden health problems by a factor of 3.2, which confirms the results of the bivariate analysis.

The variable location of the scene of accident did not show results on a significant level.

4.2.2 Results of in-depth data request to all TRACE data providers

From the WP8 data request to TRACE partners, Table 4-5 shows the statistically significant results for the types of characteristics more likely when a sudden health problem was a contributory factor. As can be seen from this table, 3 partners in TRACE were able to provide data for sudden health problem-related accidents, from 3 European countries.

Significant parameters for sudden health problem	Czech national	GIDAS (Germany in-depth)	LAB (France in-depth)
>65 ↑	Czech	GIDAS	LAB
Unemployed ↑		GIDAS	
Pensioner ↑		GIDAS	
Bicycle ↑	Czech	GIDAS	
Other type of impact↑	Czech	GIDAS	
hitting object (immobile) ↑	Czech		
going straight ↑		GIDAS	
Rural ↓			LAB
Country road ↓	Czech		
Day ↑	Czech		
16-23:59 ↓		GIDAS	LAB
8-15:59 ↑	Czech		

Table 4-5 Results from the data request 3B calculations - parameter values showing associations for sudden health problem related accidents (not multivariate)

What Table 4-5 shows is that in all 3 data sources, the road user was more often over 65 years old and additionally in the German data, was either not in employment or a pensioner. The German and

Czech data showed that the road user was significantly more likely to be a cyclist and that the impact was a type other than front side or rear (not further specified).

The vehicle more often impacted an immobile object in the Czech data, while in the German data, the results showed that the road user was more often going straight (i.e. not undertaking a manoeuvre).

The French data showed that rural roads were less prevalent and 'country' roads were less prevalent in the Czech data.

The accident was more likely to occur during the day between the hours of 0800 and 1600 in the Czech data, and was less prevalent between 1600-0000 in the German and French data.

4.2.3 Summary, Discussion and Conclusions of the Analysis of the Factor 'sudden health problems'

For the factor sudden health problems two important results were obtained in the logistic regression analysis undertaken by BASt using German GIDAS data. First the typical circumstances of accidents related to sudden health problems were identified.

Accidents on motorways, on straight road parts, in non-urban areas (surrounding: fields, trees) were overrepresented compared to accidents where the factor was not present. These accidents resulted mainly in leaving road accidents (no collision with other vehicles). Accidents at intersections in urban areas were underrepresented. In the bivariate analysis, high original velocities (>60kph) were over-represented, but in the logistic regression analysis, these were found to be under-represented. No explanation for this could be given. Therefore, any results associated with original velocity were considered with caution.

There are different possibilities to explain why this accident scenario is overrepresented in accidents related to sudden health problems. One possibility is that the surroundings outside urban areas are directly contributing to the occurrence of sudden health problem. Monotone situations like long straight road might increase the risk of sudden health problems. While during more demanding manoeuvres which need high level of concentration like turning or crossing manoeuvres the chances for occurrence of sudden health problems is less. Epileptic attacks as pre-disease was found during bivariate analysis. This could be an explanation for the increases number of accidents related to sudden health problems in rural surrounding.

Another explanation for the overrepresentation of high speed roads could be that accidents caused by sudden health problems only results in severe accidents at high velocities. At low velocities in urban areas at crossings or intersections the driver might be able to stop his car without causing accidents or only causes a minor accident which is not recorded in the accident database.

Another result of the analysis of the factor sudden health problems showed the characteristics of persons involved in these kinds of accidents. The age group older than 65 year is overrepresented in the accidents where sudden health problems were contributory. Also pensioners are overrepresented in these accidents, which directly correlate to the age. The reason is obviously the fact that elderly persons are more likely to have pre-existing diseases, which results in a higher risk of having a sudden health problem while driving. The fact that the existence of pre-diseases increases the possibility of causing an accident due to sudden health problems was also confirmed by the analysis.

A possible countermeasure could be the introduction of regular mandatory health check for the identified risk groups.

Table 4-6 gives an overview of the results obtained by the WP3 partner BASt who analysed the causation factor 'sudden health problems' using their own database, including suggestions for potential solutions based on the findings.

Factor	Partner	Method	Main question	Result	Potential Solution
Sudden Health Problems	BASt (Germany)	Logistic Regression	Circumstances and person characteristics of accidents related to sudden health problems	• Leaving road accidents ↑↑ • Persons' age: >65 years↑↑ • Type of road: federal motorway↑ • Original velocity >60km/h↓ • No pre-diseases↓↓	Regular health checks for risk group: elderly drivers and drivers with relevant pre-diseases. System which can help to 'take over' and 'guide' a vehicle to a safe stop in the event of a detected 'drift'

Table 4-6 HUMAN Driving Task-Related Factor: Sudden health problems

The results of the bivariate analysis of data from 3 databases (3 countries) supplied via the WP8 data request was found to complement and enhance the results of the logistic regression of German GIDAS data, which helped gain a slightly clearer picture of the European view. The results revealed that older (>65 years) road users were more prevalent, which is similar to the findings of the logistic regression analysis. In addition, the road users were found to be more often cyclists.

Impacts with immobile objects were more often than other accident types (Czech data only), while in the logistic regression analysis of German data, the vehicle leaving the road also was found to be more prevalent compared with when it didn't. Road users were more likely to be not undertaking a manoeuvre (i.e. going ahead) on a straight road. The road itself was less often rural (French data only), which differs to the logistic regression analysis of German data, which found that rural areas were more prevalent. Smaller ('country') roads were found to be less prevalent, which does not contradict the logistic regression results, which found that motorway accidents were more frequent.

The time of accidents where a sudden health problem was contributory was more prevalent between the hours of 0800-1600.

From the analysis undertaken, a number of main conclusions can be drawn out:

- The results suggest that accidents involving sudden health problems are more likely to occur on motorways, on straight sections of road often resulting in the vehicle leaving the road and impacting an immobile object.
- These more often occurred during daylight hours and involved drivers over 65 years with current health problems (pre-diseases). Cyclists were also found to be highly prevalent (Czech and German data only).
- Accidents involving a driver suddenly experiencing a health problem may occur more often on high-speed roads because on low-speed roads, it may be possible for drivers to control their vehicle enough to pull over safely.
- Regular health checks for high risk groups (i.e. those with pre-existing conditions and older drivers) may reduce the risk of a sudden onset of a health problem. However, in-vehicle systems which are able to take over some or all the control a vehicle (i.e. 'guide' a vehicle to a stop) in the event of a detected 'drift' may also help to reduce the severity of an impact.

4.3 Mobile phone use

Accident data where 'mobile phone user' was recorded as being contributory was made available from Germany (BASt). Unfortunately, due to sample size, it was only possible to undertake a limited amount of analysis on the sample. Due to the limited data also received from the WP8 data request, it was also not possible to undertake a bivariate analysis.

4.3.1 Results of WP3 partners analysis of the contributing factor 'mobile phone use'

4.3.1.1 Germany (BASt)

The factor 'mobile phone use' was analysed using available cases from the German in-depth data source 'GIDAS'. All accidents where the driver was speaking on the phone, handling the communication equipment or using a hands free speaking device are considered as accidents where the factor 'mobile phone use' was present. From the 6621 passenger car accidents in the GIDAS database from 1999-2005, 72 had 'mobile phone use' as a contributory factor.

MI-values of explanatory variables for the factor mobile phone use are provided in Figure 4-3. These variables which showed high correlation to accidents with the factor mobile phone use only provide information on the person or the vehicle which normally use their telephone while driving. The variables do not provide further information on circumstances, manoeuvres or type of accidents where mobile phone use was involved.

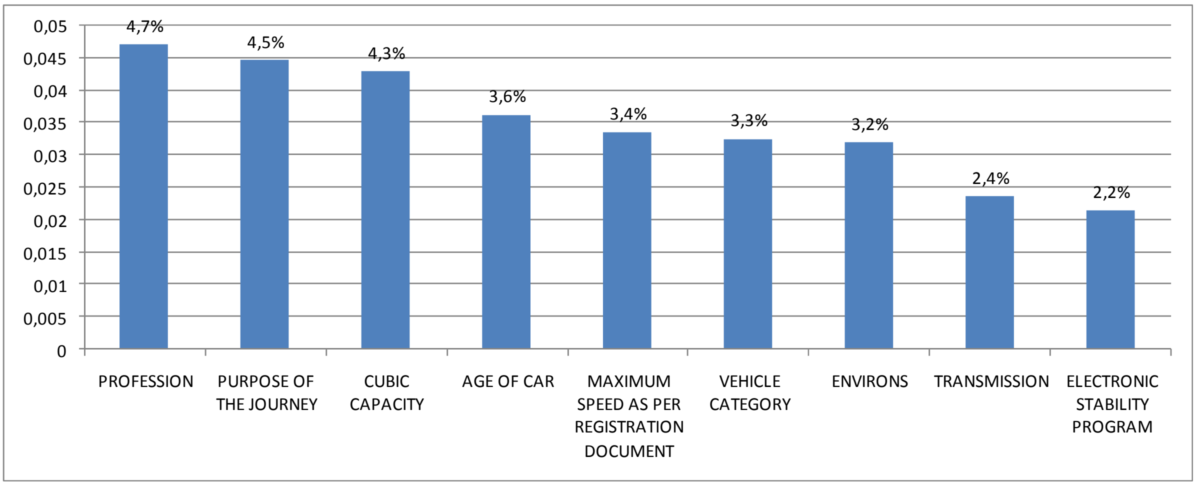

Figure 4-3 Results from mutual information analysis for the factor mobile phone use

Based on these results it was decided not to consider the factor mobile phone use further in this study, because no relevant insights on circumstances of accidents related to phone use could be expected. This is partly due to the low number of cases where mobile phone use was a contributory factor. Also, as the factor 'attention' was already being analysed separately, mobile phone use may already be included in that analysis and consequences for prevention might not be so relevant from an active safety system, but only from a law enforcement point of view.

4.3.2 Results of in-depth data request to all TRACE data providers

Due to the low number of accidents in the databases where mobile phone use was recorded as a causation factor (e.g. 1 case in Spanish data and 8 cases in GB data), it was not possible to undertake a bivariate analysis on the results.

4.3.3 Summary, Discussion and Conclusions of the Analysis of the Factor 'mobile phone use'

The few number of cases where mobile phone use was a causation factor found in the available TRACE databases possibly implies that it is not an important factor to consider in the study of accident causation. However, from previous literature highlighted in D3.1 and other studies such as those carried out by McEvoy et al (2005), plus high-profile government campaigns such as in the UK (THINK campaign launched 2008) following changes in the law, it appears that mobile phone use is an important issue to consider in terms of accident causation. Therefore the results shown in this study regarding mobile phone use highlight more issues of data collection rather than the issues of mobile phone use as a causation factor. Often in an accident where it is suspected that distraction was a contributory factor, it is not possible for accident investigators to further clarify what the specific distraction was, including mobile phone use. It would be extremely difficult to determine whether a mobile phone was being used prior to an accident happening, because it often depends on the admission of the driver at the scene. Unless there is specific witness evidence to suspect this, the possibility of mobile phone use won't be taken further apart from in more severe accidents where 'blame' becomes a more serious issue. Often, this information may only be found out later on after further investigation by the police, after the investigators have left the scene, so this information will be missing in their data collection. Therefore, the numbers shown will very much underestimate the role of mobile phone misuse in accidents.

From the small amount of analysis that was possible to be undertaken using the GIDAS data, it was found that mobile phone use was mainly related to the driver using the mobile phone rather than the surroundings. Therefore educating those who are more likely to be tempted to use a mobile phone at the wheel of the car may help to reduce numbers and as additional deterrent, as it started to be shown in many countries across Europe, stricter law enforcement and harsher penalties may help to deter those who still insist on using their phones.

In terms of data collection issues, where mobile phone may not be collected as a specific factor in European databases, it will often be included in the more general factor headings of 'distraction'. Therefore, the results given in the section titled 'attention' (more specifically, when 'distraction' is discussed), could also apply to mobile phone use, as it has been identified as a specific type of distraction in this study (see section 3.3).

4.4 Speed (including 'inappropriate speeding' and 'illegal speeding')

Accident data where speed was recorded as being contributory was made available from three countries, from Spain, Austria and the United Kingdom. A cross-tabulation and logistic regression analysis was undertaken using all car accidents from the Spanish data source and the Austrian data source where speed was a causation factor. Using the in-depth data source from the UK (OTS), a separate analysis of the contributory factors 'inappropriate speed' and 'illegal speed' was undertaken, firstly by undertaking a general statistical overview of all car accidents where each of the speed-related factors were contributory. Secondly, an in-depth analysis of samples of cases where each type of factor was contributory was undertaken to identify typical failure generating scenarios for these accidents using the WP5 methodology. In addition, results from the bivariate analysis of the requested data via WP8 is also given.

4.4.1 Results of WP3 partners analysis of the contributing factor 'speed'

4.4.2 Spain (CIDAUT)

From the sample of 250 drivers involved in 154 accidents in the Spanish DIANA database, speed was contributory for 55 of the drivers. From the results of the cross-tabulation analysis, which aimed to identity explanatory variables which were 'significantly' more likely to be present when the contributory factors 'speed' was present, a number of explanatory variables were identified, these being:

- *Age:* In the relation between age and speed, the category "18-25 years old" and "26-45 years old" are the ones more associated with the presence of speed as a contributing factor.
- *Driver type:* In the relation between driver type and speed, the category "private driver" is the one more associated with the presence of speed as a contributing factor.
- *Vehicle type:* In the relation between vehicle type and speed, the category "motorcycle" is the one more associated with the presence of speed as a contributing factor.

- *Vehicle age:* In the relation between vehicle age and speed, the category "less than six years old" is the one more associated with the presence of speed as a contributing factor.
- *Vehicle power:* In the relation between vehicle power and speed, the category "50-200 c.v" is the one more associated with the presence of speed as a contributing factor.
- *Day of week:* In the relation between day of week and speed, the category "Sunday" is the one more associated with the presence of speed as a contributing factor.
- *Road type:* In the relation between road type and speed, the category "country road" is the one more associated with the presence of speed as a contributing factor.
- *Road alignment:* In the relation between road alignment and speed, the category "curve" is the one more associated with the presence of speed as a contributing factor.

There were 11 variables where a 'significant' link with the factor 'attention' was not found (i.e. $p>0.05$), which were 'intersection', 'manoeuvre', 'traffic density', 'gender', 'nationality', 'employment', 'vehicle colour', 'active safety system', 'time of accident', 'luminosity', 'speed limit'.

The variables that had the strongest results in the bivariate analysis were included in the logistic regression model, these being vehicle type, vehicle age and road alignment. The way they were found to relate to drivers involved in accidents where speed is contributory is as follows:

- **Vehicle type**: the category "Motorcycle" is the one more associated with the presence of speed as a contributing factor.
- **Vehicle age**: the category "<= 6 years old" is the one more associated with the presence of speed as a contributing factor.
- **Road alignment**: category "Curve" is the one more associated with the presence of speed as a contributing factor.

4.4.2.1 Austria (TUG/LMU)

Of the 801 drivers in 514 fatal accidents available from the Austrian data source, 236 involved speeding which contributed to the accident.

4.4.2.1.1 Bivariate analysis

After undertaking an initial bivariate (cross-tabulation) analysis, the following variables were found to be significantly ($p<0,2$) more likely to be present in an accident when speed was a contributory factor:

- *Gender* - Males are more likely to be involved in accidents where speeding is contributory (~88%).
- *Vehicle group (car, van, motorcycle, truck)* - Car and van drivers are more likely to be involved in fatal accidents where speeding is contributory.
- *Age group (car, van, motorcycle, truck)* - Young drivers and drivers in the age group between 25 and 44 years are more likely to be involved in accidents when speeding is contributory. Null hypothesis of independence between age of drivers and speeding is rejected.
- *Engine power (passenger cars, motorcycles, trucks)* - Vehicles with an engine power between 60-120 [kW] are more likely to be involved in accidents where speed is contributory.
- *Road type (car, van, motorcycle, trucks* - Drivers involved in accidents where speeding is contributory are more likely to be driving in country roads. Autobahn and national roads have the second highest portion.
- *Weekday (car, van, motorcycle, trucks)* - Drivers involved in accidents where speed is contributory are more likely to be driving on Fridays and Sundays.
- *Daytime (car, van, motorcycle, trucks* - Drivers involved in accidents where speed is contributory are more likely to be driving between 16-23 o'clock.

- *Lighting conditions (car, van, motorcycle, trucks)* - Drivers involved in accidents where speed is contributory are more likely to be driving during dark lighting conditions.

Variables where a significant link with the contributory factor 'speed' was not found (p>0,2) were 'year of manufacture' (passenger cars), 'vehicle colour' (passenger cars), 'location' (car, van, motorcycles, trucks), 'month' (car, van, motorcycles) and 'speed limit' (car, van, motorcycles).

Variables where no statistical information could be derived were vehicle transmission and driver nationality.

4.4.2.1.2 Logistic regression model

Based on the homogeneity test (significance level p<0,2) in the previous chapter the variables were brought into the model. Even if the significance level of p<0,05 would be considered, the same variables would be included in the model as it was figured out.

In general, eight variables explain the outcome variable "speed" in some way. These variables are: gender, vehicle, age, engine power, road type, weekday, daytime and lighting condition. They can be associated with fatal accidents whereby speed was contributory.

It needs to be pointed out that according to the homogeneity test all of the data were filtered. That means that only passenger cars, motorcycles and trucks are considered.

Out of these eight parameters two were removed and not considered namely "engine power" and "weekday" (see Table 4-7). These two variables have been excluded because the significance was exceeding the limit of p<0,2. Looking at the significance level p<0,05 the daytime would have been removed from the model too.

Variables in the Equation		B	S.E.	Wald	df	Sig.	Exp(B)
Step 6(f)	Vehicle	,315	,125	6,345	1	,012	1,371
	Age	,403	,095	17,911	1	,000	1,496
	Gender	1,069	,256	17,469	1	,000	2,912
	Time	,197	,114	2,996	1	,083	1,218
	Road Type	,332	,173	3,705	1	,054	1,394
	Lighting	-,371	,140	6,989	1	,008	,690
	Constant	*-2,082*	*,734*	*8,040*	*1*	*,005*	*,125*

Table 4-7: Variables included in the regression model for speed

To conclude, variables which can be associated with fatal accidents whereby speed was contributory are identified as age of the driver, gender, type of vehicle, lighting conditions, road type (and the daytime). Most associated factors are identified as age and gender of the drivers.

