

Analysis of causes of accidents with vulnerable road users with the ACASS system, using GIDAS case examples

M. Jänsch, D. Otte

Accident research Unit, Medical University Hanover

Accidents with vulnerable road users require special attention within the road safety work because these accidents are often accompanied with severe injuries. Thus In 2006 at least 6200 Powered Two Wheeler (PTW) riders were killed in road crashes in the EU 25 representing 16% of the total number of road deaths while accounting for only 2% of the total kilometers driven [1]. For the prevention of accidents with VRU above all the knowledge of the causes of the accidents is of special importance.

This study is based on the methodology of the German In-Depth Accident Study GIDAS. Within GIDAS extensive data on various fields of accidentology are collected on-scene from road traffic accidents with injuries in the Hannover and Dresden area. Using a well defined sample plan the collected data is highly representative to the whole German situation (Brühning et al [2], Otte et al [3]). The need of in-depth accident causation data in accident research led to the development of a special tool for the collection of such data called ACASS (Accident Causation Analysis with Seven Steps), which was implemented in the GIDAS methodology in 2008 and described by Otte in 2009 [4].

ACASS System

Accident causation factors of traffic accidents can be divided in to three different groups: Human factors (group 1), factors from the vehicle technology (group 2) and factors from the driving environment and/or from the infrastructure (group 3). These groups describe the first number of the ACASS code. The core of this system however is based on the analysis of human factors (Figure 1) as human factors yield over 90% of the causes of traffic accidents [5]. The analysis of the human factors is achieved by describing the human participation factors - and failures of these - in a chronological sequence from the perception to concrete action/operation. This is done by considering the logical sequence of basic human functions when reacting to a request for reaction. In addition to the Information access (1) these 6 basic human functions are Observation (2), Recognition (3), Evaluation (4), Planning (5), Selection of operation (6) and the Operation (7) itself, where the participant can have an error when accomplishing the driving task [6]. These functions provide the 7 subcategories of human causes (group 1) and are described by the second number of the code (Figure 1). The causes from each of the seven categories of the basic human functions may be further specified by subdividing them into their characteristics (influence criteria) and from there further into specific indicators of these characteristics (e.g. *distraction from inside the vehicle* as a characteristic of an *observation-error* and *the operation of devices* as an indication for *distraction from inside the vehicle*). In doing so the human causes of accident participants can be adequately described independently of the amount of information available by using a four digit code.

