

SWOV's position in *a new Field of Knowledge*

During the last few years, there have been quite a lot of changes in the realm of road safety knowledge. The relationship between government and market has changed drastically and road safety policy has been decentralised. More and more organisations, bodies, and policy workers concern themselves with road safety; they all need knowledge in order to carry out their work properly. More and more organisations are trying to play a role in this. This has all led to the field being even less clear. It is often unclear who needs which information, or where such information can be obtained. All these changes have also effected what SWOV does.

According to SWOV's statutes, its task is to improve road safety by using the results of research. This task will be unimpaired in the future.

Knowledge distribution and research

The first, crucial element in this task is improving road safety. This means that, however SWOV has obtained its knowledge, it must be made suitable and available to all those working to improve road safety. SWOV's target group is professional users of this knowledge. Knowledge distribution is, therefore, a central part of SWOV. It is, therefore, part of the SWOV mission. The second element of SWOV's task is improving road safety by means of the results of

research. This means that SWOV's contributions must always be able to withstand scientific criticism. It also means that its recommendations, based on results, are impartial. Results of research can either be obtained from its own studies (carried out alone or together with others) or by studying results of others' studies. These results must be tested to see if, and to what extent, they are relevant to situations in the Netherlands; this latter if the results are from research in other countries. This is the second element of the SWOV mission.

Long-term research

SWOV has agreed with the Ministry of Transport that it will carry out so-called 'there-and-then research', and not so-called 'here-and-now research'. This means that SWOV will carry out research whose application is not aimed at the short-term ('now'), but research aimed at the middle and long-term ('then'). The time-path is, therefore, one which will produce results in, for example, 3-5 years time. Shortly afterwards it can be implemented. A second important characteristic of SWOV research is that it will always be aimed at knowledge that can be generalized; it is not only usable for just one actor (one road authority, one municipality, one police corps). A result of this is that, in general, research results can only contribute to improving road safety if they are publicly known. The results of SWOV research are, therefore, basically always publicly available. As far as the way in which, and the moment of publication are concerned, it goes without saying that this will be the subject of agreements drawn up between the organisations involved.

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SWOV reports in brief

Speed and motivation: ideas about the
content of questionnaires and the designing
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Using car phones while driving is
undesirable

Recognition of sustainably safe road types

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design for an experiment in the Netherlands

Rewards and road user behaviour

Use of seat belts outside built-up areas
increased

Searching for quantitative relations between
road design and road safety

Nine themes

SWOV has drawn up a first proposal for nine future research and knowledge distribution themes. It is to be expected that, within a number of themes, limited, additional research will be carried out for others than the Ministry of Transport.

Such ideas include specifically, but not exclusively, European projects.

Moreover, SWOV aims, as far as is possible and desirable, to study the themes together with other research institutes. This in agreement with the ultimate users of the knowledge gained from that study.

More information

During the second quarter of 1999, more information will become

available concerning the future filling in of SWOV's tasks. In April 1999, SWOV makes a new start. This will, among other things, express itself with a new (company) logo. We will keep you informed by means of a newsletter. We will also make information available via Internet. We expect the SWOV-Website to be ready about this time.

SWOV REPORTS IN BRIEF

The effect of enforcement on speed behaviour

*A literature study
Oei Hway-liem
D-98-8. 55 pp. Dfl. 22,50.
(in English)*

The objective of this literature study, which was conducted within the framework of the EU MASTER project, was to give an overview of research on speed enforcement and its effect on speed behaviour and safety. In the past ten to fifteen years many reports and articles have been written on this subject. In this study, which does not have the ambition to be complete, examples of experiments at locations, road stretches and road networks are given. Most of the literature deals with enforcement at a locality or on a road stretch. There are few reports on area wide enforcement. Research reports from the Netherlands, United Kingdom, Australia, some Scandinavian countries and the USA are reviewed. It was concluded that the experiments with local speed management showed positive results: the average speed reduced significantly and the number of accidents decreased. Experiments with speed enforcement on routes also showed a reducing effect on the average speed and on the number of serious accidents. Experiments with speed enforcement

on road networks showed a variety of outcomes in some experiments the results were a reduction of the average speed; in other experiments the speed reduction effect was only found for the group excessive speeders. The report concludes with recommendations for efficient (optimal enforcement planning given a certain number of policeman hours) and effective (achievement of aimed speed reduction) speed enforcement strategies.

A speed campaign in the South East of the province of Friesland

*Results of the evaluation study
Oei Hway-liem
R-98-46. 94 pp. Dfl. 30.-
(in Dutch)*

SWOV has carried out an evaluation study of which the objective was to ascertain the effect of a long and repetitive campaign on speeding offences and attitude of drivers on a network of rural roads with a speed limit of 80 km/h. A campaign was conducted in South East Friesland, part of a northern province in the Netherlands during a period of 2.5 years. The aim of the campaign was general prevention, that is to reduce speeds driven irrespective of time and place. The campaign consisted of publicity, enforcement



using a radar car and camera (speeders were not stopped), a feed-back sign downstream the radar car ('Your speed has been checked'), and a survey among drivers. The main results were that although the percentage of speeders on two intensely controlled roads was reduced, the percentage of speeders was still high: 68% on one road and 41% on the other. There was almost no spreading effect on the neighbouring roads.

Safety strategies for rural roads

*Summary of the OECD report
'Safety strategies for rural roads' (1998)
and possibilities for putting them into
practice in the Netherlands
I.N.L.G. van Schagen & F.C.M. Wegman
D-98-11. 22 pp. Dfl. 17,50.
(in Dutch)
Copies of the final Expert group report
entitled 'Safety Strategies for Rural
Roads' can be purchased from the OECD
Transport Division, 2 rue André Pascal,
F-75775 Paris CEDEX 16, France*

During the period 1997-98, an OECD Scientific Expert Group produced a report about road safety on rural non-motorways and the possibilities of improvement. This report attempted

to approach the problem as broadly as possible, in order to enable all the (very divergent) OECD member states to apply it. The Transport Research Centre of the Netherlands Ministry of Transport commissioned SWOV to produce this report as:

- 1 a summary of the most important results in this OECD report, and
- 2 translate these results and recommendations for use on Dutch roads. Relevant developments in the Netherlands had to be taken into account.

The OECD report itself presents an overview of the safety, in various countries, of rural non motorways, the accident characteristics, and their possible causes. The usefulness and necessity of a strategic approach to improve safety is then considered. Various measures, fitting within such an approach, are discussed. These are: network planning, infrastructural measures, enforcement, intelligent traffic and transport systems and trauma management.