4.4.2.2 Great Britain - Inappropriate speeding

4.4.2.2.1 Statistical overview of cases where inappropriate speeding was a causation factor

In the OTS database, 474 accidents involving cars were identified where inappropriate speeding was a causation factor, inappropriate speeding being defined as when a road user is not travelling above the speed limit of the road, but the vehicle's speed is inappropriate (i.e. too fast) for the road conditions (e.g. bend in road, slippery road conditions, heavy traffic conditions...). These accidents involved 703 vehicles (includes pedal cycles and pedestrians), including 627 cars. An overview of the typical characteristics of these accidents was undertaken and the results of statistical analysis revealed that the following explanatory variables were significantly more likely to be present in accidents when inappropriate speeding was a cause:

- Rural roads;
- Minor roads;
- Single carriageway roads;
- Not at an intersection;
- No manoeuvre undertaken by the main road user;
- Single car accidents;
- Car drivers;
- Frontal impacts;
- Roads with 60mph (97km/h) speed limit;
- Bends;
- Poor weather conditions;
- Poor road surface conditions;
- Night (darkness) conditions;
- Light density traffic conditions;
- Drivers <25 years old;
- Male drivers.

4.4.2.2.2 In-depth analysis of 'inappropriate speeding' cases using TRACE WP5 methodology

Using the TRACE WP5 methodology, a sample of 20 cases where inappropriate speeding was a cause was selected from the UK OTS database. Analysis was undertaken separately on the road users deemed to be primary active in the accident (i.e. the road user in each accident who was responsible for the initial destabilisation of the situation) and those who were not the primary active.

From the 20 **primary active road users** in the sample of cases, the majority were going ahead and not undertaking a manoeuvre or at an intersection at the time of the accident. When a manoeuvre was being undertaken, the road user was either turning across traffic, overtaking, stopping or starting. The main 'conflict' came from ahead from vehicles travelling in the same direction (either stationary or moving).

For the 26 **non primary active road users**, the most frequent 'situation' involved the road user being stationary (11 road users), while 7 road users were stopping or starting from stationary in a traffic queue. The main conflict came from a vehicle following behind.

Figure 4-4 shows the categories of human functional failures that occurred in the 20 accidents analysed using the classifications derived in TRACE Task 5.1.

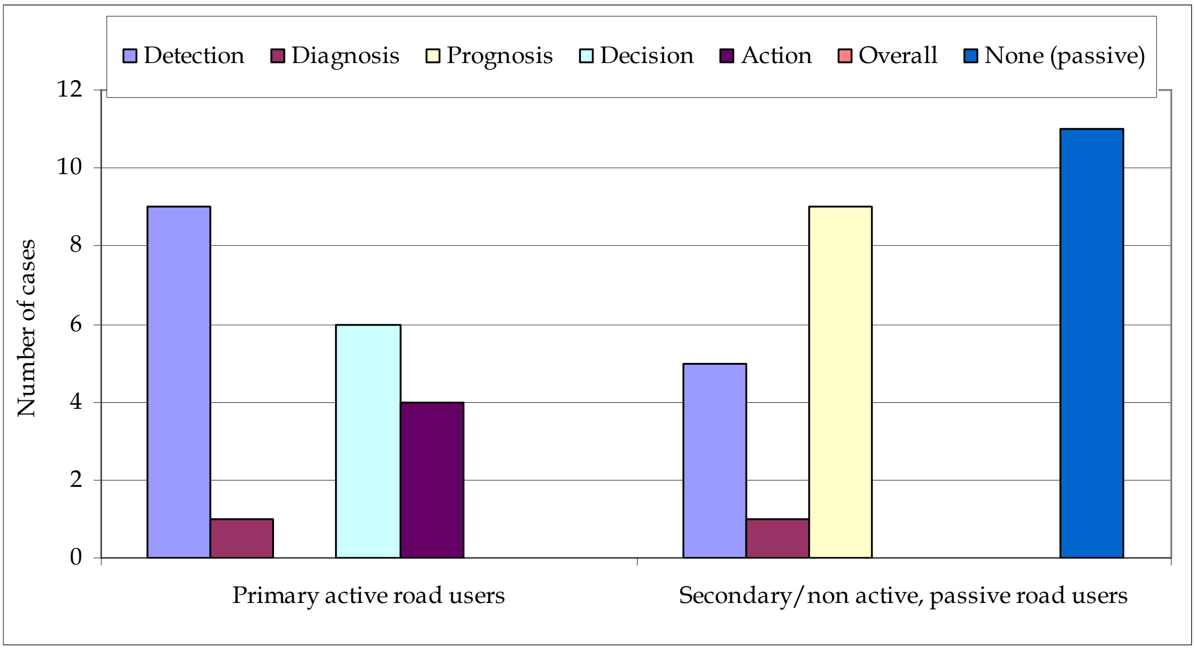

Figure 4-4 The type of human functional failures for the road users in the 20 'inappropriate speeding' accidents

Figure 4-4 shows that for the **primary active road user** in each accident, the most frequent type of human functional failure was related to a failure in detection (9 road users). Further analysis showed that the most frequent specific type of failure was the detection failure P2 'neglecting the need to search for information', the decision making failure D2 'deliberate violation of a safety rule' and the executing action failure E1 'poor control of an external disruption'.

In addition to the speeding, other user behaviour-related factors were the most frequent causation factors in the sample, in particular the road user being 'in a hurry' and the road user driving too close to the vehicle in front ('risk taking – vehicle positioning'). In terms of environmental factors, road surface condition was the overriding contributory factor amongst the primary road users.

Of the 26 **non primary active road users**, 11 did not experience a human functional failure (i.e. they were stationary). When a functional failure did occur, the most frequent was when the road user was the prognosis failure T5 ''actively expecting another user to take regulating action' (8/26). Detection-related failures were also experienced by 5 non primary active road users, although the specific type of failure varied (i.e. P1, P2, P3 & P5).

It was the behaviour of other road user(s) which most frequently contributed to these failures (i.e. absence or ambiguity of clues to their manoeuvre or atypical manoeuvre). 'Visibility impaired' was also contributory on a number of occasions, along with 'traffic condition' (flow/speed) and 'risk taking' (speed/vehicle positioning).

The 20 sample cases were evaluated against the descriptions of typical failure generating scenarios defined in TRACE Deliverable D5.3. For the 20 primary active road users, 13 could be identified with a pre-defined typical failure generating scenario. The most frequently occurring pre-defined scenarios were:

P5A - Late detection of the slowing down of the vehicle ahead (7 road users)

E1B - Sudden encounter of an external disruption, more or less expectable (3 road users)

For 7 primary active road users, a pre-defined failure generating scenario could not be identified. Table 4-8 outlines 5 newly defined scenarios, the majority of which were related to a decision making D2 failure.

Newly defined failure generating scenarios		Number of road users
Code	**Description**	
P4X	Late/No detection of the slowing/stationary of vehicles ahead due to internal/external distraction	2
D2Q	Risky overtaking on approach to intersection	1
D2R	Risky overtaking (not at intersection) which leads to a loss of control	2
D2S	Intentional inappropriate speeding on approach to intersection	1
D2T	Risky turning manoeuvre at speed onto main road (not at intersection)	1

Table 4-8 Newly defined failure generating scenarios for primary active road users in 'inappropriate speeding' accidents

When examining the 26 non primary active road users in the sample cases, only 7 could be related to pre-existing D5.3 scenarios. Of the 19 who could not, 11 were regarded as being passive in the accident (i.e. they were stationary prior to impact and therefore unable to do anything to avoid it), so did not experience a human functional failure and therefore it is not possible to define a failure generating scenario for them. From the sample of non primary active road users, 6 pre-defined D5.3 typical failure generating scenarios were identified, as shown in Table 4-9.

Pre-existing typical failure generating scenarios (as defined in TRACE D5.3)		Number of road users
Code	**Description**	
P1D	Driver surprised by the manoeuvre of a non-visible approaching vehicle	1
P2A	Focalisation on a directional problem	1
P3A	Cursory search for information while turning on the right (in UK)	1
P5A	Late detection of the slowing down of the vehicle ahead	2
T5A	Expecting a non-priority vehicle not to undertake a manoeuvre in intersection	1
T6C	Erroneous expectation of the stopping of a non-priority vehicle coming on the trajectory	1

Table 4-9 Pre-existing typical failure generating scenarios for non primary active road users involved in 'inappropriate speeding' accidents

It was not possible identity a pre-defined D5.3 typical failure generating scenario for 8 of the of the 19 non primary active road users who were not passive. Therefore, 2 newly defined failure generating scenarios were identified, as shown Table 4-10.

Newly defined failure generating scenarios		Number of road users
Code	**Description**	
T4X	Mistaken understanding of a vehicle ahead's recovery manoeuvre	1
T6Y	When braking, actively expecting the road user behind to take regulating action	7

Table 4-10 Newly defined failure generating scenarios for non-primary active road users in 'inappropriate speeding' accidents

4.4.2.3 Great Britain - Illegal speeding

4.4.2.3.1 Statistical overview of OTS cases where 'illegal speed' was a causation factor

In the OTS database, 257 accidents involving cars were identified where illegal speeding was a causation factor, illegal speeding being defined as when a road user is driving/riding above the legal speed limit of the road at the time of the accident. These accidents involved 395 'vehicles' (includes pedal cycles and pedestrians), including 353 cars An overview of the typical characteristics of these accidents was undertaken and the results of statistical analysis revealed that the following explanatory variables were significantly more likely to be present in accidents when illegal speeding was a cause:

- Minor roads;

- Single carriageway roads;
- No manoeuvre undertaken by the main road user;
- Single car accidents;
- Car drivers;
- Frontal impacts;
- Roads with low speed limit (30mph/48km/h);
- Bends;
- Night (darkness) conditions;
- Light density traffic conditions;
- Drivers <25 years old;
- Male drivers.

4.4.2.3.2 In-depth analysis of 'illegal speed' cases using the TRACE WP5 methodology

Using the TRACE WP5 methodology, a sample of 20 cases where illegal speeding was a cause was selected from the UK OTS database. As with the 'inappropriate speeding' cases, analysis was undertaken separately on the road users deemed to be primary active in the accident (i.e. the road user in each accident who was responsible for the initial destabilisation of the situation) and those who were not the primary active.

From the 20 **primary active road users** in the sample of cases, the majority were going ahead and not undertaking a manoeuvre or at an intersection at the time of the accident. When a manoeuvre was being undertaken, the road user was overtaking. The 1 pedestrian in the sample was crossing the road. For half of the primary active road users in the sample, there was no 'conflict', meaning the road user lost control for reasons which did not involve another road user or object on the road and as a result, left the carriageway before a collision. When there was a conflict, it came from either ahead (oncoming or travelling in same direction) or from the side (from a side road or a pedestrian crossing the road).

For the 14 **non primary active road users**, 'going ahead on a straight road' was the most frequent pre-accident driving situation. Turning manoeuvres were being undertaken by 2 of the non primary active road users, and the 2 pedestrians in the sample were crossing the road. The most frequent conflict amongst the non primary active road users involved another road user ahead, most frequently travelling in the same direction. However, there were also instances of conflicts from behind (following vehicle) and from the side (vehicle from side road or pedestrian crossing road).

Figure 4-5 shows the categories of human functional failures that occurred in the 20 'illegal speeding' accidents analysed using the classifications derived in TRACE Task 5.1.

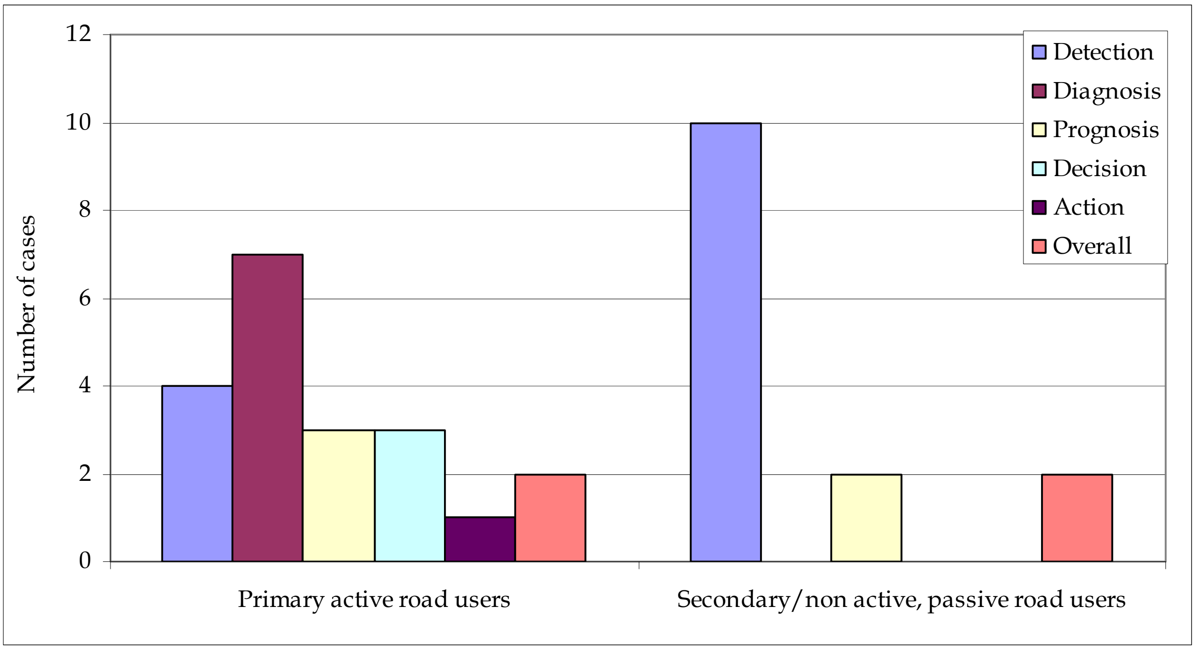

Figure 4-5 The type of human functional failures for the road users in the 20 'illegal speeding' accidents

Figure 4-5 shows that for the **primary active road user** in each accident, the most frequent type of human functional failure was related to the diagnosis of the situation (7 road users). Further analysis showed that the most frequent specific type of failure was the diagnosis failure T1 'erroneous evaluation of a passing road difficulty', meaning the road user misjudged the layout (or conditions) of the road ahead (e.g. under-estimating the tightness of a bend or the surface friction on the road).

Detection failures were experienced by 4 of the primary active road users, although the specific reason for each detection failure varied (P3, P4, P5). The prognosis failure T7 'expecting no perturbation ahead' and the decision-making failure D2 'deliberate violation of a safety rule' were each experienced by 3 primary active road users.

In addition to the speeding, 'in a hurry' was the most frequent type of factor in the sample of primary active road users (14 road users), with other human-related factors such as 'distraction within user' and 'risk taking (eccentric motives)' also occurring frequently. 'Road geometry' was the most frequently occurring environmental factor in the sample, with factors related to the 'traffic condition' or 'visibility impaired' also contributing on a number of occasions.

The most frequent type of human functional failure experienced by the 14 n**on primary active road users** in the sample was a failure in detection (10 road users), with half of these failures involving the P5 failure 'neglecting the need to search for information' and a further 3 involving the P1 failure 'non-detection in visibility constraint conditions'. The detection failure P2 'information acquisition focussed on part of situation', the prognosis failure T5 'expecting another user not to perform a manoeuvre' and the overall failure G2 'alteration of sensorimotor and cognitive capacities' were all experienced by 2 non-primary active road users.

For all but 1 non primary active road user in the sample, it was an 'atypical manoeuvre', or the 'ambiguity' or 'lack of clues' to a manoeuvre of 'other road user(s)' in the surrounding environment that contributed to the functional failure. The positioning (proximity) of the non primary active road user to another road user was contributory for 4 road users in the sample, while ' visibility impaired' and 'rigid attachment to the right of way status' were each contributory for 3 of the road users.

The 20 sample cases were evaluated against the descriptions of typical failure generating scenarios defined in TRACE Deliverable D5.3. For the 20 primary active road users, 14 could be identified with a pre-defined typical failure generating scenario. Table 4-11 shows the 8 pre-defined typical failure generating scenarios for the first 14 primary active road users.

Pre-existing typical failure generating scenarios (as defined in TRACE D5.3)		Number of road users
Code	Description	
P5A	Late detection of the slowing down of the vehicle ahead	1
T1B	Under evaluation of the difficulty of a known bend	3
T1C	Erroneous evaluation of a bend difficulty in a context of 'playful driving'	3
T4B	Mistaken understanding of the other's manoeuvre related to their ambiguous signals	1
T7A	Expecting no vehicle ahead in a bend with no visibility	2
D2B	Overtaking on an axis-limited visibility zone	1
E2A	Guidance interruption as a consequence of focussed attention towards a secondary task	1
G2B	Alteration of guidance capacities	2

Table 4-11 Pre-existing typical failure generating scenarios for 14 of the primary active road users

There were 6 primary active car drivers where a pre-defined failure generating scenario could not be identified. Table 4-12 shows these 6 new failure generating scenarios.

Newly defined failure generating scenarios		Number of road users
Code	Description	
P3X	Cursory search for information when attempting to overtake a vehicle ahead	1
P4P	Non-detection of an approaching vehicle when pedestrian is crossing the road due to external distraction	1
P5X	Late detection of a pedestrian crossing the road	1
T7Y	Not expecting a vehicle ahead at an intersection with no visibility	1
D2U	Intentional inappropriate speeding on roundabout	1
D2V	Intentional risk taking when going ahead at a non-priority intersection	1

Table 4-12 Newly defined failure generating scenarios for the 13 remaining primary active road users

When examining the 14 **non-primary active road users** in the sample cases, pre-existing D5.3 scenarios could be defined for 9, and from these, 3 typical failure generating scenarios were identified (Table 4-13).

Pre-existing typical failure generating scenarios (as defined in TRACE D5.3)		Number of road users
Code	Description	
P1D	Driver surprised by the manoeuvre of a non-visible approaching vehicle	3
P2A	Focalisation on a directional problem	2
P5A	Late detection of the slowing down of the vehicle ahead	4

Table 4-13 Pre-existing typical failure generating scenarios for 9 of the non-primary active road users

New failure generating scenarios were defined for 5 of the non-primary active road users and are shown in Table 4-14.