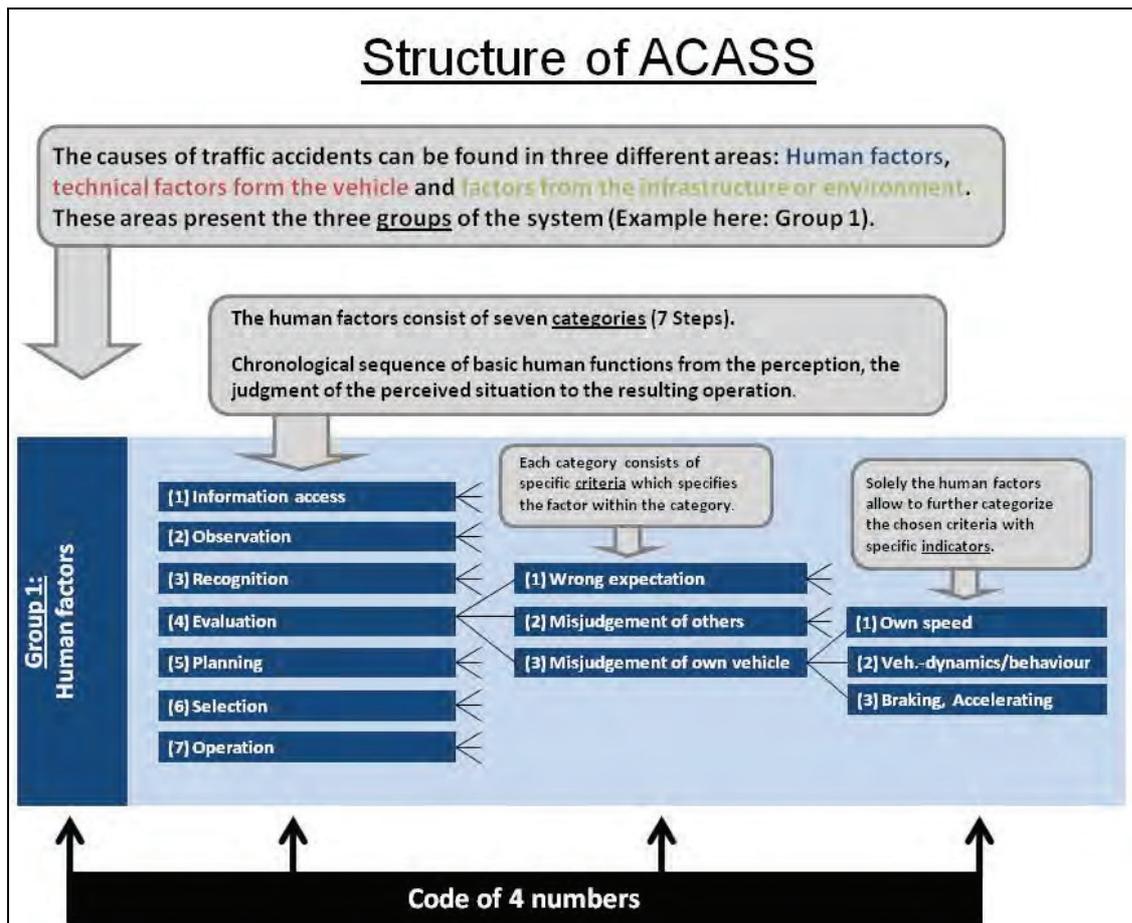


Figure 1: Structure of ACASS with subcategories – exemplarily demonstrated on Group 1 (human factors).

With ACASS a system was developed, which also provides a tool, especially for on-scene accident causation investigations. Due to their injury situation especially two-wheel riders are not very often able to answer questions about the accident circumstances. Considering this special issue within a request procedure of accident causation analysis, a multiple step of interview process related to time is needed after the accident, which can be done with ACASS. The interview of accident participants can be conducted effectively and in a structured way (both: on scene and also later by questionnaires) by asking dedicated questions to each human category, in a sequence of the course of the accident, beginning with the information access in the situation of the accident and ending with the executed action. In addition to the coding the chosen case examples will show this approach when interviewing the accident participants.

Case examples

Two accident cases involving vulnerable road users which were collected for the GIDAS project are used to display the application of ACASS as used within GIDAS. Exemplarily these cases will demonstrate how typical accident causation factors of vulnerable road users are identified by the research team in an interview and subsequently are coded in the database.

Case 1

During day time a 34 year old rider of a scooter is driving along a straight urban road with tram rails in the middle of the road. The road surface is wet. As the rider begins to pass a parked car he runs over the wet rails and subsequently loses control over his scooter and falls on the road (Figure 2).



Figure 2: Accident pictures of first case example

Interview and Causation coding of the case using ACASS

To obtain the accident causation information the rider of the scooter was questioned in hospital. Initially asked about the accident occurrence the rider stated that he wanted to pass a parking car, went on the rails and lost control over his scooter. He said that he saw the rails but did not think that it was so slippery on the rails. From this information a structured interview along the 7 categories of human causes was conducted. The rider stated that at all time he could see everything and that his view was not obstructed by anything. Therefore no code from the first category (Information access) is relevant in this case. Asked about being distracted, tired or under the influence of substances (Category 2 – Observation) he stated that he was not distracted by anything and was riding attentively. Further asked, the riders also stated that he had recognized all the relevant information (Category 3 - Recognition) such as the parking car, the rails and also the fact that the road surface was wet. In the course of the interview the rider was then asked if he had made a correct evaluation of the situation (Category 4 - Evaluation) concerning the expectation at the accident place, of the behaviour of other road users or concerning speed or behaviour of the own vehicle. Here he stated that he did not expect his scooter to react so “nervously” on the wet rails. Hence a first accident causation factor was found in category 4 of the human factors. No more human failures were identified in the further course of the interview: Concerning to the category 5 – Planning, a correct plan or a different manoeuvre could not have been made as the evaluation of the situation in the first place was based on an incorrect assumption (as coded in the previous category); Concerning the categories 6 – Selection of the operation and 7 – Operation it is unclear if a better reaction or operation could have avoided the accident.