The possible causes are given of the three most common types of accidents on Dutch rural non motorways: single-vehicle accidents, crossroads, and head-on collisions. From these, the measures were deduced for improving the situation.

These measures involve enforcement and education, infrastructure and the new intelligent information technology. Such measures can be applied in respectively, the short term, the short-to-middle term,

and the middle-to-long term. The expectations are that, with further elaboration and implementation of the principles of the 'sustainably safe' concept, the safety of rural non-motorways will improve. Of utmost importance here is the redivision of the road network in three mono-functional categories. These are through-roads, residential roads, and collector roads. Equally essential is a consistent road design around each described function.

Accidents in the Netherlands involving heavy motor vehicles

An analysis concerning underrun protection of rear ends compared to the sides and the front ends
 L.T.B. van Kampen
 R 98-50, 28 pp. Dfl. 1750.
 (in English)

On behalf of the RDW Vehicle Technology & Information Centre, SWOV analysed accident data concerning heavy vehicles (all motor vehicles with a total weight of more than 3,500 kg). The question was whether the collision involving the rear end of heavy vehicles, including their trailers and semi-trailers is a serious problem to other road users, compared to collisions involving the front end and the sides of these vehicle types. It was also examined how the number of heavy vehicle accidents have developed over the years 1985 to 1997. This investigation was done, since it should be decided by EEVC whether rear underrun protection of heavy vehicles need

specific attention, as compared to side and front underrun protection.

It was figured out that the absolute number of accidents involving heavy vehicles with rear-end damage is far lower than the number of heavy vehicles with side damage. The number of heavy vehicles with frontal damage is the highest of the three. Differences in injury severity of drivers of opponent vehicles suggest that semi-trailer tractors are more aggressive than lorries, while buses are the least aggressive. Cars are by far the most important opponent in rear-end accidents, while in side collisions both cycles and mopeds are prominent too. In frontal collisions both cars and cycles are the more important opponents. Considering these results, one could therefore say that front underrun protection deserves more attention than side underrun protection, while rear underrun protection would only be third in this row. But, the decision for this kind of priorities may also depend on the costs and effectiveness of protective devices that are available or in development for either of the three heavy vehicle sides.

Therefore, application of rear underrun protection could theoretically become a first priority, if devices of low costs and with high effectiveness could be developed and applied.

Testing traffic education in primary schools

Criteria for a high quality and a recommendation for monitoring
 R.D. Wittink
 R 98-40, 25 pp. Dfl. 1750.

Organisations involved in traffic education want insight in the relevance of traffic education for road safety. Only then can they determine how much effort they can and should make, especially when renewal of education or road safety policy takes place. The question that can be asked here is what the yield is of the efforts of actors in traffic education or rather, how can it be tested whether the



traffic education that is given is of a high quality?

SWOV was asked to conduct a preliminary study of the possibilities of testing the results of traffic education. The first question is: which demands of substance may be made on traffic education in primary schools?

We need to take into account two things. On the one hand, the time and resources that primary schools have for traffic. On the other hand, the effects of traffic education are dependent on the activities of others, such as parents and guardians who teach children traffic drill, and municipalities who should provide a safe infrastructure.

Once it has been established what a good and feasible traffic education programme is, the method of testing its quality can be determined. This should in the first place be the substance, at the childrens' level in terms of safe behaviour and behaviour determinants such as knowledge and skills. Apart from this testing should also be carried out at the process level. This concerns the method of education and instruction, the organisation of traffic education at school, agreement between parents and school, support from teachers and school, and (finally) tuning the education to an integrated municipal road safety policy.

Based on the knowledge that has been developed in the Netherlands during the last few years, this project formulates quality criteria for traffic education of children.

Testing possibilities have also been determined. As a result of this project, the thus formulated points of application for testing have been developed into a monitoring system. This instrument should be suitable to regularly measure how children have been equipped for safe traffic behaviour and how substance is given to traffic education. It is also

recommended to monitor those activities undertaken by

1 governments at the local, regional, and national level to support traffic education in schools; and

2 other relevant organisations.

Working out the monitoring system should take place in cooperation with the bodies that conduct (or commission) the monitoring. The final responsibility lies with the national government.

It is important that those actively involved with traffic education should exchange experiences, and that knowledge should be developed further. Exchange, for example, can occur using 'best practices'. Research into parts or aspects of traffic education can be necessary to learn more about the conditions for results. The newly acquired knowledge and insight can lead to changes in the traffic education programmes. In this way, a system of feedback for the pupils has been created.

The effect of a no-claim bonus system on reported claims

A research into the effect of financial stimuli on traffic accidents
F.D. Bijleveld.
R-98-47. 52 pp. Dfl. 22.50.
(In Dutch)

This report attempts to provide an answer to the question of whether negative or positive financial consequences of insurance claims really do lead to fewer accidents. The research question was phrased as follows: what are the effects of financial stimuli on reported damages? To answer this research question, two groups of insured motorists were compared: one group insured according to a no-claim bonus system, and one group who was not insured according to a no-claim bonus system. From the claims data made available by the Association of Dutch Insurers, a selection was made in order to create the two groups. The selection was made in such a way that a certain

association of claims could be made with 'accidents'. Non-accident related claims were removed from the analysis. For example claims with regard to stolen property.

Injury accidents were also excluded from the analysis because they make up only 5% of all claims, but represent extensive losses. If not excluded they would have dominated the analysis due to third party liability claims. The analysis was conducted in three steps:

- 1 An analysis of the claim amounts made to investigate the similarity of the groups showed no marked differences between the two.
- 2 A paired comparison was based on groups differing only in insurance policy. Claims data associated with groups having only different insurance policies are assumed to be similar were compared. In these analyses, no systematic differences were found which could indicate that one of the two kinds of policies would score significantly better than the other.
- 3 A comparison was made based on individual policies by applying a generalised linear model.

The most conspicuous conclusion from this analysis was that it is not true that a no-claim bonus arrangement generally leads to fewer reported claims and/or less third party loss. This finding was based both on the paired comparison analysis and the analysis using the generalised linear model.

Investing in a sustainably safe road traffic system

Can that be organised?
F. Poppe
R-98-58. 38 pp. Dfl. 20.-
(In Dutch)

This report builds on research reported earlier, on the cost of traffic unsafety, and the thus resulting social cost effectiveness of investments into a sustainably safe road traffic system. This is recapitulated in the first chapters. Also this is placed into an international perspective. Next is

concluded that the developments in recent years with respect to prices (relating to the cost of traffic unsafety and to investments), the amount of traffic, and the traffic risks are not so large that the earlier calculations now would lead to other conclusions. The fact that these social cost-effective investments are not made spontaneously, points to economical market failures. A broad economic analysis gives the following potential causes of this:

- external effects (like traffic unsafety) are not incorporated into the price;
- traffic safety is a 'public good' with connected free ride behaviour;
- incomplete information with several concerned parties;
- transaction and perception costs.

