AN INTERNATIONAL STUDY ON THE CALIBRATION OF TRAFFIC CONFLICT TECHNIQUES

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Introduction

In the summer of 1983, traffic safety workers from twelve countries gathered in the ancient city of Malmö in the south of Sweden to take part in a unique event. Known to participants simply as the Malmö study, it was the culmination of months and even years of discussion and planning by ICTCT - the International Committee on Traffic Conflict Techniques.

The basic idea of the conflict or near-accident had been around for many years before it was first applied systematically in the traffic safety field in the late 1960s. Since that time conflict techniques have been developed and used in many countries. Although attempts have been made to find an agreed definition of "conflict", there is still much variation in the terms and procedures used in different countries. For an overview of traffic conflict studies see Kraay (1983).

Before starting the fieldwork for the calibration study, a meeting was held in Copenhagen to discuss the latest developments in conflict studies. During this meeting each team participating in the Malmö study described its own technique in detail. The Copenhagen meeting was partly subsidised by the Scientific Affairs Division of NATO, and the proceedings were published as part of the NATO series of ASI publications (Asmussen (ed.), 1984).

The primary aim of the study was to make a detailed comparison of the agreement and disagreement between the various observational techniques currently in use, based on data obtained from a field study. Points of specific interest were how well teams agreed in identifying conflicts in a similar way, and to what extent these activities were influenced by location, type of manoeuvre, the road users involved, and so on.
A longer-term objective was to establish whether data obtained using one technique could be used in a meaningful way by workers with other techniques. This aim is perhaps the more important, since it opens up the possibility of greatly extending the data-base for research and practice from a national to international level. This is particularly relevant to the question of validation. It would be difficult for any one country to collect all the data needed for a comprehensive approach to the problem

of validation, but if it was possible to draw on the results from other countries, then the task would be considerably easier. This was the long-term objective of the Malmö study.

Design of the study

In planning the general design of the study a number of alternatives were considered. One possibility was that films or video recording might be circulated to the participating teams. Such a technique would be inexpensive due to the limited demand for travelling. Also, the conditions for each team would be very similar, e.g. angle of vision, what could be seen by the observers. However, recording from video or film is not commonly utilised by most of the teams in their normal recording procedure. This disadvantage was considered to be crucial, and the idea of circulating films or video tapes was therefore rejected.
By contrast, recording with manual observers on the ground is regularly used by almost all teams. It was therefore considered as beneficial if the recordings could be carried out in this way, together with simultaneous collection of objective data on traffic situations from video recordings.

Sweden was one of the countries that offered to organise the study, and the city of Malmö was chosen for the fieldwork. Malmö is a medium sized city (240,000 inhabitants) that would allow the selection of sites that were as similar as possible to those that might be familair to the participating teams.

Three intersections were selected for the study
- a non-signalised intersection with low motor-vehicle speeds (Figure 1a)
- a non-signalised intersection with high motor-vehicle speeds (Figure 1b)
- a signalised intersection (Figure 1c).

It was considered at an early stage that two weeks was the optimal duration for the study. A longer study might be too expensive for some teams and there was then a risk that these teams could not participate. On the other hand less than two weeks would create too few days for recording.

Three days at each location was considered to be an acceptable distribution of the time available. This allowed one last day for summing up of the study with all observers still present.

With regard to observation hours it was decided that six and a half hours a day was the maximum that the observers could be expected to stand for a two week period under non-domestic conditions. Similar observation periods were planned for the three intersections. Each of the three days per intersection had different hours in order to cover the whole period between 7 a.m. to 8 p.m. Parts of the noon peak and afternoon peak were covered two or three times in order to obtain as many conflicts as possible. A common data sheet was used (Figure 2).

Participants in the field study

The following observation teams took part in the study:
Austria: Kuratorium für Verkehrssicherheit (KfV), Vienna
Canada: Transport Canada, Ottawa
Finland: Technical Research Centre (VTT), Espoo
France: Organisme National de Securité Routière (ONSER), Arcueil
Germany: Technical University, Braunschweig
Great Britain: Transport and road Research Laboratory (TRRL), Crowthorne
Netherlands: Institute for Perception (IZF-TNO), Soesterberg
Sweden: University of Lund, Lund
USA: Midwest Research Institute, Kansas City.

The Danish Council of Road Safety Research carried out accident analysis and behavioural studies.
The Institute for Perception (IZF-TNO), Soesterberg, the Netherlands, collected objective data on speeds, distances, etc. using a video-based technique. They also participated as a conflict team for one of the days.
The Road Safety Centre at Technion, Haifa, Israel, the University of Leuven Department of Civil Engineering, Belgium, the local road office of Malmö and the Swedish National Roads Administration all had representatives present during the study.

Table 1 shows the type of definition and the severity scaling used by each of the teams.

Collection of objective data

The objective quantification of road user behaviour was carried out by means of recordings on video followed by a quantitative analysis. For detailed information about the method itself, see Van der Horst (1982, 1984).

At the three intersections studied two types of black and white recordings were made: one continuously by a normal speed video recorder (Umatic system), and one by a timelapse video recorder (VHS system) with a reduction factor of 8 (6.25 fields/s). In the intervals between successive observations periods, the timelapse recorder was running with a speed of 3.125 fields/s. At two intersections, a second camera was used for an insert of one approach to obtain more detail. In principle, the timelapse recordings are not necessary in the analysis process, but were made in case an important traffic conflict occurred during the change of a Umatic cassette (each hour for about 30 s). Afterwards, one slight collision between two cars appeared to have occurred during an intervening period at the third location.

In total, the recordings were made on 48 one-hour Umatic tapes and 7 three-hour VHS tapes.

The technique of the Institute for Perception (IZF-TNO), the Netherlands

At the Institute for Perception (IZF-TNO) a video-technique has been developed to establish different aspects of traffic behaviour.
The vehicle movements, recorded on video-cassette, are analysed quantitatively to describe the behaviour. The quantitative analysis consists of selecting the positions of some points of the vehicle on a video still. By means of transformation rules, positions in the plane of the picture can be translated to positions in the plane of the street. By differentiating successive positions in time, the speed of the vehicle can be obtained. The selection of one picture from every twelve (one picture per

0.24 s) appeared to be a reasonable compromise between accuracy and length of analysis time.
A full description of this technique is given in Van der Horst & Sijmonsma (1980).

An objective description of the conflict situation is given in terms of initial speed, maximum deceleration, minimum distance, time to collison, etc., as measured quantitatively from video. The measures used are shown in Table 2.

The major purpose of the quantitative analysis was to produce an objective description of conflict situations for the comparison of severity ratings between the teams (Grayson (ed.), 1984).