Therefore the fact that the driver thought that his scooter could manage the wet rails can be seen as the cause of the accident. When coding this accident cause (Figure 3), the first classification is that this cause is a human failure (Group 1). Within the human factors there are the seven categories from the information access to the operation. The failure of the rider can be allocated to Category 4 (Evaluation) as he observed and recognized everything correctly but made a wrong interpretation or evaluation of the vehicle dynamics of the scooter. Category 4 of the human factors is subcategorized in three different criteria. The relevant Criteria in this case is Criteria 3 (Misjudgement concerning own vehicle). Here the correct indicator within this criteria is Indicator 2 (Driving behavior - dynamics). Thus the correct code of the chosen case example is 1432.

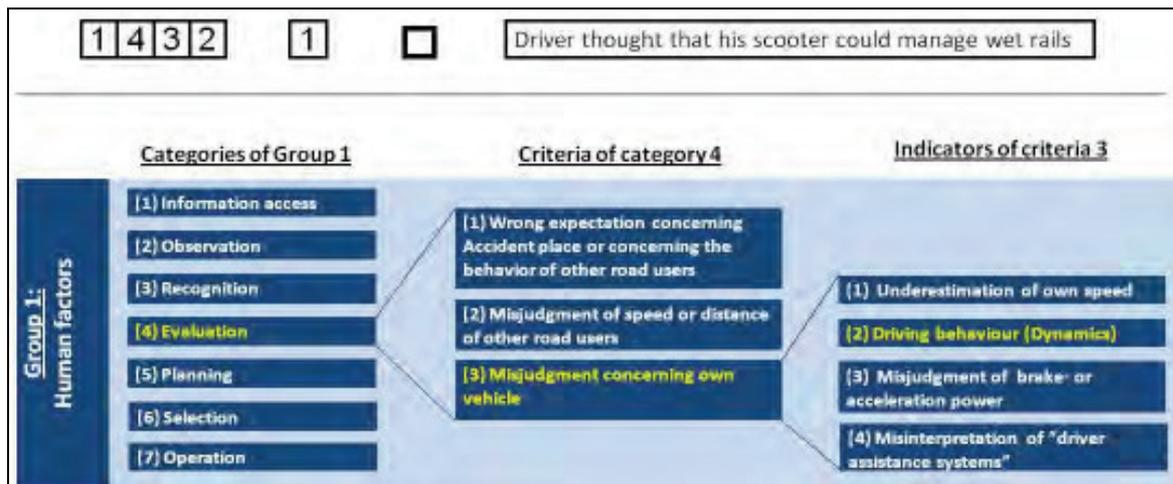


Figure 3: Coding of case 1

The second case displays an accident where typical factors of motorcycle accidents come in: The rider of the motorcycle was overlooked by a car driver and in addition the rider of the motorcycle contributed to the emergence of the accident by driving above the speed limit.

Case 2

Coming from a parking lot under a bridge the 21 year old driver of a VW Vento and his passenger want to turn left to enter an urban road with one-way traffic. Hence the driver has to give way to the traffic from the right. However he fails to see a motorcycle coming from the right and enters the road. As the rider of the motorcycle sees the Vento entering his path he immediately begins to brake but cannot avoid the collision with the Vento. The accident occurred during day light with good visibility, the road surface was dry.

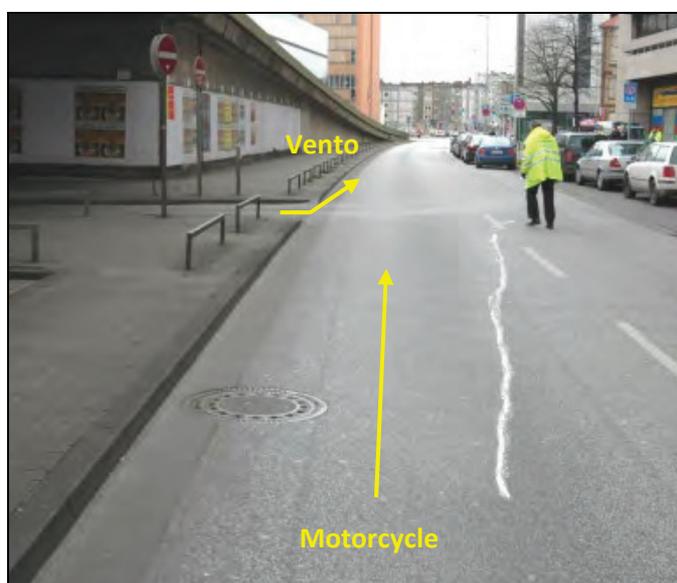


Figure 4: Perspective of motorcycle rider before the accident.

