JOINT INTERNATIONAL STUDY FOR THE CALIBRATION OF TRAFFIC CONFLICT TECHNIQUES

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1. INTRODUCTION

In order to see why so much effort is made to calibrate traffic conflicts techniques, it is necessary to understand the fundamental ideas behind the analysis of conflicts.
Conflict observation is a way of looking at the unsafety of particular locations or situations in traffic.
Unsafety as such is not visible. We call a location unsafe if the probability of an accident is too high. Accidents are rare events and seldom systematically observed. Accident potential is still harder to get at. We may arrive at a statement about unsafety from several sources.
Sometimes a general theory about traffic safety is applied to a situation and leads to statements such as "This particular lay-out of the intersection causes too much risk to the cyclists coming from the right".
In this case the statement is assumed to be proven in general and applicable to the situation under investigation.
In general, traffic safety theory is not that confirmed and statements like the one above must be regarded as hypotheses that need confirmation. More often one derives at the unsafety of a location from empirical evidence. The frequency of accidents in the past is used to estimate the probability of an accident.
In many cases, however, the accident frequency is too low to make reliable estimates and additional information is then needed to get a more reliable statement about the unsafety of a location.
Conflicts that are observed during some short period of time are often used as if they were accidents in order to estimate the accident potential.
Therefore a conflicts technique is sometimes regarded as a surrogate measure for accidents, used to detect the unsafety of locations or situations.

However, even if the conflicts techniques can be used for the detection of unsafety, then this is only the first step in the process of unsafety analyses. Much more important is what happens after the detection.
In order to improve safety, one has to analyse the problem and find the causes of unsafety and how these causes are provoked.
In most cases accident histories are scarce and far too incomplete to be used for these deductions, even if we use in-depth studies.

Observation of traffic behaviour at locations that are detected as dangerous (black) spots may clarify the safety problems and lead to effective safety measures.

The use of traffic conflicts techniques as behavioural observation techniques in safety analyses is completely different from the use of the techniques as a surrogate measure of the amount of traffic unsafety.

2. DEFINITION OF CONFLICT BEHAVIOUR

Traffic unsafety is the result of the various risks road-users meet, take or cause if they take part in traffic.
In general, traffic risk can be defined as the personal or material damage that may result from the decisions road-users take once meeting particular situations or other road-users.
In order to control risk, one has to know first which dangerous decisions take place and in which situation or under what circumstances these (conscious or inconscious) decisions are aroused or taken.
The study of dangerous traffic behaviour is fundamental for a good understanding of traffic unsafety. This study starts with the observation of behaviour and the context and the circumstances of that behaviour.
Because "the dangerousness" of the behaviour as such is not visible, an evaluation and interpretation of the situation is needed in order to detect "dangerous traffic behaviour".
Because of the subjectivity of such an evaluation and interpretation it is necessary to define narrow observation rules to arrive at objective data.
Scoring rules must be made explicit in such a way that there is an unambiguous mapping of cues in conflict severities. This entails more than agreement between observers only.
Traffic conflicts techniques may be regarded as techniques that enable systematic observation of dangerous traffic behaviour (conflicting behaviour). There are various conflicts techniques each using its own observation rules.
In order to compare results from different conflicts techniques, one has to know how the techniques have been used and from what kind of situations the data has arrived.
The first main question then is, what kind of situations a special investigator is concerned with, or stated otherwise, what is and is not a conflict.
The second main question is, how dangerous was the situation he observed, or how serious is the conflict.
Defining a conflict, one may have different aims.
One may give a global demarcation of the concept and define the "universe of discourse". It becomes more interesting however if someone tries to

give an operational definition of a conflict, in order to state the denotation of the concept instead of the connotation.
An operational definition is a rule to separate conflicts from non-conflicts.
During the First International Workshop on Traffic Conflicts Techniques in Oslo, 1977, (Amundsen & Hydèn, 1977), conflicts were defined as:
"A traffic conflict is an observable situation in which two or more road users approach each other in space and time to such an extent that there is a risk of collision if their movements remain unchanged".
This definition seems to define the universe of discourse, but was primarily meant as an attempt to define a conflict operationally.
In fact, Perkins & Harris (1967) in their now classic paper, also used such a broad operational definition of a conflict. Their definition is unambiguous and easy to apply to car-to-car conflicts.
In practice, however, the conflicts techniques have been used with regard to various situations and each time a different operational definition has been given.
The following aspects are of importance:
- The investigation mostly regards only one aspect of traffic safety, e.g. the safety of children, pedestrians, intersections, serious accidents etc.

Only those kinds of conflicting behaviour that are relevant for that aspect under consideration are classified.
- There is a variety of observation methods.

With more subjective methods we find terms such as "sudden behaviour" or "evasive action" as part of the definition, terms that presuppose a judgement of the observer. Objective methods use terms like "time-to-collision" (TTC) or "post-encroachment-time" (PET), terms that refer to registration apparatus.
- There is more or less differentiation in relevance of conflicting behaviour.

