The Development of the Traffic Conflicts Technique in the Federal Republic of Germany

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1. Intended tasks of TCT

The traffic conflicts technique is intended for application in a large number of problems, especially

1.1 Diagnostic instrument

- in-depth analysis of locations with a concentration of accidents, especially at urban junctions, in order to evaluate the possible effects of planned countermeasures
- determination of the accident proneness of junctions and highway sections with a low rate of accidents which nevertheless can be overproportional with respect to the traffic volume
- evaluation of facilities for nonmotorized participants in traffic
- assessment of safety measures

1.2 Experimental evaluation of traffic facilities, traffic signs and other measures

- observation of driving behaviour at level railway crossings with alternative traffic safety measures
- observation of driving behaviour at changeable traffic signs

1.3 Instrument for traffic observation and control

- training of policemen for traffic observation, development of systematic control techniques, actions with relevancy to safety
- observation of the quality of traffic flow in order to derive improvement measures

2. Definition of conflicts

A traffic conflict is conceived as a hazardous situation in which road users approach each other in space or time to such an exent that there is an increase in the risk of collision.

Indicators of a conflict are the critical driving manoeuvres intended to reduce the collision risk:

- braking
- accelerating
- evasion
- or a combination of these

Traffic violations without the consequence of an accident are an additional indication of a conflict, because conflict situations could have been the result (e.g., not stopping when the traffic lights are red). Traffic violations without any consequences generally have none either because there are no other road users nearby or because other road users are not affected by the traffic violation. Thus the violation remains without consequences.

2.1 Operational definition of conflict type according to three sets of criteria in relation to

- road features, section, approach to the junction, inner area of junction, pedestrian crossing, level railway crossing, deceleration lane, etc.
- driving (walking) manoeuvres, choice of lane, change of lane (weaving), joining or leaving traffic, crossing, etc.
- the accident causes register (which needs to be revised as far as its psychological and traffic engineering aspects are concerned)

2.2 Operational definition of the degree of severity of conflicts in relation to

- distance between cars or car and pedestrian
- different speeds
- rate of acceleration or deceleration
- kind of reaction of the road users involved

Finally, 4 degrees of severity were defined.

1. Controled braking, resp. change of lane to avoid collision. The driver has just enough time to execute a deliberate manoeuvre (time enough to look into the rear-view mirror). The manoeuvre is initiated because of an unforeseen traffic occurrence.
2. Vehement braking and/or abrupt change of lane to avoid collision. The driver has not enough time for deliberate reactions. Brake sounds and skid-marks frequently are associated with such manoeuvres.
3. Emergency stopping and/or avoidance in "last second". The driver only manages to avoid an accident by means of a quick reaction (near accident). In general, intensive noisesfrom brakes and tires accompany such events.
4. Collision.

2.3 Preparation of special records for specific locations or tasks in order not to overtax the limited capacity of the observers

3. Methods of conflict measurement

3.1 Definition of road sections and driving/walking manoeuvres to be observed according to structural criteria (e.g., road with parallel lanes, from the beginning to the end of the development of additional lanes, stopping area before stopping line)

3.2 Definition of direction of observation

3.3 Direct classification according to type and severity of conflicts, records on special lists. In special cases also records with graphic symbols, films or video recording

3.4 Simultaneous measurement of relevant traffic volumes (also pedestrians)

4. Study design and measurement technique

4.1 Training of observers

The observers receive a training manual in form of programmed instructions. Conflict types are graphically represented. Traffic situations and traffic conflicts are played from video-band and must be grouped into conflict categories. The interrater reliability has been studied. At the beginning, the agreement among the observers is r = 0.47. After performing the training manual and presenting the second video-film the reliability raises up to r = 0.67. In the final training observers will have to record conflicts at junctions. This showed an agreement of r = 0.84* and r = 0.94* among the trainees which were divided into two groups (Erke a. Zimolong 1977).

4.2 Analysis of accidents

All accidents that occured at the junctions under investigation during the last 3 years are compiled on the basis of accident records and collision diagrams. These are <u>all</u> the accidents (inclusive accidents without personal injuries and damages up to 1.000 DM) which were registered by the police. The accident retest reliability for all accidents is r = 0.88**, for weaving accidents r = 0.60**, rear end accidents r = 0.42.

This quite satisfactory result depends mostly on the nearly complete accident records of the local police.

4.3 Conflicts and accidents

The conflicts are assigned to the accident types. Simple linear and multiple correlations are computed to assess the relation between types of conflict, degrees of severity and the corresponding accidents. Forecast elements are the three degrees of severity and the traffic volume. In the multiple regression analysis results are cross validated on the basis of accidents and conflicts from a random sample.
The conflict to accident ratios have been investigated as well as the confidence intervals from the accident and conflict regression lines to identify junctions with high accident and conflict risks.

4.4 Before/After studies, pedestrian conflicts

To control the effect of traffic measures, traffic and pedestrian conflicts are counted after structural alteration had been carried out. Changes in conflict frequency and types are significant.