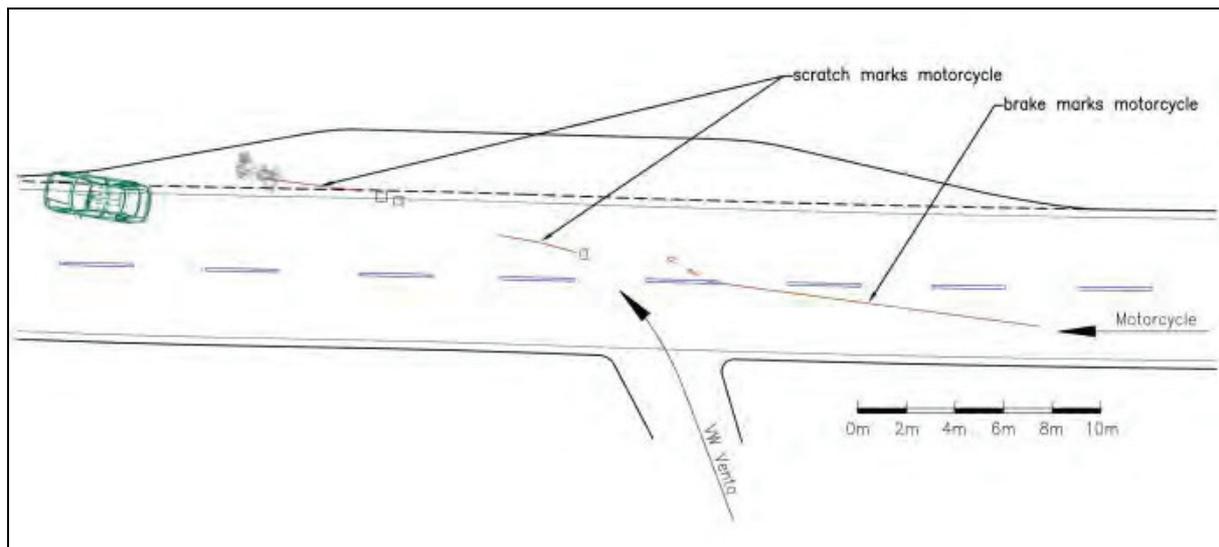


Figure 5: Accident sketch

Interview and Causation coding of the case using ACASS

The interview of the driver of the Vento was conducted at the accident scene. Here he stated that he wanted to leave the parking lot area and wanted to enter the main road. He said that he had looked but did not see the motorcycle and cannot imagine why he did not see it. Continuing the interview of the car driver along the Categories of human factors, the driver was asked if it is possible that his view towards the motorcycle was obstructed by anything (Passenger, Pedestrians, other vehicles), which he neglected. As an optical masking of the red motorcycle due to low contrast, fog or dazzle could also be excluded, no cause could be found from category 1 – Information access of the human factors. Asked about being distracted e.g. by his passenger (Category 2 – Observation) he stated that he was observing attentively and was not distracted and that they were not conversing at the moment. In the next step the driver of the Vento was asked whether he had recognized the motorcycle driver. As he had neglected before having seen the motorcycle rider, an accident causation factor was identified in category 3 (recognition) of the human factors. Category 3 contains two subcategories (Criteria): “*Wrong Identification due to excessive demands*” and “*Wrong focus of attention*”. Asked about these possibilities, the driver assured that certainly there were no excessive demands for entering this road. However he could imagine that he missed a reassuring view when entering the road. A further continuation of the interview could be aborted at this point as the driver at no time saw the motorcycle and therefore could not have evaluated the situation in a better way or reacted in a more adequate way to avoid the accident after the missed observation.

For coding this participant (Figure 6) the causation factor is clearly within the human factors (Group 1). The interview revealed that the driver of the Vento made a failure when recognising the relevant information (Category 3 - Recognition). Within this category the driver excluded the possibility of the first criteria “excessive demands” and admitted that the second criteria “Wrong focus of attention” is quite possible. However more detail concerning this factor was not obtainable so that the coding on the indicator level was not possible and thus “not specified” was chosen. The resulting code here is 1320.