Finally some possible directions for solutions are given. This particularly concerns the obtaining and dissemination of knowledge, the use of levies or taxes to internalise the external costs and to induce safe behaviour, and the introduction of conditional grants to road authorities to achieve investments directed at traffic safety.

Estimating the actual extent of road safety from 1997

Methods and results for hospital admissions
Dr. P.H. Polak & A. Blokpoel.
R-98-51. 43 pp. Dfl. 22,50.
(In Dutch)

The Dutch Ministry of Transport and Public Works wishes to arrive at a new approach for registering data concerning road traffic accidents and casualties to be able to determine the actual extent of unsafe road traffic conditions. This new approach is being elaborated in more detail by the collaborative efforts of the Netherlands Transport Research Centre, Department for Statistics and Data Management (AVV/BG), Statistics Netherlands (CBS) and the SWOV Institute for Road Safety Research. Within this context, SWOV was commissioned by AVV/BG to develop and apply a

method to assess all hospital admissions of traffic accident victims, so that the actual number of these casualties for the year 1997 could be determined.

It can be concluded that the total number of hospital admissions (excluding those who died within 30 days) resulting from road traffic accidents occurring in the Netherlands was 20,190 for 1997. Besides the numbers of casualties, the numbers of accidents were also estimated with the use of a method especially developed for this purpose. At the same time, casualties and accidents were subdivided according to important characteristics: casualties were categorised according to how they participated in the accident as well as their ages and genders, while the accidents and casualties both were categorised according to the month, day of the week, period during the day, and the province in which the accident occurred. The margins between the subdivisions are definitely wider than those between the totals.

Finally, recommendations were made for the purpose of arriving at even better assessments of the actual extent of unsafe road traffic conditions in the future. The most important possibility indicated for improving the determining of the actual number of hospital admissions was a repetition of the study linking two sources of data.

Reflections on the real numbers of road accidents

Consequences of the introduction of the 'real numbers' of road accidents. An evaluation of the estimation method. And procedures for the future
R.J. Davidse & P. Wesemann.
R-98-55. 60 pp. Dfl. 22,50.
(In Dutch)

In 1997, the real numbers of road victims were made known. During the last few years a plan to

improve the road accident registration was developed. This plan was laid down in the so-called SAVOG report. This report's title contains the Dutch acronym and describes the objective: Structural and Additional Gathering of Road Accident Data. Within the framework of the above-mentioned developments, a project was designed which has resulted in the present report. One of the objectives of this project was to set up a plan to result in an optimal set of real numbers of road accident victims. A second objective of this project was the evaluation of the estimation method that was applied for determining the real numbers of hospital inpatients, in order to be able to optimize the method. A third and final objective of this project consisted of the formulation of procedures for the period up to the realisation of SAVOG, in order that the activities that take place in the framework of the realisation of SAVOG do not influence the quality of the real numbers.

International cooperation in road safety research between the United States and the Netherlands

P.J. Wouters.
R-98-45. 62 pp. Dfl. 22,50.
(In Dutch with annexes in English)

The Netherlands Transport Research Centre (AVV) of the Ministry of Transport had in the project International Cooperation, the following goal: "To find solutions to problems that occur in the Netherlands and abroad, by means of an exchange of knowledge and experience, and other forms of cooperation". In 1991, the ministry came to a so-called Memorandum of Understanding (MoU) with the Department of Transportation (DoT) in the United States. Since 1998, the Transport Research Centre agreed to a formal agreement to exchange information and technical assistance with Volpe National Transportation Systems Center

(Volpe), a division of DoT. Part of this consists of Human centred transportation systems and safety.

The Transport Research Centre wishes to elaborate this part, and together with Volpe, cooperate on those aspects of road safety in which there are problems in both countries, and for which a similar approach would seem both possible and advisable. SWOV was invited to cooperate with the preparation of such a cooperation. The Transport Research Centre selected four themes. SWOV elaborated, among others, the following themes for discussion:

- 1 road safety in the Netherlands and the approach to it,
- 2 traffic education for the elderly,
- 3 alcohol and drugs use, and
- 4 the graduated driving licence.

The elaborations of the themes and

advice were discussed with people from Volpe: the Federal Highway Administration and the National Highway Transportation Safety Administration. This happened during a visit by representatives of the Transport Research Centre and SWOV to these bodies. At the same time a number of advices were given about specific subjects which were relevant in America at that moment. These were:

- *ALERT, Advanced Law Enforcement & Response Technology,*
- *IHSDM, Interactive Highway Safety Design Model*
- *SMS, Safety Management Systems;*
- *Road Safety Audits.*

The American partners also introduced their ideas through short lectures about their own research plans and efforts. SWOV report

R-45 presents the results of the activities and this preparation phase. Based on the information thus obtained, and a judgement from the Dutch perspective, further exploration of cooperation with the United States is recommended for the following road safety research subjects:

With Volpe:

- *'problem drivers' in relation to a fresh look at the Netherlands' policy' spearheads 'alcohol', 'seatbelts', and 'speeding';*
- *transport exposure and risk;*
- *(possibly) training methods (among which simulators) from other modes of transport.*

With FHWA:

- *Interactive Highway Design Model IHSDM.*

With NHTSA/IHS:

- *Graduated Driver Licensing Systems.*

Speed and motivation: ideas about the content of questionnaires and the designing of campaigns

This literature study which was conducted within the framework of the EU MASTER project, focuses on the preparation of surveys to be presented to road users (both motorists as well as vulnerable road users) in regard to areas within and beyond their own residential neighbourhoods. The purpose of these surveys is to provide data about motivations road users have in regard to how fast they travel on the roads and what they think about the driving speed of others. This study has consequences for the form and content of the questions that can be asked as well as for the content of possible information campaigns.

As far as the form of the questions is concerned, determining an attitude is based on asking two kinds of questions: a question about the probability that a certain behaviour will lead to a certain consequence, and a question about how the respondent evaluates that consequence.

