Don’t wait for accidents – possibilities to assess risk in traffic by applying the ‘Wiener Fahrprobe’

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Abstract

In Vienna during more than 10 years of research work a special traffic behaviour observation method has been developed, evaluated and applied by Risser et al. in the frame of many different traffic safety projects. Car drivers are accompanied by two observers who register not only errors in behaviour of drivers but also their communication and interaction with other road users. Malfunction of communication and interaction are judged as main sources for problems for danger in traffic. For example, if they lead to a bad traffic climate feelings of discomfort, anger and frustration will prevent cooperative actions of road users. Being able to recognize such negative or dangerous interaction patterns in time it seems to be easier to protect road users – most often the ‘unprotected’ ones – from getting involved in accidents. This contribution gives an impression about theory and practice of the observation method and shows results of different studies, where the method called ‘Wiener Fahrprobe’ has been applied. Furthermore it will show how the method and its results can be used in the frame of the European traffic (safety) research projects ‘PROMETHEUS’ and ‘DRIVE’. Till now no accident data exist in respect to new RTI systems. Therefore it seems to be important to have a sophisticated social–psychological method for testing the behaviour and interaction of road users in connection with these systems. This is a necessary prediction for deciding whether the systems are socially compatible or not.

1. Introduction: Future traffic

In the not so very far future man will be involved in a lot of changes in the traffic system in Europe. Within the frame of the EUREKA and EC projects ‘PROMETHEUS’ and ‘DRIVE’, e.g., we have to get prepared for the implementation of new RTI systems (Road and Traffic Information systems), where high tech shall provide for safer and smoother traffic.

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The integration of vehicle and traffic control is the essential means to improve efficiency and safety in road traffic. In PROMETHEUS this will be done on three levels of control:
- travel and transport management (trip planning and reaction to actual traffic situation for better use of the available infrastructure);
- traffic flow harmonization (the cooperation of groups of drivers in local traffic for safer and smoother traffic flow);
- safe driving (autonomous vehicle control for safer driving with less mental load on the driver).

But the last two letters of the akronym PROMETHEUS which stand for ‘Unprecedented Safety’ lead to some big problems which have to be solved to make PROMETHEUS aims become reality:
- in regard to the new technologies there exist no accident data at all till now;
- nobody really knows how road users will interact with the new systems;
- nobody knows if traffic participants, mainly the motorists, will accept these innovations in a way the producers hope they will do.

Moreover man (mainly drivers of motor vehicles) will be confronted with three groups of measurements which will lead to driving conditions that are very different from today (PRO-GEN 1990):
- systems will intervene in the operation of the vehicle, e.g., by controlling the relative speed and distance between vehicles in the same lane ( = ‘Autonomous Intelligent Cruise Control’);
- there will be a lot of warning functions regarding different traffic conditions (e.g. ‘Collision Avoidance’ systems investigate driving strategies for collision avoidance by anticipating critical situations);
- car drivers will have a lot of information at their disposal coming from special systems which combine on-board systems and infrastructure ( = ‘Dual Mode Route Guidance System’).

Looking at these changes of traffic in general and especially of driving conditions one can see that man will have to interact much more with technical systems but also with other human beings. He will be expected to behave much more according to instructions than nowadays.

And here we are again – thinking how to solve the problems mentioned earlier. In road traffic man has learned that instructions do not have to be followed so thoroughly. Behaviour is adapted rather to one’s own perception of safety and to informal behavioural norms than to official instructions.

Introduction of the previously mentioned new RTI systems can activate the following (social-)psychological mechanisms which disturb compliance with instructions:
- interference with the existing interpersonal communication,
- delegation of responsibility,
- behaviour adaptation and speed transfer,
- imitation (by non-equipped road users),
- problems with understanding and reliability of signals.

One possibility to check if road users, especially motor vehicle drivers, are behaving according to these mechanisms is to observe and register their behaviour by following them in their own cars, using a special method of observation.
Before this observation method will be described we have to introduce and explain some expressions. Thus the philosophy of safe traffic as we understand it will become clearer. We will talk about:
- errors in behaviour,
- interaction,
- communication,
- interpersonal conflicts,
- traffic climate,
and how to register these variables.

