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PROCEEDINGS OF THE SEMINAR ON SHORT-TERM AND AREA-WIDE EVALUATION OF SAFETY MEASURES, AMSTERDAM, THE NETHERLANDS, APRIL, 19-21, 1982

Edited by

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SEMINAR ON SHORT-TERM AND AREA-WIDE EVALUATION OF SAFETY MEASURES, AMSTERDAM, THE NETHERLANDS, APRIL, 19-21, 1982

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OPENING ADDRESS

Prof. E. Asmussen, Chairman of the Seminar

The content of this seminar is a subject of great actuality. We all know that in most of the countries there is a strong development in the ways of thinking about the importance of the social activities outside the house. The roads and spaces in living areas are not only the property or domain of the motorized traffic.
As a result of these developments, living areas are planned from new concepts, old areas are reconstructed according to these new concepts. Town planners, engineers and decision makers, however, are constantly confronted with the inconsistency of desires, aimes and behaviour of citizens. This is one of the reasons that the effect of new plans or reconstructions on road safety, for instance, is difficult to predict. As researchers want to give the necessary support to decision makers and planners, it is of vital importance that a short-term evaluation method is developed. If effects of measures can only be stated after a long time period there is a great possibility that the new decisions that have been made, are regretted later on.
We also know that reconstructions have influence on traffic circulation patterns, Therefore we cannot restrict ourselves to the effect of the measures on the spots or the sites, but we also have to analyse the effect on the whole influenced ares. So we have to make an area-wide evaluation. This is in a nutshell the state of the problem of this seminar.
This seminar will be opened by Mr. Allewijn, Director of Road Safety at the Ministery of Transport and Public Works in The Netherlands. He acts as the right hand of the Minister in his function of co-ordinating Minister for Road Safety.
Before giving Mr. Allewijn the floor, I would like to express my gratitude to the Roal Dutch Touring Club ANWB for all the support they gave us for organizing this seminar and printing, for instance, the seminar book with all your contributions.

INTRODUCTION

P. Allewijn, Director of Road Safety at the Ministery of Transport and Public Works, The Netherlands

In 1973 the Dutch Government decided to intensify the fight against the social evil which we call road unsafety.
It was necessary to take that decision. In a period of ten years over 30.000 people were killed in traffic in such a small country as ours. Each day there were seven people killed and more than 200 people wounded in traffic.
This government decision to intensify the fight against road unsafety meant among other things the set-up of a national road-safety plan. The Minister of Transport and Public Works was appointed as co-ordinating Minister for road safety. In this capacity he had to co-operate with seven other cabinet-ministers.
This may explain the reason why I have the pleasure to welcome you not only on behalf of, the Minister of Transport and Public Works, but on behalf of all eight Ministers of the cabinet who closely co-operate in road-safety matters.
So this means to you an eightfold welcome and to me an eightfold task to address myself to you.
You may perhaps be curious to hear what has been achieved since the government decision in 1973.
Well, without trying to mention accurate figures, I may say that road safety has increased by 40% since 1973, which means 40% less road victims. In numbers this is a reduction of 3 dead each day compared with 8 dead before and a reduction in injured of 70 each day, against 200 before. Meanwhile motorized traffic has increased enormously. The number of motorvehicles rose by 80% from 2½ to 4½ million. The number of vehiclekilometers went up by 35%.
These figures are encouraging and immediately the question arises which activities and measures have led to these results. The laymen expect the scientists to give the answer. However, nobody seems to be able to explain the general reduction in the number of road victims which occurred not only in our country but fortunately in other countries as well.

We are now quite close to the subject of your seminar. The evaluation of individual road-safety measures is a problem you are dealing with, but a scientific evaluation of a general government policy seems to be still far away.
However, this does not prevent the government from a large-scale effort which is a condition sine qua non for a substantial reduction in the number of accidents and injuries.
In this connection the eight co-operating ministers are setting up another nation-wide plan right this year. This plan will cover a wide range of measures and activities.
Fortunately we have the Institute for Road Safety Research SWOV in our country which co-ordinates all scientific research in our field. This is a great help in setting up of plan and evaluating the measures to be taken. Eric Asmussen, director of this institute, is chairing your seminar.

Evaluation is most important for the government road-safety policy. More certainty about the effectiveness of measures is very stimulating for the application as well as the improvement of such measures.
Evaluation investigation is based on accident data. Your problem is that for an effective evaluation there should occur a certain minimum number of accidents. Where this is not the case, the investigation period should be extended which could lead to inaccuracy. That is why you need other reliable indicators which enable an evaluation of the results of road-safety measures. I hope you will succeed in realizing this aim.

Though I understand that I am invited to make a short-term and not an area-wide speech, I cannot resist the temptation to make some more remarks on the theme of your seminar. However, I am neither a scientist nor a specialist, but only a policy maker.
The results of road-safety programmes and measures are usually expressed in terms indicating the reduction in the number of accidents and people killed or injured. But we become more and more aware of the fact that road (un)safety cannot be expressed in terms of accidents and victims only.
The risk of meeting with a road accident will also influence the mobility of the vulnerable road-users, in particular children, aged people and the disabled.

Therefore a road-safety policy should be aimed at the creation of safe mobility possibilities for the vulnerable road-users as well. We now realize that the immense increase of the motorized traffic has kept many vulnerable road-users in the house and consequently from normal social contacts and possibilities of recreational and cultural activities.
In our country such a policy has social political priority. It may be added that people who stay at home for such reasons are not found in road statistics.
Road unsafety may have another consequence.
We have wrongly been thinking that all people outdoors should be considered as road-users making use of some mode of transport and going somewhere. Many people are out of the house for quite other reasons. Their "being there" is of a cultural, social or recreative nature. For instance they are shopping, leaving a theatre, a sport-stadium or school, getting a breath of air or they are just enjoying a social evening in the city.
People engaged in such activities show quite a different behaviour compared to those engaged in going somewhere. They do not want to be bothered by the necessity of being alert and careful.
Road-traffic unsafety, the risks of accidents now have considerably limited or pushed aside the possibilities of being rather care-free outdoors for other purposes than making use of some mode of transport.
Therefore road-safety policy will also be aimed at the reduction of the accident risk in such a way that people can perform social, cultural and creative activities without being bothered and their health or life being endangered by motorized traffic.
Thus a road-safety policy has a broader scope than only the reduction of accidents and traffic victims, how important this may be.
A development in the objectives of road-safety policy in the way I outlined must consequently be followed by an adaption of the evaluation to the new policies which means an evaluation of evaluationresearch.

Mr. Chairman, I have made these remarks in order to try to complicate the theme of your seminar. Nevertheless I hope that I succeeded in setting the ball rolling for your discussions.
I wish you all a pleasant and fruitful time together and a safe return after the seminar.

BACKGROUND PAPER

S. Oppe and F.C.M. Wegman, SWOV, The Netherlands

1. INTRODUCTION

In this seminar we will restrict ourselves to safety measures. Thus only countermeasures that are intended to reduce accidents and the consequences of these accidents will be regarded. Of course it is of interrest to know how safety measures are related to countermeasures that have been taken for other reasons but also have an impact on safety.

Furthermore it is important to know the limitations with regard to goals of higher priority. We can ask ourselves if there are countermeasures on a higher level, such as town planning, traffic distribution, energy consumption etc., that influence safety or the safety measures that have been taken. Or, given these priorities, whether or no the safety measures are optimal with regard to safety or with regard to cost/benefit, cost/effectiveness etc.

We can also investigate the side effects of the safety measures on other subjects such as noise, air pollution and comfort.

However, we propose to restrict ourselves to the evaluation of safety measures with regard to safety.

A second limitation is concerned with the addition of "area-wide".

In those cases where traffic circulation has been changed it is always advisable not to restrict the evaluation of countermeasures to the locations where they are implemented. E.g. signalisation of intersections may result in changes in traffic flow and finally in a shift of accidents rather than a reduction. However, here we are concerned with a different thing.

Recently more and more attention has been paid to area-wide traffic plans and proper evaluation studies for these plans. Specific methodological and statistical problems result from this situation. Uncertainties about the effects of new traffic management or environmental schemes result in experimentation and evaluation. The uncertainties arise from the implementation of various different types of countermeasures in "unique" situations.

Short-term evaluations are therefore of interest not only for the policy makers but also for the investigators themselves. A second, rather cynical reason for evaluation is that it is sometimes easy to bypass the public participation process by promising such an evaluation study.

In general, however, the reason behind these studies is to improve an implemented scheme or at least specific countermeasures that are part of it. Therefore, it is necessary to understand why changes do appear. Global studies which result in some percentage of accident reduction do not satisfy the investigator completely. To understand the effects of countermeasures it is inevitable to detect the relevant conditions and to describe quite precisely how these conditions are related to the effects. Furthermore it is important to know how the results of the evaluation studies can be generalised in order to design new schemes.

Finally, two practical problems with regard to area-wide evaluation studies are important. The first one is the definition of the experimental area, the area that is not experimental itself but is influenced by the countermeasures and the control area. The second problem is how to cope with behavioural studies in small streets with low traffic volumes without influencing the traffic process.

Two main reasons for evaluation are mentioned: evaluation of the product of these countermeasures (decrease in unsafety) and evaluation of the changes in the process of traffic behaviour that are initiated with the safety measures. The product is of major concern for policy makers, the process for the investigators, although this distinction is not absolute. The question whether or no these countermeasures are effective, mostly stated in terms of hypothesis testing, is mainly concerned with the product. If explanations are wanted for the presence or absence of effects, mostly stated in terms of parameter estimation, one is mainly concerned with the process. If one is concerned with the product then questions arise such as: "Is this specific conflict measure an acceptable surrogate measure for accidents?". To test such a hypothesis, one investigates whether or no the correlation between the number of accidents and that conflict measure departs from 1. If an investigator regards a conflict to be a behavioural determinant of accidents, then he might ask himself to what extent this aspect of behaviour is related to unsafety, e.g. by asking how much the correlation between this conflict measure and the number of accidents deviates from 0. In this context we may find here

all kinds of relational studies, with regard to a large number of behavioural aspects, road conditions and circumstances.
In view of product evaluation, short-term evaluation has the advantage that the influence of disturbing factors is reduced. However, the time for evaluation may be too short to collect sufficient data, especially when residential areas are investigated. Furthermore, if we want information about the effect of countermeasures on specific aspects of safety, such as pedestrian accidents with children involved, then the problem of insufficient data becomes even more important.

2. PRODUCT EVALUATION

2.1. Safety data

If we want to evaluate the effects of countermeasures, we will measure unsafety before and after the countermeasure and see to what extent there is a reduction in unsafety due to these. If we define unsafety in terms of the probability of accidents and the resulting damage to persons and properties, then the only way to measure unsafety directly, is to count accidents and registrate their effects. We have to estimate probabilities from counts and even with well defined probabilistic models, such as the model of Poisson-distributed accidents, it is very difficult to detect differences in probabilities. In Figure 1, we find an example of the expected number of observations needed to detect various percentages of reduction of accidents. These data result from exact tests applied to Poisson-distributed accidents. A reduction of 20% of the accidents is not significant anymore at a 5%-level, with less than 80 accidents.
A reduction of 30% is only significant with more than 35 accidents. We have to wait for years to get these figures in most situations, both because the kind of countermeasures result in us larger reduction, are very rare and the areas involved have low traffic volumes and therefore low accident numbers (although these numbers may be relatively high as compared to situations with high traffic volumes). There seems to be no way out of this problem that is stated over and over again.
Apart from this fundamental problem there are many methodological problems related to the comparison of accident figures. The report from OECD

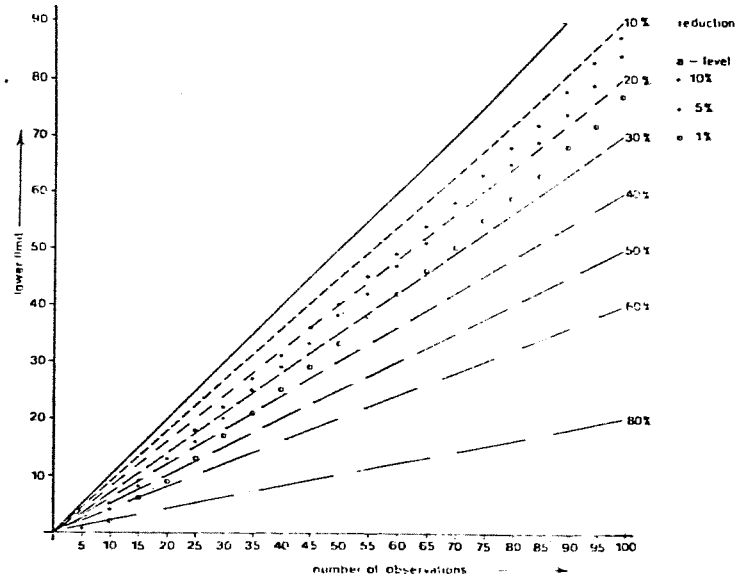

Figure 1

Figure 1 shows the numbers of observations necessary to detect significant reductions in those numbers for values of zero to hundred observations. It is assumed that the number of observations is Poisson distributed. When the number of observations is 100, a reduction of 13% (87 observations) is already indicative (at a 10%-level of significance). A reduction of 16% is already significant at a 5%-level and a reduction of 23% is significant at a 1%-level of significance. A reduction of 20% is not significant anymore at a 5%-level if the number of observations is less than 80. With numbers of observations lower than 50, this reduction is not even indicative.
A reduction of 30% can only be detected at a 1%-level of significance when the number of observations is larger than 60. At a 5%-level with numbers larger than 35. If the number of observations is smaller than 25 a reduction of 30% is not indicative anymore.
A reduction of 40% can only be detected at a 1%-level if the number is greater than 35 and if the level is 5% then only with numbers greater than 20.
If the number of observations is smaller than or equal to 10 even a reduction of 60% is not significant anymore at a 5%-level.