These answers are then multiplied by one another during statistical analysis. Additional processing of these products (correlations, factor analysis) places high demands on the character of the original scales: this processing is possible only by using ratio scales. Since many attitudes



P e t e r

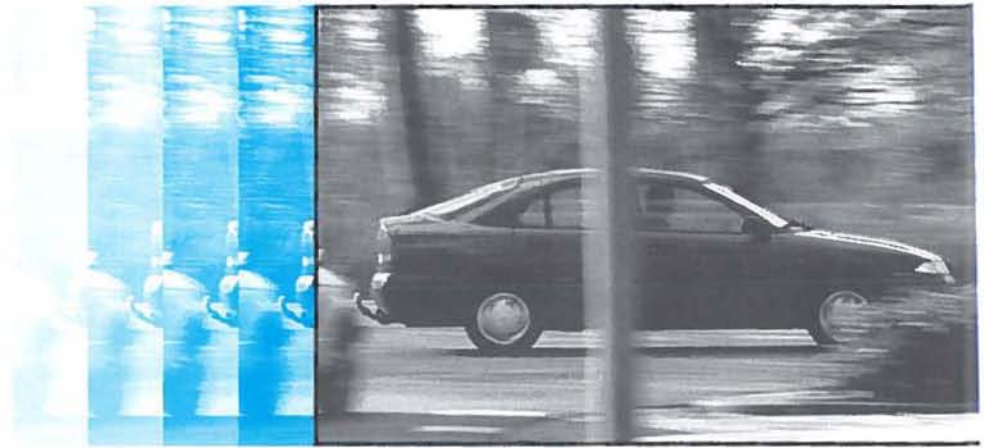
Levelt, 56 years old, studied Psychology at the University of Amsterdam. He carried out research on children and traffic. He obtained his doctorate in 1981 with a thesis on the subject: what children can learn from television. For ten years he was head of research and one of the editors of the television programme Sesame Street. Since 1986 Peter works at SWOV and his main topic is traffic behaviour.

studies about speed and other traffic behaviour fail to take this rule into account, basing results on them becomes very difficult if not impossible. Conclusions from some often cited attitude studies prove to be unreliable for this reason.

Influence of attitudes

As to the content of the questionnaires and information campaigns, both established and newly developed concepts can be found in the literature pertaining to road safety psychology and social psychology. Traditional methods of measuring attitude sometimes ignore the possibility that new motivations are going to be a factor and underestimate the factor of feelings people may have in the future. This study however, provides an overview of what is known about the influence of attitudes as well as the possible influencing of attitudes, in regard to speed, speed control measures and the speed of other road users. Attention is requested for such attitude characteristics as strength, accessibility, ambivalence, importance and consistency as well as for the difference between cognitive and affective aspects.

The behaviour of road users in regard to driving speed is affected by the driving speed of fellow road users and by how people evaluate the opinions and reactions of significant others (family friends, the government, police and passengers). The relative importance of attitudes and social norms depends on the kind of road in question. People are not only subject to but also exert social



influences. Information campaigns can make use of this fact. People's intentions and behaviours are also affected by the control people think they have over their behaviour. People not only have the feeling that it is difficult to control driving speed behaviour, but they also overestimate their own ability to control the consequences of speed.

Emotions

Attitudes can be seen as anticipated emotions: people weigh the advantages against the disadvantages as well as the pleasant and unpleasant feelings to be expected. These do not necessarily have to agree with the emotions that will arise when the time comes. Gradually, more and more is becoming known about the effect that emotions have on the choice of a certain speed and on the assessment of another person's speed, as well as about the use of emotional appeals in campaigns. Such emotions as guilt, regret, fear, anger, boredom and pleasure occupy an important place here. Emotion theory offers a good framework for studying these emotions as the basis for motivations.

Attention is requested for investigating moods since moods appear to be important for all kinds of operations and behaviours.

Personality characteristics

Finally, personality characteristics are investigated. People vary in their propensities for experiencing emotions such as fearfulness as well as the way in which they manage their emotions. The most familiar factor in speed behaviour is that of sensation-seeking. The need to control difficult situations is probably a primary factor in driving at higher speeds; the need for danger plays a lesser role. A second possibility is aggression. Aggression probably leads to all kinds of dangerous behaviour, including driving at high speeds.



Speed and motivation

Established and newly developed ideas about the content of questionnaires and the designing of campaigns

*P.B.M. Levitt
D-98-10-77 pp. D11-25
(in English)*

Using car phones while driving is

undesirable

SWOV has carried out a literature study concerning the effect of telephoning while driving on road safety. The use of the telephone in

the car has increased dramatically in recent years. The telecom industry expects that by the end of the year 2000, four million cellular telephones will be in use; the percentage of hands free installations is not known.

Questions have been raised in the Dutch House of Parliament in regard to the possible added road safety risks of telephoning while driving, and in case of increased risks, which possibilities should be employed to limit these risks. From the literature consulted, it appears that research has been conducted into the 'telephoning while driving' phenomenon in various ways, methods ranging from various forms of simulation to driving under actual traffic conditions.

Effect on the driving task

The various studies show that telephoning while driving interferes with driving tasks and therefore has a negative effect on the performance of driving tasks. This concerns both hand-held and hands-free telephoning, although hand-held telephoning appears to have a greater negative effect on driving tasks than does hands-free telephoning.

Effect on accidents

Until lately, attempts to show a relationship between telephoning while driving and the risk of accidents,

were known to have been undertaken in only two studies. These studies (having some methodological restrictions) show that telephoning while driving at least doubles the chance of being involved in an accident. From a recent German research report no conclusions could be drawn on the safety consequences.

Telephoning while driving a car is undesirable

On the basis of data now available, SWOV concludes that telephoning while driving a car is undesirable. This applies to all forms of telephone use and vehicle operation. Manually searching (in the telephone's built-in memory) and dialling a telephone number, as well as hand-held telephoning should be classified as being especially risky. Aggravating circumstances are: heavy traffic, poor weather, complex traffic situations and attention demanding conversations. The additional mental burden associated with telephoning activities is usually underestimated by the driver and is not sufficiently compensated for by taking such measures as driving more slowly and maintaining a greater vehicle spacing.

Prohibiting the use of hand held telephones while driving will benefit road safety. Upholding a legal ban on hand held telephoning would be reasonably feasible; doing so for hands-free telephoning, on the other hand, would be almost impossible. On the basis of available data and some assumptions, the number of traffic victims under the condition of telephoning while driving, is estimated for the Netherlands to be 15 killed and more than 100 injured persons. Similar activities too, such as faxing and e-mailing while driving, should be seen as undesirable. Several alternative services and systems are being offered that include voice-mail (similar to an answering device) and through connection of phone-calls. These products remove the need for telephoning during



L i e m

Oei, 61 years old, graduated at the Technical University at Delft, faculty Electrical Engineering. He is a senior researcher and has been employed by SWOV since 1969. He has conducted several experiments on (automatic) speed management on motorways, rural roads and municipal roads. A design for provincial speed measuring network was made that has been applied by several provinces. Some other research topics being dealt with were: telematics and road safety, safety of emergency vehicles.

driving while ensuring that the driver can still be contacted. A very recent development is voice-dialling in which a number can be selected by means of speech command.