2. Erroneous behaviour and interaction

Errors in behaviour and interaction can hypothetically be seen as ‘predecessors’ of traffic conflicts\(^1\) in the same way as traffic conflicts are predecessors of accidents. Hypothetically, comparable erroneous interactions can end up with an accident, lead to a traffic conflict, or pass without any problems in another case, depending on circumstances, e.g. on the presence of other road users. Without defining ‘correct behaviour’, an expert team in Vienna (see Risser, 1985) developed a scenario for deciding that a certain type of behaviour or interaction is not correct (i.e., erroneous). This team came to the conclusion that one or more of the following three criteria must be fulfilled in order to label any behaviour or interaction as ‘erroneous’:
- Any drastic infringement of the law (e.g. driving against a red light).
- Any action causing drastic danger for oneself or other road users (even if the behaviour is legally not an infringement of the law, e.g., insisting on one’s own right of way in some cases can be an example of such behaviour).
- Any behaviour that cannot be interpreted correctly by other road users, or any behaviour based on erroneous interpretation of the behaviour of other road users, in a way that danger could result from this fact.

3. Interpersonal communication

In connection with the discussion of erroneous behaviour the ‘social’ context has to be considered: one is hardly ever alone on the road, behaving independently of other road users.

Hydén (1987) stresses the aspect of interpersonal interaction or communication in road traffic, focussing on road user behaviour as social behaviour. Road users are looked upon as members of a society behaving in a complex social context, and not so much as single individuals acting according to general psychological rules.

‘Communication’ does not mean plain information (or omitting of information) and reaction to it. It also means deliberate neglecting of rules, thus offending others’ rights and/
or feelings which might lead to dangerous situations; and it also means renouncing one's own right with the aim to be cooperative and/or polite (Risser, 1988).

Communicating in traffic implies a lot of advantages:
- It is necessary to recognize the implications for one's own behaviour in the behaviour of other road users; it is necessary to make oneself understood to the other road users.
- By giving signals, the fluency of traffic can be improved.

But there can arise problems as well:
- Many of those signals are not explicitly defined by laws. Such non-official signals might be misunderstood. But also some of the official signals are ambiguous. So conflicts or errors can be caused by misunderstood communication.

4. Interpersonal conflicts

Sometimes, when looking at traffic conflicts more thoroughly it becomes clear that the registered event has to be described in different terms: road users were actually competing or fighting for the right of way or showing their strength, etc.; to react at the last moment does in many cases not mean that the persons involved, have been taken by surprise and have to react in an emergency, but that they postpone evasive action and provoke a collision course in order to intimidate each other. Such an interaction has to be defined as an 'interpersonal conflict': the aspect of surprise is lacking, otherwise typical for traffic conflicts.

In the case of interpersonal conflicts the solution depends very much on the circumstances: as long as there is a possibility to discuss, conflicts can easily be solved without violence. In road traffic, however, there are two big disadvantages:
- the possibility to discuss is absent;
- exchange of information with the help of one's vehicle very easily contains the elements of physical threat and violence.

In traffic most conflicts are not solved at all, leading to a social climate, which makes all kinds of friendly behaviour, solidarity, or considerate actions and reactions rather unlikely.

5. The 'traffic climate'

So called 'climatic' aspects represent important background conditions for the behaviour of road users: The reflected quality of interpersonal communication on the road, the perceived physical and psychological safety, including the safety of 'other' persons not directly involved in traffic processes (e.g., residents), and the fluency of traffic for all road-user groups. These perspectives often overlap quite strongly (e.g., see Sachs, 1984).

The following aspects of road traffic can be interpreted as criteria for traffic climate:
- Characteristics and efficiency of interaction between road users reflect traffic climate aspects from a factual as well as from an emotional point of view.
- Together with the traffic laws and the design of roads, interaction between road users (interpersonal communication) is the basis for the smoothness of traffic processes ('smoothness' of traffic processes must not be confused with speed! Traffic can flow at a
lower speed level as well, but it should 'flow' for all groups of road users; for pedestrians, for cyclists, for public transport, and not only for cars.)