Road Research Group TS4 (OECD, 1982) gives an excellent survey of problems such as the definition of the correct control group, finding the correct sampling procedure etc. We shall not go into detail on this here. There are also modern techniques that improve the possibilities of comparing data. E.g. De Leeuw & Oppe (1976) describe a log-linear model in which it is possible to compare accident rates of multi-way tables by means of various kinds of hypotheses.
Recently it is even possible to use exact tests to test larger tables than 2x2 designs more efficiently.
However, for each comparison that is stated by means of counts or measures such as accident rates deduced from counts, the problem of insufficient data remains the most important once the effect of safety measures is evaluated.
The only way to improve statistics is to increase the counts.
One way to do this is to extend sample time. However, with short-term evaluation this seems to be hardly the answer. Furthermore there are difficulties resulting from the increased variation in circumstances that disturb the comparison if time of observation is extended. Another way out is to enlarge the area or increase the number of areas. However, this presumes careful comparisons of situations in order to see if this is justifiable. We will return to this in Section 3.
Finally, we can use surrogate measures of safety, e.g. counting conflicts instead of accidents.

2.2. Conflict data

If we want to know how unsafe a particular area is, we really want to establish the accident potential and not just how many accidents have already occurred there. Especially if these areas of concern have very new and drastic designs. Sometimes, we try to estimate the accident potential by means of other indicators of unsafety than the accidents themselves. Sometimes the number of traffic conflicts is used as an indicator of traffic unsafety.
Experimental evidence shows that the "serious-conflict" measure is a better predictor for accidents than the total number of conflicts. Therefore, the definition of conflicts with regard to seriousness is very important in order to improve the validity of the conflict technique.

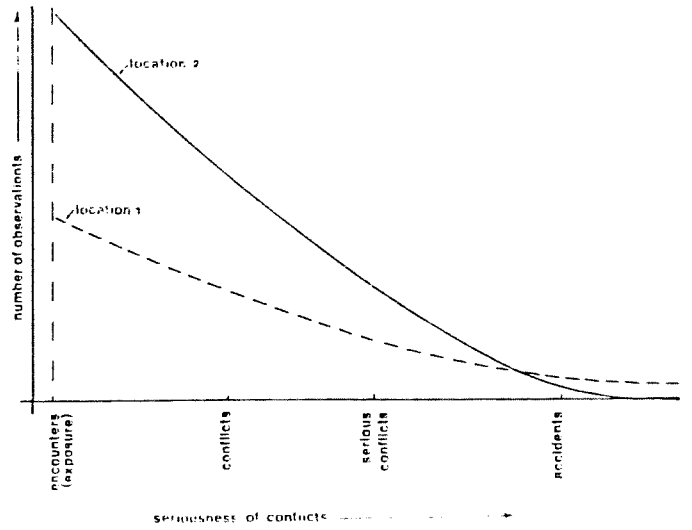

Figure 2

Figure 2 demonstrates an imaginary comparison between two locations. If we choose a definition with regard to the seriousness of conflicts, we select a point on the x-axis. On the surface underneath the curve, right from this point, we find for each location the number of conflicts. If we select the point marked "conflicts" we see that the estimated number of accidents is larger for location A than for location B. If we choose "serious conflicts", then both numbers are more or less equal, while, using the number of accidents, this number if smaller for A than for B. The use of accident rates as a measure of unsafety instead of accident totals is implicitly based on the assumption that the curves are not parallel. If the curves were decreasing at exactly the same rate for all locations, the correlation between accidents and accident rates would be perfect. In this case the denominator (some measure of exposure that is used in the accident rate) would give us the best estimation of the potential danger at the locations, because we can measure exposure the most reliably. We know that this is not the case; the accident rate gives us extra information. We have to study the curves in detail before we know if these rates give us sufficient information.

2.3. Accidents, conflicts and exposure

If we look again at Figure 2 we must realise that we use rather far going assumptions in trying to predict the small surface area at the right of the accident point, from the large surface at the right of the conflict or serious conflict point. At least the shape of the curve seems relevant. The accident rate gives us information about this shape. If we define a conflict rate in the same way, using conflicts as some measure of exposure and serious conflicts as a measure of unsafety, then we have some information about the shape of the curve. If well defined, both measures will be more reliable than accident counts, because of the larger number of counts. One problem does limit the relevance of both measures of exposure and unsafety, namely, the problem of the validity of the conflict measures. If we ask for the "content validity" of the conflict measure using conflicts as a measure of exposure we need an operational definition of exposure in each particular case.

Exposure measures deduced from gross traffic volume data, such as exposure data for pedestrians deduced from time spent in traffic or distance travelled, seem to be insufficient. Especially in situations we are interested in, e.g. residential areas. It seems better to define first situations that are relevant such as the number of encounters between road users, in order to detect which of these situations are critical. However, it will be even more difficult to find a correct operational definition for serious conflicts, for the detection of critical situations. Content validity seems to be the (very important) first step. Only the "predictive validity" with regard to accidents can inform us about the relevance of the serious-conflict measure as a measure of unsafety. The content validity can inform us only about the "face value" of the method, or in other words, how relevant the definition looks at first sight.

The face value of the existing conflict measures with regard to situations that are special for residential areas is not high. Many techniques are being developed for dense traffic arterials and/or car-to-car conflicts. It is important to know the relevant cues for accidents between cars and other road users such as pedestrians and bicyclists.

Improving the content validity of the conflict measure will be the necessary link between the conflict technique used as a surrogate measure of

unsafety and the conflict-analysis technique. This technique regards conflicts as behavioural aspects of the traffic process amongst (and related to) other aspects of behaviour, such as speeds, manoeuvres etc., under various conditions, in order to find explanations for the hazard of specific traffic situations.

3. PROCESS EVALUATION

The effectiveness of countermeasures that have been taken to improve safety, results from the extent to which it is possible to reduce unsafe behaviour or to improve conditions that cause unsafety. If one wants to know if a measure is indeed effective (or as effective as has been assumed), the question arises whether that measure has the intended effect on behaviour or conditions. This answers the question whether or no the measure can have an effect on safety. The next question then is: "Does this change in behaviour or conditions reduce unsafety as was supposed?", or: "Is the measure relevant with regard to safety?"

We can skip the first question and only look at the impact of the countermeasure on safety as has been described as product evaluation.

But if such evaluation is not possible, because there are not enough accident data to test these effects, we can ask ourselves whether it is still the best procedure to evaluate the assumed effect on safety by means of surrogate measures instead of evaluating whether or no the countermeasures have the expected impact on traffic behaviour and traffic conditions. Especially in case knowledge about the effectiveness of a particular countermeasure is scarce, it is of great importance to register, apart from the effect on behaviour and conditions that are supposed to be directly influenced in the other conditions and circumstances that existed in that situation and to measure the effect of the countermeasure on the relevant traffic characteristics. We can ask ourselves in what way the characteristics that are supposed to change, are influenced by the countermeasures and which conditions are relevant for this change.

This asks for relational studies in complex situations, especially if the countermeasures that have been taken are compounds of various area-wide countermeasures. For this kind of investigations it is necessary that the results of various situations are collected in order to find relations

that are stable and can be generalised for other situations. For example, if we want to evaluate the usefulness of humps in streets, we have to determine under what conditions and in which situations a sufficient reduction in speed will result and how we can cope with dangerous side effects in various situations.
We can possibly find a way of applying a countermeasure which is optimal for a moderate range of situations, but it is of great importance to know the results outside this range. A large-scale evaluation of countermeasures applied to a diversity of small-scale situations is needed to collect this kind of knowledge.
The registration of conditions is primarily important if we want to compare results from other studies, especially in different countries. Furthermore the registration of discrepancies between the data that is wanted for optimal investigation and the data that were available at the moment of investigation can help to improve future investigations.
If conflict techniques are used to analyse conflicts, in order to get a greater insight into the relation between various countermeasures and conditions on the one hand and the impact of these on the behaviour of road users on the other, this will also result in a better content validity of this technique as a surrogate measure of unsafety.
However, the conflict-analysis technique is only one method of investigation.
All kinds of behavioural measures are available, ranging from sophisticated registration of eye movements and galvanic skin responses to the measuring of velocities or observation of the crossing behaviour of pedestrians.
Because not much is known about the influence of various traffic conditions on the behaviour of road users, the expectations about the effectiveness of measures are based on rather vague theories.
Also little is known about the relation between the estimated risk of situations and feelings of unsafety of road users and the effect of these on their behaviour in traffic or their participation in traffic, vehicle choice or choice of routes. Although these feelings of unsafety may not be direct criteria for the evaluation of safety measures, they are relevant to investigate the relation between the behaviour of road users and safety or the effectiveness of safety measures.
A major problem in the study of this kind of relations is the fact that

many characteristics are of a qualitative nature. However, there are recently developed techniques (Gifi, 1981) which can be used to analyse relations between qualitative characteristics as well.
At last, in order to give a complete evaluation of countermeasures and to find an adequate evaluation procedure, the purpose of the measure has to be stated explicitly, together with the means by which one tries to realise this purpose, the expectation about the effectiveness of the measure and its side effects.

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ABSTRACTS/SUMMARIES

Session 1. Research-policy

1.1. COMMUNITY TRAFFIC SAFETY; AN EVALUATION CHALLENGE

Frank G. Ephraim, Director, Office of Program Evaluation, NHTSA,
U.S. Department of Transportation, U.S.A.

Abstract

When properly performed, evaluations produce the facts and analyses public officials can use to make informed programme decisions. Achieving a safe traffic environment within an official's jurisdiction is a high priority. However, the evaluation of traffic safety programmes and specific safety-oriented activity is still an uneven practice, often contingent on public policy at each Government level. This paper begins with a brief review of the changing traffic safety role of the U.S. Federal Government and the concurrent initiatives of local communities to meet traffic safety needs. One primary concern is how to properly integrate the scientific evaluation process into a community management environment while retaining its integrity and credibility, given practical constraints including the need for a short experimental time span, maintaining a control entity, incident detection problems, size of data sets, and cost and time burden. These problems are examined briefly, together with examples of evaluation efforts depicting them.
Identification and use of surrogate or proxy measures appears inevitable for most short-term or limited area delineations, and even intermediate measures would be appropriate for safety oriented activities designed to reduce a specific risk condition associated with particular accident types. Selected means of obtaining surrogate data, and certain measures of exposure, are discussed based on recent and on-going work - in terms of possible application to short-term, area-wide evaluation. Work done to construct and validate causal networks, as well as completed evaluations employing surrogate techniques, provide the conceptual and practical framework for this discussion. A series of research topics for further consideration is suggested.

1.2. SOME EXPERIENCE IN CANADA WITH PROBLEMS OF SHORT-TERM EVALUATION OF SAFETY MEASURES

J.J. Lawson. Road and Motor Vehicle Traffic Safety, Department of Transport, Ottawa, Canada

Abstract

Facing the problems of lack of sufficient accident experience under controlled circumstances to identify the impacts of safety measues, researchers in Canada have turned to assessments of impacts on "intermediate" variables in the chain of accident causation. These include road user attitudes, knowledge, physical condition, self-reported and observed behaviour, and (in some initial experiments) perceived risks. Alternatively, assessments have attempted to use traffic "conflicts" as proxy measures of safety.

The paper briefly examines some of these efforts, considering the questions:
- can the evaluation techniques be improved so that conclusive results can be obtained; and
- if not, are partial answers useful?

1.3. SHORT-TERM EVALUATION AND DECISIONMAKING

Robert C. Matthews, F.H.W.A., U.S. Department of Transportation, U.S.A.

Abstract

Research budgets too often are among the first to be reduced in times of fiscal restraint. Public research organizations must remain aware of their public character, since they function in politically competitive frameworks. They must be able to respond in a timely manner to top-level officials when the opportunity arises, or risk losing and alienating an important clientele.

The objective of road safety research is to contribute to the content and direction of public decisions in the field by providing scientific and technical support. Yet, decisions often must be made on questions on which little or no definitive research exits, while moderate levels of controversy may require relatively quick responses. Valid short-term methodologies can help fill this void and can enhance the ability of the research community to secure from the political-budgetary process the level of resources required to carry on a broad range of quality research by increasing the visibility of its expertise.

Short-term methodologies, though, must be kept in perspective. Most decisions in road administrations are rather routine and are undertaken in a "stable" environment. This is conductive to applying the results of long-term research, which must remain the primary activity of research organizations.
However, "open" decisions, i.e., not routine and not foreclosed to staff input by highly charged controversies or by firmly established governmental positions, offer the research community the oppertunity to apply short-term methodologies in a useful and timely manner. If applied to appropriate questions, short-term methodologies can help research organizations to reach two important objectives:
1. contribute to a broader range of public questions; and
2. secure the necessary resources in the future.

1.4. WHY AN EVALUATION OF TRAFFIC SAFETY MEASURES?

Nicole Muhlrad, O.N.S.E.R., France

Summary

Traffic safety is a major preoccupation in most countries, and the high cost of road accidents justifies that large sums of money should be spent on safety research and safety countermeasures.
Now, how to use the money as efficiently as possible? How to reach the best results in terms of numbers of lives saved and accidents avoided? How to assess these results? How to improve future safety policies? It is clear that there is a need for evaluation studies and definition of evaluation processes, adequately designed to answer the various preoccupations of researchers and policy-makers.

The purpose of this paper is to list some of these preoccupations, find out which forms of evaluation are best suited to bring an answer to them, and state (briefly) which kind of data is required to perform the task.

We hope that it will contribute to promoting a better evaluation of safety work, which will be a help for research and increase the general efficiency of safety action.

1.5. PRINCIPLES IN SHORT-TERM EVALUATION OF SAFETY MEASURES

Matti Roine, Roads and Waterways Administration, Finland

Summary

The last development in the field of technics has solved many problems in applying theory to the practise. This is how short-term evaluation of safety measures has become more and more important and at the same time very much has happened in the theoretical development.

With short-term evaluation there is a better possibility to get an insight of the real process of the traffic. We are able to measure the basic changes in the variables that connect behaviour for instance to the improvements of safety.
At the same time we anyway meet new challenges like questions of generalizing of results, controlling factors and planning of test arrangements.