Recommendations

The following recommendations are given:

- to conduct a public campaign to inform drivers about the risks of telephoning during driving;
- to discourage this practice;
- to issue a legal ban on hand-held telephoning during driving;
- to evaluate the effects of these measures.

Telephoning while driving a car and the relation with road safety

A literature study

Oei Hway-liem
R-98-41 - 44 pp - Offl - 22.50.
(in Dutch)



Recognition of sustainably safe road types

The sustainably safe concept presupposes a limited number of road types, each with its own function. Each of these road types requires a different traffic behaviour and leads to different interactions between road users. It is, therefore, of great importance that road users can establish quickly and correctly which road type they are on. It is also important to know which other vehicle and road user types showing which behaviour can be expected, and what their own behaviour should be.

It can be determined which road characteristics are important to optimize the recognisability of the sustainably safe road types. This is done by using a structured TNO Human Factors Research Institute laboratory experiment, in which photographs and video animations

are used. This report, within the framework of the long term project 'Sustainably Safe Road Environment and Behaviour', presents the results of the preparatory activities for such a laboratory experiment. These were: identifying and selecting potential, relevant road characteristics; and making a definite research design.

Design and layout of sustainably safe road types

First of all an overview is given of these ideas, up till now about the design and layout of sustainably safe road types. These ideas should be seen as the preconditions, within which the laboratory experiment must take shape. Next, a number of general criteria are formulated, to which the variable road characteristics have to conform. Then a summary is given of previous studies of this subject.

The research design involves experimenting with four variants of road designs of the five road types according to the principles of sustainably safe:

- through roads;
- 80 km/h collector roads;
- 60 km/h residential roads;
- 50 km/h collector roads;
- 30 km/h residential roads.

The design variants have been so worked out that it is possible to study the effect of the following five road characteristics on the recognition of the road types by the road users:



- surface colour;
- type of central marking;
- type of edge marking;
- alternative pavement marking (narrowing illusion marking);
- roadside posts.

At the same time, the influence of these characteristics on the expectations (road user types, safe speed etc.) of road users of a particular road type will be investigated.

Finally, the design of the experiment is examined more closely.



Ingrid

van Schagen, 40 years old, in 1984 graduated from the Groningen University as a research psychologist. From 1984 till 1994 she worked at the Traffic Research Centre of the Groningen University and was involved in various road safety research projects, in particular in the field of vulnerable road users. Between January 1994 and July 1997 she worked for the Brussels-based European Transport Safety Council (ETSC) as its Research and Information Officer.

Since July 1997, she has been employed by SWOV as a researcher and has been involved in a number of national and international projects. Current activities focus on the relationship between road design and traffic behaviour as well as the development of safety audits in the Netherlands.

Recognition of sustainably safe road types

Selection of potentially relevant characteristics and an examination of the design of the experiment

I. N. L. G. van Schagen (SWOV),
A. Dijkstra (SWOV),
F. M. M. Claessens (TNO-TM) &
dr. W. H. Janssen (TNO-TM).
R 98-57-38 pp. Dfl. 20,-.

Intelligent Speed Adaptation (ISA): a research design for an experiment in the Netherlands

An important part within developments in the field of telematics is the Intelligent Speed Adaptation (ISA). Especially in Sweden, where the policy objective is to have zero fatalities or seriously injured victims on the roads in the year 2020, research has been conducted on ISA during the last 10 years.

Intelligent Speed Adaptation (ISA) can be done in several ways:

- the driver is provided continuously with information about the local speed limits;
- the driver is warned when speeding, by sound or light signals;
- the system reacts automatically to make speeding impossible (through counterpressure of the accelerator or reduction in fuel supply).

The information about local speed limits can be obtained in different ways:

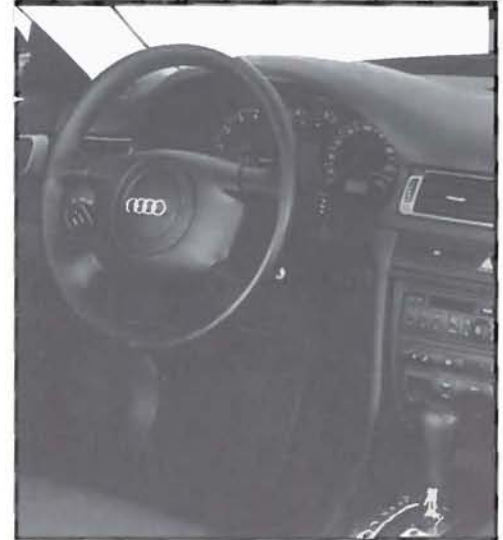
- by manual adjustment of a maximum level by the driver;
- by a signal to the vehicle, from a beacon along the road driven on;
- by an autonomous system in which information about the road network and relevant data about the speed limits is stored in the vehicle, and in which the vehicle is located by a Global Positioning System (GPS). This system can at all times determine the exact location of a vehicle.

With GPS it is known at every moment where the vehicle is, and what the speed limit is. Current data can be transmitted to the vehicle, so that a lower speed limit is installed as soon as, for example, there are poor weather conditions, or road works ahead. In some new cars, especially the more expensive brands, a maximum speed can be manually adjusted. A warning signal is given when this speed is exceeded. Some systems even make exceeding the adjusted speed limit impossible because the fuel supply will then automatically be cut off.

Acceptation by the driver

An important question is the extent to which ISA is accepted by the driver. From Swedish research it is known that after experiencing ISA's obligatory speed reduction, the acceptance is greater than beforehand. When car drivers have the choice between an ISA system and speed control humps (or other infrastructural measures), they choose for ISA. In general, a warning system is preferred above a system that limits the speed.

The acceptance is also greater when the problem situations are recognizable: in residential areas, on roads where fast and slow traffic are not separated, at the approach of complex intersections,



at road works, and during bad weather conditions, etc.

Influence on driver behaviour

ISA can also influence driver behaviour. Some Swedish studies show a reduction of the average speed, a more constant speed, an increase in travel time and an increased alertness towards other road users.

The Dutch experiment

In the Netherlands, a practical experiment with intelligent speed adaptors will be carried out in the borough of Tilburg during the period 1998-2000. The goal of this project is to:

- develop support and a public acceptance of ISA as a speed control instrument via a practical demonstration;
- gain insight in a number of effects of ISA by using a small-scale, pilot, practical application.