Terms like "serious" and "less-serious" conflicts have been used, referring to the difference in accident potential. The seriousness dimension is seldom specified - and if so - usually one dimensional (sudden action or not, short or long TTC etc.).
Only in a few investigations we find more aspects, including qualitative aspects such as kind of road usage, to define the severity.

If we regard the conflict analysis technique as a systematic way of observation and investigation of risky interactive traffic behaviour, than the question what aspects of traffic behaviour are dangerous in which situations is most important.
The usefulness of the conflict analysis technique does not, as it is often stated, depend on the extent to which accident numbers are correctly predicted but whether or not safety problems can be detected.
The prediction of accident numbers is often unrealistic due to the (statisticly speaking) rare occurence. Validation of conflicts techniques with regard to accident numbers will always be difficult, especially in situations where there is no dense traffic. This kind of validation is not the exclusive one. Another validation procedure that primarily regards the fundamental issues of traffic unsafety is much more important.
Attention must be stressed to the confirmation of the conflict analysis technique as a theory about risky interacting traffic behaviour. Confirmation of a theory that tells us which behaviour is dangerous in which situation.
To do this it is not enough to classify observations as conflicts. One has to specify the seriousness of the conflict with regard to the accident that may result from it. In order to do this, one has to state the relevant cues and the weight these cues have with regard to the seriousness of the conflict.
The calibration experiment is planned as an international effort to arrive at such a better understanding of danger in traffic. First we have to know what a specific investigator is doing and how his doings are related to interactive traffic behaviour. This is a premise to understand results from his work and to relate these to one's own findings.

3. THE SERIOUSNESS OF CONFLICTS

If we take the seriousness of conflicts into account, then the problem of finding a useful operational definition of a conflict, will be translated into the assessment of the determinants of the conflict that are relevant with regard to safety. The severity-rating is supposed to be a weighted sum of these relevant determinants.

Knowledge of the relation between interactive traffic behaviour and safety is needed in order to state the degree of dangerousness of conflicts: the explanation of traffic unsafety in relation to traffic behaviour.

Once this relation is stated, safety measures may be directed to the limitation or complete removal of serious conflict behaviour and the replacement by safe behaviour.

In depth studies of serious conflict behaviour as a tool in safety analysis are not yet well established.

In many cases one does not have the intention to accomplish a safety analysis, but as mentioned before one will use the conflict technique only to state the degree of unsafety of a location (absolute or relative, with regard to other locations).

However, also in this last case is the seriousness of conflicts of importance. We will give an example.

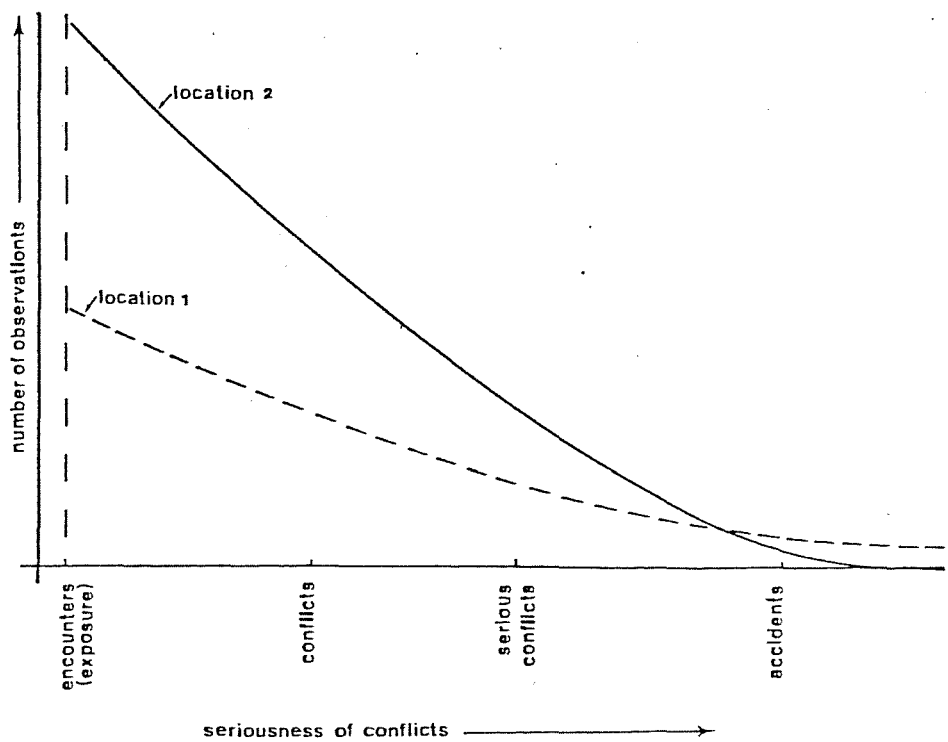

Figure 1.