The experiences we have show that short-term evaluation can be a very useful tool in producing information for decisions.
Methods have been used often in giving quick answers for restricted and practical questions. Relevant hypothesis should be tested and also the exact control of the possible affecting variables is an prerequisite for using the results in safety work.

We cannot give up the use of statistics. They have their role at least in everydays' safetywork. Short-term evaluation of safetywork has its advantages in the possibilities of quick analyses and in the tight contacts to the explaining variables.

1.6. THE POTENTIAL FOR AREA-WIDE APPLICATION OF ACCIDENT COUNTER-MEASURES IN RESIDENTIAL AREAS

D.T. Silcock and R.T. Walker, Transport Operations Research Group, University of Newcastle upon Tyne, United Kingdom

Abstract

The research reported in this paper involved an evaluation of the potential for wide-spread application of low-cost accident counter-measures in residential areas where, typically, vehicular and pedestrian volumes are relatively low. It presents a summary of the procedure by which the counter-measures were evaluated against certain criteria and then compared one with another, in order that the most promising could be identified.

Fifty-three counter-measures were identified, within six strategies. Most have been applied in the UK, although not necessarily in residential areas or as a single measure. Evidence of the effectiveness of individual counter-measures is rare as most are commonly used as components of an overall traffic or enviromental management scheme. Furthermore, despite the relatively widespread use of some of the devices, in general little examination of their effectiveness appears to have been undertaken.

As a result this evaluation, in some respects, is subjective. The framework however, has been designed with this in mind and allows the adoption of alternative value-judgements and the consideration of their implications on the results of the evaluation. The results presented, where firm evidence does not exist are based on a range of plausible judgements and are relatively stable with respect to them.

The research was carried out under contract to the Transport and Road Research Laboratory.

ABSTRACTS/SUMMARIES

Session 2 + 3. Methodology and analysis

2+3.1. THE "REGRESSION-TO-MEAN" EFFECT; SOME EMPIRICAL EXAMPLES CONCERNING ACCIDENTS AT ROAD JUNCTIONS

Ulf Brüde and Jörgen Larsson, National Swedish Road and Traffic research Institute, Sweden

Abstract

A randomly large number of accidents during a "before-period" is normally followed bij a reduced number of accidents during a corresponding "after-period" even if no countermeasures have been implemented. This statistical phenomenon is termed the "regression-to-mean" effect (or shorter the regression effect).

Road junctions constitute points in the road network with particularly high accident rates although the average number of accidents per junction is low. The latter means that the regression effect can be expected to appear even in very modest accident numbers.

The examples described in this report are based on accidents at unaltered rural junctions in the national major road network. The years 1972-1975 have been regarded as the before-period and 1976-1978 as the after-period.

The examples show that the regression effect (accident reduction) in accidents reported to the police often can be about 30-40%. For accidents involving personal-injury the regression effect is often about 50-60%. In the case of junctions with a significantly large number of accidents (in relation to the amount of traffic) during the before-period the regression effect is usually even greater.

2+3.2. AN INTERACTIVE COMPUTER SYSTEM FOR TRAFFIC ACCIDENT ANALYSIS

S.O. Gunnarsson and S. Lillienberg, Sweden

Abstract

Traffic accidents are a serious consequence of the road traffic system and should be carefully monitored. This creates a need for a computer system which provides continuing information on traffic accidents within a particular area (e.g. a county, a metropolitan area, a city or a town). An interactive computer system (called TRAFO) has been developed in order to:

- study trends in accident statistics;
- analyze factors contributing to accidents, particularly the "traffic environment";
- design proposals for improvements;
- make priority lists for improvements; and
- follow-up studies.

Input consists of accident data, network data and data in clear text.
The results of the processing can be displayed as:

- Cross-tables
- Ranking lists
- Accident maps
- Collision diagrams.

The tables are designed so they can easily be duplicated and published.

The TRAFO system is used by traffic safety departments in several Scandinavian cities, e.g. in Göteborg, Sweden, and in Oslo, Norway. It has been found a useful tool for analysis and evaluation of safety measures.
The TRAFO system has also been used in connection with traffic safety research projects, financed by the Swedish Transport Research Delegation.

2+3.3. A LEARNING DISABILITY AND ITS CURE

Ezra Hauer, University of Toronto, Canada

Abstract

Sensible management of traffic safety is predicated on having reasonable expectations about the effect of various safety programmes and countermeasures. Unfortunately, in spite of decades of research and experience, the safety effect of many countermeasures is largely unknown. This sorry state of affairs is mainly due to the fact that it is difficult to conduct conclusive experiments about the effect of safety countermeasures.

Recognition of this objective should lead one to question the usefulness of classical statistical tests of significance as a device for scientific progress in this field. The unquestioning and all-pervasive use of significance testing in evaluative research on safety amounts to a selfinflicted learning disability. The first part of the paper explains why.

The fundamental problems of evaluative research is how to build knowledge from experimental results. Recognizing that in transport safety knowledge is gradually accumulated from the results of many studies, alternative approaches are explored. The application of a Bayesian approach in a specific case is described.

2+3.4. BAYESIAN METHODS APPLIED TO ROAD ACCIDENT BLACKSPOT STUDIES; SOME RECENT PROGRESS

D.F. Jarrett, C. Abbess, and C.C. Wright, Middlesex Polytechnic, U.K.

Abstract

Statistical methods for evaluating the effectiveness of treatment at black spots are important for two reasons. First, they allow the engineer to determine how succesful his efforts have been, and hence to estimate the costs and benefits of different types of treatment applied to different types of site. Second, they enable the researcher to test new treatment measures objectively. However, the methods which are currently used both in research and in local authority practice are not very suitable as a basis for making decisons. Bayesian methods, on the other hand, are ideally suited to this type of work.

In this paper, a Bayesian approach to evaluation is briefly outlined. The 'prior' distribution of accident rates at a site can conveniently be estimated from accident data for the population of sites as a whole, and the method generates a 'posterior' distribution which can be used to determine confidence intervals within which the future accident frequency would be expected to lie. If the frequency distribution of accidents over the population of sites in any one year happens to follow a negative binomial distribution, the Bayesian approach leads to mathematically simple results, and allows one to predict the 'regression-to-mean' effect by means of a simple formula. Some predictions for accident sites in the south of England are compared with the actual accident frequencies; the two are in reasonable close agreement. In some cases, the regression-to-mean effect is quite large, and it clearly ought to be taken into account when evaluating the effects of treatment.

Some further developments in the Bayesian model, including an analysis based on a bivariate negative binomial distribution, are discussed, and suggestions made for future research.

2+3.5. DETECTION AND ANALYSIS OF BLACK SPOTS WITH EVEN SMALL ACCIDENT FIGURES

S. Oppe, SWOV, The Netherlands

Abstract

Accident black spots are usually defined as road locations with (relatively) high accident potentials.
In order to detect such hazardous locations, we have to know the probability of an accident for a traffic situation of some kind (e.g. the crossing of a pedestrian or the encounter between two cars), or the mean number of accidents for some unit of time.
In almost all procedures known to us, the various road locations are treated as isolated spots.
One tries to detect the black spots by estimation of the expected number of future accidents for a specific location from the number of accidents that already have occurred at that location. For many locations, especially in residential areas, this number of observed accidents is too small to give an accurate estimate of the accident potential. This results in a rather inaccurate ordering of the locations with regard to accident risk.
If one still uses this method for detection, then the next problem is to find the causes of the supposed dangers. Little information is given with the small accident numbers and one is almost completely dependent from an ad-hoc analysis, based on general theories about accident causation.
An alternative procedure starts from the comparison of the locations with each other. The central question is: "What do accident black spots have in common and in what respect do they differ from save location?" To answer this question, we have to relate the accident figures to the road and traffic characteristics of the locations.
However, the usual techniques such as multiple linear regression analysis and cannonical correlation analysis ask for rather strong assumptions. Several of these assumptions, such as the assumption of linear relations of the independent variables with the dependent variables that have been used and the additive combinations of variables does not seem to hold for the kind of data that we deal with in accident black spot analysis.

Fortunately, there are recently developed generalizations of these techniques that make them applicable to categorical data.
The application of these techniques does not only result in a description of unsafety with respect to combinations of characteristics, but also gives us a far more reliable ordering of the locations with regard to the accident potential.
The ordering of the locations is based on the characteristics of the locations. A cannonical score is computed for each location from the road and traffic characteristics of the locations. This score may be transformed into the probability of an accident. Given the accident reduction effect of some countermeasure, we can predict the expected number of accidents after reconstruction. In this case, we do not have to deal with problems such as regression-to-mean effect, is we want to evaluate these countermeasures.

2+3.6. THE APPLICATION OF WEIGHTED MULTIPROPORTIONAL POISSON MODELS IN SAFETY IMPROVEMENT MEASURES

J.P. Roos, R. Hamerslag and M. Kwakernaak, The Netherlands

Abstract

Accidents are caused by faulty decisions of traffic participants, often partially influenced by the traffic situation itself. There are specific situations in which numerous accidents occur; these accidents can be studied and the circumstances improved accordingly. However, the majority of accidents occur outside these so-called black spots. Other traffic situations are characterized by the fact that pratically no accidents occur in a period of a year. Nevertheless, because there is a countless number of such situations, the total number of accidents is high.

It is virtually impossible to make a study of accidents in such isolated situations. For example, the number of severe accidents on secondary and tertiary roads outside the built-up area is about 0.3 per km per year. To analyse the accidents occurring in such situations, data would have to be collected for a long period, say 30 years. Apart from other considerations, traffic and road characteristics would after so greatly in this period of time that the analysis would be valueless.

Regression model techniques do provide a feasible approach to this type of traffic situations.
Such a model that describes the effects of the traffic and road characteristics can be used to determine the accident rate. Instead of waiting for until accidents occur which can then be analysed, a forecast is made of the accidents that can be anticipated. Systematic and area-wide reconstruction regulations can then be enforced to reduce the probability of such accidents occurring.
This contribution deals with a regression model technique that is suitable for such cases. This technique, which has been successfully applied in studies on interurban bicycle and car traffic, is based on the weighted multiproportional Poisson model.

The relevant bicycle traffic study showed car volume, bicycle volume, bicycle lane width, median width and the presence of trees along the road to be of major importance; the relevant car traffic study showed car volume, shoulder width, type of obstacle, obstacle distance, sight distance and horizontal curvature to be of the major importance.

2+3.7. SHORT-TERM AND AREA-WIDE EVALUATION OF SAFETY MEASURES IMPLEMENTED IN A RESIDENTIAL AREA NAMED ØSTERBRO; THE STATISTICAL TOOLS

Lars Krogsgaard Thomsen, Danish Council of Road Safety Research, Denmark

Abstract

With emphasis on a newly finished traffic restraint programme carried out in Østerbro, Copenhagen, the mathematical statistical tools for evaluation are exposed.

The exposition will fall in two parts. The first will deal with the statistical procedures related to the actual accident analysis. The second will be the analysis of different behavioural studies of the street-users with emphasis on speed-measurements on motorized vehicles.
The statistical tools for the accident analysis have two main-purposes. The first is: "Has the accident rate actually changed?" While the second is "In case of a change, what size has this change and what are its limits?"
The first question is answered by means of statistical tests using multiple-dimensional log-linear Poisson models. A special case of control-area (Placebo) philosophy is used here. The second question about the size of the effect is answered by more conventional statistical theory but carried out as well with as without a control-area.
Supporting the accident-analysis behavioural studies have been carried out. The speed-measurements are dealt with in mathematical statistical terms using analysis of variance, investigating the assumptions of these analyses and dealing with general behaviour of street-users in terms of log-linear Poisson models.
Finally some conflict and accident studies by Zimolong (1980) are reanalyzed by means of log-linear Poisson models.

Conclusion: In order to make a satisfactory accident-frequency study of the before/after-effect of a traffic-replanning programme two periods of three years and a densely populated area of half a square-km is needed.

2+3.8. EVALUATION OF AREA-WIDE SAFETY SCHEMES BY MONITORING TRAFFIC AND ACCIDENTS

Heather Ward and Richard Allsop, University College London, United Kingdom

Abstract

Area-wide application of low-cost engineering measures for accident reduction aims to prevent many accidents which occur at diffusely scattered points in urban areas. It is designed to affect road user behaviour and the usage of roads of different types. Because the possible effects of introducing measures over whole areas may be widespread it is important to carry out efficient monitoring which can be used to evaluate a scheme both in terms of effectiveness in reducing accidents and in terms of ease of movement by car, bus, bicycle and walking. The resulting information is relevant not only to technical and economic assessment but also to any public debate which may arise.

Efficient monitoring should provide both short-term and medium-term information. In the short-term it should give indication not only of success in reducing accidents but also of any undue inconvenience of additional accidents which might be occurring as a result of unforeseen features of the operation of any component of the scheme. In the medium-term traffic and accidents can be detected by continued monitoring.

This paper describes various methods that have been developed for monitoring occurrence of accidents and distribution of traffic in residential areas and on main traffic routes outside town centres. The techniques described deal with analysis of accident frequencies and with measurement and sample sizes for traffic flows, turning movements, pedestrian crossing behaviour, journey times, journey lengths and speed of movement along main roads and through residential areas.

ABSTRACTS/SUMMARIES

Session 4. Product evaluation: Accident studies

4.1. CHANGES IN THE ROAD-ACCIDENTS PATTERN AS A RESULT OF A STRIKE AT THE MUNICIPAL PUBLIC TRANSPORT UNDERTAKING IN THE HAGUE

T.J.P.M. Boot, P.W. Wassenberg and H.H.P. van Zwam, The Netherlands.

Summary

This paper presents the results of a study into the changes in the road accident pattern in the Municipality of The Hague (450,000 inhabitants) as a result of a strike by the drivers at the Municipal Public Transport Undertaking (7 to 27 May inclusive 1981). The aim of the study was to find out in what manner and, to some extent, the degree to which the road accident pattern can change when:
a. the level of public transport services is reduced;
b. a shift occurs in the modal split.

