CP - 75 - 1

INTERNATIONAL INSTITUTE FOR IIASA APPLIED SYSTEMS ANALYSIS

CONFERENCE PROCEEDINGS

PROCEEDINGS
OF
IIASA WORKSHOP
ON
ROAD TRAFFIC SAFETY IN EUROPE

January 24, 1975

SCHLOSS LAXENBURG
2361 Laxenburg
AUSTRIA

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Applied Systems Analysis

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The views expressed are those of the contributors and not necessarily those of the Institute.

The Institute assumes full responsibility for minor editorial changes made in grammar, syntax, or wording, and trusts that these modifications have not abused the sense of the writers' ideas.

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Preface

Road traffic safety represents one of the most perplexing dilemmas for modern man. On the one hand, the invention of the automobile has undoubtedly contributed to the exponential growth of civilization achieved in this century. On the other hand, this invention had introduced massive undesirable side effects, among the most notable of which are noise and air pollution. From the public health viewpoint, road traffic accidents are among the leading causes of deaths in advanced countries, in addition to causing vast amounts of disability.

Recognizing these problems, the European Regional Office of the World Health Organization sought to initiate a research effort aimed at ameliorating some of them. The Austrian Government, noting the high rate of road accidents in Austria, was also keenly interested. It was thus agreed that the IIASA Bio-Medical Project and the Austrian Kuratorium für Verkehrssicherheit would carry out such a study in cooperation with WHO. This workshop was organized in order to discuss the overall traffic safety efforts currently underway in Europe and to point out some open areas of research in which the system-analytic approach may be useful. It is anticipated that this will be the first step in a long-term research effort, possibly funded by WHO.

A. Afifi

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Agenda

Workshop on Road Traffic Safety in Europe

January 24, 1975

IIASA Conference Room

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Introductory Remarks by the Institute Director

H. Raiffa

Prof. H. Raiffa gave a general introduction to IIASA, and its history and goals. He mentioned the fact that this was one of the first workshops to be held in the new Wodak Conference Center, making use of the simultaneous translation equipment.

Prof. Raiffa spoke about IIASA's aim to bring together scientists from different disciplines, cultures, and ideologies to work together on problems of significance to mankind and to establish a network of research instruments with coordinated research orientation. By being a catalyst, disseminator, and critic of research ideas on systems analysis, IIASA hopes to raise the sophistication level of both technical and policy analysts and to bridge the gap between the analyst and the practitioner.

Prof. Raiffa then described IIASA's research program. He stressed the importance of the work being done in close collaboration with other institutions, like those in the UN family such as WHO, IAEA in Vienna, UNEP in Nairobi, UNIDO, and, of course, the IIASA national member organizations. For IIASA to fulfill its mission as an exchange agency to keep the scientific community informed, he explained that the Institute convenes conferences and workshops such as the present one.

Prof. Raiffa next commented on the background of this particular workshop. Mr. Bauhofer of the European Office of WHO first mentioned the idea of IIASA's having a workshop on road traffic safety as an area to which systems analysis might be able to contribute. The idea was then subsequently discussed in a meeting held with Messrs. Raiffa, Bauhofer, Venediktov, and Andréasson. The impetus for this workshop was furthered by the excellent cooperation obtained from many Austrian bodies, including the Ministry of Health, represented at the workshop by Drs. Ventruba and Velimirovic the statistical authority represented by Mr. Auer, and the Kuratorium für Verkehrssicherheit, represented by Dr. Knoflacher.

Prof. Raiffa stressed the fact that this was a preliminary workshop to ventilate ideas. It was not to be an end

project but the beginning of more work to come. He felt that this study was particularly appropriate to IIASA since it involves several of the Institute's projects in the areas of road traffic safety as a prototype problem in safety engineering, and in both preventive and curative medicine.

Prof. Raiffa closed his remarks by noting some people involved in the Bio-Medical Project. Prof. Venediktov, Deputy Minister of Health of the USSR, is the Bio-Medical Project Leader. Dr. Kiselev will shortly join the project as deputy project leader. The Bio-Medical Project also has several distinguished advisors, including Dr. Rapoport from the GDR, Dr. Bailey of WHO in Geneva, and Howard Hiatt, Dean of the School of Public Health at Harvard University.

Overview of Traffic Safety Efforts in Europe

R. Andréasson

Mr. Andréasson presented an overview of the current traffic safety efforts in Europe. He began by stating that problems caused by road traffic and accidents and their prevention have a long history. In ancient Rome, for example, horse driven wagons were forbidden during the night hours because of the noise they made on the cobble-stone roads. In those days, too, there were parking restrictions and rules for regulating traffic. He went on to show some slides illustrating traffic hazards, the first of which dated from almost 500 years before.