Different activities

In the realisation of the project, three types of activities can be distinguished:



P e t e r

Polak, 58 years old, studied Physics at the University of Amsterdam, culminating in a doctorate in 1973. He is a senior researcher employed by SWOV since 1975. His main fields of interest are methodology, mathematical models and data reduction: the representation of complex results by simple concepts.

- developing and testing an operational ISA system, and selecting and equipping a demonstration area;
- developing and executing a communication and PR plan;
- developing and executing a research programme.

SWOV was asked to make the design of the research plan.

Conditions

The following conditions apply to the further elaboration:

- approximately twenty vehicles will be equipped with ISA and will be driven by a varying team during a period of approximately one year;
- the system has been selected and the functional specifications have been established. The most important aspect of the research is the so-called 'hard limits' i.e. that a particular speed cannot be exceeded;
- the experiment will be conducted within a marked area.

The Campenhoef district of the borough of Tilburg has been chosen for this.

At a later stage it was suggested to use a GPS-guided system instead of a beacon-guided system. However, this has not been taken as a starting point for further elaboration.

Assumptions

The possibilities have been looked at of introducing experimental variations for a number of aspects. By this is meant especially: the 'hardness' of the system, the system's intelligence, the recognisability of the ISA vehicle, and the system of speed limits in the Campenhoef district. Although not all choices are to be considered as definite, the elaboration of the research plan assumes the following:

- that the hardness can only be varied slightly (possibility of 'on' and 'off');
- that no, or very little, intelligence will be built in (situation and/or time dependent changes in the border values), and
- that the recognisability of the ISA vehicles will not be encouraged or varied. There are possibilities within

the experimental district of, either varying the speed limits for a number of locations, or distinguishing between 30 km/hour streets with and without (i.e. few) speed bumps.

Research design

The chosen research subject follows the model of a before-during-after study, with three distinguishable experimental groups, plus control-groups. The three experimental groups will consist of:

- participants in the ISA experiment;
- non-participating inhabitants of the experimental district who know about the experiment, for example because they have been exposed to recruitment procedures and such, and
- inhabitants of the surrounding neighbourhoods who know something about the experiment.

In determining the ISA sample there is a possibility of choice between participation by individuals or by families within which more than one person can use the ISA vehicle.

The preference is for the second possibility.

Measurement scheme and experts

The point of departure for setting up the measurement scheme is a coherent system of measurements of the fields of knowledge, outlooks and support with regard to ISA, speed behaviour, and interactions or conflicts with other road users. In addition, for the ISA sample, there will also be observations about the operation and ergonomics of the system; its effects on fuel consumption and emissions as well as specific experiences of use and specific judgements. A number of experts are needed to execute the complete research plan.

Their specialities need to be from:

- technical (functioning of electro-mechanical systems, effects on emission and fuel consumption), through
- ergonomic (man-machine interface), and
- traffic engineering and

- psychological (measurement programmes for speeds and judging road behaviour), to
- socio-psychological/sociological aspects (measuring attitudes and support, and designing questionnaires).

Priorities

The research plan thus designed should be seen as a maximum programme. Some parts can be omitted for practical or budgetary reasons. To arrange the thoughts on this, the following order of priority can be indicated, in terms of those parts which should be carried out first of all, or, in any case, at some time:

- the operation and ergonomics of the system;
- judgement and acceptance by ISA users;
- effects of ISA on speed behaviour (before-and-during);
- effects on groups other than ISA users (neighbourhood, area);
- effects of ISA on speed behaviour (compared with non-participants ISA);
- effects of ISA on interactions and conflicts with other road users;
- comparison with representative control-groups (attitudes, speed behaviour).



B o b

Roszbach graduated in Experimental Psychology at the University of Amsterdam. He is 55 years old and has been working at SWOV since 1970. He worked on a variety of subjects. Nowadays his main concerns are the quality control of research proposals and research reports and intermediate and long term research programming.

When some parts of the programme are omitted for practical or budgetary reasons, the minimum programme should at least give information on the effectiveness of ISA; and it also should tell something about the acceptance of the system. Within such a (maximum) plan it is, in addition, possible to add or link certain parts that can be included to a greater or lesser extent.

Among others these are:

- *the modular calculation of effects of speed on consumption/emission,*
- *explaining attitudes to ISA from underlying attitudes and knowledge,*
- *carrying out after-measurements, and*
- *the possible complexity of the method used (especially concerning speed measurements and interaction).*

Research design, Practical demonstration of Intelligent Speed Adaptation ISA

*Dr. P.H. Polak & R. Roszbach.
R-98-54. 45 pp. Dfl. 122,50.
(In Dutch)*

Intelligent Speed Adaptation ISA

A comparison between Dutch and Swedish systems

*Oei Hway-liem.
R-98-52. 28 pp. Dfl. 17,50.
(In Dutch)*

Rewards and road user *behaviour*

It has been traditional practice in the traffic system for desired behaviour to be stimulated by rules, regulations, and laws, resulting in the punishment of offences. Until recently, modifying road user behaviour by reward has not been given much attention in the practice of road safety. In this thesis it was aimed to get a better understanding of the possible role of reward in influencing road user behaviour. The main questions that were addressed are whether rewards are effective in modifying individual road user behaviour, which types of reward (programmes) are more effective than others, which other conditions or circumstances mediate this effectiveness, and whether reward programmes can be successfully applied on a larger scale.

In the first part of the thesis, the results of a literature review are reported in which attention is paid to the role of rewards in psychological theories and



models of road user behaviour. In addition an inventory is made of what is known - as becomes apparent from evaluation studies - about the effects of rewards on road user behaviour. A variety of reward programmes have been studied in the area of road safety. These programmes can be categorised as either outcome-

oriented or behaviour-oriented. A number of studies have investigated the effect of (material) rewards on the outcome of 'unspecified driving behaviour': accidents versus an accident-free driving record, where it is assumed that the driver is aware what concrete behaviour is required to prevent accidents. Other studies have investigated the effects of rewards on the occurrence of specific discrete behaviours (such as using a safety belt) or their influence on continuous behaviour (speed).

Safety belt use

A review of empirical findings in the area of road safety shows that both outcome-oriented and behaviour-oriented reward programmes can be effective, that such programmes generally appear to be viewed positively by the participants and that these can also be cost-effective from a financial point of view. Of all

road safety applications of behaviour-oriented reward programmes, those directed at discrete behaviours appear to be the most susceptible for finding substantial effects. Therefore, it was decided to first concentrate further research on the effects of rewards on discrete behaviour, and more specifically on the effects of rewards on safety belt use and the factors that mediate the effectiveness.