5. Practical applications of the TCT

5.1 First TCT study was performed at the approach roads of 6 signal-controlled junctions in Braunschweig (n = 10) (Zimolong a. Erke 1977). There exists only a poor relation between Rear End Conflicts and Rear End Accidents (r = .20). Weaving accidents and the Total of accidents can be better predicted on the basis of conflicts (r = .67, .82).

By a weighted combination of the independent variables: degrees of severity of conflict types and traffic volume much more variance of the criterion can be accounted for (Table 1).

Table 1 Multiple Correlations of Types of Accident and Types of Conflicts. Independent Variables are degrees of severity K1 and K2 of Types of Conflict, Traffic Violoations K0 and Traffic Volume (VOL). (*p .05, **p .01).

	Type of Conflict		
Type of Accident	K1,K2	K0,K1,K2	VOL,K1,K2
REAR-END	.31	-	.76
WEAVING	.65*	.80*	.68*
TOTAL	.82**	.83*	.86**

5.2 The second TCT study was conducted at six signal-controlled junctions in Braunschweig and Hannover, including all approach areas roads (n = 24) and 72 observation areas in the junctions proper (Erke a. Zimolong 1977)

The correlation coefficient of traffic volume, types of accident and all degrees of severity of types of conflict are shown in table 2. The coefficients are computed together from the junctions and the approach roads.

Table 2 Correlations between Traffic volume, Accidents and Conflicts

Types of Variable	REAR-END	WEAVING	TOTAL
Volume/Accident	.40*	.36*	.46*
Volume/Conflict	.67**	.45*	.54**
Accident/Conflict	.52**	.47**	.63**

The different degrees of severity of conflicts (K1 = slight, K2 = medium, K3 = serious) generally are recorded in the ratio of 80 to 19 to 1. The relationship depends on the site and type of conflict. The best correlations of accident and conflicts are found for slight conflicts K1 (Fig. 1).

The correlations between accidents and types of conflict computed for the inner area of junctions and the approach roads are shown to be different. A well established relation has been found for the approach roads (Fig. 1), but for the inner area especially the left-turn accidents cannot be predicted by means of left-turn conflicts.

The multiple correlation coefficents computed for all accidents and the forecast elements, degrees of severity of all conflicts, traffic violations (K0) and traffic volume (VOL), are shown in table 3. The correlations have been computed seperately for the approach roads (segment 2, segment 3) and the observation areas at the inner junctions (right, left, through).

Table 3 Multiple correlations of accidents and various independent variables

Approach	K1-K3	K0-K3	K1-K3,VOL
Segment 2	.72**	.73**	.74**
Segment 3	.73**	.76**	.73**
Segment 2 + 3	.86**	.88**	.87**
Junction			
Right	.29	.30	.38
Left	.77**	.80**	.77**
Through	.23	.24	.71**