Today, Andréasson mentioned, anti-automobile campaigns were underway almost everywhere in the industrialized world. "Get rid of the cars--give us mass transportation systems" is the slogan. He felt, however, that for the time being there was no real practical alternative to the car. The hundreds of millions of automobiles now on the roads can still be used for many years to come; those cars being planned today by designers and engineers will be in production in four to five years, and their lifetime will be at least ten to fifteen years.

His conclusion was that even if all further production of cars as well as the use of automobiles were to be halted now, the results would be chaos, not only in the transport system but in the economy as well. A program for changing the transportation system must be very carefully planned and alternatives to the automobile set into production in due time. He said that it took one generation to move from the horse to the motor age and so it is realistic to count another generation for changing to a new transportation system on the roads.

In today's motor age the pattern of road traffic accidents has changed, and the high number of victims of such accidents is shocking. Throughout the world, at least a quarter of a million people are killed and about eight million injured annually. Europe's contribution toward this total was about 45 percent.

Mr. Andréasson brought up the fact, however, that during 1974 there had been a reduction in injuries and fatalities due to the gasoline shortage, speed limitations,

use of seat belts, better control of drunken drivers, etc. Many factors had influenced the situation, but there was no doubt that the oil crisis, together with the resultant lower speed limits, had had the greatest influence upon the situation. He felt it may be appropriate to thank the oil-producing countries for the 5,000 lives saved in Europe and the 9,000 saved in the USA in 1974.

Although all the figures were not yet available, some countries had reported preliminary statistics for the past year:

France

accidents - 10,431 fewer than in 1973;
injuries - 21,931 fewer than in 1973;
fatalities - 2,119 fewer than in 1973--a drop of 13.6%.

If the figures for 1974 were compared with those for 1972--the worst year in French traffic history--there were:

accidents - 14,289 fewer;
injuries - 35,337 fewer;
fatalities - 3,100 fewer.

Switzerland (January to June only)

accidents - 31,800 (2,900 fewer than in 1973);
injuries - 14,650 (700 fewer than in 1973);
fatalities - 564 (67 fewer than in 1973).

Belgium (January to November)

accidents - 4,100;
injuries - 2,450;
fatalities - 675.

Federal Republic of Germany

accidents - 120,000;
injuries - 52,000;
fatalities - 2,000.

Austria

injuries - 4% less than in 1973;
fatalities - 10% less than in 1973.

Mr. Andréasson discussed the classical factors causing accidents: the driver, the vehicle, and the road, or better, a driver-vehicle-environment system, each of the factors interacting upon one another. He said he was becoming more and more convinced that the man behind the wheel could no longer meet all the demands pressed upon him by modern traffic and showed a slide illustrating the overabundance of information often presented by too many traffic signs.

Not only are planning and rules necessary to support safe traffic, but also enforcement is an important task. He mentioned speed limits as one great contributor to the drop in the number of traffic fatalities and injuries in 1974. For example, in Switzerland, there had been a drop of 16 percent in fatalities and 8 percent in accidents on roads upon which speed limits had been introduced, in comparison to previous years without such limits. In Austria, the drop in the accident rate during 1974 was highest on roads where speed limits had been put into force during that year. There were thousands of examples of how better roads, lighting, better design of intersections, enforcement, etc. had improved traffic safety. Such improvements usually had a preventative effect he said.

In the crash phase of an accident, car occupants should be protected from receiving severe injuries. However, Andréasson pointed out that there are many weak points in vehicles. These have been discovered by reconstructing accidents and by forensic medicine in collaboration with technicians. The results of such studies have been discussed with car designers and others responsible for the safe automobile design and equipment. Studies of this kind are being carried out in most countries in the industrialized world.

Andréasson then showed some examples of reconstructions of fatal accidents done at the Forensic Medicine Institute of the University of Lund in Sweden. In none of these cases had seat belts been worn. The reconstructions showed that in almost every case the lives would have been saved if three-point seat belts had been used properly.

Based on accident statistics, it has been estimated that if 50 percent more of the occupants of automobiles had worn seat belts, the number of fatalities would have been reduced by 20 percent, and with 100 percent more users, by 64 percent. The number of injuries would have dropped by 8 percent had 50 percent more people used seat belts and by 29 percent if 100 percent more had been seat belt users.

Such information and knowledge of how seat belts can save lives and make injuries less severe has led to laws which make it mandatory for drivers and passengers in the front seats of cars to wear seat belts. Such a law already

exists in Australia, Puerto Rico, Czechoslovakia and France, and it was put into force in Sweden on January 1 of this year. In Austria, such a law could be expected sometime during 1975. Many other countries were preparing mandatory seat belt laws, as recommended by expert groups such as the ECE of the United Nations and WHO.