1. A statistical analysis was made of the road accident figures for the period 7 to 27 May inclusive for the years 1978 to 1981 inclusive to see whether any shift had occurred in the road accident pattern during the period of the strike.
Comparison of 1981 with 1978 to 1980 inclusive was the main issue. The following conclusions were drawn:
- There was a significant difference between the number of road accidents in 1981 and the number in 1978 to 1980 inclusive. The number of road accidents in 1981 was 27% up on the average number of road accidents between 1978 and 1980 inclusive.
- No significant differences were found for the years 1978 to 1981 inclusive regarding the severity of the road accidents, i.e. the ratio of accidents with injury to accidents with material damage only did not change substantially in the years in question.
- The number of cars, mopeds an bicycles involved in road accidents was clearly greater and the number of busses and trams involved in road accidents (naturally) was clearly smaller in 1981 in relation to 1978 to 1980 inclusive. The differences were all significant.
- Under heading of types of collision a relatively large number of road accidents were encountered in which bicycles and mopeds only involved in 1981 in relation to 1978 to 1980 inclusive.

- No major differences were found between the years 1978 to 1981 inclusive regarding the road situation and the light conditions under which the road accidents occured.

2. Few data are known on the change in the modal split during the strike. A very general picture of the change in the modal split can be obtained from the traffic counts of cars and of bicycles and mopeds prior to, during and after the strike at 19 locations in the municipality of The Hague.
During the strike there was a very sharp increase in the number of bicycles and mopeds (44%) and a less sharp increase in the number of cars (10%) observed during the morning and evening rush hours.
No general conclusions can be drawn regarding the effect of the change in the modal split on the change in the road accident pattern during the strike.

4.2. INFLUENCE SUR LA SECURITE ROUTIERE DE LA MISE EN PLACE DES PLANS DE CIRCULATION DANS LES VILLES

A. Douvier, Centre d'Etudes des Transports Urbains, France

Abstract

Because of the increasing traffic in cities and therefore increasing noise and air-pollution, preventive measures are wanted. The French government has introduced in the beginning of the seventies traffic management schemes for cities with more than 20.000 inhabitants. Such traffic management schemes have three main objectives:
1. to improve traffic conditions and traffic flow
2. to decrease urban traffic and
3. to conserve and even to improve the environmental conditions decreasing traffic noise.
Financial help is given by the government for the introduction of the scheme. An evaluation regarding traffic safety is given of some schemes now in action. There are about 10.000 accidents less in 1977 due to the introduction of the schemes.

4.3. EFFECTS ON ACCIDENTS, ELIMINATING THROUGHTRAFFIC OF CARS IN CITY AREAS

M. 't Hart, The Netherlands

Abstract

Reducing traffic accidents in towns is part of improving the environment. In the post-war period towns were overcrowded with cars. In the years 1960-1980 it became clear that the cities could not be equiped with traffic regulations and parking facilities to handle the ultimate car-ownership and car traffic. The number of cars in the street stopped growing in many cities, whereas outside the cities traffic volumes increased even more. A counter movement started. Through traffic of cars should be eliminated in town centres. In 1977 the sectorplan was introduced in the city of Groningen. This sectorplan is presented as a possible example for an area-wide evaluation process of measures reducing accidents in an innercity area.

4.4. CO-ORDINATED TRAFFIC SAFETY STUDIES IN THE NORDIC COUNTRIES; EXPERIENCES FROM THE 'EMMA'-PROJECT.

Stein Johannessen, The Norwegian Institute of Technology, Norway

Summary

This paper is a summary of a joint Nordic traffic safety project called EMMA - "Evaluation of the traffic safety effects of minor road improvements". The contents include an introduction to the organization of the project, a summary of the most important results, as well as a discussion of the benefits and drawbacks with the research method that is applied in this study.

4.5. EXPERIENCES IN TWO INVESTIGATIONS INTO THE EFFECT OF ONE-WAY TRAFFIC ON ROAD SAFETY

M. Slop, Study Centre for Traffic Engineering SVT, The Netherlands

Summary

A report is made of the practical experiences in two statistical investigations into the effect of one-way traffic in residential areas on road safety. These investigations can be regarded as falling under "short-term and area-wide evaluation of safety measures".
The first investigation consisted of chi-square tests on the development of accident hazard in a number of residential areas following the introduction of one-way traffic, also using a control group without one-way traffic. An attempt to split up the neutral effect determined into positive and negative sub-effects was unsuccessful.
Some experiences of the first investigation were:
1. It proved to be almost possible to avoid selecting entire areas as the units of investigation.
2. Defining the boundaries of the areas was problematical.
3. The validity of the control areas is subject to doubt.
4. The choice of some of the control areas led to interdependency of data.
5. The before and after periods had to be restricted to one year each.
6. Since only one measurement before and one after were at the disposal of the researchers for each area, no estimate was possible of the variance in time, as a result of which grounds for doubt will always remain.
7. Since relatively few accidents take place in residential areas, and these are not very reliably recorded, the issues could not be specified satisfactorily.
8. The development in particular aspects of road safety was found to be area-dependent in the control areas; this was a further obstacle to differentiation of the results with regard to these aspects.
9. A supplementary reconnaissance was necessary for examining the relationship between the nature of the accidents and the characteristics of the areas; but it was decided not to carry this out for practical reasons.

10. For the same reasons, no specific conclusions could be drawn about the various ways in which one-way traffic may be implemented.

In a second investigation, Tanner's test was applied to a selection of the same data. However, the aimed-for differentiation in the issues could be achieved to only a very limited extent.
Some experiences of the second investigation were:
1. In a design using at least two measurements per area, both before and after, it would have been easier to determine which accident frequencies could be considered the result of a stationary Poisson process.
2. For this check, which was considered to be necessary for applying Tanner's test, the time intervals between the accidents have been studied instead.
3. The problem of the time-dependent variance increasing and decreasing with the mean value of the intervals was counteracted by a log-transformation.
4. To restrict the number of very small intervals, interdependent accidents have been considered as a single event; duplicated accident recordings were also removed.
5. To avoid the problem of the remaining zero intervals, the intervals have been taken four by four.
6. A large portion of the intended tests had to be omitted, also because of the requirement that the number of accidents in a control area must be more than 50 in each before and after period.
7. The practical problems associated with afterwards obtaining supplementary data formed an obstacle to getting more differentiated issues, also from this follow-up investigation.
8. Concealed effects of area structures may still have coloured the issues given.
9. Since the investigation carried out was into gross effects, the results could not be explained, and could therefore be generalized to only a limited extent.
10. No start-up effect could be determined.

Since the effect of one-way traffic appears to a large extent to be determined by the individual circumstances, results can be expected only from investigation methods in which these circumstances are considered in detail. However, these results cannot be generalized then.

4.6. STUDY ON THE EFFECT OF ELIMINATING INTERMITTENT SIGNAL FROM TRAFFIC LIGHT PROGRAMMES IN EINDHOVEN

P.A.M. de Werd, The Netherlands

Abstract

Based on the results of an experiment on eliminating intermittent signals out of traffic light programmes of installations in the inner city cordon in Eindhoven, the decision was made to enlarge this experiment to all traffic light installations in the town.
A decrease in accident occurrence could be expected since the results of the first experiment had pointed out a decrease of ca. 75%. The aim of this second experiment was to investigate the rate of generalization of the effect on the other installations and, on the other side, to establish this measure, if it might turn out to be as positive as it (still) is for the intersections in the inner city cordon.
The evaluation of the experiment was carried out by comparison of the numbers of accidents before and after effectuating, both for the intersections in the experimental group and those in a control group. The evaluation started three months after effectuating and was repeated every three months until one year had passed.
The accident data of the corresponding 3, 6, 9 and 12 months-periods could be grouped in 2x2 contingency tables. Testing the data of the first 3 months period provides an early impression of the effect, so that it is possible to decide whether or no it will be justified to prolongate the experiment.
The frequencies, especially in the first months may be very small. In that case the Fisher exact probability test has to be used. Larger frequencies allow using the chi-square test for two independent samples.
The first test (three months after effectuating) admitted to suppose that the direction of the effect was the same as found in the original experiment: in other words there was no reason at all to cancel the experiment.
Further testing confirmed the expectations: one year after the effectuating of this measure a highly significant decrease in accident occurrence was stated.

The choice of a three-months period depends on the availability of accident data. On principle the period can be as short as data become available.

ABSTRACTS/SUMMARIES

Session 5. Product evaluation: Conflict studies

5.1. EVALUATION OF TRAFFIC RESTRAINT MEASURES IN RESIDENTIAL AREAS WITH RESPECT TO PEDESTRIAN SAFETY

R. Albrecht, Regional Planning Group ARP, Germany

Abstract

An important aim of traffic restraint in residential areas by means of street network alteration schemes, is to achieve that pedestrians and drivers show more consideration for one another and to improve pedestrian safety in particular. This paper deals exclusively with the methodological aspects of the problems associated with the control of these effects by means of before-and-after and with-and-without studies. The historical residential quarter surrounding the Klausen(er) Square in Berlin-Charlottenburg was selected for the empirical investigation. It is a residential area in the city of Berlin; its streets are relatively quiet, with no special traffic control measures (within the limits of this area drivers on the left have to yield right-of-way to drivers on the right). Around the area there are major roads or arteries carrying heavy traffic volumes. After preliminary surveys had been completed, traffic restraint measures were undertaken in the area under study within the frame of a model project. The objectives of the project were:

1. Better road safety.
2. More freedom of movement for pedestrians.
3. Improved quality of the residential environment: A method of indirectly measuring pedestrian safety by means of systematic behaviour study, volume counts and studies of driver behaviour used for the analysis, is described.

5.2. FROM ACCIDENTS TO CONFLICTS; ALTERNATIVE SAFETY MEASUREMENT

Viktor A. Güttinger, Netherlands Institute for Preventive Health Care TNO, The Netherlands

Abstract

The danger of traffic is commonly determined by the occurence of accidents. This paper presents some of the history of alternative measures for describing traffic unsafety (measurement of so-called conflicts). It also gives the results of a series of research projects aimed at the development of a conflicts observation technique for the estimation of the safety of child pedestrians in residential areas.
The reliability, practical applicability and validiy of the developed technique prove to be satisfying.
It is concluded that the use of this technique seems to be justified for those situations in which accident rates are relatively low, e.g., in residential areas. This is not only because of the strong relationship between serious conflicts and accidents but also because other potential alternative indicators for the estimation of traffic unsafety often used in practice, such as traffic volumes and subjective estimation of risk by residents, had little success in predicting accidents.

5.3. SHORT-TERM EVALUATION OF SAFETY COUNTERMEASURES; TWO EXAMPLES OF EXPERIMENTS WITH SPEED-REDUCING COUNTERMEASURES IN SWEDEN

Christer Hydén, Per Gårder and Leif Linderholm, Lund Institute of Technology, Sweden

Abstract

The need for surrogates to accidents for the evaluation of accident-risks resulted in the development of a Traffic Conflicts Technique at the department. The technique was first presented in 1976. Modifications have been made during the last years and right now a project is on-going aiming at validating a new technique with a modified definition of a serious conflict. An international cooperation in the area is established and joint activities are planned aiming at comparing techniques developed in different countries.

The paper also deals with the extensive research work that is under way at the department on the effets of actual speed-reductions in urban areas. The speed reduction is achieved by physical measures such as humps etcetera. Experiments are carried out on different types of streets, ranging from local residential streets to arterials carrying ten to fifteen thousand vehicles a day. The results so far are very promising and it seems as if speed-reduction is a very interesting complement or alternative to the traffic-safety measures traditionally used.

5.4. TRAFFIC CONFLICT STUDIES IN FINLAND

Risto Kulmala, Technical Research Centre of Finland, Finland

Abstract

The Technical Research Centre of Finland has for many years used the traffic conflict method in evaluating the effects of traffic safety measures and devices. Effectively trained observers and video equipment are used at the field studies. In addition to conflicts also potential conflict situations, traffic violations and traffic flows are registered at the study locations.

Following are some safety measures, the effects of which were studied with the traffic conflict method:
- refuges on pedestrian crossings
- characteristics (signal control, refuges, location at junction or beween junctions) of pedestrian crossings across a 20 m wide street
- acceleration lanes at grade-separated junctions
- the replacement of crawling lanes with overtaking lanes.

A conflict simulation model for junctions has also been developed.

5.5. SAFETY EVALUATION OF FLASHING OPERATION AT SIGNALIZED INTERSECTIONS

D. Mahalel, A. Peled and M. Livneh, Technion Transportation Research Institute

Abstract

This article focuses on the safety evaluation of stopping traffic signal operations at off-peak traffic hours and substituting a flashing amber for all directions. This control strategy is motivated by the need for energy conservation considerations through reduced amounts of acceleration and idling time of vehicles. Although this policy is intended for those hours when signals are not warranted by the low traffic volumes, there still exists the need to investigate the safety implications of this kind of operation.

In the present study, a conflict was defined as "an event in which a road user was forced to change his path of direction in space and/or in time following the existence of another road user in his vicinity". This broad definition has freed the observer from the need to detect only emergency evasive manoeuvres, and therefore decreased the range of subjective interpretation of the observer. As a result, the reliability and consistency of the data has increased.

The observations were carried out by trained observers at a sample of intersections using two control strategies: full signal operation and flashing amber phase. The observers were stationed at each leg of the intersection using pre-prepared forms, and noted the travel direction of the two vehicles involved in the conflict. The results showed that the most frequent type of conflict under full signal operation were of the rear end type, while during the flashing amber operation crossing and merging manoeuvres were dominant.

ABSTRACTS/SUMMARIES

Session 6 + 7. Process evaluation: Behavioural studies

6+7.1. THE ANALYSIS OF TRAFFIC BEHAVIOUR BY VIDEO

Richard van der Horst, Institute for Perception TNO, The Netherlands

Abstract

The range of methods in the study of road user behaviour varies from mere observation by individual observers in the real traffic situation to highly controlled laboratory experiments, sometimes using advanced simulation techniques. The choice of methods depends on the questions to which the research is addressed.