Results of the study

There were large differences between the numbers of conflicts recorded by the various teams, with the highest scoring team listing over four times as many conflicts as the lowest scoring team. However, it should be noted that some of the teams included in their data numerous minor or less severe conflicts that they would not normally use in an assessment exercise. In addition, a few of the teams were employing techniques that were still in the development stage. Thus the range of scores between establised techniques was not as great as it may first appear.
With these provisos, the analysis showed that the English and Canadian teams recorded the most conflicts, and the French and Swedish teams the least. Differences were also found between the teams in the proportions of conflict types (i.e. the road users involved) and of manoeuvres that were recorded. Although statistically significant, these differences were not particularly large, and with a few exceptions the general impression from the analysis was one of agreement in proportions, if not in numbers.
If the scores of the teams are related to the objective aspects of the conflict situations then it is seen that the most important variable is TTC (minimum time to collision). Conflicts with low TTC-values are severe conflicts, but not all conflicts rated as severe have low TTC-values.
Other aspects of the conflicts that were found to be important are minimum distance between road users, conflict type and, to a lesser degree,

type of manoeuvre. In general, teams relate more to TTC than to PET (post encroachment time). As far as conflict type is concerned, pedestrian conflicts are regarded as the most severe and conflicts among cars and lorries as the least severe (Figure 3).

Further analyses were carried out comparing the objective aspects with the common severity scores, rather than the individual team scores. If TTC and PET are excluded, then minimum distance seems to be the most important variable for severity rating, followed by conflict type and manoeuvre type. If TTC and PET are included, then TTC turns out the most important, and PET does not correlate with severity. The relation between TTC and conflict severity score seems to be logarithmic in type.

In summary, TTC is the most important of the objective measures, followed by minimum distance, although the latter does not add much to the description of severity given by TTC. More is added by conflict type. The fact that speeds and decelerations do not correlate with the severity scoring may be caused by the diversity in the conflict data. Some preliminary analyses with more homogeneous sub-sets of conflicts showed these variables to be much more important. The sub-sets, however, are too small for conclusive answers on this point.

It may be inferred from these results that, even if observers are instructed to use specific cues such as TTC of PET, they will incorporate other aspects of the situation as well. Although severity scaling is linked to objective measures, it also includes a subjective dimension. This results in a common understanding of conflict severity, at least for trained observers.

<u>Practical results</u>

1. Perhaps the most obvious, but far from trivial, results of the Malmö study is that international field studies are indeed feasible. This is not to say that they are easy to arrange, for there were formidable problems of organisation to overcome when teams from ten countries conducted fieldwork simultaneously over a period of two weeks. Nevertheless, it proved to be possible. The Malmö study was almost certainly unique, but it need not be the last of its kind.

2. The design of most experiments in the field is a compromise, and this one was no exception. In theory there are many ways in which the scores of teams of observers could be compared, but in practice there are only a few. The design that was used was to have teams observing sites simultaneously; thus eight teams studied three intersections for a total period of 47 hours over nine days. This entailed having up to sixteen observers on site at a time. Some concern was expressed over the possibility of observers or teams influencing each other, but careful examination of the results showed no evidence that this occurred. Interestingly, it was the more experienced teams that expressed least concern.

3. The Malmö study has generated a unique set of data that can be used in further research at a national as well as an international level. The collection of objective data on video during the observation periods meant that, as well as comparing results between teams, each team had the opportunity to compare their results with the objective data. This would be difficult to organise in normal circumstances, and in this way the Malmö study can make a valuable contribution to future research and development of the conflict technique.

Conclusions of the Malmö study

1. Nearly 1000 conflicts were observed by at least one team during the nine days of fieldwork; two of these were minor collisions. Cars were involved in 900 of the conflicts, cyclists in 250, pedestrians in 160, and lorries in 95.

2. Considerable differences were found among the teams in the numbers and types of conflicts they recorded. The highest scoring team recorded over four times as many conflicts as the lowest scoring team. However, it should be noted that some teams scored highly because they included numerous minor or less severe conflicts that they would not normally attach much importance to in a safety assessment exercise; thus the range in scores is not as great as may appear.

3. A multivariate analysis of the subjective scores revealed that there was a one-dimensional common structure in the data-set that could justi-

fiably be interpreted as a severity scale. On average, conflicts are scaled on this dimension in the right order by all teams. This compatibility means in effect that severity is a common concept for all teams that use the traffic conflict technique, even though their definitions and procedures might differ.

4. The outcome of this analysis was the same when carried out both on the selected set of conflicts that had been scored by four or more teams, and on the total set of conflicts scored. This implies that conflicts that are rated in total as more serious are not treated in a different way to other conflicts apart from being assigned a higher severity score.
All highly scored conflicts in the total data set were present in the selected set.

5. Although this common dimension in the data is very robust, there are still differences between the scores of the various teams. However, an important finding from the analysis is that the variations in scoring derive mainly from differences in the detection of incidents as conflicts rather than in the evaluations of severity. Once a conflict was scored, then the teams agreed to a large extent on the level of severity. Observers therefore seem to have more difficulty with the detection than with the severity rating of conflicts.

6. If the scores of the teams are related to the objective aspects of the conflict situations then it is seen that the most important variable is TTC (minimum time to collision). Conflicts with low TTC-values are severe conflicts, but not all conflicts rated as severe have low TTC-values. Other aspects of the conflicts that were found to be important are minimum distance between road users, conflict type and, to a lesser degree, type of manoeuvre.
In general, teams relate more to TTC than to PET (post encroachment time). The relation between TTC and conflict severity score seems to be logarithmic in form. As far as conflict type is concerned, pedestrian conflicts are regarded as the most severe and conflicts among cars and lorries as the least severe.

7. The strength of the relationship with objective data is largely influenced by the diversity in the conflict data. When dealing with homogeneous sub-sets of data, variables such as speed and deceleration assume greater importance. This finding has obvious implications for future research.

8. The results showed that while severity scaling is linked to objective cues, it also includes a subjective dimension due to the part played by human observers in the data collection process. Even if observers are instructed to use specific cues such as TTC of PET, they will incorporate other aspects of the situation as well. Trained observers appear to have some common understanding of conflict severity.

9. The results of the data analysis show that there is a good degree of agreement between most of the techniques calibrated in Malmö: all of them operate on the basis of a common concept. Once conflicts are detected the level of agreement is particularly high, particularly for the more serious conflicts.

Future development and application

1. Conflict techniques in their present state of development are capable of being used as a complement to accident data in all fields of safety work, from research to more practical purposes. The potential applications of conflict techniques include process evaluation of safety countermeasures, behavioural analysis, safety diagnosis and countermeasure design, and more generally any investigation aimed at throwing light on the interactions between the different factors, human and technical, that contribute to danger or to safety improvement.

2. Development and applications of a traffic conflict technique in countries that do not have one at present can be done in two ways: either work out a new technique, or choose from existing operational techniques the one which appears to be the most relevant to the problem in hand. In the first case, the new technique will require calibration against the others. The second solution is easier to implement as calibration results and methods for training observers are already available.