Mr. Andréasson emphasized also the importance of driver fitness for safety. He stressed the importance of every driver knowing his physical and mental status, since only in this way could he compensate for his handicaps. A typical example was that of diabetics as reported by Herner and Ysander: these drivers had a lower frequency of accidents after the commencement of the disease than before it. Studies have shown that drivers with other handicaps had better or at least not worse accident records than nondisabled drivers because they were aware of their handicaps and compensated for them; they were found to be more careful and therefore drove only when fit. Another study has shown that amputee drivers were as safe as those in the general class.

Andréasson felt that a medical examination for driving license candidates was an important part of the traffic safety program, because it makes possible selection among potential drivers. It is also of great importance that physicians warn their patients when their driving ability is impaired. The drivers also have the right to be informed by their doctors on the impairment, e.g. which prescribed medicines might bring it about, especially in interaction with alcohol. This information should also be printed on medicine packages, as recommended by the Council of Europe.

The medical role in preventing accidents also concerned the elderly. With increasing age, reaction time becomes longer, hearing and vision become impaired, etc. It is important that the doctor inform the elderly about their handicaps, not to prevent them from driving, but to advise them about how to compensate for this deterioration in driving ability.

Andréasson stressed that the medical condition not only included chronic conditions, but also acute conditions such as fatigue, impairment by alcohol and drugs, acute illness, etc. However, doctors could not be responsible for all of this information. Most of it should be taught in traffic safety educational programs, and this should start at a preschool age and continue at the various levels in the public school, ending with driving instruction. Driving instruction in Europe is offered by privately-operated driving schools. In the USA this is a task for the secondary schools, although there are also private driving schools.

After having worked on the subject of driving instruction for many years--in close collaboration with Dr. Munsch in Munich--Mr. Andréasson has been convinced that such training is necessary and that it must be offered systematically. He felt it should be mandatory to take an approved and government-controlled course before passing the theoretical and practical test for a driving license. This demands that controlled driving schools be available for training, and this is the case in only a few of the European countries. The best situations now exist in Austria, Sweden, and, to some extent, in the FRG.

However, he mentioned that inflation has put the prices for the lessons so high that there has been a great drop in the number of students at these schools. For economic reasons, potential drivers prefer to be educated privately. Since there was almost no control of such private training, the accident risk rose because the instructor was not trained for his task. Passing the test for a license was no guarantee that the examinee was a good driver. His motivation, however, is important for safe driving, as is his knowledge of how to handle the car in critical situations. Both must be taught professionally. Since it is necessary to develop controlled, well-taught courses in order to create less risky drivers in the future, Andréasson felt it must be the responsibility of the governments to take a major part in implementing this development.

He then described the organizations for traffic safety in Europe, they are:

Intergovernmental organizations in Europe	Nongovernmental organizations in official relationship to the UN and WHO
Economic Commission for Europe of The United Nations (ECE)	International Association for Accident and Traffic Medicine (IAATM)
World Health Organization (WHO) Headquarters Regional Office for Europe	League of Red Cross Societies (LRCS)
	Prevention Routiere Internationale (PRI)
Organisation for Economic Cooperation and Development (OECD)	World Touring and Automobile Organization (OTA)
Council of Europe	International Federation of Pedestrians (IFP)

European Conference of Ministers of Transport (CEMT)

International Labour Organisation (ILO)

International Organization for Standardization (ISO)

European Economic Community (EEC)

International Road Transport Union (IRU)

International Council on Alcohol and Addictions (ICAA).

In conclusion, Mr. Andréasson expressed his gratitude to IIASA for its interest in traffic safety, saying he was most impressed by the scientists he had met during the week. Without having the burden of years of experience in traffic safety work upon them, they had looked at the problems with open eyes and fresh minds. He expressed the hope that the proceedings from this symposium and the ensuing report to the WHO Regional Office for Europe would make a contribution to more effective measures for traffic safety in Europe through suggested research programs.

Mr. Afifi then asked Mr. Andréasson to describe the different modes of organizations for traffic safety within the various countries.

Mr. Andréasson answered that they were about the same in all countries. Sweden was special because it had had left-hand traffic until 1967 and then had changed to right-hand traffic. There was an immediate drop in the number of accidents. The public had had to be motivated during the two years before the change. It had been possible to find liaisons between the voluntary organizations and authorities and a special commission for right-hand traffic had been founded with all organizations collaborating. The decisions were made by governmental authorities, but all voluntary organizations were used as long arms for reaching people around the country.