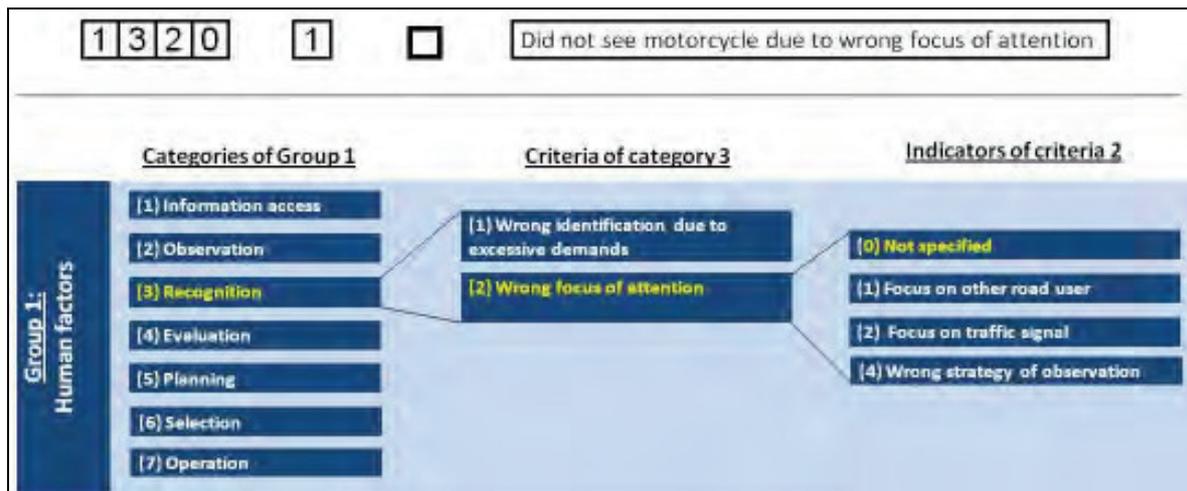


Figure 6: ACASS coding of Vento driver

The rider of the motorcycles was questioned in hospital. He stated that he was driving along the road at about 30 kph and saw the Vento at the exit of the parking lot. Unexpectedly the Vento started to enter his path. The rider assured that he immediately started to brake but could not avoid the collision. At first glance the rider of the motorcycle did not contribute to the emergence of the accident in a causative way. Hence originally no causation factor was coded on behalf of the motorcycle rider. A technical reconstruction of the accident however revealed that the rider of the motorcycle was travelling with about 70 kph at the moment of the accident. Given the fact that the inner city speed limit is only 50 kph, the motorcycle rider was obviously speeding. Driving 20 kph over the speed limit is a planned action it can be coded (Figure 7) in category 4 (Planning) of the human factors as an intentional breach of rules (criteria 2) with the indicator 2 (Driving above speed limit). Interestingly the reconstruction further revealed that the accident could have been avoided if the rider of the motorcycle had not been speeding. The resulting code for this participant is 1522.