In the following chapters the background of the observation method 'Wiener Fahrprobe', the method itself, and some important results from different studies, in the frame of which the method has been used, will be discussed.

6. Behaviour registration methods

Driver observation methods do exist and are applied since the sixties (Klebelsberg and Kallina, 1963; Quenault and Fuhrmann, 1969; Kroy and Pfeiffer, 1973; Klebelsberg et al., 1968; Barthelmess, 1974; Risser, 1976).

Lately, in the frame of a large study done for analyzing the behaviour of younger drivers by Rolls et al. (1991) in England, the 'Route assessment marking procedure' was used.

About ten years ago in Vienna a method called the 'Wiener Fahrprobe' was developed by Risser et al. (1982; description see below). In the past 10 years different behaviour registration methods — but all of them based on the behaviour variables and interaction variables used in the 'Wiener Fahrprobe' — were used in Austria, Germany, Switzerland, and Sweden in the frame of different projects:

(a) In the year 1982 driving tests were carried out on a standardized route in Vienna (Risser et al., 1982). In this study traffic conflict situations were studied to get hints about behavioural details which raise the probability of accidents.

(b) In the year 1984 drivers from foreign countries as well as Austrian citizens were observed along typical transit-routes by following their cars. Their behaviour was analyzed with respect to possible differences between the nationalities and was afterwards correlated to accidents along the route they were followed on. The observed drivers did not know, that their behaviour was registered by the two observers behind them (Chaloupka et al., 1985; Brühning et al., 1989).

(c) In the years 1985/1986 elderly people — both drivers and pedestrians — were observed with respect to their possible difficulties and handicaps in traffic. Drivers were accompanied in their cars, pedestrians and their surroundings were observed by using both observer descriptions and video registrations; camera registrations were done out of a second-floor flat near a cross road.

Behaviour was correlated to different personal performance variables at different ages, and to different accident rates (Risser et al., 1988).

(d) In 1990/91 in Vienna 150 test persons were observed by driving with them along a standardized route of 35 km (Chaloupka et al., 1991).

The behaviour variables (different types of correct behaviour, errors in behaviour and for the first time in interaction) were correlated to different types of accident circumstances and traffic conflicts registered along the driving route (see below).

(e) Now since spring 1992 in Vienna and Zürich a project is carried out (by FACTUM) comparing the driving style of people in a car with an electric motor with the behaviour of the same people in their own, 'normal' petrol cars. It was of main interest to find out, if the small electric cars are driven in a way which is socially better acceptable than the way
conventional cars are driven. With 'socially acceptable' a driving style is meant which make other road users, most of all the vulnerable ones, feel more comfortable and safe.

(f) A very similar study is going on at Lund Institute for Technology, where behaviour of drivers in conventional cars equipped with a speed limiter is tested ((Almquist, Hydén and Risser, 1991).

(g) The safety aspects connected to LISB, a PROMETHEUS system, have been evaluated with help of a modified version of the Wiener Fahrprobe, as well (see Gstalter, 1991).

7. Some relations between traditional behaviour variables and variables reflecting risk

The aim of driving observations in general was and is to find out which hints for the risk for danger and in the long run for accidents there are in the behaviour of the observed persons.

The main hypothesis in connection with the 'Wiener Fahrprobe' is that such hints cannot be found in the behaviour of single traffic participants but in the interaction between car drivers (and other people). Modifications in order to put more weight on the observation of interaction and communication were implemented in 1990 (see study (d) above by Chaloupka et al., 1991). The variables derive from an older version of the 'Wiener Fahrprobe'. The latest version will be discussed in the following chapter.