After the change the road safety office had been founded. It consisted of two parts--a planning committee where the authorities dealing with road safety problems were represented and an advising committee with members from voluntary organizations. This plan exists in many European countries. The voluntary organizations worked because when they carried out a program it would be better understood and received by the public than if the authorities had done the same. Therefore, it is important that the governments and authorities support and use the voluntary bodies. In

most countries there is a special voluntary national board for traffic safety. Here all the organizations of motor clubs, organizations for children's welfare, etc. can collaborate. These activities should be harmonized and backed up by a national road-safety office sponsored by the government.

Note: Following are abstracts of six presentations. The presentations of Bigelow, Glass, Majone, and Thompson will be published as IIASA Research Memoranda.

Abstract

Comments on Systems Analysis Applied to Road Safety

J. H. Bigelow

Whenever a traffic accident occurs, there are present a driver and a vehicle in an environment. Thus people dealing with road safety have usually tried to analyze the problem in terms of these factors. This paper points out a fallacy of the usual approach.

Any policy analysis is best approached in terms of the factors policy, nature, and impacts. Nature includes those factors that are not under the policy makers' control, e.g. stochastic factors such as the weather. Impacts are all the consequences by which the effectiveness and efficiency of the policy are to be judged. Impacts include both the desirable outcomes and possible undesirable side effects. Thus traffic accidents represent only one impact. Others are mobility and independence.

It is pointed out that policy can reasonably be classified into measures affecting the driver, the vehicle, and the environment, plus measures that are directed at the pedestrian. However, this same classification fails completely when applied to impacts, and even when applied only to the one impact, viz, traffic accidents. A more reasonable approach to the classification of accidents, based upon an accident's relation to one or more traffic streams, is outlined in the paper.

Abstract

Externalities of the Traffic System

P. Fleissner

Traffic accidents are not the only external effect of the traffic system. An Austrian study of Doz. Loetsch and Mag. Schoenback (as part of a larger project on "long-term systems analysis of Austrian Health Care") analyzes other effects in detail:

- emissions (lead, CO, NO_x, carcinogenic substances);
- noise;
- driver's stress leading to cardiovascular diseases;
- reduction of flora and fauna;
- increasing land use for the traffic subsystem.

They compare different kinds of existing types of transport with respect to their energy consumption, air pollution, noise generation, accident pattern, and necessary space per vehicle at different speeds.

The study has two guidelines:

1) lowering the density, and
2) lowering pollution.

They end up with comprehensive measures to make mass transportation more attractive for the first guideline, and with the recommendation to adapt the internal combustion engine for liquid gas, in the short run, for the second guideline.

Abstract

Cost-Benefit Analysis and Road Traffic Accidents

N. J. Glass

Cost-benefit analysis is a tool for examining choices among public policy or expenditure projects. The paper outlines some of the typical problems in cost-benefit analyses and shows how similar problems arise with respect to proposals to reduce road traffic accidents.

Among the problems listed are:

1) definition of the project;
2) tracing all the relevant effects;
3) valuation of intangibles;
4) discounting and uncertainty;
5) distribution of benefits.

Among the valuation problems explicitly considered are those of the valuation of life and of travel time. A number of different approaches to each are outlined.

The paper also addresses itself to some problems of insurance in relation to traffic accidents and finishes by comparing road traffic accident prevention programmes with conventional public health programmes.

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Abstract

Assessment of Control Measures for Traffic Safety

G. Majone

Any methodology for the evaluation of the results of social policies (or rather, of policy changes since, strictly speaking, we are never in a situation of "no policy") must recognize the fact that for many public programs, including traffic control measures, the possibility of experimentation is severely limited by legal, ethical, political, and sometimes even technical, constraints which cannot be easily overcome. I am referring, of course, to experimentation in the scientifically-accepted sense of the word, where an experimental and a control group are set up, with the control group as similar as possible to the experimental group (the equivalence being usually assured by randomization), except that the control group does not receive the same experimental treatment. Even when experimentation is possible, the scale factors involved in extending the policy to the entire target group may seriously invalidate conclusions derived from experience with a limited sample.

In nonexperimental situations, a strictly behavioristic ("black box") approach to evaluation breaks down, and we must rely on a more subtle blend of theoretical analysis and rather crude assessment procedures. This can be accomplished in two different, but closely related, ways: 1) by using weaker forms of statistical design and analysis, while trying to compensate this weakness through more imaginative data analysis and the use of a multiplicity of indicators of outcome; and 2) by carefully analyzing the logical models and empirical assumptions embodied in the policy under consideration. In this paper I shall give a few examples of both methods, giving particular emphasis to their mutually reinforcing character.