Newly defined failure generating scenarios		Number of road users
Code	Description	
P5X	Late detection of a pedestrian crossing the road	1
T6Y	When braking, actively expecting the road user behind to take regulating action	1
T5Z	Not expecting another road user in opposing lane to undertake an overtaking manoeuvre	1
G2P	Alteration of sensorimotor/cognitive capacities (e.g. due to alcohol) which affected the pedestrian to such a level, it prevented them from either being able to carry out their task safely (e.g. stay on the pavement or check for traffic adequately before crossing the road)	2

Table 4-14 Newly defined failure generating scenarios for 5 of the non-primary active road users

4.4.3 *Results of in-depth data request to all TRACE data providers*

From the WP8 data request to TRACE partners, Table 4-15 shows the statistical significant results for the types of characteristics more likely when speeding was a contributory factor. As can be seen from this table, 7 partners in TRACE were able to provide data for speed-related accidents, from 5 European countries.

Significant parameters for speed	Czech national	BASt (Germany national)	GIDAS (Germany in-depth)	OTS (GB in-depth)	INRETS (France in-depth)	LAB (France in-depth)	CIDAUT (Spain in-depth)
Male ↑	Czech	BASt	GIDAS	OTS		LAB	
<25 ↑	Czech	BASt	GIDAS	OTS	INRETS	LAB	CIDAUT
Car, Van, <3.5t ↑	Czech			OTS			
PTW ↑		BASt	GIDAS				CIDAUT
Frontal ↑		BASt	GIDAS	OTS		LAB	
hitting object (immobile) ↑	Czech		GIDAS				CIDAUT
Other impact type ↑	Czech						
Rollover ↑				OTS			
running off the road ↑		BASt					
Overtaking ↑						LAB	
other manoeuvre↑							CIDAUT
GOING AROUND BEND ↑				OTS			
going straight ↑			GIDAS		INRETS		
Rural ↑	Czech	BASt	GIDAS	OTS			
Autobahn, National road ↑		BASt					
Autobahn, National road ↓							CIDAUT
Country road ↑	Czech		GIDAS	OTS			
50-100 ↑		BASt		OTS			
>100 ↑			GIDAS				
Dark ↑	Czech	BASt	GIDAS	OTS			
day↑							CIDAUT
0-7:59 ↑	Czech	BASt	GIDAS	OTS			

Table 4-15 Results from the data request 3B calculations - parameter values showing associations for speed related accidents (not multivariate)

What Table 4-15 shows is that in the majority of data sources, the road users were significantly more often male and under the age of 25. The Czech and GB data shows that car and small goods drivers were more prevalent, whereas in German and Spanish data sources, powered two-wheelers (PTW) were more frequent.

Impacts to the front of the vehicle were more prevalent in German, GB and French data, while in terms of the crash type, the most frequent in Czech, German (national) and Spanish data involved an impact with an immobile object on the road, in the German (in-depth) data it involved the vehicle running off the road, and in the GB data, it involved a rollover.

Overtaking was the most prevalent manoeuvre in the French (in-depth) data, while in the German and French (also in-depth) data, the vehicle was going ahead. In GB data, the vehicle was more specifically going ahead on a bend.

In terms of the accident location, rural roads were more prevalent in the Czech, German and GB data. The roads were generally not major roads, apart from in the German (national) data, with the speed limits being greater than 50kph (greater than 100kph in German in-depth data).

Darkness between the hours of 0000-0800 were the most frequent in Czech, German and GB data, although in Spanish data, it was daytime.

4.4.4 Summary, Discussion and Conclusions of the Analysis of the Factor 'speed'

From the results of the cross-tabulation analysis undertaken using the Spanish DIANA database, which aimed to identity explanatory variables which were 'significantly' more likely to be present when the contributory factors 'speed' was present, a number of explanatory variables were identified, which were drivers aged 18-25 years old and 26-45 years old, private driver, motorcycle, vehicle less that six years old, vehicle between 50-200 c.v , Sunday, country and curved road. Following on from this, a logistic regression analysis was undertaken and the categories more probably associated with the presence of speed as a contributing factor were found to be a motorcycle, a vehicle less than 6 years old and a curved road.

As a result of the development of vehicle conditions, in recent years new vehicles are improved in a way that can reach higher speed than before (always depending on vehicle type and make). So it makes sense to check that vehicles less than six years old are the ones more associated with the presence of speed as a contributing factor, according to the model shown above.

Related to vehicle type the literature review in TRACE D3.1 showed that the risk for causing a collision as a powered two wheeler is increased for inappropriate speed (OR=13.1) and for excessive speed (OR=7.0) (Lardelli-Claret, 2005). Excessive speed was also stated as risk factor in fatal accidents on slippery roads for 16 to 19 year old drivers (Marmor, 2006), and in 11% of 44 fatal rural traffic accidents (Davis, 2005).

In accordance with literature review about road geometry, Matthew and Barnes, (1988), studied the relation between the length of the straight section preceding sharp curves and the crashes in curves finding a positive association between them. Regarding this fact, the higher speed is the less time to detect a conflictive situation (as a sharp curve) in order to react avoiding an accident. Furthermore, taking into account the result found by Lyles (2006) who reported that the average crash rate was 3 times higher on curves compared to tangents, speeding a motorcycle in a curve adds to the time reduction explained above the higher probability of losing the control of the motorcycle.

The recently increase in accident rate involving motorcyclist have set in motion several lines of investigation. Concerning European Commission, projects such as SIM (Safety In Motion) and PISA (Powered two-wheeler Integrated Safety) focus their work on motorcycles safety. Those kinds of initiatives should be supported and encouraged in order to find out the most appropriate actions to decrease this trend.

Furthermore, a set of educational measures should be developed, probably related to risk perception and decision taking; and another set of training measures to improve riders' motorcycle control while negotiating difficult situations such as curves. This kind of abilities should be practised in driving licence training.

Measures in accordance with the day of the week such as campaigns about driving or travelling during the weekend, are supported by the results found in DIANA data.

A combination of in-vehicle and educational measures should be recommended due to limitations on systems found by Van Elslande et al. (2008). So, for example, authors showed that the motivation to speeding could limit the effectiveness of Intelligent Speed Adaptation. Taking into account their usefulness for safety, research to improve the safety effectiveness of these functions should be promoted. The authors of the aforementioned study (Van Elslande et al. 2008) compile a set of suggestions which could lead future investigation in this way.

In the ZEDATU fatal database of TU Graz (Austria), the bivariate analysis showed an association between speed as a contributing factor and gender, age, vehicle group, engine power, road type, time, weekday, and lighting condition. The specific characteristics found to be most prevalent in speed accidents were male drivers, ages between 25-44, cars and vans, vehicle engine power 60-120 kw, country roads, Friday and Sunday, between the hours of 1600-2300 during darkness.

In the sample of 704 speeding drivers in fatal accidents in the logistic regression model, most were found to be in the age group of 25-44 years and <25, in rural areas and on country roads. The most associated variable with fatal accidents whereby speed is contributory can be identified as gender and age. As additional factors the lighting conditions and type of vehicle are determined. Gender and age have the highest impact due to the fact that the null hypothesis is rejected also on the significance level of $p<0,05$. Therefore, according to the logistic regression analysis, male drivers under the age of 44 were more associated with accidents where speed was a causation factor, with darkness and car/vans additionally associated to a lesser degree.

The Austrian results give to some degree a 'traditional' picture of the characteristics of an accident involving speed, these being younger (<44) male drivers in a car/van at night. It is interesting to note that, as opposed to the results of the WP8 data request, which showed that for all 7 partners who provided data, a significant link (at a bivariate level) was found with drivers under the age of 25 in speed-related accidents, the logistic regression results of Austrian data show that not only are drivers under the age of 25 more associated with speed-related accidents, but also the 25-44 age range.

Interestingly, the results from Spain and Austria provide different types of variables more associated with speed

Using GB OTS data, it was possible to analyse separately cases where 'inappropriate speeding' and 'illegal speeding' was a factor. It was therefore possible to identify the differences in the characteristics of each of these accidents and the type of scenarios that occur. For example, poor road surface and weather conditions were found to be factors in many in 'inappropriate speeding' accidents, but did not feature as highly in 'illegal speeding' accidents. High speed roads were more prevalent in 'inappropriate speeding' accidents, but low speed roads were more prevalent in 'illegal speeding' cases. Also, scenarios involving detection failures were more prevalent in inappropriate speeding cases, but scenarios involving diagnosis failures were more frequent in the sample of illegal speeding cases.

The statistical overview of all cases in the OTS database where inappropriate speeding or illegal speeding was a contributory factor was able to identify differences between characteristics of accidents that were more likely when each factor was causative. Using a basic cross-tabulation analysis and the statistical chi-squared test, it was possible to identify the accident characteristics significantly more related to accidents where inappropriate or illegal speeding were contributory. The results could give an implication of where the greatest risk may lie.

From the sample of 474 cases where inappropriate speeding was a causation factor, the greatest risk appeared to be on high speed single carriageway rural roads during low density traffic at night when the environmental conditions are poor, with the young male car driver going ahead on a bend when there is no other road users involved (i.e. single vehicle accident).

From the analysis of 257 cases where illegal speeding was a causation factor, the greatest risk appeared to be on low speed minor single carriageway roads during low density traffic at night, involving young (<25) male car drivers going ahead on a bend when there is no other road users involved (i.e. single vehicle accident).

Therefore, slight differences in the characteristics of accidents between these two type of speed-related accidents were found. A link with high speed roads, rural road, poor surface and weather conditions was found with 'inappropriate speeding' cases, which was not found with 'illegal speeding' cases. However, low speed roads were found to be more prevalent in the sample of 'illegal speeding' cases than the sample of 'inappropriate speeding' cases.

The results of the analysis using the TRACE WP5 methodology also found differences between the two types of speed-related accidents.

4.4.4.1 Inappropriate speeding

Three main types of failure generating scenario were found for the 20 **primary active road users** in the sample of 20 'inappropriate speeding' accidents, and involved one of 3 types of human functional failure;

Detection failures (most frequent) – late/no detection of slower vehicles ahead due to either the road user not thinking there was a need to search for information or were distracted. The road user was travelling at an inappropriate speed for either the traffic condition or for approaching an intersection. Other factors which contributed to these failures included the road user being 'in a hurry', 'vehicle positioning', the 'traffic condition' (i.e. sudden changes in speed), and the road users' 'visibility impaired'.

Decision-making failures – intentional risk-taking manoeuvres (e.g. overtaking, turning, the inappropriate speeding itself) at an inappropriate speed which led to a loss of control and/or collision with another road user, both at intersection and non-intersection. Other risk-taking factors were mainly contributory (e.g. 'vehicle positioning', 'disobeying traffic controls', 'eccentric motives'), as well as the road user being 'in a hurry' and 'user inexperience'.

Taking action failures – the road user suddenly encounters an 'external disruption' (a combination of either bends and/or surface conditions and/or vehicle controls), and coupled with the road user's inappropriate speed for the conditions (i.e. geometry, road surface conditions, approaching intersection/traffic queue), is unable to regain control in time and has a collision.

The most frequent type of failure generating scenario experienced by a **non primary active road user** in the sample involved a prognosis failure, more specifically when the road user, 'when braking, actively expected the road user behind to take regulating action' (T6Y). The 'behaviour of other road users', 'traffic flow' and 'visibility impaired by weather' were often found to be contributory.

4.4.4.2 Illegal speeding

The most frequent failure generating scenario for the primary active road users in the sample of 'illegal speeding' cases involved a diagnosis failure (T1B or T1C) and involved the road users misdiagnosing a bend ahead and having a single vehicle accident, the poor diagnosis being a result of either the road user's over-exposure to the bend or due to thrill seeking behaviour.

Scenarios involving a number of types of detection failures were also identified, along with scenarios involving prognosis failures (T7 – expecting no perturbation ahead).

The most frequent type of failure generating scenario experienced by a non primary active road user in the sample involved a detection failure (P5 – late detection of the slowing down of a vehicle ahead/pedestrian crossing road).

Two further scenarios were identified, which involved either prognosis failures (T5Z/T6Y) or overall failures (G2P).

Therefore, drivers who are driving at a speed inappropriate for the conditions are more likely to encounter a problem in detecting (or perceiving) the roadway ahead, often in situations where they do not think additional detection of the road ahead is required. Therefore, when they are suddenly faced with a 'conflict', they have little time left to avoid it.

However, drivers who are driving above the speed limit are more likely to have a problem in diagnosing the situation ahead. In other words, they may detect a potential 'problem' ahead, but do not judge it correctly, therefore are unable to deal with it (i.e. keep control of their vehicle) at the high speed they are travelling at.

Also, differences were observed between the failures experienced by road users who encounter both type of speeding drivers. When encountering a driver travelling at an speed inappropriate for the conditions, the road user was more likely to experience a failure in prognosis (i.e. their expectations of the other road's manoeuvre was incorrect), while road users encountering a driver travelling above the speed limit was more likely to experience a failure in detection (i.e. did not think there was need for additional detection, so did not detect the speeding motorist until it was too late to avoid).

These findings imply that different solutions to prevent accidents involving these two types of speeding-related factors are needed. Road users would benefit from current and future technologies to help avoiding travelling at 'inappropriate speeds', including ABS, ESC, better advance warning/advisory signage, driver education, and in-vehicle technologies such as collision avoidance systems and advance warning systems. To alleviate illegal speeding or avoiding a collision with another road user illegally speeding, road users would also benefit from current and future technologies, including stricter enforcement of speed limits at high risk locations, improved education to new drivers, speed limiters in vehicles, and advance warning mechanisms to help avoid collisions with speeding motorists.

Also, this outlines the importance of ensuring that in future analysis, these two types of speeding-related factors are considered separately, as it has been shown from this work that that the failures behind 'inappropriate speeding' and 'illegal speeding' accidents and their characteristics are often not the same.

However, in terms of preventing both inappropriate speeding and illegal speeding, it may be possible in the future to alleviate both types of speeding at the same time. This could be achieved by introducing intelligent speed adaptation which not only keep the vehicle within the speed limit, but can also regulate the speed of the vehicle to safely negotiate bends and poor environmental conditions. However, in order to do this, a clear definition of inappropriate speeding would have to be developed which may involve more than just road geometry and weather/road conditions.

Table 4-16 gives an overview of the results obtained by the WP3 partners CIDAUT, LMU (TUG) and VSRC who analysed the causation factor 'speed' using their own databases, including suggestions for potential solutions based on the findings.

Factor	Partner	Method	Main question	Result	Potential Solution
Speed	CIDAUT (Spain)	Crosstabs	Environmental characteristics associated with "speed"- related accidents.	• Motorcycle • Vehicles less than 6 years old • Road alignment (bend/curve)	• Research and improvement of road alignment (visibility and curve degree), especially in country roads. • Research and development of in-vehicle systems: ADAS to warn the driver about driver's behaviour (e.g. Intelligent Speed Adaptation, Cornering Brake Control). • Educational campaign and training in risk perception and decision-taking and in riding abilities while negotiating a curve for motorcycle users.
Speed	TUG (Austria)		Which explanatory factor is associated with speed?	• Age (<44 years) • Gender (Male), • Lighting (Darkness) • Vehicle (Car/Van)	Efficient monitoring by police at night on specific points; driver education (how to deal with different road conditions, foresighted driving)

Inappropriate speeding	VSRC (UK)	General statistical overview	Which explanatory variables are more often associated with inappropriate speeding?	• Rural • Minor • Single carriageway • Not at intersection • No manoeuvre • Single car • Car drivers • Frontal impacts • 60mph (97kph) speed limit • Bends • Poor weather conditions • Poor road surfaces • Night (darkness) • Light density traffic • Young drivers (<25) • Male drivers.	Current solutions: ABS, ESC, better advance warnings on roadside (e.g. of bends in road; advisory speed limits) at higher risk locations which can also be seen at night. Better education for younger drivers about the dangers of inappropriate speeding as well as illegal speeding. Future solutions: In-vehicle devices which provide road users with advance notification of the road geometry/surface conditions ahead and also assists by automatically reducing the vehicle speed on approach.
Inappropriate speeding	VSRC (UK)	In-depth analysis sample of cases using WP5 methodology	What are the most typical failure generating scenarios in accidents where inappropriate speeding was a cause?	**Primary active** – P5A. Mainly detection-related failures, but also 'decision-making'(D2) and 'taking action (E1)'. ' **Non-primary active** – . Many road users were stationary, but for those who were not, T6Y	Advance warning devices to warn road users of hazards they may not have detected themselves (especially in a situation where they may not have expected a hazard to appear and/or thought that a 'detection' of the scene was not required) and therefore give enough time for the vehicle to slow down to a more appropriate speed. Also, collision avoidance devices.
Illegal speeding	VSRC (UK)	General statistical overview	Which explanatory variables are more often associated with illegal speeding?	• Minor roads • Single carriageway • No manoeuvre • Single car accidents • Car drivers • Frontal impacts • Low speed limit roads (30mph/48km/h) • Bends • Night (darkness) • Light density traffic • Young drivers(<25) • Male drivers	On lower speed limit roads, in particular at night, stricter enforcement of the speed limits. Better education of 'higher risk' road users of the dangers of driving above speed limit, no only for others, but for themselves. Speed limiters in vehicles of the most 'at risk' road users, the limiters working on 'higher risk' roads, especially at night
Illegal speeding	VSRC (UK)	In-depth analysis of sample of cases using WP5 methodology	What are the most typical failure generating scenarios in accidents where illegal speeding was a cause?	**Primary active** - No one specific scenario. However, diagnosis-related failures (T1 in particular) were most frequent. **Non-primary active** – P5A. Mainly detection failures.	Educating road users of the increased risk of making 'errors' when driving at high speeds. Speed limiters to stop road users from breaking the speed limit in the first place. Advance warning devices (and collision avoidance systems) to help road users avoid a collision with a speeding motorist.