The use of observation techniques generally is needed for unobtrusive study of actual behaviour, e.g. in studies on serious interactions between road users.

An observation technique, based on video, has been developed, which makes objective quantification possible. Video pictures of traffic situations are analysed by positioning two electronic crosshairs on certain points of the vehicle in the picture. By a simple transformation these points can easily be translated into street positions. By calculating successive positions in time, the speed of the vehicle can be obtained. By use of a small mini-computer a semi-automatic procedure is possible.

The method and equipment were tried out on the behaviour of cyclists, using new specially designed cycletracks through two cities in the Netherlands, and motorists crossing cycletracks. As part of an overall evaluation of the cycletracks, course, course changes, speed, speed changes and interactions between road users were recorded and analysed, in order to determine whether the behaviour observed was that expected by the designers.

The method, in particular, offers good possibilities in developing a conflict analysis technique, in which time-to-collision (TTC) is the final criterion.

6+7.2. ROAD HUMPS, THE REMEDY FOR EACH AND EVERY TRAFFIC SAFETY PROBLEM?

P. W. van der Kroon, The Netherlands

Abstract

In 1978 the city of Amsterdam conducted a trial with road humps. As a start 15 humps were constructed. The trial was viewed as successful and, after comparison with experience elsewehere, road humps were used on a larger scale. In March and November 1980 the effectiveness of road humps and the attitudes towards them of residents of the streets involved, were studied. Remarkably, there is a clear decrease in the positive opninion on aspects such as crossability, safety, speed and livability. A small majority still holds a positive opinion. The idea that frequent users would have a different, more positive opinion of the effects of road humps was not confirmed. Considering the fact that the construction of the road humps requires a comparatively high investment depending on the situation 6000 - 10.000 dfl, it is necessary to reconsider if road humps are useful everywhere when the city budget is faced with considerable reductions.

6+7.3. MEASURES FOR REDUCING VEHICLE SPEED ON RESIDENTIAL ROADS

Finn Harald Amundsen and Stein Lundebye, Institute of Transport Economics, Norway

Abstract

Excessive speeding by vehicles on residential streets is a problem experienced by the majority of residents living along these streets. Especially great is the problem since the planners after the last World War did not consider traffic safety as a problem and therefore wanted wide and straight roads which could take large traffic flows.

In many cities new planning concepts and reconstruction have been carried out by the authorities. This has resulted in large reductions of the vehicle speed and hence an improvement of the road safety situation in these areas. However, on a National Scale, the problem is so considerable that a total reconstruction of a really large number of residential streets is not possible in the near future. We therefore wanted to study simple physical countermeasures, which could be implemented on a large scale without excessive costs being the deciding factor. Even though the individual countermeasures did not give a great reduction of the speed, a large number of measures in an area could result in an overall positive effect, and hence make the countermeasures economic viable.

We investigated initially 30 km/h speed limits, implemented by the use of "30 km/h-zone" sign for larger residential areas. Experiments were carried out in 8 local authorities in Norway. Generally speaking, the speed limit signs resulted in a 3-4 km/h reduction of the vehicle speeds.

Increased enforcement of the speed limits by the traffic police resulted in a speed reduction of 10-12 km/h over a short time period. The experiments showed also that 30-60% of the motorists drove faster than the actual speed limit. The result was that other countermeasures had to be introduced on the roads where speed limits only did not give a sufficient reduction of vehicle speed. Studies were therefore carried out with speed

humps at 8 locations and an artificial depression at one location. The reduction of the speed was considerably greater, almost 10-15 km/h. Experiments using narrowed road sections with different layouts have been carried out later at 5 locations. The speed reduction was dependant of the geometrical layout of the road narrowing.
Continuous speed measurements have been carried out over at least a one year period to measure the effectiveness of the experiment. Road side interviews have also been carried out to ask for comments on the counter-measures from the motorists.

6+7.4. AN ADAPTIVE THEORY OF ROAD SAFETY

Walter Molt and Hans Beyrle, University Augsburg, Germany

Abstract

The theory of adaptation, as a psychological theory, assumes that the human being tries to adapt its behaviour to its environment. In agreement with the hypothesis of risk-compensation (Wilde, 1976) it is argued that roads, free of any apparent dangers induce the driver to drive faster and in a more risky way than he would do under circumstances, where he has to adjust his behaviour to other vehicles, pedestrians and cyclists. So it is assumed that efforts that make driving safer through obstacle-free roads are compensated by more risky driving.
In new approaches of road planning such as "Verkehrsberuhigung" which is realized in not too strongly frequented roads, the seperation of side-walks and traffic-lanes is given up and there is one common surface for all traffic participants. These new approaches in practice already apply to the theory of adaptation.

In such roads interactions increase and even slight conflicts increase, but not accidents. In order to evaluate the road safety under such circumstances, the change in perception and attitudes, caused by the altered road design, have to be measured in order to evaluate the effects. An analytical-model of evaluation of road-safety has been proposed and implemented. This permits a short-term evaluation of effects of road design. Validation will be achieved by behaviour measures (e.g. vehical speed) and also by long-term observation of the roads evaluated in such a theory. A pilot study that was carried out three years ago will be presented together with accident-accounts which occurred during these years.

6+7.5. EVALUATION OF A PEDESTRIAN TRAINING PROGRAMME FOR PRESCHOOL CHILDREN

J.A. Rothengatter and H.H. van der Molen, Groningen State University, The Netherlands

Abstract

Traffic accidents are a major threat to the life and health of pre school children. Pedestrian training is one possible countermeasure. It was attempted to identify important and feasible training objectives. This was done on the basis of

1. A comprehensive behaviour requirement analysis of the pedestrian task,
2. Assessment of important tasks on the basis of empirical data concerning child pedestrian's accidents, exposure and behaviour;
3. Assessment of feasibility of tasks on the basis of empirical studies in the area of developmental psychology.

On the basis of various principles from learning psychology and pilot experiments a pedestrian training programme was developed for pre school children, to be carried out by parents, backed up by some pre school activities.

An experiment was carried out to test the programme's effectiveness in terms of (a) improved knowledge of safe road crossing procedures, (b) the ability to perform three pedestrian tasks when tested in the street, (c) the degree to which children display correct road crossing behaviour when observed unobtrusively on their way to or from school and (d) the behaviour of mothers and children observed unobtrusively when walking together to or from school. The programme appeared to have positive effects on pedestrian behaviour. After this experiment an implementation study was carried out in two cities in order to study the degree of acceptance of the programme when scientists were not interfering as was the case in the prior experiment.

Further possibilities for evaluation are discussed to be carried out when the programme is implemented nationwide.

ABSTRACTS/SUMMARIES

Session 8. Product and process evaluation

8.1. AN ATTEMPT AT EVALUATING LOCAL AREA SAFETY IMPROVEMENTS IN AN AUSTRALIAN TRAFFIC STUDY

N.R. Ashton and R.E. Brindle, Australia

Summary

The paper will review Australian local area traffic management practice. Evaluation of these schemes is rare.
Area-wide treatments have not as yet received detailed evaluation but there is a considerable body of research into the effects of individual treatments such as local street roundabouts, road humps and other devices.

A current study in Sandringham a suburb of Melbourne aims to:
. identify the traffic management, safety and related amenity problems in Local Traffic Areas throughout the municipality of Sandringham
. propose specific solutions to these problems as appropriate
. evaluate the effectiveness of the proposed solutions as implemented by Council.

The study is being jointly managed by the office of Road Safety, Department of Transport - a federal agency, the Road Safety and Traffic Authority - a state agency and the municipality of Sandringham - local government.

An essential part of the study has been a review of methods of evaluation which has included a workshop involving experts in the field. The conclusions of this part of the study will be discussed.

8.2. EVALUATION OF THE SAFETY OF SPEED CONTROL HUMPS

C.J. Baguley, Transport and Road Research Laboratory, United Kingdom

Abstract

To illustrate various problems which arise in the evaluation of accident counter-measures this paper presents a case study of the public road trials of a design of speed control hump developed at TRRL. The objectives of the study are outlined together with details of the legal and practical constraints affecting its design and the various evaluation measures used.

The effectiveness and acceptability of humps as a means of improving safety and amenity on residential roads was investigated. The period for which the experimental humps could remain in position was restricted by law to one year which thus also restricted the length of evaluation period. The way in which suitable sites were selected for study is discussed.

The study took various measures of the effect of the humps on vehicle ltimate evaluation, made in terms of accident changes (the 'product' evaluation) is also disussed. A survey of public opinion at the experimental sites was carried out and the importance of this (as a possible further 'process') is considered. The paper also outlines the problems associated with selecting appropriate control data.

Both types of evaluation techniques demonstrate the need for area-wide studies and the value of monitoring as many variables as possible to enable all the advantages and disadvantages of the measure to be assessed.

8.3. SHORT-TERM AND AREA-WIDE EVALUATION OF SAFETY MEASURES IMPLEMENTED IN A RESIDENTIAL AREA NAMED ØSTERBRO; A CASE STUDY

Ulla Engel, Danish Council of Road Safety Research, Denmark

Abstract

The Danish Council of Road Safety Research proposed in 1971 to the road authorities of the City of Copenhagen to carry out a joint research project. The aim of the project was an area-wide traffic replanning of a part of Østerbro, a residential area with 17,000 inhabitants. The aim of the scheme was to reduce the number of accidents by simple physical countermeasures.

The project consisted of three stages:

1. Collecting data and proposing a scheme
2. Implementing the scheme
3. Evaluating the traffic safety effect of the scheme

The evaluation of safety measures is primarely based on an analysis of the traffic accidents in the area, which have taken place before and after the implementation of the scheme. But also studies of the behaviour of the road users have been carried out in order to registrate whether or no the intentions of the countermeasures were obtained.

In the before-period (1969-1971) 475 police reported accidents took place, and in the after-period (1977-1980) 370 accidents took place. However we are still dealing with small numbers of accidents, since the traffic scheme consists of 25 different countermeasures and each of them are directed towards specific (and more or less different) accident types.

The study will try to provide answers to the following questions:

1. Which conclusions can be drawn from the results concerning the reduced number of accidents and number of persons injured, when defining "short-term" as a period of 7-10 years and "area-wide" as a sum of 25 physical countermeasures implemented in a residential area of about half a square kilometre?
2. How do we distinguish between the accident reducing effect of the implemented safety measures, the reduced number of road users in the area

and general safety measures implemented in the whole country in the same period?

3. To what extent have the behaviour studies supported or invalidated the results of the accident analysis?

8.4. MEASUREMENTS OF DEGREE OF SEPARATION BETWEEN VEHICLES AND PEDESTRIANS IN URBAN AREAS

Göran Nilsson and Hans Thulin, National Swedish Road and Traffic Research Institute, Sweden

Abstract

Most measures in order to increase traffic safety for unprotected road users are measures which separate vehicles from pedestrians or bicyclists in time or space.

This paper presents some results from empirical studies at pedestrian crossings concerning the proportion of pedestrians who can cross the street without disturbing or being distured by vehicles. This proportion of pedestrians is defined as the degree of separation between vehicles and pedestrians. Video technics were used for the measurements.

Both theoretical calculations and empirical measurements of the degree of separation have been made for the central part of Linköping at 16 randomly chosen pedestrian crossings.

The observation period at each crossing was 90 minutes distributed on three 30-minute periods during daytime for three weekdays. From this it has been possible to estimate the traffic composition during different hours of the day for the central part of the city.

By comparing the total degree of separation of pedestrians during different periods of the day and accidents for the corresponding periods, relationships between risk (number of collisions between vehicles and pedestrians per pedestrian and pedestrian crossing) and pedestrian flow for different degrees of separation have been calculated.

8.5. ON THE METHODOLOGY UNDERLYING THE SHORT-TERM EVALUATION OF TRAFFIC ENGINEERING MEASURES E.G., SOLUTIONS TO LEFT TURNS IN THE CITY OF HAMBURG

G.O. Riediger and G. Zimmerman, Bundesanstalt für Strassenwesen, Germany

Abstract

For some considerable time, the Federal Transport and Road Research Institute (BASt) has supported and furthered the development of methods to analyze specific traffic situations, devise and select countermeasures and evaluate their effectiveness in the traffic safety context. The search led to the discovery of a blatant need of evaluation instruments by which reliable results can be found economically and within a short period of time. For that reason, our interest is focussed on the development of an operable traffic conflicts technique, in particular also within the frame of the methodological considerations on the removal of accident black spots.

A comprehensive model study employing specifically developed methods of analysis and evaluation is being carried out in the City of Hamburg to examine systematically and comprehensively the solutions to left turns applied on 60 intersection approaches. Within the frame of this study the following characteristics, among other things, are documented and evaluated:

- constructional and traffic engineering features of facilities;
- traffic flow, composition and speed;
- accidents and traffic conflicts.

A comparison of the methods employed has shown that adequately reliable results can be obtained by means of short-term effectiveness studies. The basic problems "with"/"without" and "before"/"after" studies involved are presented and discussed by means of situation studies, estimates of effectiveness and its control once measures are put into operation.

REPORT OF SEMINAR SESSION 1. RESEARCH POLICY

Chairman : C. Gressier, France
Rapporteur : M. Ledru, France

The first discussion topic during this session was dealing with the problem of recommendations, made by a researcher and presented to policy makers.