Consider a change in traffic policy such as the new speed limits introduced in Austria in November, 1973, or the Connecticut crackdown on speeding of 1955. A commonly used procedure to assess "the results of such measures" consists in comparing the value of some indicator, e.g. the number of accidents per vehicle-kilometer, in the period immediately preceding the change, with the value of the same indicator at some later moment. It is easy to see that a conclusion based on this simple before-after comparison, when

so many experimental conditions may be changing, can be vitiated by a number of logical and statistical fallacies. Some of these may be revealed by careful analysis of a longer segment of the relevant time series; note, in particular, that a policy change is often introduced after an extreme value has occurred in the series, say at time T_{i-1}. This very fact introduces a source of error known as the regression artifact. Because of the statistical nature of the phenomenon under observation (traffic accidents), the observed values will fluctuate randomly around some trend line. Whenever an extreme value occurs, there is a tendency for the following observations to "regress" toward more normal values, i.e. to move closer to the trend line. This descriptive statement can be justified, under suitable hypotheses, on the basis of the ergodic theorem. Thus, a statistically significant reduction in accident rates between T_{i-1} and T_i may be due to a regression artifact, rather than to the policy change. Other "artifacts" are often introduced by the methods used to implement the change, by modifications in reporting practices and in legal procedures, not to mention sudden new developments in social and economic conditions. Such concomitant factors can be controlled, to some extent, by considering other indicators in addition to accident rates, for instance, speeding violations, as a percentage of all traffic violations, and suspension of licenses for speeding, as a percentage of all suspensions.

But it is clear that even the best analysis of output measures cannot, by itself, conclusively establish the effectiveness of a policy change. What is observed is strongly influenced by the conceptual model used, and prior opinions cannot be significantly modified by ambiguous evidence. Thus, data analysis must be complemented by theoretical (and, in a sense, a priori) considerations. For instance: a control measure can be too strong as well as too weak, and its timing is also very important. Several questions arise. Are there general criteria by which we can judge whether the policy change has been introduced at the right time, and set at the right level? Since it is impossible to reduce the number of traffic accidents to zero, how do we define an optimal, or at least an acceptable, level of risk? What are the intrinsic limitations of different methods of regulation? (I have in mind some rough upper bound, of the type suggested by Ashby's "law of requisite variety.") What are reasonable assumptions about drivers' reactions to the system of incentives and disincentives created by the policy? How do we know that the decision variables used are relevant? (For instance, the available evidence on the significance of speed limits is rather ambiguous.) Would we interpret the data differently if we assumed a different conceptual model of the process under consideration?

Space does not permit detailed applications of the kind of analysis suggested here; but I hope that enough has been said to demonstrate the need for a more thorough blend of empirical and theoretical arguments in the evaluation of traffic policies.

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Abstract

Some Notes on Physiological Impairments in Relation to Traffic Safety

J. Page

A 1963 study compared accident rates per person suffered by a group of physically impaired drivers with a similar group of non-disabled: the disabled drivers had a lower accident rate than the control group, but little can be inferred from this as no information was given on the relative exposure of the two groups to driving.

Visual impairment is probably the most important physiological handicap to be studied since at least 90 percent of all useful information in driving is gained through the visual sense. Incidence of visual malfunction is high (as much as 50 percent of the population in, for example, the USA), with 3 percent of the US population being visually impaired to the extent of having trouble seeing even with corrective lenses. 0.9 percent are severely visually impaired, i.e. have restricted mobility or are unable to undertake vision-related tasks without special apparatus. Defective vision is closely correlated with age: 75 percent of the visually impaired are in the over forty-five age group, and about 20 percent are in young adult age groups. However, in a study of 2,000 drivers in California who volunteered to have visual acuity measurements carried out, no correlation was found between visual acuity and accidents or bad driving records. From studies of low vision patients, i.e. the severely visually impaired, only a very approximate connection has been found between visual acuity and visual ability. It may be that at the higher end of the visual acuity scale, the same indefinite relationship applies.

It seems essential to define, for regulatory purposes, what are the functional visual requirements for driving. Adequate central vision is necessary to provide basic information including distance judgment (not necessarily binocular): the central field should be uniform in response, and while acute central vision defects will normally place subjects in the visually impaired group and therefore will be picked up by routine examination, less acute cases may not be. A particularly important central field problem is light/dark adaptation, affecting driving ability at night or in conditions of bad visibility. This is known to be age-dependent, but

measurements of this kind are not normally made for driving tests.