Table 4-16 HUMAN Driving Task-Related Factor: Speeding

The results of the bivariate analysis of the WP8 data request returns from 7 TRACE partners generally were found not to contradict the results of the individual analyses undertaken by the TRACE WP3 partners. Male drivers were most prevalent, although for all 7 data sources in the bivariate analysis, the drivers were significantly more often under 25, while in the individual analysis undertaken by CIDAUT and TUG, the drivers were generally more likely under the age of 45.

In both the overall bivariate analysis and the individual analyses, cars, small goods vehicles and/or PTWs were found to be the most frequent vehicle type for speeding road users in accidents.

Bend (or curved) road was also similarly found in the bivariate analysis and also the individual analysis undertaken by CIDAUT.

'Country' road (i.e. not major national roads or motorway/autobahns) were the most prevalent road type found in the bivariate analysis and the Spanish (CIDAUT) & Austrian (TUG) data, while accidents in darkness was generally the more frequent than daylight accidents, although the time of day differed in the bivariate analysis (0000-0800) to the individual analysis undertaken using Austrian data (TUG) (1600-2300).

General conclusions which can be made from this extensive analysis of the causation factor 'speed' are:

- The typical characteristics of accidents involving speeding include young male road users, either driving cars, small goods vehicles or riding a motorcycle. The accidents generally involved front impacts from either impacting an immobile object on the road or running off the road, but also could involve a rollover. If the driver/rider was undertaking a manoeuvre, it was an overtake. However, going ahead on a straight or a bend was also prevalent. Generally, they occurred on minor roads but with a speed limit of >50kph, while the conditions were generally dark.
- The separate analysis of inappropriate speeding and illegal speeding undertaken by VSRC using the UK OTS data found subtle differences in the characteristics in the two types of speeding accidents.
- When inappropriate speeding was contributory, high speed rural roads with poor surface conditions during poor weather conditions were more likely, with the speeding road user more likely to experience a failure in perception (detection), especially in a situation where an encounter with a conflict was not expected (e.g. late detection of a vehicle unexpectedly slowing down ahead).
- When illegal speeding was contributory, low speed roads were more likely, with the speeding road user experiencing a failure in diagnosing the situation correctly, in particular a poor judgement of how to negotiate the road infrastructure ahead (e.g. bend in road, road works).
- Solutions to alleviate both inappropriate speeding and illegal speeding would include current and future technologies, such as ABS, ESC, improved roadside warning signs, in-vehicle technologies to advise on appropriate or legal speeds, speed limiters, plus educating new drivers of the dangers, plus stricter law enforcement to deter potential illegal speeding.
- In the future, both types of speeding could be prevented jointly by introducing technologies such as intelligent speed adaptation. However clear definitions of inappropriate speeding would be required to ensure that all types are considered by ISA.

4.5 Sudden technical defects

Accident data where 'sudden technical defects' was recorded as being contributory was made available from Germany (BASt). A cross-tabulation and logistic regression analysis was undertaken using all car accidents from the German data source where 'sudden technical defects' was a causation factor. In addition, results from the bivariate analysis of the requested data via WP8 is also given.

4.5.1 Results of WP3 partners analysis of the contributing factor 'sudden technical defects'

4.5.1.1 Germany (BASt)

The factor 'sudden technical defect' was analysed using available cases from the German in-depth data source 'GIDAS' by the WP3 TRACE partner BASt. All accidents where an acute technical defect was experienced by the road user are considered as accidents where the factor 'sudden technical defect' was present. From the 6621 passenger car accidents in the GIDAS database from 1999-2005, 31 had 'sudden technical defect' as a contributory factor.

Figure 4-6 shows the MI-values of some explanatory variables higher than 2% for the factor 'sudden technical defects'. For these variables the results of bivariate analysis are provided below.

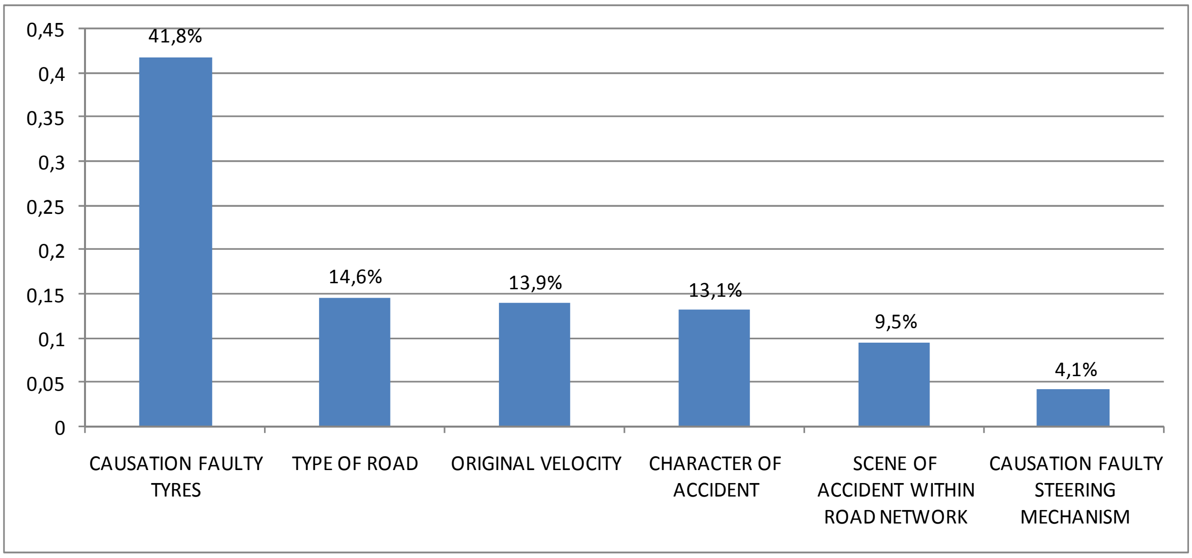

Figure 4-6 Results from mutual information analysis for the factor sudden technical defects

The variable with the highest MI-value (41,8%) is 'causations faulty tyres', which is true for a significant high part of the accidents were 'sudden technical defects' was a contributing factor.

The other technical defect which was given as causation in many accidents where 'sudden technical defect' was contributory was a faulty steering mechanism. 'Faulty steering mechanism' was identified as accident causation by the technical inspection of the accident survey team in 4 cases total. 2 of these cases were the accidents were 'sudden technical defects' resulted in an accident. This is significantly high compared to accidents were no sudden defect was involved.

The type of road is significantly different between accidents were sudden technical defects were involved compared to accidents where this was not true.

In accidents related to sudden technical defects the road type federal motorways (Autobahn) is significantly overrepresented whereas urban road are significantly underrepresented. The velocity range which is overrepresented in accidents were sudden technical defects were involved is above 100 km/h while low velocities (0 to 30 km/h), which are typical for urban roads, are underrepresented.

Bivariate of the character of accidents show that 'leaving road' and 'other' are overrepresented in accidents where 'sudden technical defects' were involved, whereas accidents while 'crossing' or 'turning' were underrepresented.

Most accidents related to sudden technical defects happen at straight part of the road while these kind of accidents at traffic nodes are significantly underrepresented.

The final selection of explanatory variables for the logistic regression analysis is shown in Table 4-17. The categories of the variables 'character of accidents' and 'type of road' were aggregated to new categories to reduce the complexity of the logistic model. The variable causation faulty steering mechanism was not considered in the model due to the low number of cases where this variable was coded true.

Variable	Aggregated category 1	Aggregated category 2	Aggregated category 3	Aggregated category 4
Character of accident	Crossing or turning	Leaving road	Other kind of accident	Others
Causation faulty tyres	True	False	-	-
Type of road	Federal motorways	Urban roads	Others	-

Table 4-17 Final Selection of explanatory variables for logistic regression analysis of factor sudden technical defects.

4.5.1.1.1 *Results of logistic regression analysis*

The results of the logistic regression analysis are provided in Table 4-18. The road type federal motorway is significantly overrepresented in accidents where sudden technical defects were involved. Delogarithmization of the model using the estimated coefficient of 1.12. shows that accidents were sudden technical defects are involved occur more than 3 times more often on federal highways compared to the reference category of road type. However, the road type urban roads did not show significant differences in the logistic regression compared to the reference type.

	Estimate	Std. Error	Pr(>|z|)
(Intercept)	-6,50	0,51	**< 0,01**
Type of road federal motorways	1,12	0,48	**0,02**
Type of road urban roads	-0,83	0,83	0,32
Character of accident crossing or turning	-0,77	1,12	0,49
Character of accident leaving road	1,04	0,51	**0,04**
Character of accident other kind of accident	1,41	0,84	0,09
Causation faulty tyres true	4,97	0,48	**< 0,01**

Table 4-18 Results of logistic regression analysis for factor sudden technical defects

The only category of the variable 'character of accident' which showed significant differences compared to the reference category were 'leaving the road' accidents which were significantly overrepresented in accidents where sudden technical defects contributed to the accidents. They were overrepresented by factor 2.8 compared to the reference category. The other category of 'character of accident' did not show result on significant level during the logistic regression analysis.

Furthermore the logistic regression showed on significant level that faulty tyres as accident causation is true rather than false by several factors more often in accidents were sudden technical defect were involved.

4.5.1.2 *Results of in-depth data request to all TRACE data providers*

From the WP8 data request to TRACE partners, Table 4-19 shows the statistical significant results for the types of characteristics more likely when a sudden technical defect was a contributory factor. As can be seen from this table, 3 partners in TRACE were able to provide data for sudden technical defect-related accidents, from 3 European countries.

Significant parameters for sudden technical problem	Czech national	GIDAS (Germany in-depth)	LAB (France in-depth)
Male ↑	Czech		
25-44 ↑		GIDAS	
truck >3.5t ↑	Czech	GIDAS	
Other type of impact ↑	Czech		
going straight ↑		GIDAS	
running off the road ↑	Czech		
Rural ↑	Czech	GIDAS	
Autobahn, National road ↑	Czech	GIDAS	
>100 km/h ↑		GIDAS	
50-100 km/h ↑			LAB
Day ↑	Czech		
Day ↓			LAB
8-15:59 ↑	Czech		
16-23:59 ↓		GIDAS	

Table 4-19 Results from the data request 3B calculations - parameter values showing associations for sudden technical problem related accidents (not multivariate)

What Table 4-19 shows is that significant results were mainly only found in the Czech and German data. When significant results were found, it revealed that in the Czech data only, the road user was more often male and in the German data, was more often between the ages of 25 and 44. Heavy goods vehicles (>3.5 tonnes) were more prevalent in both the Czech and German data.

In terms of the impact/accident type, an impact which was not at the front, rear or side (not further specified) was found to be most prevalent in the Czech data, while running off the road accidents were also found to be most frequent in the same data.

In terms of location, major (autobahn, national) rural roads were most prevalent in the Czech and German data, with speed limits of above 100kph on German roads. On French roads, the speed limit was more often between 50 and 100kph.

There was found to be discrepancies in the most frequent time of day the accident occurred between the data sources. In the Czech data, daytime accidents between the hours of 0800 and 1600 were most prevalent, whereas in the French data, daytime accidents were less prevalent. In the German data, accidents involving sudden technical defects were less prevalent between the hours of 1600-0000.

4.5.2 Summary, Discussion and Conclusions of the Analysis of the Factor 'sudden technical defects'

The results of the logistic regression analysis by BASt appear to show that accidents related to the factor 'sudden technical defects' seem to happen mainly at high speed (higher than 100 km/h) resulting in 'leaving the road' accidents. The reason could be that at lower speeds while crossing and turning, the driver can keep the vehicle under control when the acute technical defect occurs. It is also possible that technical defect are less likely to happen at lower velocities. At higher velocities the driver can not manage anymore to stop the vehicle safely and loses control which results in 'leaving the road accidents'. The road type motorway is significantly overrepresented. This directly connected with the high velocity as only on motorways velocities of more than 100 km/h are allowed.

The analysis also shows that tyre defects (e.g. blowouts) are mainly responsible for the main technical defects resulting in accidents related to sudden technical defects. This confirms the findings of a French (ASAF) study which was discussed in the literature review in TRACE Deliverable D3.1. It is interesting to note that although tyre defects themselves are a factor which affect the driving task rather than the trip as a whole, the reason for the tyre defect itself is will often be a result of a maintenance issue, which in turn is a trip-related factor (as defined in WP3).

Table 4-20 gives an overview of the results obtained by the WP3 partner BASt who analysed the causation factor 'sudden technical defects' using their own database, including suggestions for potential solutions based on the findings.

Factor	Partner	Method	Main question	Result	Potential Solution
Sudden Technical Defects	BASt (Germany)	Logistic Regression	Circumstances of accidents where factor sudden technical defects was contributing	• Causation faulty tyres↑↑ • Type of road: federal motorway ↑↑ • Leaving road accidents ↑↑	Frequent inspection of vehicle condition with focus on tyres.

Table 4-20 VEHICLE Driving Task-Related Factor: Sudden technical defects

The results of the bivariate analysis of the WP8 data returns from 3 TRACE partners regarding sudden technical defects generally were found to complement the results of the logistic regression analysis of in-depth German data undertaken by BASt. In both analyses, federal motorways were over-represented, as were accidents where the vehicle left the road. Also, the variables which were only included in the bivariate analysis in the BASt in-depth analysis were found to correlate with the WP8 data analysis. Rural roads were more prevalent in the WP8 analysed data, whereas urban roads were less prevalent in the BASt bivariate analysis. Roads with high speed limits (>100km/h) were over-represented in both analyses. In addition, the BASt analysis showed that faulty tyres were the main reason for the sudden technical defect, although a faulty steering mechanism was also a cause to a less extent.

The general conclusions which can be made from the analysis of available accident data where sudden technical defects were a cause are:

- The typical characteristics of accidents involving sudden technical defects include male drivers of HGVs between the age of 25 and 44 who were travelling straight but ended up running off the road. The road was a major (e.g. motorway) rural road with high speed limits, with the accident occurring during daylight hours, often between 0800-1600.
- The sudden technical defect itself was found to be caused by a faulty tyre, which in itself is generally a maintenance issue related to the whole trip (not just the driving task).
- The strongest links (i.e. through the logistic regression analysis of 31 German cases) was found to be with major roads (i.e. motorways), the vehicle leaving the road and faulty tyre itself.
- The results imply that sudden technical defects are more likely to contribute to an accident occurring in situations on high speed roads when the road user is less able to control their vehicle when a sudden defect, caused by a faulty tyre, occurs, leading to the vehicle leaving the road.
- As the cause of faulty tyres is often related to a maintenance issue, the most effective countermeasure would to ensure frequent maintenance inspections of vehicles, in particular tyres, especially before every long distance journeys where high speed roads are morel likely to be involved. Educating drivers on the importance of maintaining their vehicles would be the first step to prevention, but systems which inform the driver if maintenance on a part of their vehicle is required would also help. In the event of a sudden defect during driving, systems to assist the driver in keeping control of the vehicle so they can stop safely would be of use.

4.6 Dazzling sunshine

Accident data where 'dazzling sunshine' was recorded as being contributory was made available from Germany (BASt). A cross-tabulation and logistic regression analysis was undertaken using all car accidents from the German data source where 'dazzling sunshine' was a causation factor. In addition, results from the bivariate analysis of the requested data via WP8 is also given.

4.6.1 Results of WP3 partners analysis of the contributing factor 'dazzling sunshine'

4.6.1.1 Germany (BASt)

The factor 'dazzling sunshine' was analysed using available cases from the German in-depth data source 'GIDAS'. All accidents where the 'at fault' road user was dazzled by sunshine are considered as accidents where the factor 'dazzling sunshine' was present. From the 6621 passenger car accidents in the GIDAS database from 1999-2005, 41 had 'dazzling sunshine' as a contributory factor.

Figure 4-7 shows the MI-values of explanatory variables analyzed with the accident factor dazzling sunshine. Only variables with an MI-value higher than 2% were considered for bivariate analysis.

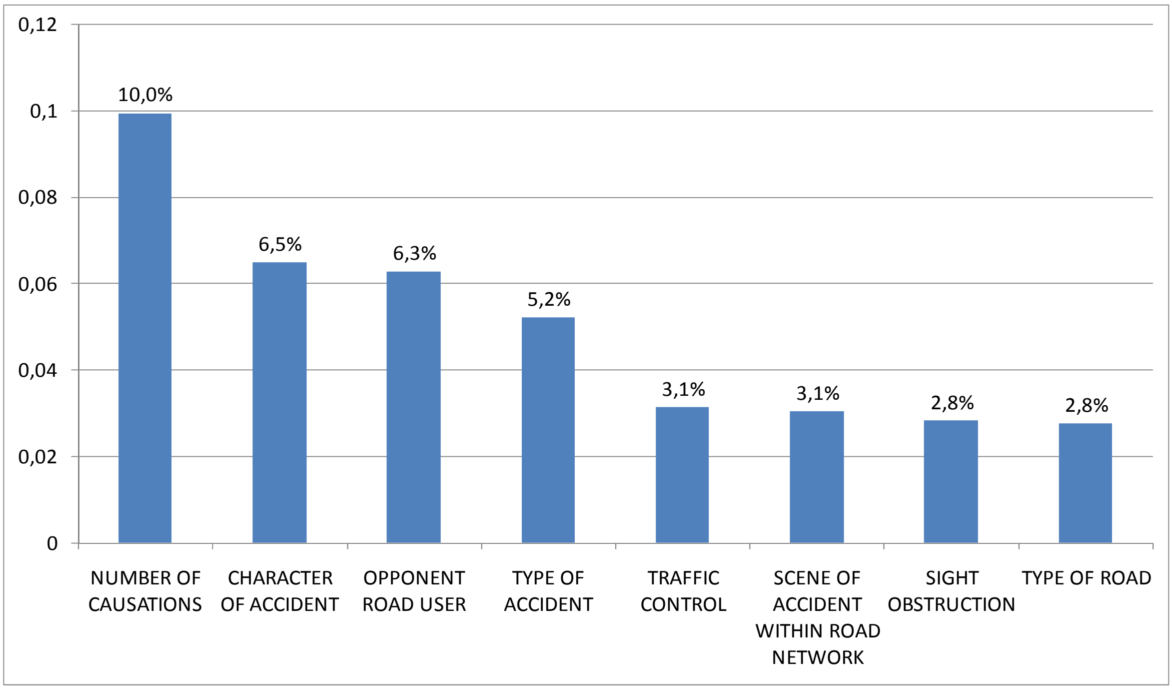

Figure 4-7 Results from mutual information analysis for the factor dazzling sunshine

The variable number of causations has a high MI-value (10%). This variable is significantly different for accidents where the factor dazzling sunshine was contributory compared to accidents where it was not present. A number of causations higher than one is overrepresented in accidents related to dazzling sunshine.