3. The calibration of conflict techniques makes it possible to promote international co-operation in traffic safety research and in the design of new safety measures: research benefits will be increased through easier transfer of results from one country to another; results should be obtained faster thanks to the use of TCT's.

4. Further international co-operation is indicated in three areas. The first is the drawing up of guidelines for potential users. The Malmö results are sufficiently encouraging to be able to commend the traffic conflict technique to safety workers who do not at present use it. A set of guidelines for this purpose could draw on the lessons learned at Malmö, and could use the Malmö video data base for instruction purposes. The second area is that of validation. The calibration study has cleared the way for better transfer of information and generalisation of results from individual countries. International co-operation to produce evidence capable of convincing those still sceptical about the technique is now a real possibility, and should be given a high priority.
Thirdly, it is becoming clear that the flexibility of the technique and the insight that it can provide into behavioural factors make it possible to recommend wider application of the technique into more areas of road safety research and practice. The Malmö study has shown clearly that the traffic conflict technique has a future that it can face with confidence.

Further analysis

For further analysis by the Dutch Institute for Perception (Van der Horst, 1984) a manageable sub-set of more serious conflicts was obtained of those conflicts which were scored by four or more teams, e.g. 111 conflicts. There were added 7 conflicts to this sub-set, namely those which had been scored with a very high severity rate by one or more teams. For location M3 also the conflicts scored by three teams were inclued (see Table 3).
Obviously, in this way the sub-set has been chosen rather arbitrarily. The first results of PRINCALS (principal components analysis of categorical data, conducted by SWOV; see Oppe, 1982), however, show a good agreement between the severity-dimension based on the sub-set and the one, resulting from the analysis of severity ratings of the total set of conflicts (see Figure 4). The correlation coefficient is 0.89.

Another point of interest is the rather sharp decrease of interactions with a TTC-value larger than 1.5 s in this sub-set (scored by four or more teams plus six "extra" conflicts), 37% is larger than 1.5 s. For the conflicts scored by three teams at location M3 (n = 16) about 50% is larger than the 1.5 s (see Figure 5).

During the observation periods two slight collisions occurred. Also one slight collision was registrated on time lapse video in an intervening period. Remarkable for both collisions is that an evasive action did not take place at all. A third collision has not been analysed quantitatively yet, but also here no avoiding action was seen: on the contrary, the acceleration of the waiting car was the cause of the collision. Although the speeds of the road users involved were rather low, it is obvious that not all collisions necessarily are preceded by an evasive action, which has consequences for the formal definition of conflicts as was stated before (a.o. Hauer, 1975).

A multivariate analysis (PRINCALS) of the severity scores by the eight observer teams showed that, although the homogeneity of the scores is not high, one common dimension can be found which indeed can be interpreted as a severity dimension (Oppe, 1983). In the following this common severity dimension, based on the subjective scores of the observer teams, is indicated by DIM1 or DIM2. DIM1 stands for the severity dimension based on the sub-set of conflicts analysed quantitatively, and DIM2 for the severity dimension from the total set of registrated conflicts (see Figure 6). The conflicts scored as severe have all low TTC-values. But it is obvious, that not all conflicts with a low TCC have a high severity dimension.

This calibration study enables a comparison between the objective measure based on computed TTC-values and the estimated TTC-values by the Swedish observers in the field (the estimated TTC-values were drawn from the observer sheets). However, it is important to note that there exists a difference in both measures. While we use the absolute TTC-value for defining the seriousness of a conflict, the Swedish method is based on the value of the TTC measure at the moment one of the road users involved starts braking or swerving to avoid a collision (Hydèn & Linderholm,

1983) (see Figure 7). So, the assumption is that in general the Swedish TTC-values will be a little higher than the computed TTC-values.

In Figure 8 the analysed conflicts with a TTC-value are divided into scored and not-scored by the Swedish team. The group of conflicts not scored by the Swedish team is certainly not restricted to the interactions with relatively high TTC-values. This is another interesting point to discuss further with the Swedish team. The Swedish technique discriminates well between conflicts with TTC-values less and greater than 1.5 s, only 9% of the Swedish conflicts has a TTC-value above 1.5 s.

The Finnish technique is derived from the Swedish one, they are scoring conflicts within three categories: potential conflicts, conflicts with a TTC less than 1.5 s, and conflicts with a TTC less than 1.5 s and a high deceleration level (Kulmala, 1983). So it is also interesting to compare the TTC-values with the results of the Finnish team (Figure 9). The number of conflicts not-scored by the Finnish team is lower than for the Swedish team, but at the cost of more false alarms (scored by the Finnish, no TTC).

Conclusions of the detailed analysis

First results of the comparison of the objective measures, as derived from video, with the subjective severity scores by the observer teams indicate that the TTC-value is the most important variable, but not the only one. Together with conflict type it can predict the severity scale (canonical correlation coefficient 0.67). Speed and deceleration do not contribute very much. Still some questions remain about the relation between TTC-value and severity. For example, what is the reason for the relative large group of interactions with a low TTC-value in the lower range of the severity ratings by the other observer teams? A first impression is that for interactions between different types of road users (car - bicyclist or car - pedestrian) it seems important for the subjective scoring who is going first. A situation with a bicyclist approaching the side of a car might be different from a situation where the front of the car is approaching the bicyclist, although both might have the same TTC-value. To which extent this aspect can contribute in describing the severity scale needs further research. This aspect was also suggested for explaining the discrepancy between the number of conflicts scored by the Swedish team and the number of conflicts with a TTC-value less than 1.5 s; about one half was not scored by Swedish observers. For the conflicts scored by both methods the estimated TTC-values are a little higher than the calculated TTC-values, as was expected according to the Swedish definition. The minimum TTC is just one element of the TTC-curve; for example, looking at the TTC-values at the moment the evasive action is started may give more understanding in the way human observers are estimating TTC-values. Also different shapes of TTC-curves can be distinguished for different manoeuvre types and different avoidance actions.

Another point concerns the group of interactions without an actual collision course (no time-to-collision measure), while the subjective feeling occurs that one sometimes definitely has to do with serious ones, the real "near misses". Just in this kind of situations the PET-measure seems to be adequate for describing the potential danger. So a balanced combination of TTC and PET, which are complementary to each other, might solve the occurring deficiencies using each measure separately. A comparable solution might be to define a kind of safety margin around each road user, dependent on his speed, as suggested earlier (Van der Horst & Riemersma, 1981).

The Dutch situation

In recent years the area of application of the conflict method has grown considerably. The essential purpose is not so much to detect unsafe traffic situations as rather to explain their causes, to describe the many factors in the traffic process that, together, result in accidents. The conflict method is already being used in many practical situations of widely varying kinds in a number of countries. Following the results of the calibration study at Malmö work is now taking place to enable it to be more widely used in the Netherlands. At present it already has applications in connection with the implementation of a number of measures as part of the National Plan for Road Safety (NPV).