8. The 'Wiener Fahrprobe'

The 'Wiener Fahrprobe' is an observation method, where drivers are accompanied by two observers who have tasks of the following kind:

8.1. The 'free observer'

This observer is called 'free' because in the original version of the Wiener Fahrprobe he does not have to use any standardized observation sheet. He has to register the following variables:

- All kinds of behaviour representing a severe offence of the law and/or causing danger (e.g. increasing the probability of an accident) and/or causing misunderstandings. These types of behaviour are defined as erroneous.

Additionally, there is a thorough instruction to register communication processes between the observed person and the traffic participants around him/her. This means that if, during the driving test, the behaviour of the accompanied person or another traffic participant contains any aspect relevant for the behaviour of other traffic participants, this behaviour is registered and described in its relationship to the behaviour of the other traffic participants, i.e., it is described as communication.

In the latest modified version of the Wiener Fahrprobe the interactive aspects are taken into account more thoroughly, even with respect to reliability.
Table I
Coding variables for the standardized observation

- Use of the lateral indicator (late, not at all)
- Accuracy of lane use (extremely on right or left side of lane)
- Timing of lane change in the case of obstacles (early–late)
- Performance of evasive actions (abruptly, not at all)
- Lateral distance to road margins or to other vehicles
- Distance to preceding car
- Choice of speed with relation to speed limit
- Continuity of speed
- Behaviour with respect to pedestrians
- Driving in curves
- Choice of lane at intersections with several alternatives for proceeding afterwards
- Slowing down before intersections
- Choice of lane on multi-lane roads
- Performance of lane change (hesitantly, abruptly)
- Behaviour when not having the right of way, and potentially:
  - Endangering road users who have the right of way
  - Turning left against oncoming traffic
  - Behaviour at traffic lights
- Driving past and/or overtaking other vehicles

8.2. The ‘coding observer’

The coding observer has to describe the behaviour of the testee along all sections of the test route using a standardized coding system that considers communicative implications in those cases, where behaviour with respect to other traffic participants (overtaking, right of way, etc.) is described. Table 1 gives an overview of the variables registered in the frame of the standardized observation.

9. A more thorough view on communication in traffic

The original variables of the ‘Wiener Fahrprobe’ are described and discussed comprehensively by Risser (1985) in AAP. Below, modifications and new variables connected to the latest version of the Wiener Fahrprobe are discussed shortly (see Chaloupka, 1991; Chaloupka et al., 1991; Chaloupka, 1990a/b):

The standardized observation (coding observer) was completed by adding two variables:

- missing efforts to avoid (traffic) conflicts, and
- lack of anticipation concerning one’s own behaviour (e.g., choice of wrong lane in spite of contradictory instruction).

In connection with the free observation, communicative aspects were stressed more than before. There exist a lot of possibilities to communicate by using car movements, car signals (indicator, etc.) or body language. Drivers partly do know ‘what they are saying’ (i.e. they know about the communicative effects of their behaviour); but to a considerable part they obviously communicate ‘unconsciously’ – this at least is to the impression of the observers.
In the frame of the study of Chaloupka et al. (1991) the observation of interactions was trained intensively and discussed. The registration of the main variables of communicative behaviour resulted after sample splitting in the reliability coefficients as shown in Table 2.

With respect to the observers' impressions and their comments of what they could observe two important aspects concerning the perception of other road users' behaviour and interaction were underlined:

(a) car drivers often do not realize that a lot of information which is coming from their motor vehicles is a potential information source for the other road users;

(b) many signals by car drivers obviously have strong emotional effects (fear, anger, etc.), especially on the side of the vulnerable road users.

The observers were also asked to try to register, whether the actions/reactions of the observed persons were intentional or happened as unreflected routine behaviour.

Independently of the fact that any communication happened on purpose or not, the registered events were labelled as 'dangerous' resp. 'negative', 'neutral' or 'positive' behaviour in respect to their influence on the other traffic participants, according to everyday understanding of the meaning of communication.