Also the variable 'character of accident' is different for accident where dazzling sunshine was a factor compared to the group of other accidents. Collisions with other vehicles moving ahead or waiting and moving laterally in the same direction are overrepresented. Also accidents with pedestrians are overrepresented in dazzling sunshine accidents.

The bivariate analysis of the variable type of accident gives similar results. Turning and crossing accidents as well as accidents with parallel moving road users are overrepresented within the accidents related to dazzling sunshine.

Cyclists, motorbikes and pedestrians are overrepresented when analysing the type of opponent in accidents where dazzling sunshine was contributory. This gives additional information to the results of the variable 'character of accident' in case the character of accident is not pedestrian accident the crossing or turning vehicle seem to be a cyclist or motorbike. In summary it can be said that vulnerable road users are highly overrepresented as collision opponent in accidents related to dazzling sunshine.

Accidents where the factor dazzling sunshine was involved happen mainly at traffic nodes whereas straight parts of the road are significantly underrepresented.

When analysing the results of bivariate analysis of the variable traffic control with respect to the factor dazzling sunshine, it seem that most accidents related to dazzling sunshine happen at parts of the road which are controlled by special infrastructure or traffic rules like traffic lights, zebra crossings, stop signs or intersections where give way rules apply.

Accidents where dazzling sunshine is involved mainly happen in urban road. All other types of road are underrepresented in these kinds of accidents.

In many accidents where the factor dazzling sunshine was contributory another sight obstruction was present while accidents without sight obstructions are significantly underrepresented.

Table 4-21 provides a list of the final selection of explanatory variables used for logistic regression of the factor dazzling sunshine. All variables were dichotomized to simplify the model. For all variables one specific category from the original categories was chosen as one category. All other original categories were summarized to 'others' (reference category).

Variable	Aggregated category 1	Aggregated category 2
Traffic control	Regulated	Others
Road network	Traffic node	Others
Sight obstruction	Sight obstruction	Others
Type of road	Urban roads	Others
Opponent road user	Vulnerable road user	Others

Table 4-21 Final Selection of explanatory variables for logistic regression analysis of factor dazzling sunshine.

4.6.1.1.1 Results of logistic regression analysis

Table 4-22 shows the results of the logistic regression analysis of the factor dazzling sunshine. The results of the variable 'traffic control' do not show significant differences between regulated and unregulated situations for accidents where dazzling sunshine was involved.

The analysis of the variable 'accident locating with road network' shows significant differences on 5% level between accidents at traffic nodes and other parts of the road network. Accidents related to dazzling sunshine seem to occur 3.25 times more often at traffic nodes compared to straight, bends and other road parts.

Accidents, where dazzling sunshine is a contributing factor, seem to happen 3.55 times more often when additional sight obstruction (like trees, walls, parking cars, fog) is involved compared to accidents without additional sight obstruction. The type of road 'urban roads' is overrepresented in accidents involving the factor dazzling sunshine. However, in the logistic regression analysis this results is not is not significant on 5% level.

The analysis clearly showed that vulnerable road users are overrepresented in accidents related to dazzling sunshine by a factor of 2.3 compared to other opponents like cars or objects. This result is highly significant.

	Estimate	Std. Error	$Pr(>\lvert z\rvert)$
(Intercept)	-6,90	0,49	**< 0,01**
Traffic control regulated	0,17	0,42	0,69
Road network traffic node	1,18	0,51	**0,02**
Sight obstruction sight obstruction	1,27	0,34	**< 0,01**
Type of road urban roads	0,68	0,37	0,07
Opponent road user vulnerable road user	0,85	0,40	**0,03**

Table 4-22 Results of logistic regression analysis for factor dazzling sunshine.

4.6.2 Results of in-depth data request to all TRACE data providers

From the WP8 data request to TRACE partners, Table 4-23 shows the statistical significant results for the types of characteristics more likely when dazzling sun was a contributory factor. As can be seen from this table, 4 partners in TRACE were able to provide data for dazzling sun-related accidents, for 3 European countries.

Significant parameters for dazzling sun	Czech national	BASt (Germany national)	GIDAS (Germany in-depth)	OTS (GB in-depth)
Female ↑		BASt		
45-64 ↑	Czech		GIDAS	
>65 ↑		BASt		
worker/employee ↑			GIDAS	
Car, Van, <3.5t ↑	Czech	BASt	GIDAS	
Frontal ↑	Czech	BASt	GIDAS	
hitting object (mobile -e.g. animal) ↑	Czech	BASt		
going straight ↑			GIDAS	
Rural ↓	Czech			OTS
Autobahn, National road ↓	Czech			
Country road ↑		BASt		
50-100 km/h ↑		BASt		
day ↑		BASt	GIDAS	
dusk/dawn ↑	Czech			
0-7:59 ↑	Czech			
8-15:59 ↑		BASt		
16-23:59 ↑	Czech			

Table 4-23 Results from the data request 3B calculations - parameter values showing associations for dazzling sun related accidents (not multivariate)

What Table 4-23 shows is that significant results were mainly found in 3 of the 4 data sources (Czech and the 2 German data sources). When significant results were found, these showed that, for the German (national) data only, the road user was more often female, with the age groups generally being over 45 years old (>65 in German national data).

Car and small goods vehicles were more often involved in the Czech and German data sources, and in these same sources, the most frequent type of impact was a frontal impact. In the Czech and German (national) data, the accident type involved impacting an mobile object, such as an animal, while in the German (national) data, the road user was more often going ahead and not undertaking a manoeuvre.

Rural major roads (i.e. autobahn/motorway/national road) were less prevalent in the Czech data, while in the German (in-depth) data, 'country' roads with speed limits between 50 and 100kph were the most frequent.

Accidents where dazzling sun was a cause were most prevalent during the day in both German data sources (between 0800-1600 in in-depth data), while in the Czech data, dusk/dawn was most prevalent between the hours of 0000-0800 and 1600-0000.

4.6.3 Summary, Discussion and Conclusions of the Analysis of the Factor 'dazzling sunshine'

The analysis of the factor 'dazzling sunshine' undertaken by BASt using German GIDAS data revealed interesting details about circumstances leading to an accident where the factor was involved.

The character of an accident related to dazzling sunshine was a collision with a vehicle crossing, turning, moving ahead or waiting. Also pedestrian accidents were overrepresented. Unlike in accidents where other factors were involved 'leaving road accidents' were underrepresented in accidents where dazzling sunshine was contributory. Also driving accidents as accident type were underrepresented whereas crossing and turning accidents were significantly overrepresented. This seems to be surprising as one might expect that dazzling sunshine would also lead to accidents where the driver in blinded by the sunlight on a rural road and does not see an upcoming curve which results in a 'leaving the road' accident: where the driver hit a tree. However, the analysis showed that this does not happen.

Accidents related to dazzling sunshine rather happen on urban roads at low velocities, at traffic intersections. Analysis of the variable 'opponent road user' shows the mainly cyclists, pedestrian, and motor bikes are the main opponents in collision where dazzling sunshine was a contributing factor. Thus the typical scenario leading to a dazzling sunshine related accident seems to happen as follows.

A driver is blinded by the sunlight and does not see other road users at intersecting while crossing or turning. These road users seem to be mainly vulnerable road user (VRUs), which are smaller than other vehicles and more difficult to see. Also the results of the variable 'traffic control' show that the sunlight causes problems while turning or crossing at controlled intersection with complex traffic control like zebra crossing or traffic lights are overrepresented in these accidents.

The analysis of the variable sight obstruction shows that the problems caused by the sunlight are increased when additional sight obstructions are present. This can be trees, bushes or parking cars blocking the view on pedestrian entering the road. This is also expressed by the variables 'number of causations' which shows that always more than on accident causation is necessary together with dazzling sunshine to cause an accident.

These results show that unlike in accidents related to the other driving task-related factors, which were analyzed in the study by BASt, high velocity seems not to be a problem in combination with dazzling sunshine. Rather a complex driving manoeuvre in combination with dazzling sunshine can result in accidents. To derive possible countermeasures, which address this kind of accidents, seems difficult. One possibility could be campaigns to raise the public awareness of this problem to increase the attention of drivers in complex situation at intersections when dazzling sunshine in present.

Factor	Partner	Method	Main question	Result	Potential Solution
Dazzling Sunshine	BASt	Logistic Regression	Circumstances of accidents where factor dazzling sunshine was contributing	• Accident at traffic intersection↑↑ • Additional sight obstruction↑↑ • Collision opponent: vulnerable road user↑	Raise public awareness towards the problem to increase driver attention in these situations.

Table 4-24 ENVIRONMENT Driving Task-Related Factor: Dazzling sunshine

Although different results were found in the logistic regression analysis compared with the more overall bivariate analysis, these results were found to complement each other rather than conflict.

For example, the logistics results revealed that there was a significant link between accidents where dazzling sunshine was a cause and the type of opponent road user involved in the accident, the road user specifically being a vulnerable road user (cyclists, motorcyclists and pedestrians). In the bivariate analysis, no information was given regarding the opponent road user, but the road user who was directly affected by the dazzling sun was found to be more likely a car or a small goods vehicle. The bivariate analysis also shows that accidents involving hitting a moving object was more prevalent. This correlates well with the results of the logistic regression analysis, as the moving object was often found to be vulnerable road user.

Although not significant, in the logistical regression results, accidents involving dazzling sun were found to be linked with urban roads, while in the overall bivariate analysis, rural roads were found to be les prevalent.

In the logistic regression results, dazzling sun accidents near intersections were more prevalent and involved sight obstructions, although in the bivariate analysis, the road user was found to be more likely to be going straight. However, if the road user was going straight at an intersection (with/without right of way), then these results would correlate, although because the results are aggregated, it is not possible to identify whether this is the case.

The general conclusions which can be made from the analysis of available accident data where dazzling sunshine was a cause are:

- The typical characteristics of 'dazzling sunshine' accidents were a female middle-aged (45-64) driver of a car or small goods vehicle, who has a frontal impact with a mobile object (i.e. a vulnerable road user) while going ahead at an intersection where there are additional problems with sight obstruction (e.g. trees, walls, parked cars). The road itself was more likely to be a non-rural, non-major road or roads with speed limits 50-100kph, and the accident more likely to be either during the day or dusk/dawn.
- The strongest links (i.e. through the logistic regression analysis of 41 German cases) with dazzling sun accidents was found to be at intersections with additional sight obstructions when the opponent road user was a vulnerable road user (pedestrian, cyclist, motorcyclist).
- The results imply that vulnerable road users are most at risk of being involved in an accident when a driver is dazzled by sun, in particular at intersections, where these type of road users are often already more difficult to detect, especially road users. The results also highlight the importance of good visibility for road users approaching intersections, in particular in urban locations where the use of intersection by vulnerable road users are at it's greatest.
- It is difficult to suggest potential solutions for preventing road users from being affected by dazzle from sun, apart from to suggest that windscreens are design to give some protection from the dazzle. However, indirect solutions may also help to reduce these situations. By improving the design of intersections in terms of visibility, in particular at intersections used a lot by vulnerable road users, this will give vehicle drivers a better chance of detection in the first place. Where improved visibility is not possible, one suggestion would be to include systems in vehicles which can assist the road user to locate the most difficult to detect vulnerable road users, in case their vision is suddenly reduced by dazzle.

5 Overall discussion of analysis of driving task associated factors

The aim of the analysis performed in TRACE Task 3.4 was to gain a better understanding of the characteristics of accidents that are caused by driving task-related factors, that is, factors which are 'directly and causally contributing to the accident occurrence, very specific and detailed, are short-term lasting or dynamic in nature, and refer to the actual conditions of the components' (TRACE D3.1).

From the numerous driving task-related factors identified in Task 3.1 of TRACE, the following factors were chosen for analysis:

- Attention
- Sudden health problems
- Speed (including 'inappropriate speeding' and 'illegal speeding')
- Sudden technical defects
- Dazzling sunshine

The results of the analysis undertaken by each partner within WP3 identified the main characteristics of accidents where each of these factors were contributory and also gave suggestions for ways to prevent these sort of accidents from occurring. The type of methods of prevention varied from education methods, regulatory methods (e.g. control and law enforcement), vehicle-related methods (active and passive safety features, see also D6.1 and D4.1.5) to road infrastructure and traffic-related methods.

By analysing the explanatory variables as circumstances for the above contributing factors, more effective prevention efforts can be recommended.

The circumstances of accidents as described by explanatory variables comprise time (e.g. advice when to intensify prevention efforts), place (e.g. sites for controls in general, sites for infrastructural improvement), situations/manoeuvres/scenarios (which active safety device could be apt) and target groups (drivers and vehicles).

Depending on the results only limited but reliable recommendations can be given for most of the analysed factors. However, the most detailed results (due to data availability and frequency) were given for the driving task-related factors 'attention' and 'speed'.

5.1 Attention

The driving task-related factor 'attention' was studied by CIDAUT using Spanish data and the results implied that monotonous situations (i.e. not at an intersection) were more likely to lead to poor attention in the driver. Also, drivers were more likely to be undertaking an illegal manoeuvre when attention was low. As the data does not specify whether this illegal manoeuvre was intentional or not, it could be a possibility that the illegal manoeuvre was a direct result of the lack of attention. For example a driver is not paying attention to the road and overshoots a junction or crosses into the opposing carriageway or even turns the wrong way up a one-way road.

In addition, drivers who had active safety systems in their vehicles were more likely to be inattentive when involved in an accident. This implies that an active safety system in a vehicle leads to a greater likelihood of a driver being less attentive, which is possible if the driver believes they don't have to concentrate as much on the aspect of the driving that the active safety system undertakes. This is a behavioural adaptation issue. This may also be another reason why illegal manoeuvres are more likely with inattentive drivers, because they believe they can take more risks because the active safety system will help them control their vehicle. Alternatively, it should be considered that active safety systems will be fitted mostly in new and recent vehicle models which may be driven by people who have a different, possibly lower risk taking propensity to the drivers of older vehicles. These suggestions regarding active safety systems are therefore speculative and because of the lack of detail regarding the type of active safety systems involved in these accidents, this result should be considered with caution, as it is highly likely that the benefits of the presence of active safety systems outweigh these possible side effects, bearing in mind this analysis only included 66 cases.

It was also possible, using the results of the TRACE WP5 analysis of the factor 'attention' by INRETS, to identify the typical failures experienced by road users in accidents where attention problems were experienced. In over half of the accidents studied, attention-related problems were found to contribute to the accident. Overall, perception (detection) failures were found to be most vulnerable to problems with attention, being either directly or indirectly causative, where 'focalised acquisition of information' was the most frequent failure in detection. Unlike vigilance problem (see D3.3), failures when attention is a contributory factor occur in combination with other explanatory elements (attention-related and non-attention-related). Of the three types of attention analysed, inattention was found to be the most contributory and was mainly found to affect the information acquisition (detection) stage and the road difficulty diagnosis stage. 'Competition for attention' mainly resulted in perception (detection) failures involving the focalised acquisition of information and 'distraction' mainly resulted in perception (detection) failures or failures when taking action, in both cases where the driver has taken their eyes of the road due to the distraction, resulting in the driver becoming aware of an impending 'situation' too late to be able to avoid it.

When supplementing this information with the aggregated data related to 'attention' accidents supplied from across 5 European countries, the type of road users, vehicles, locations, accident/impact types and the time of day varied across the data sources. The main reason for this is probably due to the varying nature of 'attention' itself, as found in the analysis of French data using the TRACE WP5 methodology. Therefore, it is important to ensure that when investigating accidents where attention was thought to be a cause, that the variations found in this analysis are investigated separately, and that when trying to decide on potential solutions to the problems of attention, that all types are considered.

Because attention is strongly related to the human in the system, the most effective solutions to reduce problems in attention when driving must be aimed at the driver. Drivers need to be supported and where possible educated to increase their awareness of and minimise risks from the dangers of driving while not fully being attentive on the task in hand and to be aware of the ways in which low attention of the driving task can manifest itself (e.g. when the driver has a lot on their mind or when they are distracted by another task/person/object not directly related to the driving). Competition for attention is not a problem of a low attention on the driving task, but more a problem with the complexity of the multiple tasks that the driver is sometimes faced with when on the road. Competition for attention could be between two aspects related to the vehicle (e.g. looking at the dashboard lights while trying to demist the windscreen), the external environment (e.g. trying to look for directions while also trying to follow the curve of the road) or a combination of both. Where there is a risk of one driving task taking over the attention of another part of a driving task, systems which take over one of these tasks for the driver would alleviate the problem for the driver so they can concentrate on the other. In both the in-vehicle and external environment, competition for attention can also be reduced by improved design of both the vehicle and the highway itself (making roads and vehicles more supportive and 'self-explanatory') , to reduce the chances of competition for attention occurring in the first place. In addition, consideration should also be given to the increased introduction of eSafety and information systems into vehicles, which could carry potential for competition for attention and distraction, depending on whether or not it is related to the driving process.

5.2 Speed

Speed was investigated in total by 3 TRACE WP3 partners: CIDAUT (Spain) and LMU (TUG – Austria), using the logistic regression analysis to investigate accidents involving speed as a cause in general and by the VSRC (UK), giving a statistical overview but mainly using the TRACE WP5 methodology to investigate inappropriate speeding and illegal speeding separately. Road users will travel at high speeds both intentionally and unintentionally. The intentional reasons could include because the road user is in a hurry to reach their destination or they enjoy driving fast (ERSO, 2007) and it can unintentionally happen because of either the design of the road or the vehicle. The analysis undertaken by the TRACE WP3 partners investigated these issues further.