Conflict Method Advisory Group

The Conflict Method Advisory Group was set up at the end of 1984 to bring together the relevant activities of both the government and research institutions and the uses made of the method so as to ensure that it is used correctly. The Advisory Group's duties are:

- to indicate the possible applications of the conflict method in road safety research;
- to carry out quality control of the use of the techniques employed;
- to supervise and guide further developments relating to the method;
- to encourage the use of the techniques.

To support the work of the Advisory Group, SWOV has included the following activities in its plan of work:

- developing methods for systematic observation of traffic behaviour based on a more theoretical approach to road safety;
- providing methodological supervision, in joint consultation, of the application of the method in various studies;
- producing a manual for the use of the method;
- devising training programmes to enable more organisations to make use of the method.

The Advisory Group consists of: the Road Safety Directorate DVV, the Traffic and Transportation Engineering Department DVK and the Institute for Road Safety Research SWOV; ad hoc members are the Institute for Perception (IZF-TNO), Consultant Agency Advisie, one municipal representative and those bureaus that are familiar with conflict techniques.

In this way, we believe, the applications of conflict observation techniques in the Netherlands can be co-ordinated. It also provides a basis for a more permanent forum to consider the most important point, systematic behavioural research.

A Dutch technique

While every foreign technique has its advantages and its limitations, it is developed on the basis of local conditions; consequently a Dutch conflict observation technique is required. The latter needs to be universally applicable, methodologically sound and applied in a controlled fashion. The conflict observation technique developed by the Netherlands Institute for Preventive Healtcare (NIPG-TNO) and the Swedish technique of Lund University, which latter has been in use in the Netherlands since last year, form the basis, with the information from the international calibration study and the continuation of the behavioural analysis by IZF-TNO (Van der Horst, 1984).

Since the technique makes use of field observers, a clear description of its application is needed, in the form of a manual, to ensure that the observations of behaviour are carried out in a systematic and controlled way. The manual will set out the theoretical background to the conflict method, its area of application, practical techniques, instructions for observers etc. There will be an instruction and training videotape to go with it.

The following makes it clear why it was decided not to take over an existing technique but to make a number of essential changes and additions to current developments.

The idea behind conflict observation is to record critical traffic situations, i.e. to ascertain both the likelihood of an accident and the seriousness of the outcome. It must thus be decided how large the risk is and what cues are relevant.

There are various shortmonings in present observation techniques.
- The foreign techniques give little, if any, consideration to traffic situations involving pedestrians, cyclists and moped-riders.
- The commonest observation techniques make no allowance for either the likelihood of an accident or the seriousness of the outcome.
- Where two road users are on a collision course it is important whether two cars are involved, say, or a car and a bicycle. Because of its speed and distance a cycle has more chance of executing an avoiding manoeuvre, which in turn has an effect on the likelihood of an accident.
- A number of techniques look at the traffic situation from a single cue (e.g. TTC); others form an idea of the situation as a whole without

indicating specific aspects. Consequently both approaches provide too little relevant information for a good diagnosis to be make.
- With the Swedish and Finnish techniques it has been found that some of the conflicts which scored a low degree of seriousness in the calibration study also had a low TTC-value.
- Another problem with TTC-values is that they may be equal while relating to different types of manoeuvre, which should yield different results in the overall assessment of the seriousness of the conflict.

In other words, the obstacles to a good conflict observation technique are operationalising the relevant behaviour characteristics and systematising the observations. As stated above, the likelihood of a traffic situation in which a collision could occur is an important factor, as is the extent to which the various road users are protected against each other in the event of a collision, since there is a transfer of energy. Given the difference in mass between a car and a bicycle, for instance, a collision between the two at a given speed will have different consequences for each, and this will in turn differ from those of a collision between, say, two lorries.

SWOV and IZF-TNO are currently working on the above points. The aim is to have a conflict observation technique ready in draft form after the summer holidays.

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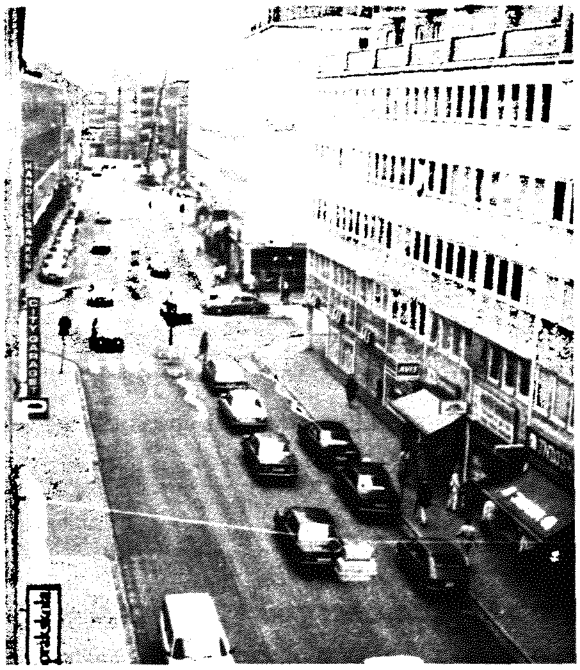
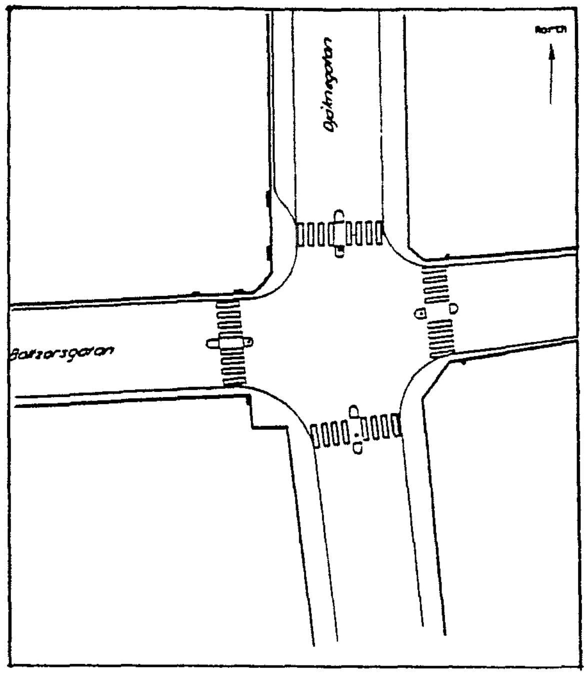
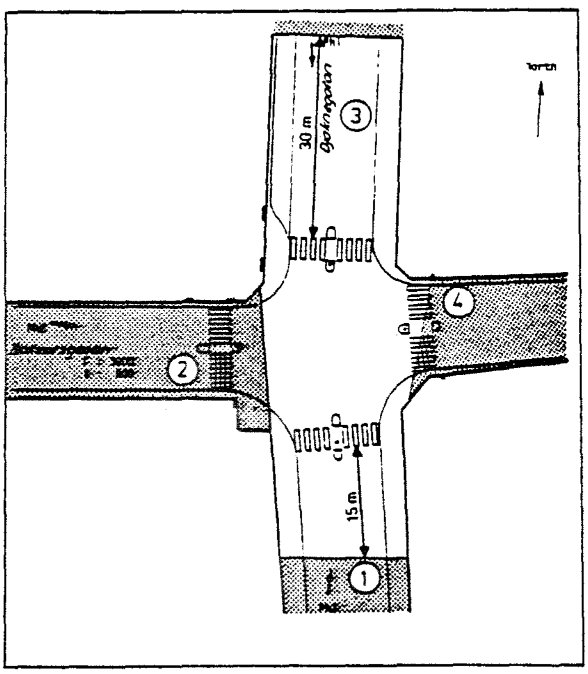
FIGURES 1-9



View from Djäknegatan to the north



Sketch of the intersection



Area covered by the video-camera.