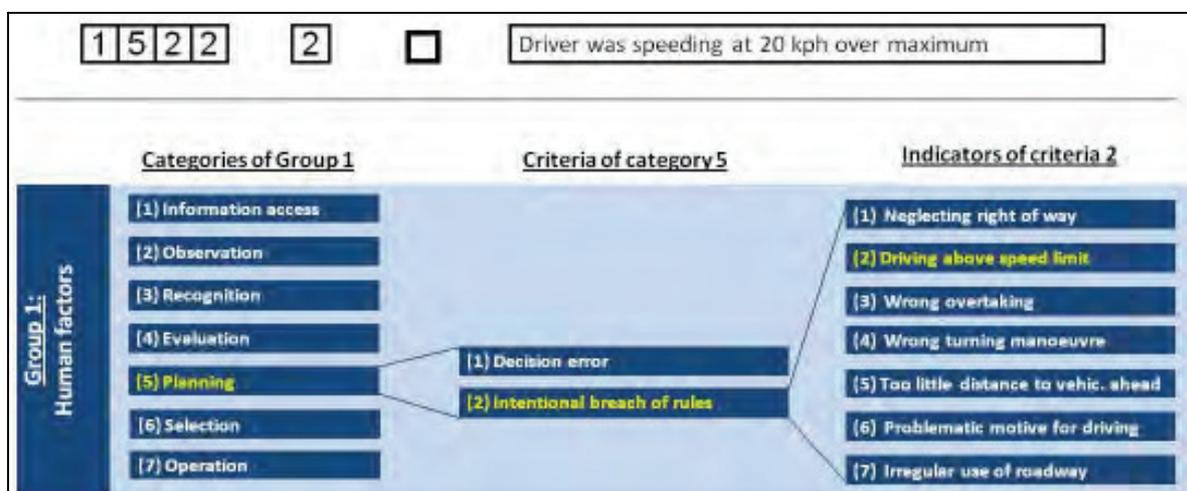


Figure 7: ACASS coding of motorcycle rider

Conclusion

With ACASS a system was developed to collect and store accident causation information to handle on scene and retrospective collection of causation data. This makes it an adequate tool for in-depth investigation by research teams. The human factors are subcategorized in seven categories considering the logical sequence of basic human functions when accomplishing the driving task. The application of this system was displayed exemplarily on two cases in this study to demonstrate that on one hand with ACASS it is possible to collect the accident causation factors in an economically efficient manner using a code of digits. On the other hand with ACASS it is also possible to identify the causation

information in a structured interview by asking specific questions to each human category, in a sequence of the course of the accident, beginning with the information access in the situation of the accident and ending with the executed action. Such a praxis orientated system with well structured codes for human, vehicle and environmental causation factors helps especially when analysing the accident explanations of motorized and non motorized two-wheelers

This analysis of some examples of motorized two-wheeler accidents revealed typical causation factors for powered two wheelers. The misjudgement of the own vehicle behaviour from the first case example and the overlooking of PTW's in traffic as well as the speeding factor of the motorcycle rider from the second example seem to be frequent codes of accident causes. With the knowledge of causation information specific to the type of road user more appropriate measures can be taken to prevent these accidents from happening. Therefore for the future it is desirable to conduct an analysis of the causation factors of these accidents which were collected with the help of accident causation systems. ACASS can be seen as a system adopting to these demands and is currently being praxis approved to identify the main causes of accidents.

Acknowledgements

For the present study, accident data from GIDAS (German In-Depth Accident Study) was used. GIDAS, the largest in-depth accident study in Germany, is funded by the Federal Highway Research Institute (BASt) and the German Research Association for Automotive Technology (FAT), a department of the VDA (German Association of the Automotive Industry). Use of the data is restricted to the participants of the project. Further information can be found at <http://www.gidas.org>.

Literature

- [1] ETSC: Annual Report - Countdown to 2010, Only two more years to act: Jost, Popolizio, Allsop, Eksler, 2008. European Transport Safety Council, Brussels
- [2] Brühning, E., Otte, D., Pastor, C.: 30 Jahre wissenschaftliche Erhebungen am Unfallort für mehr Verkehrssicherheit, Zeitschrift für Verkehrssicherheit 51, 175-181, 2005
- [3] Otte, D., Krettek, C., Brunner, H., Zwipp, H.: Scientific Approach and Methodology of a New In-Depth-Investigation Study in Germany so called GIDAS, ESV Conference, Japan, 2003
- [4] Otte D., Pund, B., Jänsch, M.: A New Approach of Accident Causation Analysis by Seven Steps with ACASS, Paper Number 09-0245 ESV Conference Stuttgart 2009
- [5] Jänsch, M., Otte, D., Pund, B., Chiellino, U., Hoppe, M. (2009): Implementation of ACASS – Accident Causation Analysis with Seven Steps – in In-Depth Accident Study GIDAS. In: Reports on the ESAR-Conference on 5th/6th September 2008 at Hannover Medical School, Berichte der Bundesanstalt für Straßenwesen, Heft F 72
- [6] Pund, B., Otte, D., Jänsch, M. (2007): Systematic of Analysis of Human Accident Causation – Seven Steps Methodology. In: Reports on the ESAR-Conference on 1st/2nd September 2006 at Hannover Medical School, Berichte der Bundesanstalt für Straßenwesen, Heft F 61