Ephraim. I am afraid that the focus is always on recommendations, ignorence or just complete throw out of the study itself and its conclusions. I would prefer that any evaluation should first be studied before we come in with a set of recommendations. For example, researchers concluded and then recommended that if any kind of speed zone countermeasures were applied, this should not be done without considerable enforcement. This is the point where I will draw the line. This is something which has to be discussed before it is recommended.
Schepel. I would like to contradict Mr. Ephraim on his remark that researchers should refrain from recommendations. We have seen many times that after finishing a research project researchers are not able to recommend anything and only ask for further research.
Ephraim. In my opinion it is always impossible that policy makers rely totally or almost totally on recommendations of researchers. Decision making is not a question of following recommendations, because the researcher does not know the political context of a decision: various interest groups have their influence. Researchers may in their recommendations indicate certain ways, but it is still up to the policy makers, the officials, to decide, most of the times based on incomplete information.
Muhlrad. I think that we,as researchers,are facing the problem that local authorities are demanding recommendations, recipes, rather than general lines of reflection. In my opinion one of the main tasks of researchers is to persuade those who are responsable for the implementation of countermeasures, to do more thinking and less relying on recipes.
Walker. Distinction should also be made with research which is a support of policy, when a policy proposition has been accepted. Here research

tries to find out the consequences of alternative policy actions. In these circumstances the role of the researcher will perhaps be more positive, e.g. in formulating recommendations, than in research conducted in isolation from policy. In the last case the recommendation to the politician could possibly be "you got it all wrong, do something else".
Lawson. I think there is an interesting problem on the borderline between research and policy which is, to what extent the research is allowed to make "the logical leaps". For example,in the case of using intermediate safety measurements should the researcher be allowed to make the logical leap to road safety. We, as researchers, have often hidden ourselves behind the academic backgrounds and said that we will just present the essential neutral results, results which are judgement free. But in fact we are always guiding by our recommendations. I suspect that in all cases it is the researcher and not the policy maker who makes the logical leaps.
Gressier. May I ask Mr. Schepel, working for the Municipality of Rotterdam, if local authorities are willing to accept research results?
Schepel. It is my experience that local authorities are always ready to accept research results. But the problem is that most of the time they are not willing to rely on research because of their poor experience with research which does not produce practical recommendations.
I do agree with Mme Muhlrad where she says "people should think more and read less", but I think that researchers should guide the policy makers to thinking.
Muhlrad. I would like to answer because is seems to me that there is a vicious circle. Researchers are not trusted to carry out evaluation studies because they give no practical recommendations. But if this is the reason why no evaluation studies are conducted, researchers can not get practical experience. So if it is true that researchers are mistrusted, and they are not allowed to conduct their studies, the unsatisfactory situation will continue.
Noordzij. I have a question to Mr. Silcock. On listening to the presentation of his work I have not heard who is going to do the rating of the countermeasures, especially the rating on the basis of potential accident reduction.
Silcock. What we present in the evaluation matrices are the assessments with respect to reduction in accidents. And these are drawn from as much

published information around the world as we could lay our hands on. The double plus entries are where there are statistical data available,which satisfy most people. There are not many of these and in practical terms we use the single plus entry where we think there is a possibility that an accident reduction could occur by application of these countermeasures. When I say we think, I refer rather more to collective professional opinion, including all those who are involved in the project and where people have said "there is some evidence, but it is not as soundly established statistically as most researchers normally require". So it is a subjective assessment. One of the aims of our methodology was to allow anyone to put in his own scores and own results.

Walker. What we showed in our paper was that by taking a reasonable range of values, i.e. factors from unity three to one, you can get a very consistent set of results, and by using a factor from six to one, you are allowed to step back into the process and see which particular criteria are the most important.

Hearne. There is another road-safety principle, namely that you apply a countermeasure to a recognized problem. From my reading of the paper there is no account taken of this. It seems that countermeasures can be applied irrespective of the situation of the ground, and of course that is not true.

Silcock. There is some danger perhaps as suggested by Mr. Hearne, but our paper deals with another problem. As a matter of fact I completely agree with the remark made by Mr. Hearne.

Sandelien. I want to make a point on "short-term". Under short-term conditions we know beforehand that we will not have significant data on accidents. Often policy makers will be satisfied by intermediate measures of safety. But I think that for a controversial safety measure the policy maker wants to have exact data. That is the only way to satisfy him. For non-controversial safety measures he will rely on research with intermediate variables. Or he does not need research at all.
My question is whether it is worthwhile to carry out research, based on the use of intermediate variables, if the research subject is a controversial one? It is very questionable if a policy maker will spend money under these circumstances on research, when the research is expensive in comparison with the studied measures.

REPORT OF SEMINAR SESSION 2 + 3. METHODOLOGY AND ANALYSIS

Chairman : M.J. Koornstra, The Netherlands
Rapporteur : P.P. Scott, United Kingdom

In Session 2 two papers were concentrated on treatment of the regression-to-mean effect:
2+3.1. The "regression-to-mean"-effect; Some empirical examples concerning accidents at road functions, U. Brüde and J. Larsson, Sweden, and
2+3.4. Bayesian methods applied to road accident blackspot studies; Some recent progress, D.P. Jarrett, C. Abbess and C.C. Wright, U.K.
A third paper presented dealt with the philosophy of statistical methods:
2.3.3. A learning disability and its cure, E. Hauer, Canada.

The remaining papers were presented and discussed in Session 3.
2+3.5. Detection and analysis of black spots with even small accident figures, S. Oppe, The Netherlands
2+3.6. The application of weighted multiproportional Poisson models in safety improvement measures, J.P. Roos, R. Hamerslag and M. Kwakernaak, The Netherlands
2+3.7. Short-term and area-wide evaluation of safety measures implemented in a residential area named Østerbro; The statistical tools, L.K. Thomsen, Denmark.
These three papers were concentrated on various techniques of analysing accident data in relation to various explanatory variables.
2+3.8. Evaluation of area-wide safety schemes by monitoring traffic and accidents, H. Ward and R. Allsop, U.K.
This paper described variables to be observed in an area-wide study, and methods of monitoring them.

Session 2

The discussion in Session 2 was begun by Koornstra, who identified three main points in Hauer's paper. These were
(i) the distinction between "classical" hypothesis testing and utility decision rules;

(ii) methods of combining evidence from different sources;
(iii) the use of subjective information.

Asmussen asked whether the approach proposed by Hauer would be useful only in deciding methods of "controlling" accidents, or could they also be used in exploring data for indications of possible new remedies.
Hauer responded that he saw two uses for statistical analysis of accident data. Firstly, to detect "deviant" road sections, drivers, etc. Here the statistical techniques serve as a sieve, but are probably not so useful in the later stages of identifying causes. Secondly, but more importantly, they are used in the evaluation of effectiveness, and it was to this use that his suggestions were addressed.
Koornstra asked Hauer's opinion on when hypothesis testing might be a legitimate approach, and when might utility decision methods be more appropriate.
Hauer thought that hypothesis testing is not actually used widely in the natural sciences, which might have been regarded as their main field of application. He was not really very concerned with whether classical methods have been useful in building scientific theories, but rather was interested in the process of decision making.
Jarrett suggested that a major problem with hypothesis testing, as practised, was that it involved the proposition of a very naïve null hypothesis which had no real credibility in the first place.
Roszbach identified two stages in Hauer's argument:
(i) the noting of a "learning disability" in the use of hypothesis testing;
(ii) a cure for this disability.
He agreed with the first stage of the argument, but not with the suggested solution.
Allsop agreed with Hauer and Jarrett that not enough attention had been given to the estimation of effectiveness, rather than to testing for its existence. However, he thought there were situations where the hypothesis testing procedure would be more appropriate, and cited an example in which one wished to monitor accident trends following some treatment in order to guard against a possible increase which would lead to a decision to reverse the remedy.
Hauer thought that here, too, the situation was more one of repeatedly

updating estimates of effectiveness in response to improved data, and that decisions would be based on these revisions.
Scott asked whether the methods proposed by Brüde & Larsson and Jarrett to allow for the regression-to-mean effect could be developed to yield simple correction factors which might be used by the practising engineer when evaluating his remedies.
Jarrett replied that an earlier report by his colleagues and himself had suggested a simple method. The magnitude of the regression effect depended on the number of accidents observed; corrections had been given based on this. Also, in response to a question of how easy it was to identify a sample of sites which could be regarded as similar to the test site, in order to estimate his prior distribution, he said that whether one regarded a sample as members of the relevant population depended on how well the assumed gamma distribution fitted.
Koornstra remarked that both methods presented could provide valid correcting factors, provided that their distributional assumptions were verified by the analysis. Bias-by-selection was also a problem in many educational studies, where simple correcting factors had been produced which depended on the assumed normality of the variables studied. Hauer drew attention to a paper (Morrison and Schmaittein, Management Science, Sept.1981.) which gave us a basis for correction:-
Expected total of accidents in period 2 of those sites which had x or more accidents in period 1
= total accidents in period 1 of those sites with x + 1 or more accidents.
Thomsen raised a technical point in relation to Jarrets's paper.
He himself had tried to fit negative binomical distributions to data by the method of moments and also by maximum likelihood, and had found that only the latter gave satisfactory results.
Jarrett replied that he had used maximum likelihood only and did not know how the two methods would compare when applied to his data.
In contrast to Thomsen's comments, Oppe reported that he had obtained good results with the method of moments.

Summary of Session 2

It seemed that good methods were available for correcting for the regression-to-mean effect. How simple to apply these were could only be learnt with further experience.

On the points raised by Hauer, there was wide (though not universal) sympathy with his view that the widespread use of hypothesis tests was a real impediment to progress in evaluation of road safety measures. There was less agreement with his main suggestion for an alternative (i.e. by the use of Bayesian methods with prior distributions based on subjective estimates); however, it must be pointed out that Hauer does not insist that this is the best alternative; several should be tried.

Session 3

In summarising the papers in Session 3, Koornstra identified a common theme in their use of Poisson distributions to describe accident frequencies. He also pointed out some detailed differences in the treatment of interactions in some of the models. Further, he thought that the methods described by Oppe could be seen as generalizations of those in the other papers, in that more than one dependent variable could be used, and also that fewer assumptions were made about the form of relationships with explanatory variables. Incidentally, the results of applying Oppe's methods provided some justification of the multiplicative and log-linear assumptions made elsewhere.

There was some discussion of the treatment of interactive terms in the various models. Roos said that interactions could be introduced simply into his model; indeed they had been analyzed, but had been found to be unimportant in the examples cited, and so had omitted from the paper.

Allsop said that the variable of most interest in his analysis was, in fact, an interaction term. Interactions with other factors were also tested, but were found to be mostly unimportant.

Scott commented that the analytical methods described allowed the best use to be made of limited amounts of accident data, but did not overcome the basic problems associated with shortage of data. The only way of doing this was to collect more data, either by extending the study so as to gather more accident information or by using other variables for which larger quantities of data could be obtained more readily. He wondered whether the methods used by the authors could be extended to the analysis of other variables.

Roos replied that he had used his models in behavioural studies where the responses took the form of frequencies of occurrence.

Allsop said that he had used traffic movements as first indicators of effectiveness.

Thomsen referred to the second part of his paper, where he had analyzed relationships between accidents and conflicts by means of log-linear models. Oppe was unhappy with this because of the small amount of data about both the "dependent" and the "independent" variable; the assumptions behind the model could not be well-defined.

Summary of Session 3

These papers showed how log-linear models for the analysis of accident frequencies, regarded as Poisson variables, had become well-established in recent years, giving much improved credibility to the results when compared with those of earlier analyses based on additive normal models. The cannonical analysis described by Oppe gave alternative ways of exploring relationships among variables, under fewer initial assumptions. Allsop and Ward had described an approach to the monitoring of an area-wide safety programme, in which many diverse effects required evaluation. In addition to the papers presented there was a further one describing an interactive computer system for traffic and accident analysis. It appears that the system they describe could be especially useful in the context of area-wide studies, and might be seen as relevant to the paper by Ward and Allsop.

REPORT OF SEMINAR SESSION 4. PRODUCT EVALUATION: ACCIDENT STUDIES

Chairman : S.A. Holmsen, Norway
Rapporteur: G. Nilsson, Sweden

Product evaluation of safety measures will in many cases consist of a before and after study of accident records.
In this session six different investigations have been presented which in an exellent way reflect many of the problems arising when the investigator shall give precise and qualitative results of the safety effect of a measure as well as a group of measures.

4.1. Changes in the road-accidents pattern as a result of a strike at the Municipal Public Transport Undertaking in The Hague, T.J.P.M. Boot, P.W. Wassenberg and H.H.P. van Zwam, The Netherlands
The first example shows that it is not only road or traffic planning authorities that can change the traffic safety situation. Often decisions on the international and national level - directly or indirectly - cause more dramatic changes in traffic and traffic behaviour than what is possible through ordinary traffic safety measures. The Dutch strike of Municipal transport drivers is such an example. If this kind of situation lasts long enough it is possible to investigate how a new transport pattern will influence the traffic safety situation. The opportunity gives some ideas of the relationship between the use of different modes of transport and accidents and causalities. However, because of the shortness of such periods and the lack of the traffic information it is not possible to draw direct conclusions of what the result would have been for a longer period. What is important in the investigation is the simultaneous analysis of different road user groups involved in accidents before during the strike.

The second and third paper are examples of before and after studies where the investigation may be planned before the measures are taken.

4.2. Influence sur la securité routière de la mise en place des plans de circulation dans les villes, A. Douvier, France
The French contribution represents a nation-wide evaluation of a traffic safety programme for towns with more than 20.000 inhabitants.
Besides the goal to reduce the number of accidents, the programme also treats increase of capacity and quality of the environment. The investigation period is 8 years and 226 towns of different types have been studied with respect to the change of the traffic safety situation and the amount of money spent on traffic regulations and traffic safety measures. The result is that the programme has saved about 10.000 personal injury accidents in the experimental towns. A cost-benefit estimate shows that 10 million francs invested gives a 2% reduction in injury accidents.

4.3. Effects on accidents, eliminating throughtraffic of cars in city areas, M. 't Hart, The Netherlands
Measures which move car traffic to main streets and make it difficult or impossible for trough traffic on other streets have been used in many cities. One example is Groningen, The Netherlands. The results of these measures are that car traffic in the innercity decreases while the traffic on the ring around the innercity increases. No change has been found in the total number of cars moving in Groningen. The effects of these measures are that the change of the traffic composition in different parts of the city improves the traffic safety situation for pedestrians, bicylist and moped riders. Another goal is to make the innercity more attractive.