The importance of peripheral vision in driving has been established in eye movement research in an actual driving environment. Unconscious movements of the eyes, without fixation, provide much detail on what is happening at the edge of the driver's visual field and in fact constitute his early warning system. Reduction of such movements are an early effect of fatigue and alcohol. Visual field measurements are, however, not normally carried out in driving examinations. Indeed, two states in the USA (Massachusetts and California) permit visually impaired drivers to use head-worn binocular telescopes, which have the effect of field restriction. For known visual defects, such as field restrictions, it seems clear that individuals can adapt and studies of this process in low-vision patients have been reported.

With regard to present visual standards for driving, either for the initial grant of a license or for its renewal, practice seems very diverse, ranging from complete binocular and monocular tests of visual acuity by chart reading, to reading a car number plate at an approximate distance under whatever ambient light conditions exist at the time of the driving test. Renewal of licenses may be subject to ophthalmic testing or may merely require the applicant's signature stating that he has no severe visual malfunction. In many cases, neither the applicant nor his doctor are bound to report deterioration of vision during the currency of a license. Visual acuity standards are very often quite low (for example, 20/70 in some states in the USA).

It is suggested that more effort be devoted to the problem of defining visual standards, which might be based on information derived from a study of low-vision research, on adaptation and on age dependence of the various conditions. The possibility of constructing simple tests which give a better measurement of <u>functional</u> visual driving ability than visual acuity should also be investigated.

Abstract

Road Safety Research in the Perspective of Policy Analysis

M. Thompson

The distinguishing characteristic of policy analysis to its practitioners is a commitment to improve the actions and operations of governments. In line with this, the vast and ill-defined area of scientific inquiry known as safety research should be examined to see how it may be better directed and managed to reduce the harm and injury incurred daily in road traffic accidents. A preliminary study in this vein reveals a large number of complicating factors which must be catered to or planned around before actual benefits on the highways are realized. These include:

1) pitfalls of analysis--the rarity of accidents, differing amounts of accident exposure across drivers, and problems of driver self-selection have led to much statistically defective reasoning in policy forums;

2) problems of laboratory simulation--the Hawthorne effect, the careful isolation of individual accident factors, and the basic pathological nature of accidents may yield results in laboratory simulations that are not representative of the road;

3) neglect of social goals other than that of safety--for instance, speed or reduction in the need for travel;

4) problems of equity and externality--for instance, the danger posed to others by the heavy armor of the experimental safety vehicle; and

5) lack of effective policy handles--since individuals frequently flout or ingore the ordinances and exhortations applied by governments to achieve safer road behavior.

Overview of Research Conducted by The Kuratorium für Verkehrssicherheit

H. Knoflacher

The Kuratorium für Verkehrssicherheit was established in Vienna in 1959. It has two groups of sponsors, automobile associations and insurance companies. In Austria there are two automobile associations, the ARBOE and the OEAMTC. The insurance companies, the second financing group, have thirty-two members contributing funds to the Kuratorium.

The Kuratorium für Verkehrssicherheit has an executive board of twelve members and an executive committee that oversees a director. Subordinate to this director, though not in professional matters, are the individual scientific institutes and departments of the Kuratorium. These are the department for public relations and editorial work, the Institute of Traffic Psychology, the library and Electronic Data Processing department, the Department of Traffic Engineering, the Department of Traffic Education, and the accounting department. Then there are individual staff departments affiliated with the Kuratorium and the driver training department.

In the professional fields, perfection and/or refresher courses are offered by the driver training department. A series of special activities exists, for example, the so-called "Caution and Courtesy Campaign," a public relations activity aimed at informing truck drivers and positively influencing them with regard to safe driving. In the first years following the establishment of the Kuratorium there was close collaboration with the technical services divisions of the automobile associations. The inspection stations of these associations were mainly supported by the Kuratorium.

Traffic education is concentrated at the secondary school level, and special courses are organized for teachers at Haus Rief in Salzburg. Until recently, this teacher training was exclusively organized by the Kuratorium in collaboration with the Austrian Ministry of Education. The Kuratorium constantly prepares and updates material for traffic education purposes. To date there is no legal basis for traffic education in Austrian schools, but the Kuratorium is trying to alter this. At its initiative, a pilot teaching program for school children was introduced, and it has been successful in Austria, though it is not legally established. Research work in this area formed the basis for a series of proposed laws aimed at securing

and improving traffic education in the schools. Preschool education is being considered, but there is uncertainty as to what age it should begin.

With regard to Traffic Engineering, the Kuratorium department to which I belong, there are two major working fields: research and application. Research can be divided into in-house research, performed and financed by the Kuratorium, and commissioned research, financed either by ministries or private firms and associations. Application of traffic engineering includes areas in which we ourselves become active because we know where the danger points are. Our knowledge here has been continuously improved since we have been successful, with the cooperation of the Statistical Office, in improvising and in carefully sorting out the data available to us, and in using scientific methods to locate accident prone points.