A number of field studies have been conducted in which the effect of various reward programmes on the use of safety belts was investigated in situations with relatively high baseline levels of belt use. In addition, the effects of 'rewards' as compared to police enforcement were investigated. Furthermore, it was examined - by means of a meta-analysis - how the results of these reward programmes relate to previously reported results, and which characteristics of reward programmes can be determined that mediate the effectiveness of such programmes.

Effectiveness of rewards to stimulate safety belt use

The following general conclusions with regard to the effectiveness of rewards to stimulate safety belt use can be formulated:

- *Rewards are more effective with relatively low baseline levels and in the absence of a mandatory safety belt use as compared to conditions*

with relatively high baseline levels and mandatory safety belt use.

- Rewards can be effective under conditions of mandatory safety belt use with relatively high baseline levels of belt use. Furthermore, this effect is comparable to that of police enforcement.
- Reward programmes are most effective in small scale settings; larger-scale applications are less effective but still show significant increases in safety belt use.
- Reward programmes are especially effective in reaching substantial short-term effects.
- Long-term effects are smaller than short-term effects, but belt use during follow-up measurements after withdrawal of the reward campaigns is generally higher than initial baselines.
- Immediate delivery of rewards is generally more effective than delayed rewards; a combination of both appears to be most effective.
- Both individual and group oriented programmes can be effective. On average, group based rewards show larger effect sizes than individual rewards, and a combination of both seems to be most effective.
- The size (value) of the reward, the probability of the reward, and the duration of the reward campaign are not related to the magnitude of the effect.

Advantages of reward programmes

A number of advantages of reward programmes can be named in comparison to other approaches not involving rewards. For example, whereas it has been shown that information and media campaigns often do not lead to behaviour change, reward programmes have shown to be effective in accomplishing substantial behaviour change, in particular in the short term. Furthermore, reward programmes may be less costly than enforcement programmes, requiring comparatively less manpower and administrative actions when applied

in small-scale environments.

In industry, reward programmes generally have appeared to be cost-effective. Another advantage of rewards as compared to 'punishment' is that reward programmes are often considered as measures that are generally rated favourably among the public. Finally, rewards have the advantage over punishment for those (dangerous) behaviours that are not explicitly described by law or that are difficult to check, and are therefore difficult to enforce. Dangerous overtaking and too close following, for example, are behaviours that are difficult for the police to enforce because the proof is difficult to provide. Because rewards are not part of the complicated judicial system, rewards can possibly help to change such behaviours.

Problem factors

However, some problem factors can be anticipated with regard to how rewards can be structurally integrated in the traditional traffic system. These concern the type of behaviour to be rewarded, the nature and scale of the reward programme, the necessity to systematically and carefully monitor the behaviour concerned, and the organisation and agents that set up the programme and deliver the rewards, respectively.

Because rewards have proven to be effective, it can be argued that it would be 'unethical' not to use them, although some have different views about this. The issue of rewarding road users for desired behaviour has been criticized by those who reason that such behaviour should be considered as part of 'normal' road user behaviour, and should therefore not be rewarded; instead deviations from the normative behaviour should be 'punished'. The objection seems more to how the behaviour is being influenced than to the fact that it can be influenced by rewards. In addition, 'punishment' (police enforcement) is built in into the traffic system, whereas rewards are



M a r j a n

Hagenzieker is 37 years old and graduated in Psychology at Leyden University. Since 1987 she has been working at SWOV and since January 1998 she has a shared job as Head of the Department Behavioural Sciences. She has been mainly involved in research projects on visual perception, the influence of enforcement and rewarding on the behaviour of road users, the safety of bicycles and mopeds, and the relation between road user behaviour and infrastructural aspects. In January 1999 she was awarded her doctorate with her thesis on rewards and road user behaviour.

not. Reward programmes require careful monitoring of the behaviour concerned. Large-scale applications require that reward programmes be implemented in the traffic system, and some organisation or agents should be responsible for the monitoring of behaviour and the delivery of rewards. However, one can be hesitant about government bodies actually rewarding such desired behaviour. These are in fact the same bodies that are supposed to punish breaking the law. One possibility is that private companies or organizations are used to encourage desirable road user behaviour by offering rewards; these could also be the agents that deliver the rewards.

The role of insurance companies

For example, insurance companies could offer incentives for specific (safe) behaviours, such as using a safety belt. However, insurance companies do not appear to be willing to introduce such incentives. Other reward systems that are currently applied in the form of premium discounts that car insurers offer their clients have some

drawbacks. For example, these are often not individual rewards in the sense that the discount is determined on a statistical basis for certain population groups. And when discounts depend on the number of years of accident-free driving, these discounts are usually not progressive with the year-to-year accumulation of an accident-free record, and after a certain period of time a 'forgiveness clause' comes in effect which saves drivers from an increase in their insurance fees if they have an accident. Furthermore, it is possible that the loss of a premium discount as a result of submitting a claim is more likely to be regarded as a punishment than its retention is regarded as a reward by the insurance holder. Seen from this perspective, a more effective form of reward would be to repay part of the premium for accident-free driving in

a certain period; this is indeed found to be effective in the one study available on this subject.

Conclusion

Structural large-scale implementation of reward programmes is not easy but nonetheless worthwhile to study further, because of the substantial effects found in many studies. Although reward programmes have been most successful in small scale settings, both in the area of road safety as well as in other fields of application, some larger-scale applications have also shown significant effects.

Guidelines

There are still many questions as to how to design the 'ideal' reward programme because in evaluations of reward programmes the characteristics of these programmes

have not been systematically varied. In the thesis a list is presented which should be seen as an attempt to provide concrete guidelines which are sometimes based on empirical findings, and sometimes primarily on theoretical considerations. For each guideline it is assessed whether it is mainly based on theoretical considerations or on empirical evidence from evaluation studies. It is also indicated if the guideline is backed up by 'some' or 'strong' empirical support.

Rewards and road user behaviour

An investigation of the effects of reward programs on safety belt use

*Thesis by Marjan P. Hagenzieker.
ISBN: 90-9012343-1. 141 pp. Dfl. 25,-*

Use of seat belts outside built-up areas

increased

In 1968, SWOV initiated the regular implementation of studies into the presence and use of seat belts in the front seats of passenger cars. Over the years, elements have continually been added to this research. In order of appearance, these have been: the presence and use of child restraint systems, the presence and use of seat belts in the back seats of passenger cars, the adjustment of head rests for drivers and passengers of passenger cars, and the presence and use of seat belts in delivery vans. With all of these supplements, the research produced a fairly complete picture in regard to the presence and use of the most commonly available types of safety devices. All investigations were conducted under the authority of the Dutch Ministry of Transport.