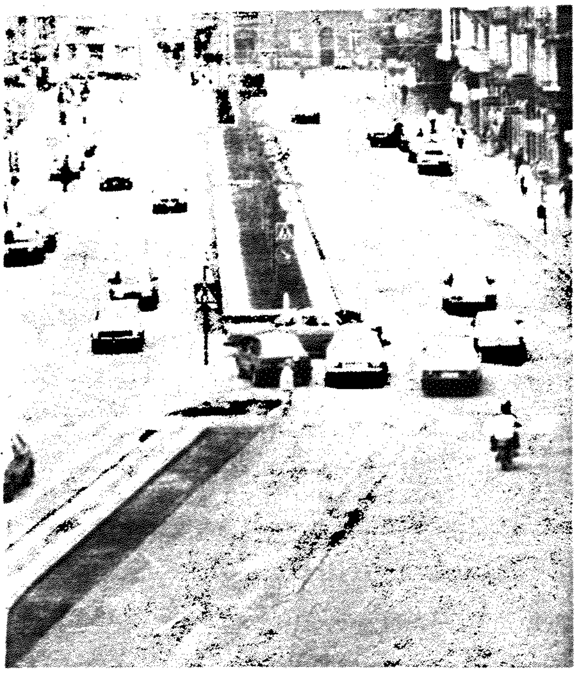
	Djäkne-gatan	Baltzars-gatan
Motor-vehicles (ADT)	13500	3000
Bicycles (ADT)	1000	800
Pedestrians	Busy	Busy
Average speeds on the approaches (Motor-vehicles)	30 km/h	20 km/h

Average annual accident rate: (1978-82)

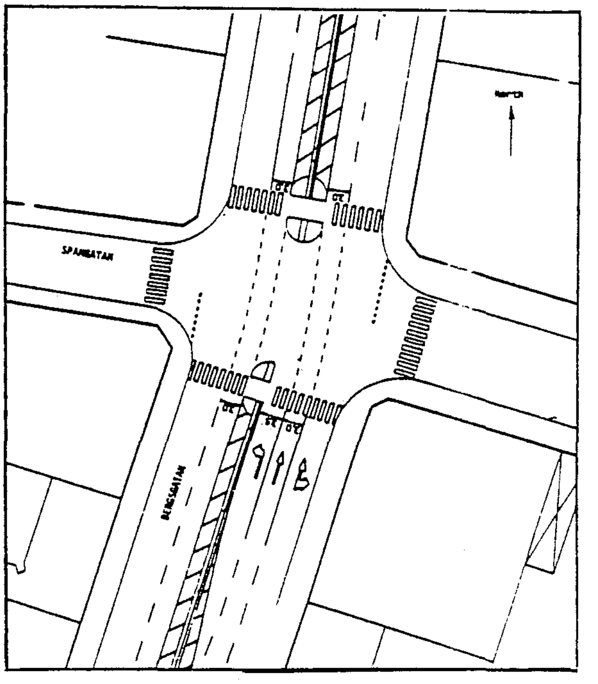
All accidents = 4.2

Injury accidents = 1.0

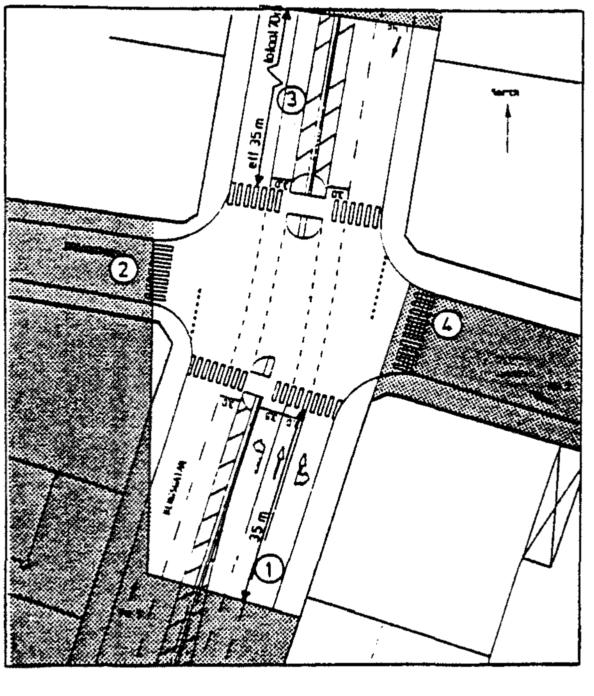
Figure 1a. Non-signalised intersection with low motor-vehicle speeds.



View from Bergsgatan to the north-east



Sketch of the intersection



Area covered by the video-camera.

	Bergs-gatan	Spån-gatan
Motor-vehicles (ADT)	11000	4000
Bicycles (ADT)	900	Unknown
Pedestrians	Semi-busy	Semi-busy
Average speeds on the apporaches (Motor-vehicles)	45 km/h	15 km/h

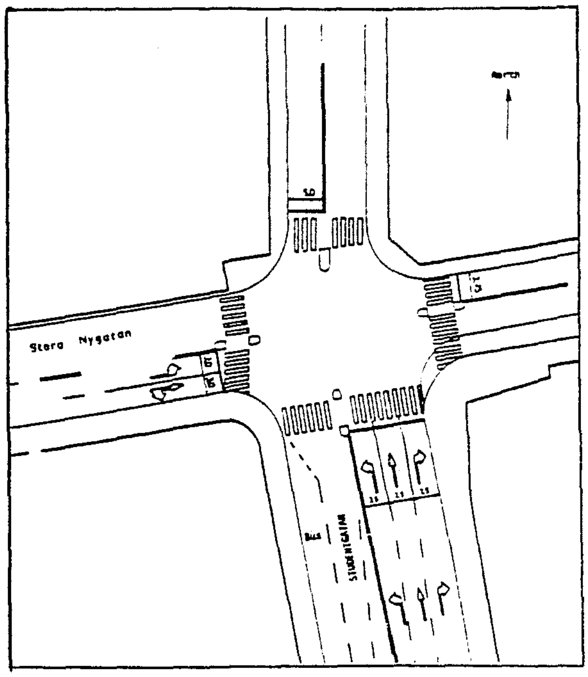
Average annual accident rate: (1978-82)