In Figure 1 the frequency distributions of conflicts are given for two locations. On the abcissa the degree of severity of the conflicts has been given. Let us define a specific kind of interactive behaviour to be a conflict if this behaviour is to the right of the point "conflict", and a serious conflict if it is to the right of the "serious-conflict" point etc.

We may notice that the following inclusions exist:

encounters $\supset$ conflicts $\supset$ serious conflicts $\supset$ accidents $\supset$ fatal accidents.

The area beneath the curve for location 1 at the right of the conflict point is equal to the total number of conflicts for location 1.

If we estimate the relative safety of location 1 with regard to location 2 from the ratio between the numbers of conflicts of location 1 and location 2 then we will decide that location 2 is more dangerous.

If we use the serious conflicts both locations are almost equally dangerous. If we use accidents, location 1 is more dangerous than location 2.

Apart from this it becomes clear from this figure that we try to estimate the area of the very small right tail of the distribution from a very large portion of the total area. Information about the shape of the curve is vital if we use these estimates. This information is related to the validity and reliability of the conflict technique.

It also is of importance for the relation between conflicts, exposure and safety.

4. CONFLICTS, EXPOSURE AND SAFETY

We may wonder whether the picture of the two crossing curves in Figure 1 is realistic or not.
If we restrict ourselves to accidents between road-users, then each encounter between road-users may be regarded as a potential accident situation. The total number of encounters may be used as a measure of exposure.
If the ratio between the number of encounters at both locations is equal to the same ratio between conflicts, serious conflicts and accidents, then a comparison between the safety of both locations will be done most reliably using the (large number of) encounters. The relative unsafety is then directly deduced from exposure.
If we compute for each location the accident rate (the ratio between the number of accidents and the measure of exposure, the number of encounters in this case) and compare these rates for different locations then we are primarily interested in the differences between the ratio of accidents for both locations and that ratio of the encounters. The picture of crossing curves corresponds to the idea of differentiating accident rates. A same kind of difference may be expected with regard to the ratio's between the serious conflicts and the conflicts.
This "conflict rate" will also give us information about the shapes of the curves. If the conflict point and the serious conflict point are well-defined, then we may use this rate, to state the relative unsafety of locations in a more optimal way.
The more the conflict point equals the point of the encounters and the more the serious conflict point reaches the accident point, the more the conflict rate will resemble the accident rate. The difference in accident rate (or conflict rate) will result in a less accurate prediction of accidents with conflicts then with serious conflicts. If the conflict rate is equal for various locations, then the validity of both measures should be equal and the prediction of the number of accidents from the conflicts superior to the prediction based on serious conflicts because the former can be stated more reliably. In general however, this will not be the case.
This dilemma between reliability and validity is important if we try to find a useful conflict definition and we don't want to discriminate between conflicts with regard to severity.

The choice of a definition will then be reduced to the problem of finding the point at the severity scale that is optimal with regard to validity and reliability.

In conclusion we may say that even if we want to predict the number of accidents or the degree of unsafety, we have to know what kind of interactive behaviour is dangerous and how serious this danger is.

5. THE CALIBRATION OF CONFLICT TECHNIQUES

Each definition of conflicts and each scoring system of conflicts as used by the different teams, is implicitely or explicitely based on a theory about risky interactive behaviour. Some theories stress the subjective aspect of this behaviour and try to evaluate the awareness of potential danger of the participants in the conflict, some theories stress possibilities for correcting behaviour in order to avoid an accident, some theories stress the possible consequences that may result if the conflict should become an accident.

These aspects are not independent of each other. Especially if the technique is subjective and presupposes a judgement of the observer, then it is of importance to know what cues of the conflict situation are used and how the different cues are combined in order to get a final judgement. Whether a conflict is serious or not, is not so much an empirical statement, but a theoretical one.

All teams may learn from the confrontation of the theoretical points of view. It is highly informative to know the similarities and dissimilarities of the final judgements because these give us the operational discrepancy between theories. Objective knowledge about the situations and especially the relation between this information and the scoring system of each team may elucidate discrepancies between scoring systems but also between theoretical views. This last kind of information is valuable not only for the application of conflict-techniques but also for a better understanding of traffic safety in general. The confrontation of traffic safety theories on its own, especially on an international scale, is reason enough to accomplish such an experiment.

With regard to the conflict techniques as such the main reason for doing the study is more specific.

As we know the justification for using the conflict technique depends on its reliability and validity. We have seen that these concepts depend on a proper definition of conflicts and are highly related to the proper severity scaling.

In order to improve techniques and to compare results with those of other investigators or to interprete their results, one has to know what the other researcher exactly means by e.g. "serious conflicts".

Validation studies are very difficult to acomplish and are very expen-

sive. In order to use the validation results of other investigators it is vital to know how to interprete their findings.
A comparison of the scales used for the determination of severity is also very important for this purpose. Calibration of conflicts techniques is the first step in the comparison of results and the exchange of ideas.
A comprehensive description of the analysis of the experimental data that must result in the information that is needed, has been given by Oppe (1982).

LITERATURE

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