Motorcycles less than 6 years old and curves (bends) were found to have the greatest link in accidents involving speed as a causation factor in the Spanish data. It is not surprising that speed accidents involving newer vehicles were found to be more likely than in accidents where speed was not involved, in particular motorcycle accidents, as advances in technologies have led to higher performance vehicles, which means that vehicles are capable of travelling at greater speeds, even if it is against the law. These reasons are often due to the road user feeling more 'comfortable' at the wheel of their vehicle, so they feel like they are travelling slower than the really are. Also, if a road user is already travelling at a high speed (whether illegal or inappropriate), the added factor of negotiating a bend in the road is only going to increase the risk of the road user losing control. It is often the presence of the curve itself which makes the speed the road user is travelling at suddenly become too fast. The design of roads could also make a driver feel like they are driving slower than they are (i.e. speed inciting), which leads them to approach a curve too fast.

In the logistic regression analysis undertaken using Austria data (TUG), the characteristics most likely to be involved in an accident where speed was contributory were male drivers under the age of 45, with darkness conditions and cars/vans associated to a lesser degree. Here, different types of characteristics were associated with speeding, more related to the road user themselves and the environmental conditions. However, slightly conflicting results were found with the type of vehicle. Whereas in the Spanish (CIDAUT) research, motorcycles were more involved in speeding accidents, in this research, it is cars and vans.

In the aggregated data analysis of 7 European data sources from 5 European countries, the results appeared to complement the results of the individual analyses. There was found to be a general split between either motorcycles or cars/vans having the most significant link with speeding accidents, which were the two main types of vehicles found in the individual analyses. Male drivers of all ages under 45 were most prevalent, while smaller (i.e. not major) roads were most involved, which involved bends, and occurred during darkness.

The main aim of the analysis of UK OTS data undertaken by the VSRC was to compare accidents involving inappropriate speeding with those involving illegal speeding using an overall statistical analysis of data and also an analysis of a sample of cases using the TRACE WP5 methodology. In the statistical overview, many of the typical characteristics found in the logistic regression analysis undertaken using Austrian and Spanish data were found for both types of speeding (e.g. male drivers (although <25), cars, bends, darkness). In addition, differences were found between two types of speeding, these being that environmental conditions and high speed roads were more prevalent in inappropriate speeding accidents, whereas low speed roads were more prevalent in illegal speeding accidents. This implies that driving over the speed limit is more likely to occur on roads with lower speed limits and it appears to be 'easier' for road users to go over the speed limit when it is low, especially if it is unintentional (i.e. not looking at the speedometer). However, on high speed roads, road users are more likely to lose control because of environmental conditions, before even reaching the speed limit, which explains the inappropriate speeding.

The WP5 methodology analysis showed that inappropriate speeding occurs most often in accident scenarios involving a detection (perception) failure, especially in a situation where an encounter was not expected. For example, a typical scenario might involve a road user who was travelling close to the speed limit when the vehicle in front starts to brake because they are turning into a private driveway. The road user does not initially detect the vehicle braking because they weren't expecting a vehicle to brake suddenly at this point in the road, so by the time they start to brake, it is too late to avoid a collision. As can be seen from this example, inappropriate speeding appears to more often occur in situations where the road user is not expecting to encounter a 'conflict', therefore when a conflict does occur, they do not detect it (because they are not searching for it) until it is too late to avoid.

Illegal speeding was more often involved in accidents scenarios where the road user failed to diagnose a situation correctly. In these scenarios, the road user often failed to diagnose the situation correctly, often the road layout (e.g. bend) ahead. Therefore, as opposed to road users who are speeding inappropriately, road users who are illegally speeding have detected a potential conflict but fail to correctly judge this conflict, so are unable to safely deal with it (mainly due to the excessive speed) once they do encounter it.

Interestingly, differences were also found between road users in inappropriate and illegal speeding accidents who were not the speeding drivers (i.e. the 'non primary active road users). Those who encounter a road user who is speeding inappropriately fail to predict the actions of this road user (i.e. assume the other road user will take regulatory action), while those who encounter a road user illegally speeding failed to detect the speeding road user until it was too late too avoid (i.e. was not expecting a 'conflict' so didn't search for one).

The overall view of a 'typical' speeding accident was one involving a male motorcycle rider or car/van driver under the age of 45, with a relatively new vehicle, travelling on a bend (curve) of a non-major road at night. When travelling too fast for conditions the road user, who was travelling on high speed roads in degraded conditions, often failed to detect an unexpected potential conflict, while those travelling above the speed limit failed to correctly evaluate a potential conflict while travelling on low speed roads.

To reduce the risk of an accident occurring in these types of conditions, education of drivers about the dangers of both illegal and inappropriate speeding would again be the simplest but not always the most effective preventative measure, mainly due to many drivers' unchanging attitude towards speeding. A considerable challenge is therefore to achieve a change in the driving culture so that speeding is no longer considered to be acceptable. Such a change in culture has been shown to be possible with regard to alcohol in some countries and the challenge is now to make a similar change for speeding. Elements of a wider policy on cultural change might include police patrols of 'high risk' locations (i.e. where speeding appears to occur the most) and stricter penalties would help to deter those who consistently illegally speed. For road users who want to avoid unintentional speeding, in-vehicle systems could be used to warn drivers or even take control when their speed is either over the legal limit or unsafe for the external conditions, as well roadside signage advising on appropriate speeds. Technology which helps to keep control of the vehicle in during 'accidental' inappropriate speeding on bends and poor road conditions. However, in order to prevent drivers who intentionally drive fast, more obtrusive measures would have to be applied, such as speed limiters, in particular on roads where illegal speeding is more frequent (i.e. on urban roads with low speed limits). Collision avoidance devices would help other road users to avoid errant speeding vehicles, whether it be inappropriate or illegal. As with attention, although these active safety devices can help in reducing the likelihood of a collision or loss of control, consideration should also be given to the potential of systems inspiring greater driver confidence, which in itself may encourage greater speed.

The remaining driving task-related factors which were analysed in this study were analysed by one TRACE partner each, who had enough accident cases to be able to undertake a valid analysis of the factor in question.

5.3 Sudden health problems

The driving task-related factor sudden health problems was investigated using German GIDAS data by the TRACE partner BASt. Using the 119 accidents that were identified with sudden health problems as a contributory factor, it was found that there was more likely to be older road users (>65 years old) who had pre-existing health problems, who were originally travelling at a velocity of greater than 60kph on motorways, which resulted in their vehicle running off the road. Most of these characteristics are directly linked to the sudden health problem itself and probably increase the risk of the sudden health problem occurring in the first place (i.e. older drivers who have a pre-existing medical condition) Run-off the road accidents are inevitable because the road user would not be able to keep any control over their vehicle once their sudden health problem had taken effect and even if the road user was physically able to try and control their vehicle during the sudden health problem, the likelihood of being able to keep control would be reduced on high speed roads such as motorways.

Additional to these characteristics, the aggregated data analysis using data from 3 European countries provided by 3 TRACE partners also found that accidents where sudden health related problems were a cause involved bicycles, 'going ahead' manoeuvres, which led to impacting an immobile object, and occurred during daylight. It is not clear while accidents involving bicycles were found to be more prevalent in sudden health-related accidents. One suggestion could be that as drivers get too old to drive, they travel by bicycle as an alternative. However, no other clear reasons could be given, apart from that possibly there are two typical scenarios involving sudden health problems. One involving an older driver on a major road who is unable to control their vehicle at the high speed when their conditions starts to deteriorate, so the vehicle runs off the road. The second involves an older cyclist in an urban location who suffers from a sudden health and they also are unable to control their cycle and therefore run off the road.

Two main prevention measures were identified for sudden health problems in accidents. Regular health checks for drivers above the age of 65 would help to identify potential health risks while driving before they occur, while in-vehicle systems which would assist a driver to stop in the event of losing control due to a health problem.

5.4 Mobile phone use

Analysis of mobile phone use as a driving task-related factor was also undertaken by the TRACE partner BASt using German GIDAS data. Using the 72 accidents where mobile phone use was contributory, a bivariate analysis was undertaken, but from this, the only accident characteristics which were found to correlate highly with mobile phone use were related directly to the mobile phone use itself (e.g. driver profession, purpose of journey). Therefore, because of this, and because of the low number of accidents in the aggregated data from other European countries, mobile phone use was not considered further in this study. However, due to the nature of mobile phone use, in that it is a form of distraction, many of the findings of the analysis of accidents where attention was a factor could also be associated with mobile phone use as well.

5.5 Sudden technical defects

Sudden technical defects as a driving task-related factor was another factor analysed by BASt using German GIDAS data. Using 31 accidents which has sudden technical defects as a contributory factor, the logistic regression analysis undertaken showed that presence of sudden technical defects were more likely to occur in accidents on motorways when the defect was a tyre defect, where the vehicle ended up leaving the road. In addition, the bivariate analysis of aggregated data of 3 data sources from 3 European countries additionally revealed that males, drivers of HGVs, between the ages of 25 and 44, those who were travelling straight but ended up running off the road during daylight hours were overrepresented.

It is interesting to note that the main result of the sudden technical defect was a faulty tyre, which in many cases will be a maintenance issue that is trip related rather than task-related. This is one good example of where one trip related factor can lead to another factor which is more related to one part of the driving task rather than the trip as a whole. Behind many driving task-related factors, there will be a more deep-rooted causal factor either at the trip level or even further back at the societal level.

As a sudden technical defect is a maintenance issue, this would be the most effective way of reducing these sudden defects while driving. Regular inspections of vehicles, in particular company goods vehicles when on long journeys involving high speed roads, including tyre maintenance, should be essential and even enforced (if not already) to ensure vehicles are fully roadworthy before starting the journey. Where sudden defects occur which are not maintenance-related (e.g. tyre blowout due to sharp object), driver assistance systems which aid the driver in keeping control of their vehicle in such a situation would also help. It should, however, be borne in mind that accident investigations for research are inherently more likely to record externally visible vehicle defects, such as tyre or lighting problems, rather than internal defects such as faults with brake or steering, due to time and resource limitations. It is therefore possible that results shown here may underestimate such problems.

5.6 Dazzling sun

Analysis of dazzling sun as a driving task-related factor was undertaken by BASt using German GIDAS data (41 cases) and found that dazzling sun was overrepresented in accidents at intersections, where the road user's sight was obstructed and where the opponent road user was a vulnerable road user. Additional results from the bivariate analysis of aggregated European data of 3 countries from 4 TRACE partners where dazzling sun was most prevalent included the road user being female, older than 45 years, in a car or small goods vehicle, impacting a mobile object, going straight and on urban roads during twilight or daylight.

As this analysis shows, dazzle from sun can result in drivers not being able to see road users who at best are not always easy to detect, these being pedestrians, cyclist and motorcyclists. This is mainly an issue when drivers are crossing an intersection, whether they have right of way or not, and are further impaired by poor visibility caused by roadside objects or vehicles blocking the view.

As it is difficult to stop glare from sun in the first place, indirect countermeasures to the problem of dazzling sun would possibly be the most simple method of reducing the risk. Countermeasures such as improved road design, in particular at junctions with poor visibility issues, and also in-vehicle detection systems which can detect pedestrians and other vulnerable road users in the vicinity of the vehicle, would help to reduce the chance of an impact in the event of dazzle by sun. Technologies to reduce the effect of dazzle on windscreens would also be of benefit. Further research might usefully investigate if dazzle from the sun is a common problem at specific road locations with a view to making recommendations for road safety audit procedures and guidelines for infrastructural modifications at high risk sites.

5.7 Overview

The following two tables (Table 5-1 and Table 5-2) shall give a general overview of the characteristics of accidents that are caused by the analysed driving task-related contributing factors and, in following on from this, suggestions for countermeasures to prevent accidents where these factors are contributory. Further, in table 5-2 the maximum relevance (frequency as found by the results of the data request 3A in Task 3.1 of the TRACE Project) of the factors in the databases that are available to the TRACE Partners is documented.

NB – The driving task-related factor, ‘mobile phone use’ has not been included in the following tables due to the limited findings produced in this study.

contributing factor	who is predominantly affected	where is it predominantly contributing	when is it predominantly contributing	other circumstances predominantly occurring/present
Attention	Male/Female <25, 45-64 years Cyclists Pedestrians Car/small goods vehicle drivers	Not at intersection Rural/Urban Major roads High/low speed limits (<50->100kph)	Daylight/ darkness, 0000-1600	Frontal/other impacts, run off the road, hitting immobile object, going straight, illegal manoeuvre, active safety system **Functional Failures:** ***Inattention:*** 'Detection' or 'Diagnosis' ***Competition for attention***: 'Detection' ***Distraction***: 'Detection' and 'Taking Action'
Speed (including Inappropriate and Illegal)	Motorcyclists, Car/Van drivers, Male, <45 years	Bends, Rural, Non-major roads ***Inappropriate:*** Rural high speed roads (97kph) Degraded road surface, *Illegal:* Low speed roads (48kph)	Darkness, 0000-0800, ***Inappropriate:*** Degraded weather	Vehicle <6 years old Frontal impacts, Hitting immobile object, Rollover, Run off the road accident, Overtaking, Going ahead, **Functional failures:** ***Inappropriate:*** 'Detection' (perception) ***Illegal:*** Diagnosis
Sudden health problems	>65 years Pre-existing medical condition, Unemployed/ pensioner, Cyclist	Urban, Motorways	Daytime, 0800-0000	Run off the road accident, Hitting immobile object, Going ahead, Other impact (not front/side/rear)
Sudden technical defects	Male, 25-44 years, Truck driver (>3.5t)	Rural, Motorway, Roads with speed limits >50kph	Daytime/Not daytime, 0800-0000	Vehicle with faulty tyres, Run off the road accident, Going ahead, Other impact (not front/side/rear)
Dazzling sunshine	Female, >44 years, Employed, Car/small good vehicle driver	Intersection, Urban, Non-major road, 50-100kph speed limits	Daytime, Dusk/Dawn, All hours	Opponent road user is vulnerable road user, Frontal impact, Hitting mobile object, Going ahead, Sight obstruction

Table 5-1 Summary of characteristics for driving task-related factors contributing to accidents

contributing factor	prevention by education/law enforcement (human) (target groups/sites/times)	prevention by (active) safety measures (vehicle) and vehicle design	prevention by improvement of infrastructure/ "environment"	% of accidents in databases available to the TRACE Partners affected by contributory factor
Attention	Educating better awareness of dangers of poor driving habits related to different types of attention, in particular monotonous and dangerous situations	Improved vehicle design so that controls and displays are 'self explanatory' to reduce likelihood of competition for attention, Automated systems in vehicle to reduce competition for attention, Collision Warning, Collision Avoidance, Intelligent Speed Adaptation.	Improved road design (i.e. 'self explaining') to reduce competition for attention,	Inattention: Up to 40% Distraction: Up to 37%
Speed (including Inappropriate and Illegal)	Means to bring about cultural changes. Driver education to highlight dangers of both illegal speeding and inappropriate speeding, Stricter enforcement of speed limits, in particular patrols at 'high risk' locations for young (<45) males in cars and on motorcycles (i.e. low speed roads)	Driver assistance systems which inform the road user of the appropriate speed to travel for the terrain. Intelligent Speed Adaptation, Lane Keeping Assistance, Electronic Stability Control, Brake Assistance, ABS Active Cruise Control Collision Avoidance for road users encountering an errant speeder Night Vision	Clear roadside signage to warn drivers of impending bend in road and advise on safe travel speed	Illegal: Up to 14% Inappropriate: Up to 41%
Sudden health problems	Regular health checks for risk group: elderly drivers and drivers with relevant pre-existing medical conditions.	System which can help to 'take over' and 'guide' a vehicle to a safe stop in the event of a detected 'drift', similar to 'Driver Drowsiness Detection' Lane Keeping Assistance Brake Assistance Electronic Stability Control	No suggestions possible	Up to 5%
Sudden technical defects	Frequent inspection of vehicle condition with focus on tyres Educating drivers on the importance of regular vehicle maintenance	Tyre Pressure Monitoring and Warning Systems Other 'vehicle condition' warning systems Lane Keeping Assistance Brake Assistance Electronic Stability Control	No suggestions possible	Tyre failure: Up to 5% Vehicle failure: Up to 12%
Dazzling sunshine	Raise public awareness towards the problem to increase driver attention in these situations.	'Anti- dazzle' on windscreens 'Vulnerable Road Users Protection' system Collision Avoidance Collision Warning Brake Assistance	Intersection design: good visibility in locations with high usage of vulnerable road users	Up to 3%

Table 5-2 Summary of preventative measures for driving task-related factors contributing to accidents

6 Conclusions and Outlook

Driving task-related factors are by definition 'directly and causally contributing to the accident occurrence, very specific and detailed, are short-term lasting or dynamic in nature, and refer to the actual conditions of the components'. Using two main methods of analysis to analyse a selection of these driving task-related factors (a statistical-level analysis and the TRACE Work Package 5 methodology), the results enabled, for each driving task-related factor, a pattern of accident characteristics to be established in terms of explanatory variables, which could distinguish and therefore define types of accidents, supplemented, where possible, by the main causes of failure in the situations identified.

From the driving task-related factors analysed, the most comprehensive findings were regarding factors 'attention' and 'speed', which is directly correlated to the occurrence of accidents involving these factors. The remaining factors were found to be less frequently occurring, but it was still possible to identify some interesting findings in the analysis.

The driving task-related factor 'attention' was found to be a complex factor which involved a variety of road users at various locations and times in a variety of situations. However, attention (or lack of) was found to have the greatest effect at non-intersections (i.e. monotonous situations), when a road user was undertaking an illegal manoeuvre or the road user's vehicle had an active safety system. It was also found that inadequate attention more often led to failures in detection (perception), although failures in diagnosis were also frequent during inattention and distraction failures frequent during distraction. It is clear from the data analysed that the main danger of inadequate attention is that drivers fail to detect a potential impediment to the progress of their journey, whether they are carrying out a task related or unrelated to the driving. Certain situations such as monotonous journeys or over-reliance on in-vehicle safety systems (possibly due to behavioural adaptation) may lead to drivers unintentionally undertaking an illegal manoeuvre such as overshooting a junction or crossing into an opposing carriageway. Drivers should be educated on the dangers arising from inattention, but also be supported by in-vehicle technologies which can reduce the need for drivers to have to multi-task. Vehicle and highway design should where possible be simplified to make them more 'self-explanatory'. But at the same time, when introducing new in-vehicle safety systems, caution should be noted about the potential for increased distraction, information overload (competition for attention) and overreliance on technologies. It would be unfortunate if promising new in-vehicle safety systems encouraged drivers to adapt their behaviour to drive with less attention or faster in inappropriate circumstances.