Our experts in traffic engineering also publish technical books as guides for administration. A brochure called "Technical Information Service" is published periodically by the Kuratorium and it includes a short survey of the scientific activities and national and international activities in the field of traffic safety. The influence upon traffic safety is brought about directly and indirectly and, in some difficult cases, we do not hesitate to approach the press for its help. The results of the technical research serve as guidelines which are passed from the Kuratorium and its research institutions to the ministries. The ministries often take corrective actions based on our recommendations. Technical and scientific publications resulting from our research appear in the traffic engineering journals.

The Traffic Psychology Department deals mainly with aptitude tests. In Austria, such psychological suitability tests are given to candidates for licenses for certain categories of vehicles. Also drivers whose licenses had been revoked because they have caused a traffic accident under the influence of alcohol must undergo aptitude testing. In addition, some professional driver groups such as those of the City of Vienna, including bus drivers, are tested by us. The Traffic Psychology Department also carries out some research on medication under commission from the pharmaceutical industry.

Press work is another aspect of the activities of the Kuratorium. We keep the public informed through automobile magazines, on our own and on international activity in the area of traffic safety. The Kuratorium's library is the official Austrian representative for international documentation.

Next, I would like to briefly report on two research projects being carried out in Traffic Engineering and which

fall under the heading of epidemiology of traffic accidents: the effects of the use of studded automobile tires on roads, and the use of major highways as access roads to private residences. Having filtered down to Austria from the northern countries of Europe, the use of studded tires has increased in Austria since their introduction in 1962. Use varies from 20 percent to 40 percent of cars on the road depending on the province. In Vienna, the share of studded tires in use is approximately 20 percent, while the share in Tirol is about 40 percent. This percentage does not always hold true due to the large share of tourist-driven vehicles, particularly from the BRD, where the share of studded tires sometimes increases to 65 percent.

The use of these tires here has spread like a virus, to give it a negative evaluation. In the beginning, their advantages were praised by the press, but after a certain time their disadvantages become evident as well. In spite of eight to ten years of usage, we have not been able to assess what is the true reduction rate in accidents under winter driving conditions attributable to the use of studded tires, if any. To this end, scientific research was started by the Kuratorium, and after one year of preparation funds from the Ministry for Construction and Technology were secured.

Our study shows that in one season four to five millimeters of surface are worn off roads driven over with studded tires, and therefore the road construction elements, e.g. the street environment, are influenced significantly by the use of these tires. Since this erosion can become one to two cm deep in only a few years, water remains on the traffic lanes creating a hazard. This is one of the negative aspects which only concerns material destruction. Accident analyses involving studded tires, apart from some rather general arguments, are not available from abroad. We do know, however, that in one province of Canada studded tires had been banned because of the above negative consequence.

Our studies were both of a statistical and engineering nature. We analyzed the behavior of drivers with and without studded tires as to their choice of speed. Drivers with studded tires drove faster on icy roads because they had been told that a studded tire is an important element of safety on such roads. On the other hand, studded tire drivers drove slower in the high speed zones when the road was dry, indeed so slow that a speed limit of 100 km/hour would have been pointless. It was also shown that the accident rate of studded tire vehicles on icy roads was just as high as that of nonstudded tire vehicles. On the other hand, the accident rate of studded tire vehicles on dry roads was lower than expected if we take the total mileage driven into account. However, the severity of these dry-road accidents was twice as high as normal. Thus, if we

combine the 30 percent reduction in traffic accidents caused by the use of studded tires with the increase of severity of these accidents, we find that studded tires are by no means as safe as claimed.

This presents only the effect of studded tires during winter time. When we analyze accident figures on wet roads and eroded roads, we can see further negative influence on traffic. The actual rate of traffic accidents on wet roads increased by 30 percent during the era of studded tires. Finally, there are other negative influences which have not been proved within the framework of this study. The mere increased number of road-repair sites naturally causes more accidents. This is an example of the studies carried out in recent years.

The development of road erosion took twelve to thirteen years, and this shows the long-term effects of studded tire use. Road surfaces in Austria today are much denser than earlier, and therefore by far more dangerous in terms of skidding, as was shown by another survey. The old roads had more airpockets, but now more binding agents, e.g. Bitumen, are added in order to improve friction to some extent. Because of this, road surfaces are now oilier and slipperier. Even if studded tires are banned now, for the next twenty years we will have to put up with less friction on some roads. These findings will probably find practical application in Austria, Germany, and Switzerland in the banning of studded tires.