All accidents = 10.0

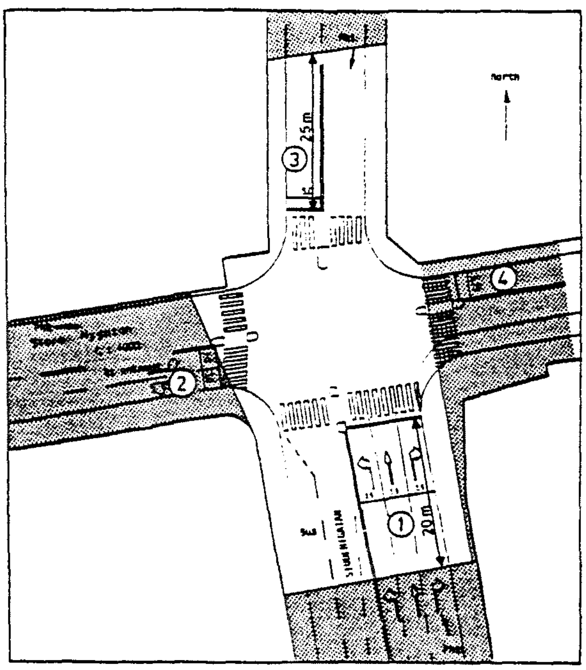
Injury accidents = 2.0

Figure 1b. Non-signalised intersection with high motor-vehicle speeds.

View from Studentgatan to the north



Sketch of the intersection



Area covered by the video-camera.

	Student-gatan	Stora Nygatan
Motor-vehicles (ADT)	15000	4000
Bicycles (ADT)	1200	Unknown
Pedestrians (ADT)	Busy	Busy

Average annual accident rate: (1980-82)

All accidents = 7.0

Injury accidents = 1.7

Figure 1c. A signalised intersection.

ICTCT - CONFLICTDATASHEET - MALMÖ 1983 | ID-code: ....

Intersection: *1) Djäknegatan – Baltzarsgatan* .... Date: ....

Team: ☐ A ☐ CAN ☐ D ☐ DK ☐ F ☐ GB ☐ NL ☐ S ☐ SF ☐ USA

Observer: ....

Precise time of conflict: .... hour - min - sec | N:o

Road-users involved:

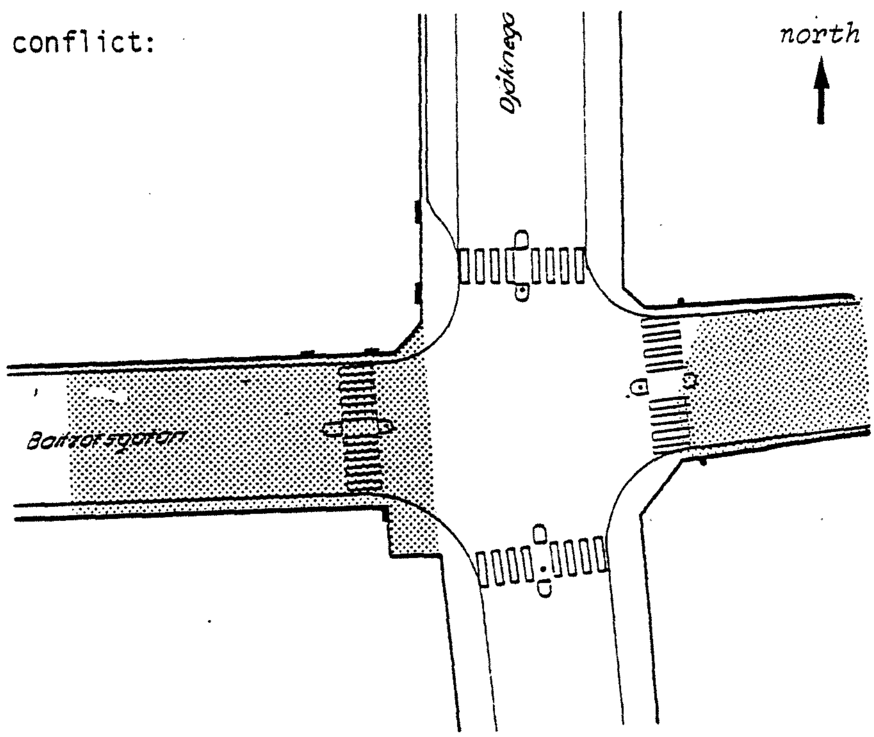
1) ⎵⎵ ....
2) ⎵⎵ ....
3) ⎵⎵ ....
4) ⎵⎵ ....

C = Car
T = Taxi
P = Pedestrian
B = Bicyclist
M = Moped
Mc = Motorbike
Bus= Public transport
L = Lorry
O = Others

Please note for,
Cars: colour, type
P/B/M/Mc: age, sex

Severity rating: ⎵⎵ ⎵⎵ ⎵⎵ ....

Sketch of conflict:



Not-covered area by video-recording

Please note: Trajectories, number or reference of road-users, particular movements breaking, stopping, skidding, falling etcetera.

Additional data/Comments (to be defined by each team)

Figure 2. The common data sheet used in the Malmö study.