Speed, although less complex than attention, was found to be a considerable issue in many accidents across the available European data sources. Typical characteristics of speeding accidents involved male drivers of cars/vans and riders of motorcycles up to the age of 45 years old being the most prevalent, involving also accidents on non-major roads on bends at night. However, motorcycles (of less than 6 years old) and bends were found to have the strongest link with speed. Inappropriate speeding in particular was more likely during degraded road and weather conditions on high speed roads, and involved a greater number of failures in detection (perception) in situations where an encounter was not expected (so the driver or rider did not search for 'danger'). Illegal speeding differed in that it occurred on low speed roads and more often involved a greater number of failures in diagnosis, in particular with regards to correctly diagnosing the road layout (e.g. a bend). Countermeasures such as driver education, more stringent law enforcement, speed limiters, roadside advisory speed signs, in-vehicle assistance technologies (new and current such as ESC, ABS) all have the potential to reduce the occurrence of both kinds of speeding. However, as with attention, consideration should be given to the effects of introducing such in-vehicle safety systems into vehicles, which may inspiring greater driver confidence, which in itself may adapt behaviours and encourage greater speed.

Due to the fact that in the bivariate analysis, the only accident characteristics significantly related to mobile phone use were related to the mobile phone use itself, this factor was not considered further in the analysis. Also, as it was considered to be a type of 'distraction', the results for attention could be related to mobile phone use.

Sudden health problems were mainly found to be a cause in accidents where the road user was over the age of 65, where the road user had a pre-existing medical condition, in urban locations but also on motorways during daylight conditions. Cyclists were also found to be prevalent. The main methods of prevention would be for regular health checks for older drivers and cyclists and for drivers; and in-vehicle vehicle control systems which can detect a loss of control and take over and possibly guide the vehicle to a safe stop.

Sudden technical defects were most prevalent in male young-mid age truck drivers (25-44 years old) on high speed rural roads during both day and night conditions, where tyre defects were present, which resulted in the vehicle leaving the road. As one of the main causes of the sudden defect was found to be related to the tyre, regular maintenance inspections, in particular of tyres and especially before long journeys involving high speed roads, would be the main countermeasure to reduce these sudden vehicle deteriorations. Sudden deteriorations could still occur even with regular checks, therefore in-vehicle monitoring and warning systems would help in these situations, as would vehicle control devices such as ESC.

Dazzling sun was found to most likely occur when car drivers were female (>44 years old), at an intersection with a sight obstruction and resulted in an impact with a vulnerable road user, who are more difficult to detect even in non-dazzle conditions. As dazzle itself is difficult to prevent, unless it is possible to introduce 'anti-dazzle' technology for windscreens, indirect countermeasures would currently be the most effective, including 'object' detection and collision warning devices to reduce the likelihood of an impact with a vulnerable road user.

Overall, when driving task-related factors are a cause in an accident, it appears that road users are caught by surprise by the sudden change in events and are unable to deal with the situation in hand. In most of the situations analysed, it appears to be the driving task-related factor itself that is the main factor that leads to the deterioration in the situation. In other words, without these driving task-related factors, it is possible that the accident would not have occurred. This is the nature of driving task-related factors, as they have an immediate effect on the road user. In order to prevent many of the driving task-related factors from occurring in the first place, other factors further back in the chain of events (i.e. trip and social/cultural) would need to be dealt with. Therefore, by preventing factors at a trip or social/cultural level, it might be possible to also prevent the factors at a driving task level.

It has been possible, using the two main types of analysis in this study, to identify not only the most 'typical' characteristics of accidents where driving task-related factors are involved (using the statistical logistic regression analysis), but also to identify the main reasons for what went wrong in the accidents where these driving task factors and their associated characteristics, are present (using the TRACE Work Package 5 methodology analysis). As opposed to providing conflicting views about these accidents, the findings produced using both methods have been complementary, and where both methods have been used to investigate the same factor, an even more detailed view of the accident process was produced. Unfortunately, due to the lengthy Work Package 5 methodology recoding process when used for retrospectively study of accident files, only two factors were analysed using both methods. However, for future accident analysis, the use of both methods to obtain a detailed picture of accident situations involving either driving task-related factors or other type of factors is recommended.

As can be seen from the results of analysis many of these driving task-related factors, in particular sudden health problems and sudden technical defects, are a direct result of factors at a trip level. The link found between factors at a driving level and other levels being investigated in WP3 (trip, Social/cultural) shows that it could be of future interest to take each specific driving task factor (e.g. speed) and analyse it's effects throughout all 3 levels investigated in this Work Package. However, in order to do this, more work would need to be undertaken to harmonise the type data collected at the scene, as it would be difficult to undertake this using retrospective data.

Harmonisation of data across data sources across Europe, using for example the Work Package 5 methodology, would also help make a more Europe-wide view of the causes of accidents at a driving task level more achievable. In this analysis, much variation was found in the type of data collected between the existing data sources, including definitions of specific factors and also the level to which they are recorded in accident databases. This made it difficult to be able to harmonise results found in this report and fully represent the European situation, although this was successfully managed to some degree, despite the limitations outlined. It has been shown that analysing accident causation at a 'harmonised' level, especially when only aggregated data is available, can be a significant challenge. The harmonisation of accident causation data across Europe, such as the work being undertaken in other European projects (e.g. SafetyNet), will enable accident causation analysis to be taken to another level and allow for an even more detailed analysis of the accident causation issues across Europe as a whole.

Many of the findings given in this study will often be related to the exposure of the road user to these situations. Another aim of this study was to try and locate exposure information relevant to the results found in the in-depth analysis of driving task-related factors so that an attempt could be made to evaluate the risk of the different situations identified. For example, as many of the driving task-related accidents occurred on specific types of roads (e.g. speed accidents on rural roads), relevant information was sought. However, no directly relevant exposure information could be located which could be compared with the accident data to permit risk calculations to be made.

This study has shown the benefits of using a unique human factors methodology such as the one used in this study, which was developed in TRACE Work Package 5. It has also highlighted further the need for a common accident causation methodology such as this, which could be developed further and usefully be taken forward into further projects across Europe. However, one limitation has been that it is difficult to use on existing accident data, but would be an extremely useful and innovative method to use when analysing new cases.

It must be noted that a selection of 6 key driving task-related factors were considered for analysis in this study, to enable a more detailed analysis to be undertaken of each. It would be of interest in further studies to consider further driving task factors to identify whether similar results were found.

The analysis covered in this study is discussed further in TRACE Deliverable D3.5, where the analysis is brought together with the analysis of factors at a trip and social/cultural level to give an overall view of analysing accidents from a factors point of view as a whole.

Acknowledgements

The Trace Partners have access to national and in-depth databases. The results presented in this report are based on the work performed by the according organisations keeping the databases.

No guarantee can be given on the correctness of the interpretations of the results. The conclusions drawn might not reflect the views of the organisations and partners, respectively.

The OTS project is funded by the UK Department for Transport and the Highways Agency. The project would not be possible without help and ongoing support from many individuals, especially including the Chief Constables of Nottinghamshire and Thames Valley Police Forces and their officers. The views expressed in this work belong to the authors and are not necessarily those of the Department for Transport, Highways Agency, Nottinghamshire Police or Thames Valley Police.

In the early 1990s, the LAB (Laboratoire d'Accidentologie de Biomécanique et de comportement humain PSA Peugeot Citroën – Renault) pooled resources with the state-funded INRETS (Institut National de REcherche sur les Transports et leur Sécurité) in a common active safety research program – VSR (Véhicule et Sécurité Routière). 4 teams of investigators were called out to injury accident scenes by the emergency services to collect real-time crash data (approximately 60 accidents per team per annum). In 1999, at the end of this joint program, the two partners chose different but complementary directions. The LAB began to evaluate the effectiveness of new safety systems, whereas the INRETS continued developing its driver failure model. The LAB has since adopted this model and included it in the ongoing in depth accident investigation program.

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Annex I Speed

Speed – data request 3A result

database	% of accidents in data sample	exact variable name
SISS ELASIS	0.1%	driving without respecting the speed limits
IDIADA-SCT	0.9%	exceeding speed
Czech Republic	1.3%	speed higher than determined by traffic sign/speed higher than according to traffic rules
GIDAS BASt	1.4%	speeding (exceeding max. speed limit)
BASt	2.9%	unadapted speed and exceeding at the same time the speed limit
TNO Trucks	4.0%	High speed
STATS 19	5.0%	exceeding speed limit
LAB	14.6%	excessive speed
database	**% of accidents in data sample**	**exact variable name**
IDIADA ETAC	1.3%	excessive speed
LAB	4.0%	inappropriate speed
IDIADA-SCT	7.1%	inappropriate speed for conditions on the road
SISS ELASIS	8.8%	driving with exceeding speed
STATS 19	11.6%	going to fast for conditions
GIDAS BASt	12.5%	inappropriate speed
CIDAUT	14.9%	inadequate velocity
INRETS	16.3%	choose of a too high vehicle speed for the situation
TNO MAIDS 2001	17.3%	speeding
DIANA	21.7%	speeding
Czech Republic	25.9%	unadaption of speed to traffic density/visibility(weather,lights)/vehicle,load/road state/road geometry/gusty side winds/other
OTS	26.6%	excessive speed
BASt	28.0%	unadapted speed in other cases
TNO MAIDS 2000	29.2%	speeding
TNO EACS	40%	speeding
HIT	41%	excessive speed

Relative representation in database

database	Contributory factor reported in accident	RR	key word	
GIDAS_in-depth	inappropriate speed	28,4	inappropriate speed	fatal RR
Monash_Australia_in-depth	Speeding or using speed excessive for conditions	13,9	exceeding speed limit	fatal RR
GIDAS_in-depth	inappropriate speed	13,8	inappropriate speed	RR
IDIADA_Catalonia_national	Inappropriate speed for conditions on the road	13,7	inappropriate speed	fatal RR
CIDAUT_in-depth	3.1. Speeding.	10,8	exceeding speed limit	fatal RR
LAB_in-depth	Excessive speed	9,7	exceeding speed limit	fatal RR
SISS_Italy_in-depth	Driving with exceeding speed	8,40	exceeding speed limit	RR
CIDAUT_in-depth	3.1. Speeding.	7,71	exceeding speed limit	RR
TUG_Austria_in-depth	Speed (high)	6,1	exceeding speed limit	fatal RR
SISS_Italy_in-depth	Driving with exceeding speed	6,1	exceeding speed limit	fatal RR
LAB_in-depth	Excessive speed	5,77	exceeding speed limit	RR
GIDAS_in-depth	speeding (exceeded max. speed limit)	5,7	exceeding speed limit	fatal RR
HIT_in-depth	Excessive speed	5,5	exceeding speed limit	fatal RR
Stats_GB_national	Going too fast for conditions	5,2	inappropriate speed	fatal RR
IDIADA_Catalonia_national	Inappropriate speed for conditions on the road	4,91	inappropriate speed	RR
BASt_Germany_national	12 and exceeding at the same time the speed limit	4,5	exceeding speed limit	fatal RR
OTS_in-depth	Excessive speed	4,43	exceeding speed limit	RR
OTS_in-depth	Excessive speed	4,3	exceeding speed limit	fatal RR
IDIADA_Catalonia_national	exceeding speed	4,2	exceeding speed limit	fatal RR
HIT_in-depth	Excessive speed	4,12	exceeding speed limit	RR
Stats_GB_national	Exceeding speed limit	3,9	exceeding speed limit	fatal RR
Stats_GB_national	Going too fast for conditions	3,89	inappropriate speed	RR
CIDAUT_Spain_national	Inadequate velocity.	3,1	inappropriate speed	fatal RR
MAIDS_NL_2000_in-depth	Speeding	2,78	exceeding speed limit	RR
LAB_in-depth	Inappropriate speed (related to weather, road surface, infrastructure…)	2,7	inappropriate speed	fatal RR
INRETS_in-depth	- Choose of a too high vehicle speed for the situation	2,47	inappropriate speed	RR
MAIDS_NL_2000_in-depth	Speeding	2,5	exceeding speed limit	fatal RR
CIDAUT_Spain_national	Inadequate velocity.	1,81	inappropriate speed	RR
Stats_GB_national	Exceeding speed limit	1,67	exceeding speed limit	RR
LAB_in-depth	Inappropriate speed (related to weather, road surface, infrastructure…)	1,59	inappropriate speed	RR
GIDAS_in-depth	speeding (exceeded max. speed limit)	1,50	exceeding speed limit	RR
BASt_Germany_national	12 and exceeding at the same time the speed limit	1,33	exceeding speed limit	RR

Data request 3B: results of preparation and calculation of OR

	Gender	OR	95% CI lower limit	95% CI upper limit
Czech	male	1,25	1,21	1,81
OTS	male	1,94	1,47	4,66
GIDAS	male	1,46	1,21	2,69
BASt	male	1,32	1,31	2,01
LAB	male	1,92	1,31	5,08

	Age group	OR	95% CI lower limit	95% CI upper limit
INRETS	<25	4,62	1,71	26,61
Czech	<25	1,69	1,64	3,15
OTS	<25	1,75	1,37	3,93
GIDAS	<25	1,67	1,41	3,43
BASt	<25	1,92	1,90	3,77
CIDAUT	<25	3,68	1,03	43,98
LAB	<25	1,88	1,28	4,94

	Vehicle group	OR	95% CI lower limit	95% CI upper limit
Czech	Car, Van, <3.5t	1,99	1,92	4,01
OTS	Car, Van, <3.5t	2,26	1,70	5,80
GIDAS	PTW	2,56	1,98	6,48
BASt	PTW	2,35	2,32	4,86
CIDAUT	PTW	3,30	1,51	15,48

	impact type multiple vehicle collision	OR	95% CI lower limit	95% CI upper limit
Czech	Other	3,50	3,40	7,21
OTS	frontal	2,09	1,55	5,30
GIDAS	frontal	2,42	1,92	5,97
BASt	frontal	3,11	3,06	6,44
LAB	frontal	3,48	1,92	12,40

	crash type single vehicle	OR	95% CI lower limit	95% CI upper limit
Czech	hitting object (immobile)	5,28	5,12	9,98
OTS	rollover	1,71	1,14	4,26
GIDAS	hitting object (immobile)	1,80	1,35	4,25
BASt	running off the road	2,94	2,89	6,11
CIDAUT	hitting object (immobile)	3,46	1,24	24,61

	manoeuvre	OR	95% CI lower limit	95% CI upper limit
INRETS	going straight	8,78	2,27	57,28
OTS	GOING AROUND BEND	8,37	6,57	15,77
GIDAS	going straight	5,22	4,32	11,06
CIDAUT	other	4,56	2,20	17,56
LAB	overtaking	3,14	1,78	11,03

	Location	OR	95% CI lower limit	95% CI upper limit

Czech	Rural	3,05	2,97	6,37
OTS	Rural	1,91	1,53	4,35
GIDAS	Rural	4,47	3,80	9,68
BASt	Rural	4,35	4,31	8,49

	Road type	OR	95% CI lower limit	95% CI upper limit
Czech	Country road	1,09	1,05	1,26
OTS	Country road RURAL	2,19	1,76	5,23
GIDAS	Country road	2,88	2,42	6,79
BASt	Autobahn, National road	1,67	1,65	3,06
CIDAUT	Autobahn, National road	0,51	0,94	0,12

	Speed limit	OR	95% CI lower limit	95% CI upper limit
OTS	50-100 40, 50, 60 MPH	2,02	1,63	4,72
GIDAS	>100	1,35	1,02	2,42
BASt	50-100	1,35	1,34	2,11

	light conditions	OR	95% CI lower limit	95% CI upper limit
Czech	dark	1,92	1,86	3,81
OTS	dark	1,78	1,41	3,94
GIDAS	dark	1,75	1,45	3,75
BASt	dark	1,93	1,91	3,78
CIDAUT	day	2,8	1,1	18,6

	time of day	OR	95% CI lower limit	95% CI upper limit
Czech	0-7:59	2,07	1,99	4,23
OTS	0-7:59	1,56	1,09	3,44
GIDAS	0-7:59	1,59	1,26	3,25
BASt	0-7:59	2,21	2,19	4,52
Czech	16-23:59	1,31	1,27	1,97
OTS	16-23:59	1,54	1,22	3,08
GIDAS	16-23:59	1,41	1,18	2,50
BASt	16-23:59	1,25	1,23	1,77

Summary

Method: Crosstabs with OR and 95% Confidence interval

Factor	Partner	Results from data request 3B
speed	INRETS	<25 ↑ going straight ↑
speed	Czech national	Male ↑ <25 ↑ Car, Van, <3.5t ↑ Other ↑ hitting object (immobile) ↑ Rural ↑ Country road ↑ Dark ↑ 0-7:59 ↑
speed	OTS	Male ↑ <25 ↑ Car, Van, <3.5t ↑ Frontal ↑ Rollover ↑ GOING AROUND BEND ↑ Rural ↑ Country road RURAL ↑ 50-100 40, 50, 60 MPH ↑ Dark ↑ 0-7:59 ↑
speed	GIDAS	Male ↑ <25 ↑ PTW ↑ Frontal ↑ hitting object (immobile) ↑ going straight ↑ Rural ↑ Country road ↑ >100 ↑ Dark ↑ 0-7:59 ↑
speed	BASt	Male ↑ <25 ↑ PTW ↑ Frontal ↑ running off the road ↑ Rural ↑ Autobahn, National road ↑ 50-100 ↑ Dark ↑ 0-7:59 ↑
speed	CIDAUT	<25↑ PTW↑ hitting object (immobile) ↑ other↑ Autobahn, National road ↓ day↑
speed	LAB	Male ↑ <25 ↑ Frontal ↑ Overtaking ↑