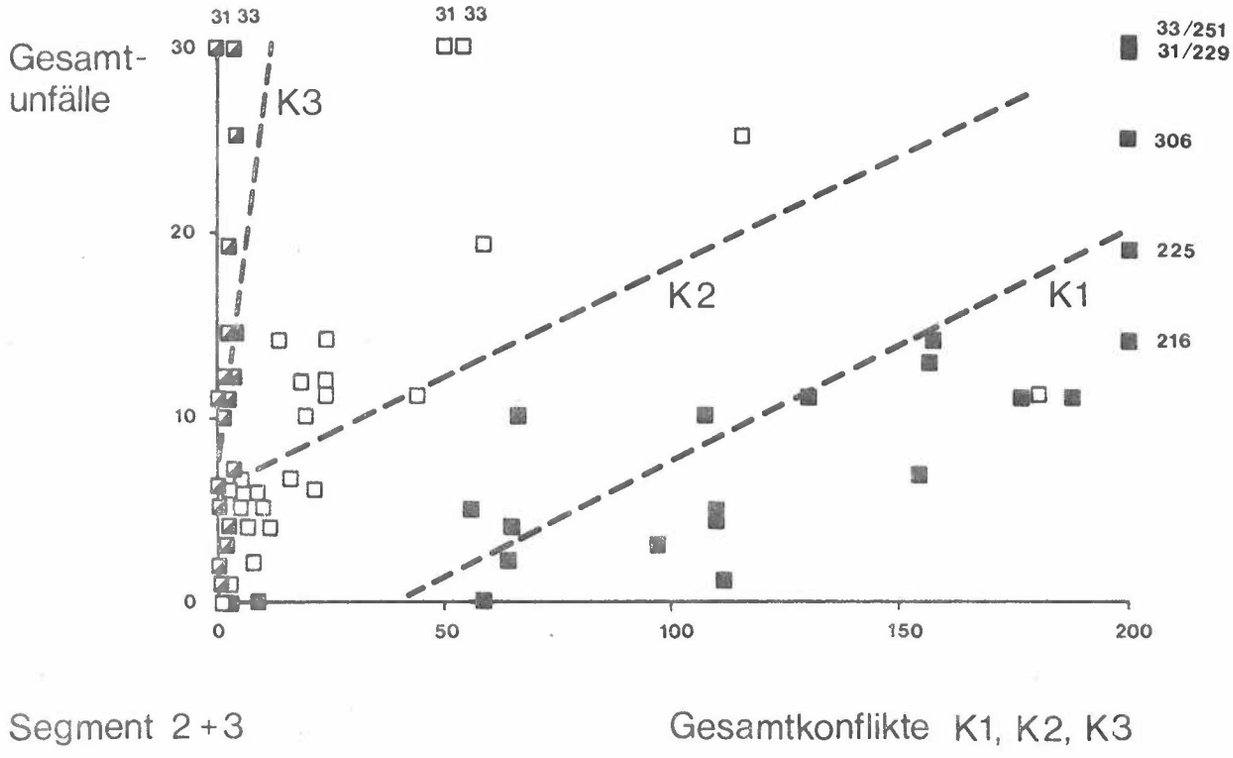

Fig. 1 Regression lines for All Accidents (Gesamtunfälle) and three degrees of severity of All Conflicts (Gesamtkonflikte) K1, K2, K3.

5.3 A pedestrian conflict study (PCT) at five locations in Braunschweig (pedestrian crossings and adjoining road sections).

5.4 Before/After study with TCT and PCT to study the effect of an installation of light signals at four junctions.

5.5 Driving manoeuvres at changeable traffic signs. Observation of lane choice, joining traffic, weaving and the corresponding conflicts under conditions of normal signal operation and signal-directed change of direction; additional interviews with drivers; validation on the basis of the accident criterion ist planned.

5.6 Traffic safety week and competition with respect to car-pedestrian-conflicts

- Series of articles on conflicts and accidents in newspapers
- Competition with 60.000 participating school children
- Competition resulting in 204 proposed improvement measures from the public, these suggestions are in part so well considered that they will be put in practice, if possible.

6. Application possibilities of a traffic conflicts technique from the point of view of the Federal Highway Research Institute (BASt)

When it was recognized that an evaluation and selection of structural or traffic control measures in order to improve traffic safety, which is based on the evaluation of accident data alone, does not lead to satisfactory results, the BASt started in 1973 with investigations into the safety-relevant behaviour of road users. The objectives of the research projects were the following:

(1) Determination of evaluation criteria for the safe design of structural traffic facilities. The nature of the criteria should be so as to be able to be

collected in a short time unlike accident data which require long periods of observation.

(2) Determination of an evaluation standard for the change of certain forms of road user behaviour with time. The great number of different public and private traffic safety measures, whose individual effectiveness can hardly be any longer evaluated, requires that behavioral trend studies be made at certain intervals.

These criteria should place the responsible authorities in a position to assess the extent to which all the measures taken really have the desired effect, the effect which, e. g., is described in the Traffic Safety Program of the Federal Republic of Germany.

The main methods used were interviews, observation of behaviour while being with road users, and field observations and the results indicated that primarily the last method mentioned should be based on a more sophisticated footing.

The available information on appropriate and target-oriented possibilities of standardizing observation techniques induced the BASt to continue its efforts in order to arrive at a fully developed traffic conflicts technique ready for application.

In comparision to other techniques this technique of observation also involves the advantage that, given standardization of application has been achieved and guidelines for the training of observation personnel can be made available, practical aids for the evaluation of measures and the observation of traffic can be offered to the responsible bodies of communities and to the police.

6.1 Aids with respect to the decision making of community authorities (highway construction authorities, public authorities financing construction works, police departments)

- Additional evaluation techniques for the support of economy-oriented decision-making techniques with respect to alternative suggestions for structural and traffic control measures affecting specific locations within the traffic network. (A traffic conflicts technique test is being planned by making use of suggestions in order to reduce the danger of left turn movements inside built-up areas).
- Control methods as part of before and after studies of structural and traffic control measures affecting total road networks, parts of networks or stretches of roads. (Traffic conflicts technique tests in comparatively quiet city areas, from which particularly through-traffic has been banned, among others on streets which are jointly used by all types of road users).

6.2 Control and survey techniques with respect to the tasks performed by the traffic police

- Standardization of police training with respect to traffic observation, conflict and accident survey as well as evaluation routines. (Harmonization of survey lists, in particular with respect to "accident causes" and "type and severeness of conflicts"; manual for the survey personnel to be trained; guidelines for instructors and teaching personnel).

6.3 At present the BASt does not possess any information according to which traffic conflicts techniques have been or are actually used on the Federal, State, or Community level.

7. Future research

- definition and validation of conflicts at urban junctions
- studies on TCT at road sections with a low rate of accidents but overproportional to the number of vehicles/ pedestrians
- development and evaluation of a conflict survey technique for pedestrians in residential areas
- development and evaluation of a cyclist conflict survey technique inside built-up areas
- analysis of the origin and development of conflict by taking into account the communication processes on the traffic scene.

8. Publications

Erke, H. u. Zimolong, B., Die Verkehrskonflikt-Technik als Methode zur Beurteilung von Verkehrsqualität und Verkehrssicherheit. FP 7615 für die Bundesanstalt für Straßenwesen. Braunschweig, 1977.

Zimolong, B. u. Erke, H., Experimental Validation of Traffic Conflict Technique. Braunschweiger Berichte aus dem Institut für Psychologie der Technischen Universität Braunschweig, Braunschweig, 1977.