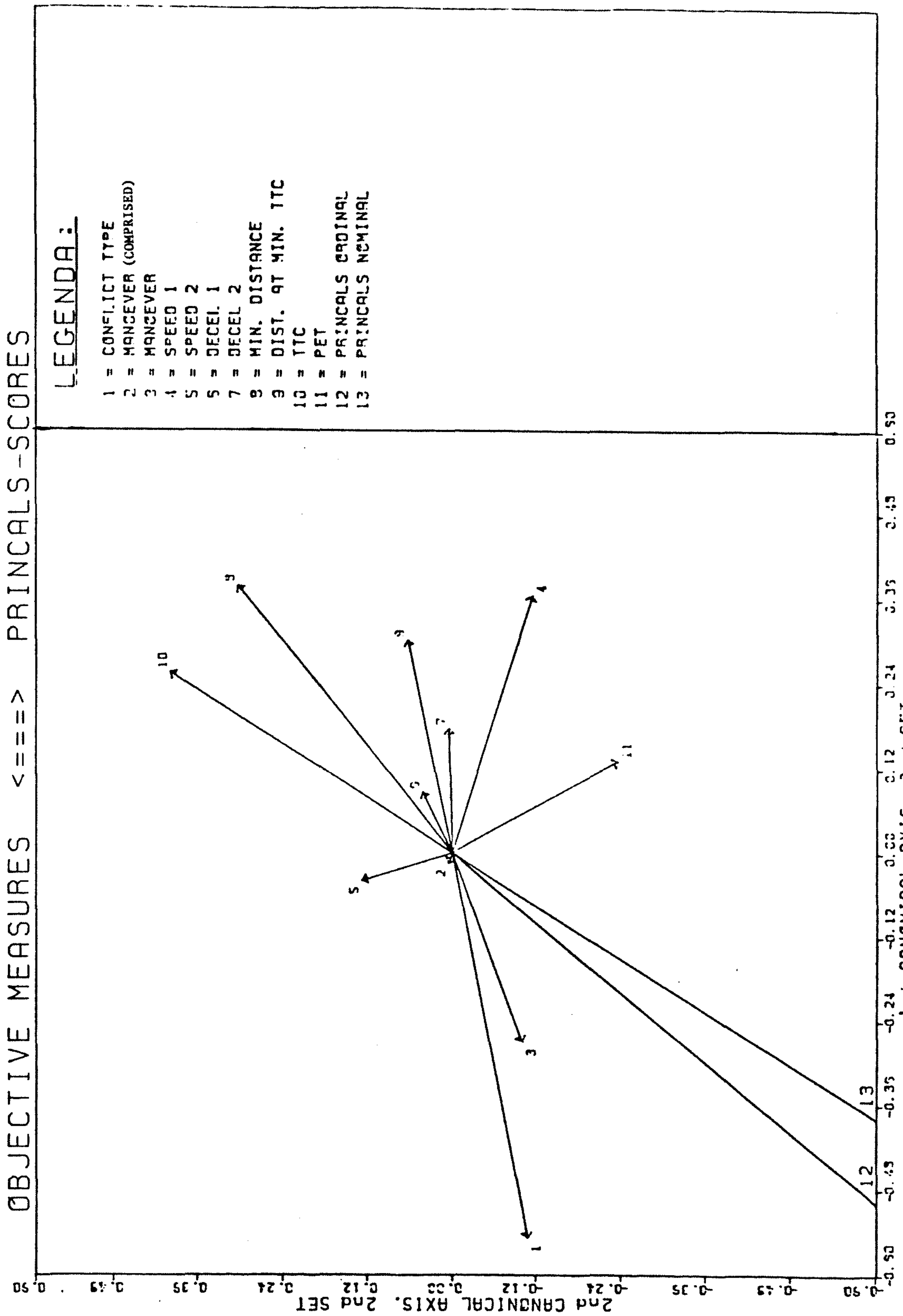


Figure 3. CANALS plot of the projections of the optimally scaled objective measures on the plane through the two copies of the PRINCALS scores.

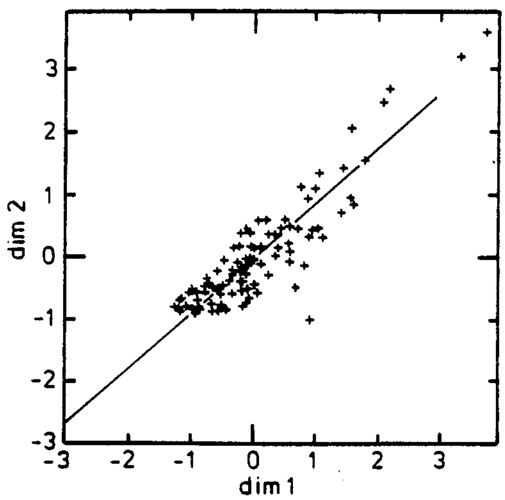


Figure 4. Correlation between PRINCALS severity dimensions, based on the sub-set of conflicts (DIM1), and the severity dimension, based on the total set (DIM2).

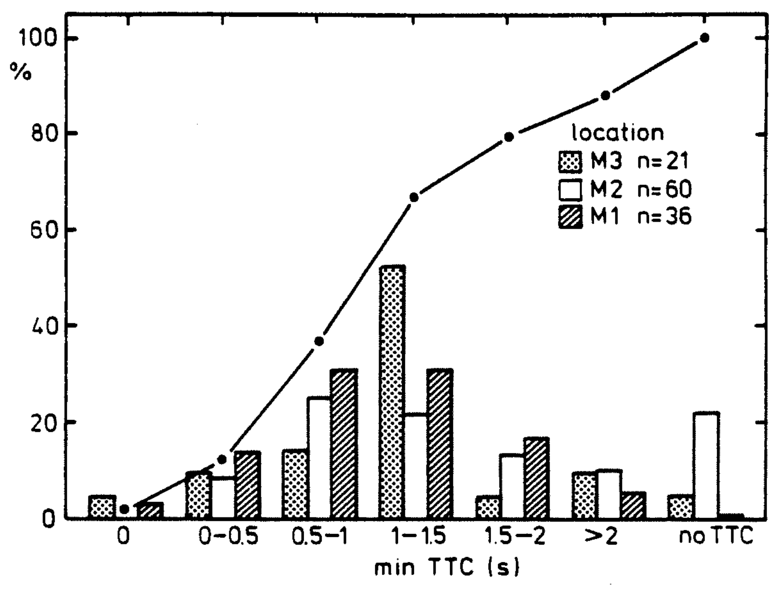


Figure 5. Distributions of min TTC-values for the analysed subset of conflicts (scored by $\geq$ 4 teams) at each location separately. The cumulative distribution is given for the total sub-set. The category no TTC stands for those interactions without a collision course.

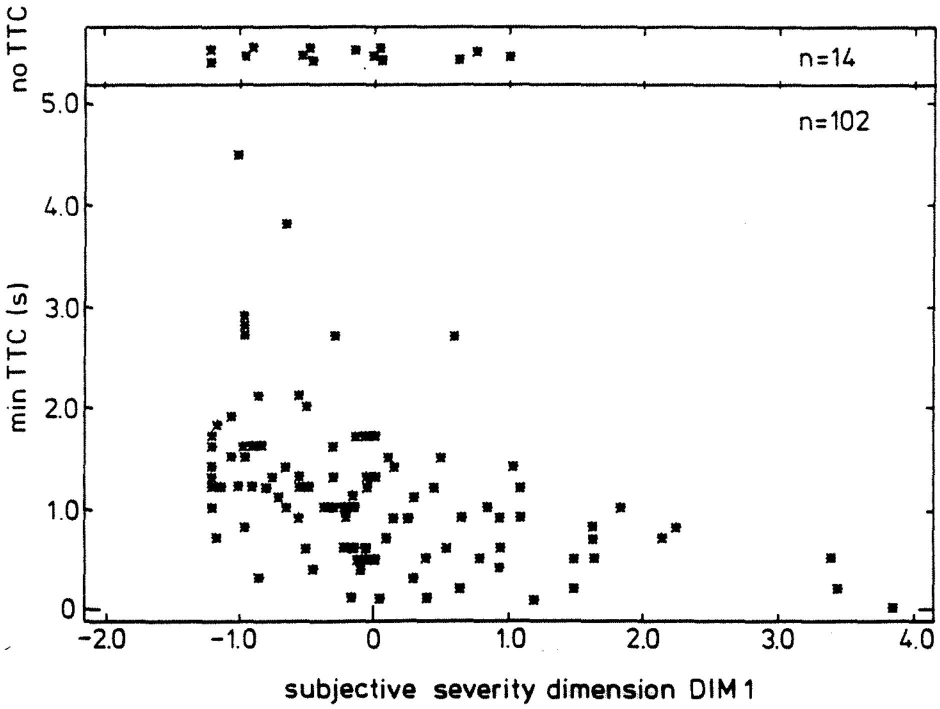


Figure 6. TTC-values against PRINCALS severity dimension DIM1 (based on analysed subset). At the top the category of conflicts without a collision course (no TTC) is given.