4.4. Co-ordinated traffic studies in the Nordic countries; Experiences from the "Emma"-project, S. Johannessen, Norway
The co-ordinated traffic safety studies of four different measures in the Nordic countries represent a study of local measures. The problem here is to get satisfactory information about a sufficient number of objects and before and after periods long enough. From the investigation many questions arise and two principal ones are how to choose control objects and how to treat the so called regression effect. The two questions are very close to each other. The conclusion of the study is that before and after studies of local measures with historical data create more questions -

which cannot be answered - after the investigation than before. This fact is very important in order to convince decision makers to plan controlled experiments to evaluate the traffic safety effect.

4.5. Experiences in two investigations into the effect of one-way traffic on road safety, M. Slop, The Netherlands
Different ways and problems in analyzing the effect of one traffic in Dutch towns have been presented and here again we meet the problems of controls. Another problem is that in urban areas other measures taken will influence the traffic safety and the length of before and after periods cannot be as long as in rural areas. This investigation also uses the hypothesis of Poisson distribution of accidents. A conclusion of the different analyses of one-way traffic is that the need for individual street and traffic information is of great value, which again points out the problem of lack of information for the before period.

4.6. Study on the effect of eliminating intermittent signal from traffic light programmes in Eindhoven, P.A.M. de Werd, The Netherlands
A more convincing experiment dealing with changes in the function of traffic signals in Eindhoven and a simple but clear analysis of the traffic safety effect shows that sometimes it is possible to draw conclusions about the effects on traffic safety, if the number of objects is large and the accident statistics can be available for short time periods after the change.

Notes from the discussion

Boot was asked by the chairman Holmsen if the study in The Hague can be treated as valid regarding for example a whole year.
Boot replied that according to the interest of the Dutch Government to stimulate the bicycle traffic the study can give some knowledge.
Douvier finished his presentation pointing out that traffic safety effects are only one side of the problem when introducing different measures and wanted more comprehensive studies including other effects which are important in traffic planning.
Johannessen put forward the question to what extent the number of accidents is criterion in implementing traffic safety measures. This is very important to know when the effect of measures are evaluated in before and after studies.

't Hart asked if the delegates have some ideas or experience of the "correlation" between accidents and air photographs of the moving vehicles (dotted figures).
De Werd wanted to have a discussion about the use of the traditional test method of two-way tables.
Chairman Holmsen asked Mr Douvier to give examples of the most important measures in the presented traffic plans.
Douvier mentioned improvement of the infrastructure, signalization of major intersections in later states pedestrian measures in the centre of urban areas and improvements for the public transports.
Detailed information is not available only some surveys from major cities.
't Hart was asked by the chairman to what extent traffic safety has been regarded in the traffic planning and answered that no accident study or other safety aspects were dicussed when the measures were introduced in order to eliminate the through traffic in Groningen.
Slop stated that safety aspects are difficult to evaluate because of the small number of accidents different street characteristics and a large amount of other factors.
Ledru pointed out that the evaluation of this kind of measures must also include the effect on lorries, public transports and other road user groups - not only cars.
't Hart replied that the aim with the measures was to improve the situation for cars on main streets but care was also taken concerning other road user groups inside residential and shopping districts.
Scott remarked that cross product of exposure is not good to predict collisions and asked if Mr Boot has tried the square root of the product or other functions.
Boot replied that data is not so good.
Thomsen referred to a Danish study which soon will be published based on traffic counts for different road user groups.
Oppe said that the square root was useful from statistical point of view - not to explain why accidents occur.
Scott said that driving behaviour will be effected by measures or that drivers compensate for measures.

Ledru mentioned the problem that measures in order to change the traffic flow often reduce or increase the vehicle speeds.

Allsop took up the problem with an unfamilliar situation due to new measures for the road users and also the problem of using pedestrian flow in order to predict accidents.

Scott pointed out that it is important to treat different accident types separately.

Slop said that a local measure will influence not only the local area but also surrounding areas, which must be regarded in the evaluating process.

De Werd concluded that the analysis of the effect of eliminating the intermittent signal from traffic lights in Eindhoven was a very quick and easy analysis.

Douvier mentioned that lights in blink are more hazardous.

Results show effects from a + 5 to + 300%. Very difficult to state one valid answer of + 40%.

Thomsen asked if the effects can depend on a traffic change in the intersections and asked for traffic counts.

De Werd answered that the traffic during the actual periods was very small and traffic counts have not been done.

Walker asked whether the result from Eindhoven was of the same or opposite experience in other countries.

Douvier mentioned that results from a French study show an increasing danger with orange blink.

De Werd said that the 75% reduction of the number of accidents are not representative for all intersections. The accident numbers were in some cases very small.

Holmsen ended the discussion and thanked the delegates for an interesting session.

REPORT OF SEMINAR SESSION 5. PRODUCT EVALUATION: CONFLICT STUDIES

Chairman : S.A. Holmsen, Norway

Rapporteur : J.H. Kraay, The Netherlands

5.1. Evaluation of traffic restraint measures in residential areas with respect to pedestrian safety, R. Albrecht, Germany (The paper was presented by G. Zimmerman.)

A study was carried out in a historical residential quarter surrounding the Klausen Square in Berlin-Charlottenburg. Traffic restraint countermeasures were undertaken in order to get better road safety, more freedom of movement for pedestrians and improve the quality of the residential environment.

In checking the effects of the countermeasures the following questions were under consideration.

- How does a certain increase or decrease in the number of encounters or conflicts affect road safety?
- Which variables are to be assigned to conflicts or encounters to describe them as relative in order to obtain information about the risk of the traffic?
- Based on which variables can conclusions on the agreement or discrepancy between objective and subjective safety be drawn?
- By what means are conclusions, based on the behaviour observed, to be drawn with respect to the acceptance of measures?

In the after-study was found a decreasing number of conflicts and encounters while the conflict/encounter ratio was worser than it was in the before-study. It was during the discussions not possible to find a satisfying explanation for this phenomenon.

5.2. From accidents to conflicts; Alternative safety measurement, V.A. Güttinger, The Netherlands

The results of some research projects aimed at the development of a conflict observation technique for the estimation of the safety of child pedestrians in residential areas were discussed. Data of the studies about the reliability and the validity of the developed technique were shown.

It was obvious that other potential alternative indicators (than conflicts) for the estimation of traffic safety such as traffic volumes and subjective estimations of risk by the restraint had little succes in predicting accidents.
A small number of validation studies are under development. It was stressed in the discussions that the aim of validation studies must be to predict the expected number of accidents. Therefore it is needed to establish the conflict accident ratio for particular traffic situations.

5.3. Short-term evaluation of safety countermeasures; Two examples of experiments with speed-reducing countermeasures in Sweden, C. Hydén, P. Gårder and L. Linderholm, Sweden
A presentation was given of the Swedish traffic conflicts technique. Two studies dealing with the short-time evaluation of the effects of speed reducing countermeasures were discussed.
The most practical application of this so far developed conflicts technique is the use of conversion factors between serious conflicts and injury accidents. The established figures differ from different speed levels, road users and types of manoeuvre.
The main hypothesis from the studies is that an actual speed reduction of ten to fifteen kilometers per hour in urban areas will reduce the number of injury accidents to less than a half. In this respect, speed reduction might be an interesting alternative to area-wide regulations based on street closures, one-way streets, etc.

5.4. Traffic conflict studies in Finland, R. Kulmala, Finland
The results of conflicts studies were presented. The conflicts technique is based on te same time-to-collision criterion as the Swedish technique. It was stated that the connection between conflicts and accidents is not known for all accident types or road environments. The ratio between conflicts and accidents varies for different accident types and the reasons behind this variaton are not known yet.

5.5. Safety evaluation of flashing operation at signalized intersections, D. Mahalel, A. Peled and M. Livneh, Technion
A study on the safety evaluation of stopping traffic signal operations at off-peak traffic hours and substituting a flashing amber for all direc-

tions was reported. With the developed conflicts technique existing safety problems at intersections can be well located.
For all reported studies the main serious question remains: what steps are taken to validate conflicts to accidents. Till now, most of the validation studies are badly designed. More attention should be paid to the methodology for validating conflicts.
Based on up till now implemented validity research can be stated that hard pronouncements about traffic unsafeness by means of the conflict method cannot yet be made. Nevertheless, for lack of accident data, is a number of developed conflict observation techniques at present the best means to get an impression of the relative unsafeness of several locations or of the effect of measures on the unsafeness.

REPORT OF SEMINAR SESSION 6 + 7. PROCESS EVALUATION: BEHAVIOURAL STUDIES

Chairman : B. Horn, OECD, France
Rapporteur : A. Wilmink, The Netherlands

6+7.1. The analysis of traffic behaviour by video, A.R.A. van der Horst, The Netherlands

A short description of the development of the registration of traffic conflicts towards more quantative and automatically registration and analysis was given.

An example was given of the registration technique used at intersections with bicycle facilities.

Conclusions:

- Video-analysis give a lot of detailed information on traffic behaviour in relation to geometry.
- Process evaluation of interacting behaviour is possible.
- Further automation is necessary.
- There is a strong need for validation of this technique.

6+7.2. Road humps, the remedy for each and every traffic safety problem? P.W. van der Kroon, The Netherlands

A study (inquiry) was carried out with respect to the effect of road humps in residential streets. The most remarkable result was the clear decrease in the positive opinion on these humps in terms of safety, speed etc.

Based on the result the policy makers show more reservation to the application of road humps in residential streets.

Conclusions:

- The discussion showed that the experience with humps is not always positive.
- Positive effects are obtained at locations where real safety c.q. speed problems existed.
- In these cases speed humps are very cost-effective. It is stressed that people very often express their safety problems in terms of speed problems, but in many cases other problems cause accidents.

- There is no relation between subjective feelings of safety and objective safety.
- Besides people tend to react negatively on infrastructural measures.

Therefore evaluations of safety measures must be more that just inquiry!

6+7.3. Measures for reducing vehicle speed on residential roads, F.H. Amundsen and S. Lundebye, Norway

The study describes the experience with various measures to reduce speed in residential streets. A speed limit of 30 km/h showed to be effective in terms of actual speed reduction and in terms of a more positive opinion of the residents.

Road humps at a distance of 50-70 metres did reduce vehicle speeds to 25 km/h independent of the inititial speed.

Residents were positive with humps. Up till now no definite conclusions would be drawn from the use of road narrowings.

Conclusions:

- It is necessary to investigate national experience with respect to the effect of geometric measures on traffic behaviour;
- There is a need for a catalogue of measures with their effects;
- The effects of zones with a 30 km/h speed limit should be studied.

6+7+4. An adaptive theory of road safety, W. Molt and H. Beyrle, Germany

An 800 m road section was rebuilt following the Dutch "Woonerf" approach. The hypothesis was that traffic behaviour can be influenced and traffic safety can be improved by changing the road geometry and environment. The traffic system will function safely, if the road user is able to adapt adequately to the demands of the traffic situation.

He must be able to predict the traffic situation on base of the information he receives from the road environment. The Adaption Theory states that traffic safety may be increased through changes in the road environment if these changes positively influence adjustment capabilities as well as adjustment readiness of the road user.

Conclusions:

- New design concepts for city streets should be demanded which provide the road user a prediction of the traffic situation.

6+7.5. Evaluation of a pedestrian training programme for preschool children, J.A. Rothengatter and H.H. van der Molen, The Netherlands
A pedestrian training programme was conducted under children, parents and experienced assistents. The first strategy is called "process evaluation" in which information is gathered about the total process of training. The second stategy is called "product evaluation" which aimed at obtaining information about the effect of the training programme.
The evaluation showed e.g. no effect on the (already good) traffic knowledge, but a positive effect on children's traffic behaviour.
Altogether the results of the evaluation offer very strongly support for the training programme.

Conclusions:

- Before a nation-wide implementation is possible, the last stage of evaluating the programme in terms of measures representing the accident risk of the target group, must be completed;
- After this stage a nation-wide implementation of the programme is required.

REPORT OF SEMINAR SESSION 8. PRODUCT AND PROCESS EVALUATION

Chairman : P.C. Noordzij, The Netherlands
Rapporteur : Mrs. N. Muhlrad, France

The papers presented at this session were the following:
8.2. Evaluation of safety of speed control humps, C.J. Baguley, U.K.
8.3 Short-term and area-wide evaluation of safety measures implemented in a residential area named Østerbro; A case study, U. Engel, Denmark
8.4. Measurements of degree of separation between vehicles and pedestrians in urban areas G. Nilsson and H. Thulin, Sweden
8.5 On the methodology underlying the short-term evaluation of traffic engineering measures, e.g. solutions to left turns in the city of Hamburg, G.O. Riediger and G. Zimmerman, Germany

Two papers introduced at other sessions but closely linked to the subject, were also referred to in the discussion:
2+3.8. Evaluation of area-wide safety schemes by monitoring traffic and accidents, H. Ward and R. Allsop, U.K.
5.3. Short-term evaluation of safety countermeasures; Two examples of experiments with speed reducing countermeasures in Sweden, C. Hydèn, P. Gårder and L. Linderholm, Sweden

Discussion first started on the technique described by Mr. Nilsson to observe pedestrian movements on zebra-crossings in relation with vehicle traffic. The main questions raised were the following:
- Is it possible to use such a technique for the evaluation of safety measures? The authors of the paper considered that the degree of separation between pedestrians and vehicles was a good estimate for risk; however, some doubts were raised as to the validity of such a tool as the encounters observed include light traffic conflicts, while all earlier research on conflict techniques showed that only serious ones were related to accidents.

- Can this technique be used to other purposes? It was suggested that the degree of separation between pedestrians and vehicles could be useful as a correction factor in the exposure product, in order to get risk-values out of raw conflict or accident data. It could also be used as an analytical tool, to investigate relations between accidents/conflicts and exposure.
- Can this technique be extended? The observation method described can be applied to cyclists as well as to pedestrians and can be used outside zebra-crossings.