In the autumn of 1997, a national campaign was launched with the purpose of stimulating the use of seat belts. The study being presented here, conducted during the spring of 1998, was intended to serve as an evaluation study for this campaign. The report describes the developments between 1997 and the beginning of 1998, of the actual and intended behaviour in regard to the previously mentioned safety devices.

Methods

The data for the study into actual behaviour was gathered as based on observations made at intersections with traffic lights. The data for the study into intended behaviour was gathered by means of a written survey that was held among a percentage of the motorists and passengers being observed. The most important results of the study revealed that since 1997:



Jan

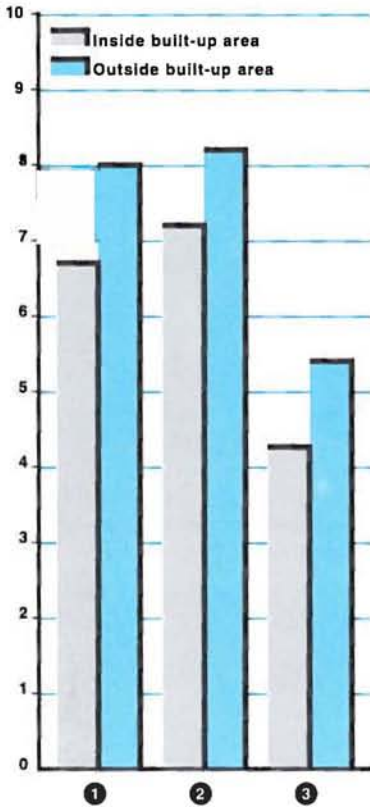
Mulder is 59 years old and is originally an aeronautical engineer. After he graduated he worked at a research and development department in the (aircraft) industry. As from 1969 he is researcher at SWOV, commissioned with drink driving, breath analyzing, speed behaviour, relations between road safety and policy.

- the percentage of drivers and front-seat passengers in passenger cars wearing seat belts within urban areas has stabilised;

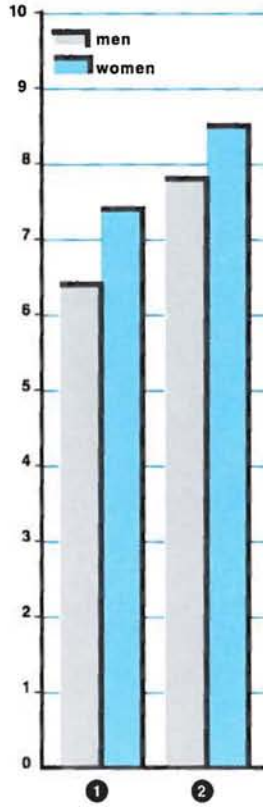
- the percentage of drivers and front-seat passengers in passenger cars wearing seat belts outside of urban areas has increased;

- the use of seat belts by occupants of delivery vans has increased
 - the use of seat belts by back-seat passengers has increased;
 - there has been no change in adjustments made to head rests.

Percentage of seat belt wearing



- 1 Drivers passenger car
- 2 Front seat passenger
- 3 Drivers of vans



- 1 Inside built-up area
- 2 Outside built-up area

The study also shows that, even though seat belts are usually present in delivery vans, they are used much less frequently in these vehicles than in passenger cars. This applies to both drivers and passengers. And about half of the children being transported in the back seat of a passenger car are being provided with a safety device. The very young are generally better safeguarded. The same applies to children being transported in the front seat. Once again, a combination of an information campaign and a policy of enforcement is being recommended to convince the public that the use of the seat belt and the adjustment of the head rest enhances their personal safety.



Use of safety devices in 1998

Seat belts and head rests in passenger cars and seat belts in vans

J.A.G. Mulder.
 R 98-44. 144 pp. Dfl. 45,-
 (in Dutch)

Searching for quantitative relations between road design and road safety

In various countries it is standard practice to quantify the relationship between geometric, engineering elements in road design and the chance of accidents occurring. Given this relationship, road designers are trying to optimize their design. In the United States, this approach has been summarized in the Interactive Highway Safety Design Model (IHSDM) under the motto 'designing highways with safety in mind'. Within Europe, this approach has been greatly developed in Germany, Sweden, Portugal, and the United Kingdom.

This approach to road designing would seem to be relevant in developing a sustainably safe traffic system. To see if this is so, an exploratory literature study of the relevant foreign research has been carried out.



The research questions were:

- Which knowledge is there (abroad) concerning the quantifying of the relationship between geometric design elements and the chance of accidents occurring?
- How is this knowledge applied when designing a road?
- Can this knowledge and its applications be used when designing a sustainably safe road system?

Structure

The study is structured according to the usual arrangement for guidelines in road design. These are: alignment (tangents, curves, and relation design), cross-section, and intersections (including roundabouts). Special attention has been paid to the size of the sample, (external) factors that could disturb the results, and the robustness of any statistical relationships found. A lot of use has consciously been made of those studies that have been peer-reviewed, to ensure their quality. A number of accident models developed in the



A t z e

Dijkstra is 44 years old. He graduated in Civil Engineering at the Delft University of Technology. As from 1983 he was researcher at SWOV, commissioned with mainly infrastructural projects. From 1992 till 1996 he worked as a researcher at the OTB Research Institute for Housing, Urban and Mobility Studies of the Delft University of Technology. Since 1996 he works for SWOV again as a project manager and he is working on the following subjects: bicycle facilities, sustainably safe traffic and transport system, roads in rural areas, main roads in urban areas, and traffic calming.

United States appear to be about to be used in IHSDM. Here, the experience gained in the 1980s is being applied. This knowledge concerns mainly rural, single carriageway roads. This knowledge was already available to American designers in generally accessible publications.

This knowledge, however, was not yet integrated in the existing guidelines. Models for junctions are available in some European countries.

Their application in design guidelines, or road design, has not yet advanced very far. The geometric design of sustainably safe roads would benefit from being able to quantify the expected safety effects of various alternative types of layout. Safety and accident models assist for this, as do overviews of reported effects. Existing foreign models should be adapted to the circumstances in the Netherlands. Practical application can only be successful if the model details fit the design variations at hand.



Orientation of quantitative relations between elements of road design and indicators of road safety

A literature study of foreign research

*A. Dijkstra.
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