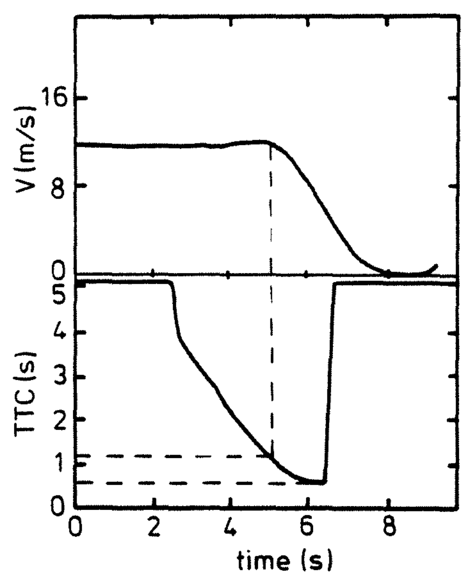


Figure 7. Example of the difference between computed TTC-value and estimated TTC-value (according to Swedish definition) at the moment braking is initiated.

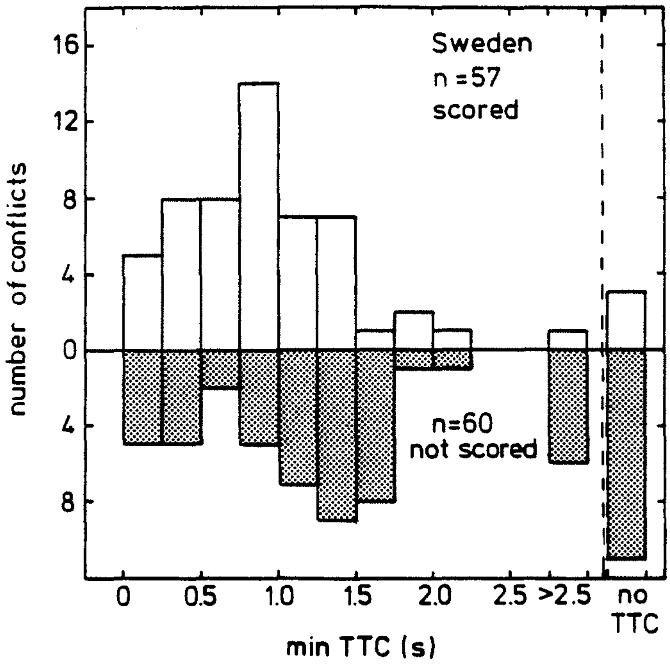


Figure 8. Number of conflicts with and without (no TTC) TTC-values, as scored, resp. not-scored by the Swedish team.

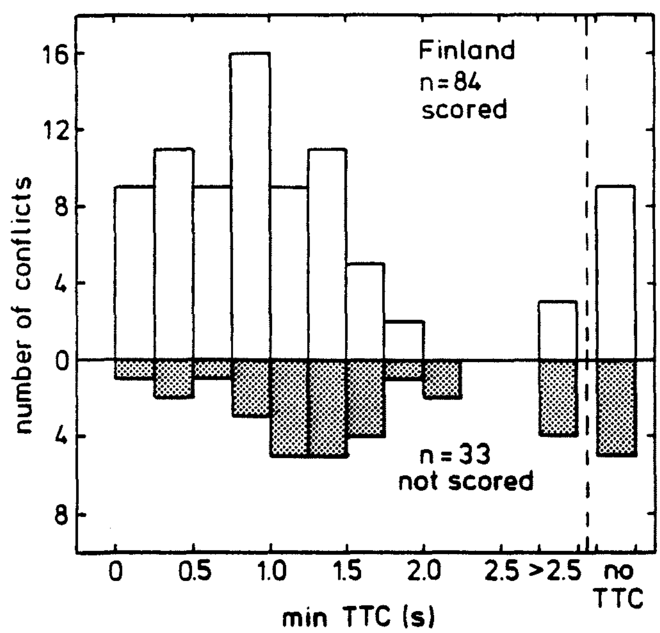


Figure 9. Number of conflicts with and without (no TTC) TTC-values, as scored, resp. not-scored by the Finnish team.

TABLES 1-3

Table 1. Conflict definition and severity scaling used by the teams.

Table 2. Explanation of parameters, used for description of conflicts.

Table 3. Total number of conflicts and the number analysed quantitatively from video.

	Conflict definition			Severity scaling	
	Estimation of Time to Collision (TTC)	Estimation of Post Encroachment Time (PET)	Interpretation of evasive action	Based on proximity to collision (any type)	Based on proximity to injury accident
Sweden 1 Finland	fixed threshold			X	
Sweden 2	fixed threshold				average speed and type of road user
Sweden 4	threshold function of speed			X	
Canada		fixed threshold	(X)	X	
Great Britain France 2			intensity and result		X
France 1 United States Sweden 3			intensity and result	X	
Germany Austria			intensity and result	X	
Netherlands	calculated minimum value			X	

Table 1. Conflict definition and severity scaling used by the teams.

- Road user 1 : Road user with right of way. In car-following situations the first one.
- Road user 2 : Other road user involved in interaction.
- V1 : Initial speed of road user 1 (m/s), as measured in the beginning of the quantitative analysis of the interaction.
- V2 : Idem for road user 2.
- A1 : Maximum acceleration road user 1 (m/s^2) preceding or during the interaction (mean value during one second around the peak).
- A2 : Idem for road user 2.
- MDIS : Minimum distance between road users (m), as measured between two nearest points ofboth road users before, during or after the interaction.
- TTC : Minimum time to collision value (s). For the used time to collision concept, see a.o. Van der Horst (1982). TTC = 9.9 s means no collision course.
- DTTC : Distance between road users (m) at the moment the minimum time to collision value occurs (99.9 means no TTC value available).
- PET : Post encroachment time (s) after the definition of Cooper (1983). 9.9 means that no realistic PET value could be computed, mainly because one of the road users had stopped.

Table 2. Explanation of parameters, used for description of conflicts.

Location	Total	Analysed
M1	290	38
M2	484	60
M3	200	37
Total	974	135

Table 3. Total number of conflicts and the number analysed quantitatively from video.