Some examples for types of interactions registered in the frame of the latest version of the Wiener Fahrprobe are the following:

<table>
<thead>
<tr>
<th>Accident circumstances</th>
<th>Observed behaviour/interaction</th>
<th>Frequency–Route section correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driving in the wrong lane</td>
<td>Driving extremely on the left or right side of a lane</td>
<td>0.42</td>
</tr>
<tr>
<td>Driving too far on the left</td>
<td>Inadequate overtaking</td>
<td>0.42</td>
</tr>
<tr>
<td>margin of the lane</td>
<td>Driving extremely on the left or right side of a lane</td>
<td>0.46</td>
</tr>
<tr>
<td>Opening the car-door</td>
<td>Too small lateral distances</td>
<td>0.37</td>
</tr>
<tr>
<td>Head-on collision</td>
<td>Delayed lane change in case of obstacles</td>
<td>0.38</td>
</tr>
<tr>
<td></td>
<td>Driving extremely on the left or right side</td>
<td>0.39</td>
</tr>
<tr>
<td>Rear-end accidents</td>
<td>Problems with lane choice ( = choosing correct lane at the last moment, choosing the wrong lane)</td>
<td>0.48</td>
</tr>
<tr>
<td></td>
<td>Exceeding speed limits</td>
<td>0.46</td>
</tr>
</tbody>
</table>
- does not give way (on purpose or unconsciously, e.g., because of lack of overview),
- ignores the other traffic participants, e.g., by not adapting the speed to their presence,
- does not interrupt his/her action, in spite of necessity (e.g., overtaking in spite of oncoming traffic),
- 'presses' others (e.g., very short headway, sometimes 'supporting' his/her action with flashing head light),
- etc.

**Positive interactions**
- road users are cooperative in tackling a certain situation (by slowing down, setting a gesture, waiting, etc.),
- they show clearly what they want to do (giving signs in a redundant way, raising the chance for being understood by slowing down),
- they take the behaviour of other road users into account,
- drivers take more precautions than strictly necessary,
- a kind of communication with other road users that excludes misunderstandings,
- etc.

**Neutral interactions**
- 'normal' (= standard) interactions according to the law, like waiting at a stop sign when there is traffic on the main road.

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10. **Relations between code variables and accident numbers**

Table 3 gives an overview of some statistically significant relations between erroneous-behaviour variables according to the up-dated observation sheet of the coding observer, and accident circumstances registered by the police during the year 1988 and spring of 1989 in Vienna.

11. **The relation between communication and traffic climate**

The registered behaviour sometimes is not erroneous behaviour in the traditional sense. However, because of its communicative character depending on the situation it can be interpreted in various ways by the other traffic participants, which leads to both different pragmatic and emotional reactions. These interpretations reflect the traffic climate.

Obviously there are places and situations where initiatives are taken that are more on the negative side seen from a communication point of view. In the report of Chaloupka et al. it is pointed out that 'unfriendly' initiatives are mainly taken by car drivers, using the language summarized above. Reactions by other road users, mainly pedestrians, are often positive in the sense that they show 'friendly submissiveness'. Pedestrians give way, they renounce their right of way, they 'make place' by virtually running on the last meters of the pedestrian crossings, etc.
12. Resumee

We have showed that efficient and cooperative interpersonal communication in traffic is a very important precondition for a safe system. Researchers dealing with the development of new high tech equipment should consider this. They should make sure that interpersonal communication will not diminish.

Moreover, car and supplier industry should be aware of the fact that safety in traffic is part of the life quality of all road users, not only of the one of the drivers of motor vehicles.

References

Almquist, S., Hyden, Ch. and Risser, 1990. A speed limiter in the car for increased safety and better environment. Lund Institute for Technology, Department for Traffic Planning and Engineering.


Chaloupka, Ch., 1990a. Human observation of interaction processes in traffic out of observed persons’ cars. In: ICTCT 1990. Theoretical aspects and examples for practical use of traffic conflicts and of other interactional safety criteria in several industrial and developing countries. LTH, Department for Traffic Planning and Engineering, Bulletin 86, Lund.

Chaloupka, Ch., 1990b. How to identify risks by observing human behaviour and interaction, ICTCT, Vienna.