The other three papers presented at the session were discussed together. Paper and discussion covered a number of methodological points:
- What is the "area" taken into account in the evaluation? In some cases, evaluation was carried out on the area of implementation of the counter-measures itself (Danish and German papers), while in others this area was extended to take into account probable traffic changes in the neighbourhood (English papers). It was generally felt that not enough attention is given to this point in the design of evaluation studies and that other factors than traffic could be considered to define borders for the evaluation area.
- How to evaluate a set of safety measures? There was some disagreement as to whether an area-wide set of safety measures should be evaluated as a whole, or safety effects attributed separately to each measure included in the set. When the latter course of action is chosen, process evaluation becomes necessary, in order to find out about interactions between the various measures and field of influence of each one of them.
- Is there a necessity for a "control-area"? Only when the evaluation study covered a fairly long period of time the need for some control-data was recognized (Danish paper). However, emphasis was put on the difficulty to find comparable areas in an urban context and general safety trends had to be estimated from a set of data collected in the evaluation area itself.
- On what basis was product evaluation carried out?
What is understood by "short-term"? Product evaluation was mostly carried out on the basis of injury accidents, except where more than safety was concerned in the evaluation study (for instance in the English paper, noise and vibration effects). Accident data were collected on before and

after periods ranging from 1 to 3 years. One year was found a sufficient length of time to get significant results when a number of implementation sites were evaluated together (English paper), while 3 years weren't found sufficient when more detailed product evaluation was required (Danish paper). It was recalled in the discussion that conflict techniques were operational under much shorter delays (a few weeks after implementation of measure for instance), and it was also stressed that a six year evaluation study, not including the time spent on actual implementation of the safety measures, couldn't be quite considered as "short-term". The discussion generally showed that, while traffic conflicts aren't yet satisfactory for product evaluation due to insufficient validation, methods based on accident data cannot be generalized when real short-term results are needed. Research should be continued on this subject.
- On what basis was process evaluation carried out? A number of variables were used, including measurements of traffic volumes and speeds, observation of pedestrian movements and kerb delays, changes in public opinion, traffic conflicts, encounters, lost time, use of the roadway by car-drivers, etc.... Analysis of these data led to a better understanding of the immediate effects of the measures evaluated, but couldn't be linked directly to safety factors. It was generally found that more work was needed on process evaluation, and that both process and product evaluation should be carried out, as they complemented each other, but answered to different aims. It was stressed that, while process evaluation is particularly useful for research purposes, decision makers will always require evaluation results based on final safety gains in terms of accidents (whether those are found directly or through validated surrogates).

Finally it was mentioned that traffic planning measures could have considerable effects in reducing accidents, and should therefore be evaluated from a safety point of view as well as more specific safety countermeasures. Safety action should not be considered in too restrictive a way.

GENERAL REPORT OF THE SEMINAR

F.C.M. Wegman, Chairman of the Scientific Committee

During the seminar, a number of methodological subjects got special attention.
One of the more general subjects was the definition of "short-term" and "area-wide" and the relation between these concepts.

The outcome is broadly the following:
- "Short-term" should be understood as length of the "after-period", regardless of how long the countermeasures took to be implemented.
- Furthermore, short-term is a relative concept. It highlights the need for results "as-soon-as-possible".
The necessary length of the after-period depends on experimental requirments, on type of data used in evaluations and on type of countermeasure considered.
"Short-term" therefore ranged from two weeks when conflict or behavioural data was used as a basis for evaluation, to three years when accident data was used to assess the effects of a complex set of measures implemented area-wide. If effects of countermeasures were small, then the time had to be even longer. Length of the period of accident data collection was considerably shortened when one particular type of measure was evaluated on a number of different but comparable sites. In this context it was said, that the "wider" the area was, the shorter the evaluation period could be.
- "Area-wide" has mostly been understood in terms of implementation of a measure. However, there were examples of evaluation studies where the area considered for evaluation was broader than the area of implementation of the measure, the assumption being that the effects would be wider spread.
Determination of the evaluation area was mostly based on possible changes in traffic flows. It is felt, however, that more attention should be paid to possible secondary effects of the countermeasures being evaluated and that other factors than traffic flow changes (for instance behavioural changes) could be taken into account.

With regard to the relation between product and process evaluation, the following methodological problems ask for further research:
- In order to make short-term evaluation with regard to the accidents (product evaluations) possible one has to define easily measurable intermediate variables, such as conflicts, serious conflicts, accidents involving material loss, and to highlight their relation with accidents involving bodily injury.
This, because these "surrogate" measures are only useful as a criterion for safety if the validity with regard for injury accidents is high enough.
- In order to evaluate the traffic process by studying the traffic behaviour it is important to select the relevant cues and to investigate how these are most effectively influenced. Which cues are relevant depend on the specific topic of study. Speed and selection of routes can for instance be vital, but also head movements.
But it is also recommended to specify and study concepts such as "dangerous driving" more in detail, and to investigate how these are related to knowledge, attitudes, habits etc.

Relationship between policy and research

A policy maker will, in the first place, need results of evaluation investigations if he is uncertain about a decision he has to make and if he could be confronted with negative consequences of a wrong decision. Results of evaluation investigations should simplify decision making. Information concerning realised plans (the problems whether such plans contributed to the realization of the goals envisaged) has to be used in decisions over new plans (how can investigation results be used in order to establish the effectiveness and efficiency of new plans?). The scientific world is asked to provide such amount of information and such kind of information, on the basis of which the decision making would become less uncertain and more simple. To prevent accidents is normally expensive. If the wrong decision is taken which don't increases the traffic safety level (e.g. reduces accident), and if the decision maker don't have that information (from a proper research project) he will waste money, not only in the first case but every time he decides to implement the same countermeasure.

The policy making people are asked to formulate their problems, questions, as clearly as possible, in order to provide the researchers with an adequate investigation scope, ensuring that the investigation results will give answers to actual policy problems.

The next question is in what form such information has to be presented to the policy maker, at the same time indicating the limit where the responsibility of the researcher stops and that of the decision maker begins.

As a rule it has been accepted that in investigation reports distinction is made between the presentation of facts and their interpretation. There are different opinions as regards the question: should the researcher make recommendations about taking or not taking certain concrete measures, about the character of such measures and about their expected outcome. According to some, the researcher has to make practical recommendations. The uncertainty of the policy maker, mainly on a lower echelon of the hierarchy, will not be removed by reading research only containing generalised and more often than not, hypothetical information. His uncertainty only disappears when his decision is supported by concrete, unambiguous directives. The question arises, whether research results could be of such definitive character, which would justify the formulation of directives.

The general opinion is, that usally not enough information is required for a decision and yet, the decision must be made. The researcher should point out the possible consequences of certain decisions and the risks the decision maker is exposed to thereby. According to another opinion, over the boundary zone between policy and research, the researcher has to reserve council and to limit himself to the presentation of research conclusions. Further on, it is up to the policy maker to make out which recommendation he will derive from the supplied conclusions.

A possibility of simplifying decision making consists of providing a decision making model, filled with as much relevant information as possible and to find out to what extent the consequences of a decision will change on a certain spreading of information (mainly in the so-called "road factors", implicitly and explicitly).

Such sensibility analyses are likely to remove uncertainties of the policy maker.

The suppression of uncertainties in decision making through evaluation investigation is only possible, if evaluation investigation has really to

say something. Practical evaluation investigations, as a rule, take place under many limitations, on account of which it is difficult to state definitely that changes in dependent variables are the results of changes in independent variables. Since nearly always "quasi-experiments" are being carried out, it is necessary to report clearly the conditions under which certain statements have been made. In this connection it is not sufficient to limit the report to the presentation of the results of statistical tests and the conclusions that zero-hypotheses have been discarded or not. On the contrary, it is of great importance to indicate the extent of the reliability of statements and to assess in this way the extent on uncertainty of decisions.

Should researchers pay more attention to these issues, it could be hoped that research will really provide informations. Thereby it will also be simpler to relate informations from different investigations to one another.

A more intensive exchange of ideas by researchers will increase the chance of removing the uncertainties in decision making and at the same time ensuring that decision makers will make use of investigations in their decisions.

CONCLUSIONS AND RECOMMENDATIONS

Session 1. Research policy

1. The importance of short-term and area-wide evaluation to decision makers and researchers is broadly recognized.

2. Short-term evaluation can monitor the effects of newly implemented programs and can help to inform decision makers concerned with development of new programmes.
The results of short-term evaluation give decision makers better base for the allocation of resources for safety programmes. Carrying out short-term evaluations might lead to more understanding by decision makers of the expertise that resides in the research community and the need for longterm research.

3. Obviously, researchers are not called upon to replace decision makers, but they should be able to provide them with relevant information and scientific knowledge. To do this, researchers must co-operate closely with administrators and technicians. They must assist in designing these evaluations in order to be able to advise decision makers on road safety measures.

4. In evaluating the effects of measures on safety, the initial objectives of the researcher must be stated clearly. These objectives must not be mixed up with those of decision makers.

5. Decision makers will require both the long-term evaluation based on accident data and the results of continuous "short-term" evaluation ("monitoring").

Session 2 + 3. Methodology and analysis

1. Where locations have been selected on the basis of a high number of accidents a correction for the so-called regression-to-mean effect must be made when evaluating the effects of the safety measures applied in order to estimate the real effect of those measures on accidents.

2. If the aim of the evaluation is not to describe the effectiveness of road safety measures, but to inform decisionmakers about investments then decision analysis instead of classical hypothesis testing is recommended.

3. In order to permit the statistical accumulation of evidence from several related studies, it is recommended that results should be presented in the form of estimates and standard errors of parameters (representing effectiveness) rather than as hypothesis test results alone.

4. If Bayes rule were to be used to revise estimates of effectiveness, than the use of subjective prior distributions would be controversial.

5. Recently developed techniques such as the log-linear model, the multiplicative Poisson model and the cannonical regression model for categorical data are highly recommended for the analysis of complicated relations between several safety aspects.

6. The identification of certain situations as "dangerous" on the sole base of (often small) accident numbers is uncertain. This might be improved by using information coming from the analysis in which the risk is related to the characteristics of those situations.

7. In cases where short-term evaluation is not easily applied it is sometimes possible to proceed if one extends the number of relevant situations. In this way the short-term can be compensated to some extent by making the area "wider" (larger).

Session 4. Product evaluation: Accident studies

1. The papers strongly suggested that accident analyses are too often done without sufficient information about traffic (volumes, composition) and other relevant circumstances in the before and after periods. Such information is important as a complement to accident data in the evaluation of traffic safety measures.
If traffic information is available the investigations can be more comprehensive and other effects of different measures can be treated simultaneously.

2. The traffic safety situation in before and after period cannot be expressed only by the number of accidents or injured persons, especially not in those cases where the exposure has been influenced. How to define exposure and corresponding risk estimates depends on how problems are stated.

3. Some delegates noted that when officials in urban traffic management seek to move traffic on to main streets, they must not overlook the traffic safety problems that lorries and public transport can pose for pedestrians and cyclists in shopping and residential districts.

4. In designing an accident investigation it is important to identify the relevant problems and to focus the design on those problems: "problem oriented" design. Moreover, it is important to choose the right investigation methods and use statistical methods that are as efficient as possible for the evaluation process.

Session 5. Product evaluation: Conflict studies

1. In order to evaluate safety measures by means of the traffic conflict technique it is necessary to know how valid these techniques are. No conclusive comprehensive validation studies have been presented.
There is a strong need for validation for those circumstances where this technique is relevant, because of the scarcity of the accident data, e.g. the residential areas.

2. The traffic conflict technique is still being used in connection with other aspects of behaviour in order to describe changes in the traffic process as a result of countermeasures (process-evaluation).

3. There is a number of different conflict techniques according to different operational definitions. In order to find out which elements are relevant for a conflict technique it is important to compare definitions and results.

An international calibration study is designed by ICTCT (International Committee of the Traffic Conflicts Techniques) in order to answer the following questions:

- What differences and similarities in severity ratings exist between events as classified by different teams?
- Do conflict data recorded by different techniques differ? If so, to what extent can the differences be explained by type of location, vehicle manoeuvres, road-users' behaviour, etc.?
- What modifications of the various techniques are suggested?

Session 6 + 7. Process evaluation: Behavioural studies

1. More research and an international exchange of information is needed on the extent to which traffic behaviour can be influenced by specific road design elements which are particularly suitable in urban areas with special emphasis on residential zones.

2. Short-term process evaluations by means of video recording and analysis techniques give much detailed information on traffic behaviour in relation to the functioning of road design elements.
Further automation of quantitative analysis techniques is necessary to make it more cost-effective.

3. Speed is an important aspect of traffic behaviour and changes in speed variables are especially important as an indicator of safety effects. Measures to solve speed related safety problems can be recommended if the actual road and traffic conditions lend themselves for successful applications. If the measure aims at extensive changes in behaviour, it will not be effective, unless it is self-enforcing.

4. To be able to evaluate the effect of pedestrian training programmes in terms of behaviour, a large scale implementation of these programmes is required.

Session 8. Product and process evaluation

1. Documentation should be provided whenever evaluation studies are reported so that results of different projects can be combined to increase knowledge in the field. The state-of-the-art should also be reviewed regularly.

2. It is recommended therefore that each evaluation project gives a comprehensive documentation of
- countermeasures,
- how countermeasures are actually applied,
- the conditions under which the measure is applied,
- the dependent variables that have been used,
- the details of data analysis,
- the assumptions underlying the selection of the countermeasures and dependent variables.

3. More detailed research is necessary with respect to the influence of feelings of safety, attitudes and motivation on the behaviour of road users and their influence on accidents.

4. A distinction has to be made in the design of evaluation studies between effect assessment (product evaluation) and obtaining more knowledge about the reasons why safety measures are working and how they work (process evaluation).

5. When an area-wide set of countermeasures (or "pro-measures") is evaluated, product evaluation is not sufficient in attributing safety effects to each countermeasure of the set. Process evaluation is a necessary complement to throw light on the process of interaction of different measures. This is necessary if proper generalization of findings are to be made.

6. "Short-term" evaluation may also serve different objectives as compared with long-term evaluation and as such short-term evaluation will never be a substitute for long-period evaluation, rather they are complementary.

SEMINAR ON SHORT-TERM AND AREA-WIDE EVALUATION OF SAFETY MEASURES, AMSTERDAM, The Netherlands, April, 19-21, 1982

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