Table 0-1: VEHICLE Driving task-related factor: speed

Annex II Attention

Attention – data request 3A result

database	% of accidents in data sample	exact variable name
LAB	1.3%	inattention
IDIADA ETAC	4.3%	inattention
TNO MAIDS 2000	10.6%	Attention failure
INRETS	11.6%	low level of attention
TNO MAIDS 2001	17.3%	Attention failure
OTS	40.1%	Inattention

database	% of accidents in data sample	exact variable name
IDIADA ETAC	0%	external distraction
DIANA	0%	distraction outside vehicle
DIANA	0%	distraction in vehicle (use of mobile phone)
IDIADA ETAC	0.3%	internal distraction
LAB	0.9%	distraction (non driving task) and passengers (comfort, distraction)
STATS 19	1.5%	distraction outside vehicle
TNO MAIDS 2001	1.3%	passenger action distracted MC Rider
STATS 19	2.0%	distraction in vehicle
OTS	2.5%	Distraction through stress or emotional state of mind
Czech Republic	2.6%	external □nfluencing of the driver (except being dazzled, by action of other drivers, of wild animal)
OTS	3.1%	Distraction through physical object outside of vehicle
OTS	4.0%	Distraction through physical object on or in vehicle
INRETS	7.0%	internal distraction (thinking)
DIANA	34.8%	distraction in vehicle (not talking to other passengers/use of radio/use of mobile phone/smoking, drinking)
CIDAUT	37.7%	distraction

Relative representation in database

database	Contributory factor reported in accident	RR	
Stats_19 GB_national	Failed to look properly	10,6	RR
Monash_Australia_in-depth	Failed to observe other road user – requires statement by crash participant or eyewitness, not simply coders inference; e.g., driver day-dreaming, preoccupied with thoughts, chatting with passenger, reaching down, manipulating radio etc…handling food, removing items of clothing or attending to inappropriate unit/signs outside of vehicle (i.e., monitoring street signs, looking at vehicle other than the one struck, looking at scenery)	8,14	fatal RR
INRETS_in-depth	- Automatic driving: low attention level due to high experience of the trip (or ist monotony)	7,05	RR
OTS_in-depth	Inattention	6,78	RR
TUG_Austria_in-depth	Attentiveness	5,91	fatal RR
Stats_GB_national	Failed to look properly	5,43	fatal RR
Czech_national	external influencing of driver	5,37	fatal RR
CIDAUT_Spain_national	Distraction.	4,57	RR
Czech_national	external influencing of driver	4,56	RR
OTS_in-depth	Looked but did not see	4,32	fatal RR
OTS_in-depth	Distraction through stress or emotional state of mind	4,32	fatal RR
OTS_in-depth	Looked but did not see	3,98	RR
CIDAUT_Spain_national	Distraction.	3,93	fatal RR
OTS_in-depth	Failed to look	2,73	RR
LAB_in-depth	Mood (stress, preoccupation, anger…)	2,59	fatal RR
INRETS_in-depth	- Automatic driving: low attention level due to high experience of the manoeuvre	2,47	RR
OTS_in-depth	Inattention	2,16	fatal RR
OTS_in-depth	Failed to look	2,16	fatal RR
OTS_in-depth	Distraction through physical object outside of vehicle	2,16	fatal RR
Monash_Australia_in-depth	Extreme Emotional state – includes chronic or abnormal mental state (e.g., a history of psychiatric disorder, intellectual handicap, age-related dementia)	1,98	fatal RR
INRETS_in-depth	- Low level of attention (in ist psychological sense: affectation of attentional resources to driving task)	1,76	RR
LAB_in-depth	Mood (stress, preoccupation, anger…)	1,55	RR
INRETS_in-depth	- Internal distraction (thinking)	1,06	RR

Data request 3B: results of preparation and calculation of OR

	Gender	OR	95% CI lower limit	95% CI upper limit
Czech	female	1,07	1,02	1,22
OTS	female	1,34	1,08	2,27
LAB	male	1,98	1,21	5,94

	Age group	OR	95% CI lower limit	95% CI upper limit
Czech	45-64	1,11	1,06	1,36
OTS	<25	1,36	1,09	2,36
GIDAS	45-64	1,27	1,08	1,97
CIDAUT	45-64	2,47	1,03	13,81

	Vehicle group	OR	95% CI lower limit	95% CI upper limit
Czech	bicycle	2,44	2,32	5,18
OTS	pedestrian	2,27	1,63	6,09
GIDAS	pedestrian	5,76	3,91	13,89
CIDAUT	Car, Van, <3.5t	3,06	1,51	13,12

	impact type multiple vehicle collision	OR	95% CI lower limit	95% CI upper limit
INRETS	rear	0,18	0,63	0,00
Czech	Other	2,56	2,46	5,42
OTS	frontal	1,85	1,47	4,20
GIDAS	frontal	1,27	1,06	1,96
CIDAUT	frontal	0,19	0,71	0,00

	crash type single vehicle	OR	95% CI lower limit	95% CI upper limit
Czech	hitting object (immobile)	2,04	1,96	4,16
GIDAS	running off the road	1,43	1,03	2,81

	manoeuvre	OR	95% CI lower limit	95% CI upper limit
OTS	going straight	1,88	1,53	4,24
GIDAS	turning	2,85	2,34	6,84
GIDAS	crossing	9,05	5,63	19,48
CIDAUT	going straight	2,14	1,05	8,94
LAB	overtaking	0,20	0,67	0,00

	Location	OR	95% CI lower limit	95% CI upper limit
Czech	Rural	1,12	1,08	1,38
OTS	Urban	1,28	1,05	2,04
GIDAS	Urban	3,07	2,64	7,07

	Road type	OR	95% CI lower limit	95% CI upper limit
Czech	Autobahn, National road	4,74	4,32	9,59
OTS	Autobahn, National road MOTORWAY OR TRUNK ROAD	1,36	1,05	2,41
GIDAS	Country road	0,36	0,42	0,00

	Speed limit	OR	95% CI lower limit	95% CI upper limit
OTS	>100 70MPH	1,30	1,00	2,15
GIDAS	<50	1,35	1,08	2,32
CIDAUT	>100	2,40	1,16	10,57

	light conditions	OR	95% CI lower limit	95% CI upper limit
Czech	dark	1,12	1,07	1,38
OTS	day	1,38	1,12	2,42
GIDAS	dark	0,62	0,73	0,17
CIDAUT	dark	3,49	1,23	25,59
LAB	dark	3,0	1,8	9,6

	time of day	OR	95% CI lower limit	95% CI upper limit
Czech	0-7:59	1,29	1,23	1,94
GIDAS	0-7:59	0,61	0,74	0,16
GIDAS	16-23:59	0,75	0,87	0,40

Summary

Method: Crosstabs with OR and 95% Confidence interval

Factor	Partner	Results from data request 3B
attention	INRETS	Rear ↓
attention	Czech national	Female ↑ 45-64 ↑ Bicycle ↑ Other ↑ hitting object (immobile) ↑ Rural ↑ Autobahn, National road ↑ Dark ↑ 0-7:59 ↑
attention	OTS	Female ↑ <25 ↑ Pedestrian ↑ Frontal ↑ going straight ↑ Urban ↑ Autobahn, National road MOTORWAY OR TRUNK ROAD ↑ 50-100 40, 50, 60 MPH ↓ Day ↑
attention	GIDAS	45-64 ↑ Pedestrian ↑ Frontal ↑ running off the road ↑ crossing ↑ Country road ↓ <50 ↑ Dark ↓ 0-7:59 ↓ 16-23:59 ↓
attention	CIDAUT	45-64 ↑ Car, Van, <3.5t ↑ Frontal ↓ going straight ↑ >100 ↑ Dark ↑
attention	LAB	Male ↑ overtaking ↓ dark ↑

Table 0-2: HUMAN Driving task-related factor: attention

Annex III Sudden health problem

Sudden health problem – data request 3A result

database	% of accidents in data sample	exact variable name
IDIADA ETAC	0%	loss of consciousness
SISS ELASIS	0.2%	sudden illness
Czech Republic	0.3%	sudden physical indisposition
INRETS	4.7%	faintness

Relative representation in database

database	Contributory factor reported in accident	fatal RR %	key word	
Monash_Australia_in-depth	Blackout precrash, ill health or injury not related to taking of alcohol or drugs; e.g., non-fatal heart attack, asthma attack, includes effects of prior injury which reduced driving capacity	1,28	health status	fatal RR
MAIDS_NL_2000_in-depth	respiratory, cardiovascular	1,23	health status	fatal RR
BASt_Germany_national	04 Other physical or mental faults	1,08	health status	fatal RR
Stats_GB_national	Illness or disability	1,07	health status	fatal RR

Data request 3B: results of preparation and calculation of OR

	Age group	OR	95% CI lower limit	95% CI upper limit
Czech	>65	7,58	6,18	14,41
GIDAS	>65	1,86	1,13	5,44
LAB	>65	9,14	4,91	22,12

	occupation	OR	95% CI lower limit	95% CI upper limit
GIDAS	unemployed	2,32	1,12	10,14

	Vehicle group	OR	95% CI lower limit	95% CI upper limit
Czech	bicycle	3,04	2,40	7,52
GIDAS	PTW	1,99	1,13	6,59
GIDAS	bicycle	2,26	1,49	6,61

	impact type multiple vehicle collision	OR	95% CI lower limit	95% CI upper limit
Czech	Other	4,80	3,71	10,99
GIDAS	Other	2,57	1,14	13,05

	crash type single vehicle	OR	95% CI lower limit	95% CI upper limit
Czech	hitting object (immobile)	3,07	2,51	7,37

	manoeuvre	OR	95% CI lower limit	95% CI upper limit
GIDAS	going straight	2,69	1,77	8,09

	Location	OR	95% CI lower limit	95% CI upper limit
LAB	Rural	0,53	0,96	0,15

	Road type	OR	95% CI lower limit	95% CI upper limit
Czech	Country road	0,60	0,79	0,17

	light conditions	OR	95% CI lower limit	95% CI upper limit
Czech	day	2,15	1,63	5,41

	time of day	OR	95% CI lower limit	95% CI upper limit
Czech	0-7:59	0,51	0,69	0,07
Czech	16-23:59	0,51	0,64	0,06
GIDAS	16-23:59	0,58	0,85	0,16
LAB	16-23:59	0,39	0,82	0,04

Summary

Method: Crosstabs with OR and 95% Confidence interval

Factor	Partner	Results from data request 3B
Sudden health problem	Czech national	>65 ↑ Bicycle ↑ Other type of impact↑ hitting object (immobile) ↑ Country road ↓ Day ↑ 8-15:59 ↑
Sudden health problem	GIDAS	>65 ↑ Unemployed ↑ bicycle ↑ Other type of impact↑ going straight ↑ 16-23:59 ↓
Sudden health problem	LAB	>65 ↑ Rural ↓ 16-23:59 ↓

Table 0-3: HUMAN Driving task-related factor: sudden health problem

Annex IV Sudden technical problem

Sudden technical problem – data request 3A result

database	% of accidents in data sample	exact variable name
Czech Republic	0%	tyre wear out under prescribe value
INRETS	0%	blow out of tyre
SISS ELASIS	<0.1%	explosion or exceeding usury of tyres
Czech Republic	0.2%	tyre defect caused by shock or sudden decrease in pressure
OTS	1.8%	Tyre deflated before impact
TNO MAIDS 2001	2.7%	Tyre or wheel failure
TNO MAIDS 2000	5.3%	Tyre or wheel failure
database	**% of accidents in data sample**	**exact variable name**
Czech Republic	<0.1%	driving system failure
CIDAUT	0.6%	vehicle failure
TNO MAIDS 2000	0.9%	Steering failure
INRETS	2.3%	sudden mechanical breakdown
LAB	2.4%	mechanical defect
TNO MAIDS 2001	4.0%	brake failure
TNO Trucks	12.0%	mechanical defect

Relative representation in database keyword – sudden technical defects/vehicle condition

database	Contributory factor reported in accident	RR	key word	
GIDAS_in-depth	defects tyres	1,89	vehicle condition	fatal RR
LAB_in-depth	Mechanical defect	1,61	vehicle condition	fatal RR
Monash_Australia_in-depth	Critical vehicle malfunction or defect (record the malfunction / defect in the vehicle record)	1,40	vehicle condition	fatal RR

Data request 3B: results of preparation and calculation of OR

	Gender	OR	95% CI lower limit	95% CI upper limit
Czech	male	1,30	1,01	2,18

	Age group	OR	95% CI lower limit	95% CI upper limit
GIDAS	25-44	2,43	1,42	8,26

	Vehicle group	OR	95% CI lower limit	95% CI upper limit
Czech	truck >3.5t	3,81	3,17	8,73
GIDAS	truck >3.5t	3,03	1,48	13,15

	impact type multiple vehicle collision	OR	95% CI lower limit	95% CI upper limit
Czech	Other	3,03	2,49	7,26

	crash type single vehicle	OR	95% CI lower limit	95% CI upper limit
Czech	running off the road	2,65	2,56	5,59

	manoeuvre	OR	95% CI lower limit	95% CI upper limit
GIDAS	going straight	4,37	2,24	15,83

	Location	OR	95% CI lower limit	95% CI upper limit
Czech	Rural	2,22	1,86	5,12
GIDAS	Rural	3,40	2,07	10,87

	Road type	OR	95% CI lower limit	95% CI upper limit
Czech	Autobahn, National road	9,25	7,44	16,61
GIDAS	Autobahn, National road	3,74	2,28	11,66

	Speed limit	OR	95% CI lower limit	95% CI upper limit
GIDAS	>100	4,04	2,21	13,96
LAB	50-100	178,67	90,51	199,90

	light conditions	OR	95% CI lower limit	95% CI upper limit
Czech	day	2,09	1,66	5,00
LAB	day	0,32	0,69	0,01

	time of day	OR	95% CI lower limit	95% CI upper limit
Czech	0-7:59	0,52	0,68	0,08
Czech	16-23:59	0,70	0,84	0,30
GIDAS	16-23:59	0,57	0,99	0,18

Summary

Method: Crosstabs with OR and 95% Confidence interval

Factor	Partner	Results from data request 3B
Sudden technical problem	Czech national	Male ↑ truck >3.5t ↑ Other type of impact ↑ running off the road ↑ Rural ↑ Autobahn, National road ↑ Day ↑ 8-15:59 ↑
Sudden technical problem	GIDAS	25-44 ↑ truck >3.5t ↑ going straight ↑ Rural ↑ Autobahn, National road ↑ >100 ↑ 16-23:59 ↓
Sudden technical problem	LAB	50-100 ↑ Day ↓

Table 0-4: HUMAN Driving task associated factor: sudden technical problem

Annex V Dazzling sun

Dazzling sun – data request 3A result

database	% of accidents in data sample	exact variable name
SISS ELASIS	*0.1%*	*dazzled (and driving with dazzling light against other vehicle)*
GIDAS BASt	0.2%	dazzle, glare
BASt	0.9%	dazzling sunshine
Czech Republic	1.0%	dazzled by sun
OTS	1.8%	Glare from sun
STATS 19	2.1%	Dazzling sun
LAB	3.4%	luminosity (bright sunlight, reflections)
INRETS	*23.3%*	*temporal inconvinience of for visibility (sun, other vehicle)*

Relative representation in database

database	Contributory factor reported in accident	RR	key word	
LAB_in-depth	Luminosity (bright sunlight, reflections…)	2,24	visibilty and view obstruction	fatal RR
LAB_in-depth	Luminosity (bright sunlight, reflections…)	1,34	visibilty and view obstruction	RR

Data request 3B: results of preparation and calculation of OR

	Gender	OR	95% CI lower limit	95% CI upper limit
BASt	female	1,14	1,09	1,45

	Age group	OR	95% CI lower limit	95% CI upper limit
Czech	45-64	1,27	1,10	1,96
GIDAS	45-64	1,71	1,16	4,22
BASt	>65	2,03	1,91	4,18

	occupation	OR	95% CI lower limit	95% CI upper limit
GIDAS	worker/employee	1,78	1,18	4,60

	Vehicle group	OR	95% CI lower limit	95% CI upper limit
Czech	Car, Van, <3.5t	1,66	1,41	3,38
GIDAS	Car, Van, <3.5t	2,45	1,54	7,64
BASt	Car, Van, <3.5t	2,32	2,18	4,95

	impact type multiple vehicle collision	OR	95% CI lower limit	95% CI upper limit
Czech	frontal	1,25	1,04	1,92
GIDAS	frontal	2,43	1,62	7,08
BASt	frontal	1,22	1,14	1,72

	crash type single vehicle	OR	95% CI lower limit	95% CI upper limit
Czech	hitting object (mobile -e.g. animal)	1,56	1,35	3,00
BASt	hitting object (mobile -e.g. animal)	7,52	5,72	15,03

	manoeuvre	OR	95% CI lower limit	95% CI upper limit
GIDAS	going straight	16,28	11,89	25,80

	Location	OR	95% CI lower limit	95% CI upper limit
Czech	Rural	0,82	0,94	0,54
OTS	Rural	0,37	0,96	0,05

	Road type	OR	95% CI lower limit	95% CI upper limit
BASt	Country road	1,29	1,23	1,94
Czech	Autobahn, National road	0,13	0,39	0,00

	Speed limit	OR	95% CI lower limit	95% CI upper limit
BASt	50-100	1,39	1,32	2,27

	light conditions	OR	95% CI lower limit	95% CI upper limit
Czech	dusk/dawn	1,99	1,54	4,79
GIDAS	day	5,85	2,93	19,08
BASt	day	40,33	34,96	49,62

	time of day	OR	95% CI lower limit	95% CI upper limit
Czech	0-7:59	1,27	1,07	1,99
Czech	16-23:59	1,17	1,01	1,58
BASt	0-7:59	0,63	0,68	0,17
BASt	16-23:59	0,72	0,75	0,30

Summary

Method: Crosstabs with OR and 95% Confidence interval

Factor	Partner	Results from data request 3B
Dazzling sun	Czech national	45-64 ↑ Car, Van, <3.5t ↑ Frontal ↑ hitting object (mobile -e.g. animal) ↑ Rural ↓ Autobahn, National road ↓ dusk/dawn ↑ 0-7:59 ↑ 16-23:59 ↑
Dazzling sun	OTS	Rural ↓
Dazzling sun	GIDAS	45-64 ↑ worker/employee ↑ Car, Van, <3.5t ↑ Frontal ↑ going straight ↑ day ↑
Dazzling sun	BASt	Female ↑ >65 ↑ Car, Van, <3.5t ↑ Frontal ↑ hitting object (mobile -e.g. animal) ↑ Country road ↑ 50-100 ↑ Day ↑ 8-15:59 ↑

Table 0-5: ENVIRONMENT driving task-related factor: dazzling sun