Referring to the presentations of this morning, I shall now present an example which points out, on the one hand, how wrong the interpretation of accident statistics can be, and, on the other hand, how difficult it is to teach drivers to prevent accidents. On the average, it takes approximately thirty years of normal driving to get involved in an accident where people are injured. Therefore many theoretical models based on such rare events have to be put into question. Here, near Laxenburg, we analyzed a site where a sudden group of sixteen traffic accidents had occurred within a period of eight months. These were caused by the fact that on this site, the coefficient of friction of the road surface had diminished. This could not have been known by the drivers since the road surface did not look any different. This cause does not appear anywhere in the accident records since it is not obvious to a policeman. Inattention or skidding were given as reasons (unfortunately, speed does not appear on our accident forms) together with other accident circumstances. But the real reason for the accidents was that the road surface had lost its grip; this was shown by our final measurements. The drivers cannot adjust to this situation since they do not have the information. This points out the

thought that it is possible that thorough training reactions can perhaps be improved.

A second survey has been completed which, we hope, will soon lead to guidelines for practical application, namely the survey on safety and flow of traffic. A great deal is being said about the influence of driveways and the fact that traffic and roads represent an environmental hazard (but very little is being said about the fact that the environment has an equally disturbing influence on the flow of traffic). The normal Austrian federal roads are being used as private access roads in the first phase of the project because legal regulations are lacking and it is very inexpensive and simple to get to one's house from a federal road. Once a person has a house he can also afford a car, and then he is disturbed by the traffic passing nearby, though when he began it was an advantage to be able to build a house cheaply off the federal road.

Today about 30 percent of all Austrian federal roads have houses built alongside, and the consequences of this settlement pattern with regard to traffic engineering had to be examined in the course of this research. It turned out that one single access to a house causes the same disturbance to the flow of traffic as an increase in traffic by thirty extra cars per hour, i.e. the same reduction in traffic speed as an increase in traffic density in this area.

The methodology of this research for us was to build a simulation model of the traffic flow and the respective disturbing factors on the basis of practical measurements and fix the influence, for example, of the hindrance probability on traffic accidents based on examinations of accidents. We discovered that an increase of 1 percent in the hindrance probability causes an increase of 0.4 traffic accidents per year per kilometer of road. If you increase house entries over one kilometer from 0 to 60, the speed which had been 80 km/h will be reduced to 50 km/h.

With this quantification of negative influences it was possible to work out guidelines for the planning engineer and for the traffic technician in order to enable them to make clear decisions. I hope I have given you a short overview of the activities of the institute as far as they are being carried out in the Kuratorium.

Discussion

Mr. A. Afifi

I have several questions on the point of organization. From the Kuratorium's point of view or your personal point of view, what do you think of the organization of safety efforts in general in Austria?

Mr. H. Knoflacher

This is an easy question, but it is not so easy to answer. If you have been active in the field of traffic safety for a long time then you know very well the weak points of the system. It is difficult to take an unbiased and objective stand toward your own established system, even if you are familiar with other traffic and organization systems. The difficulty, which is not only limited to Austria, is that the path from scientific findings to the application of these scientific findings is prolonged by a great many obstacles and hesitations, sometimes of a purely formal and not functional nature. This time span of delay may amount from two to ten years and more.

One example is the question of seat belts. This question was vigorously pushed by the Kuratorium. We hold workshops such as this one today on special topics with different participants every year or two, and as early as the beginning of the 1960's these workshops dealt with the question of safety belts. You know our situation today: we have not reached the point Sweden has reached, i.e. mandatory seat belt wearing, which attests to the difficulties and the unsatisfactory situation from a scientific point of view.

There is a second difficulty with regard to organization of traffic police. Representatives of every country complain about this, but in Austria, if one compares the situation to the FRG, the measuring instruments of our police are by far worse. There are only a few speed measuring instruments, and even if they are available they are rarely used. This cannot be stated generally, as there are variations among the provinces. In our area, Vienna, we have problems in traffic safety in that it is difficult to obtain a blood alcohol test if there is a traffic accident involving a drunken, injured road user. It is therefore not only the wish of traffic engineers but also the wish of psychologists and the Kuratorium to improve the control measures, for example, by breath analysis. The legal framework does not exist.

Referring to the presentations of this morning, most of the other questions are similar to those in other countries. We have no static traffic system but a system that interacts with the data of the structure. The question of public

transportation versus individual traffic is similar to that in other countries. Due to the existence and usage of private cars the structure of our cities has changed to such an extent that today it is nearly impossible to create a useful and economic public city transportation system. Of course, there are the 400 to 500 new improvements being made on public transportation systems, but basically the improvement, which would also be an improvement in the area of traffic safety, would have to start with the basic conception of our cities.

Mr. A. Afifi

I know that you have a great many activities on an international level. Would you care to say a little more about them?

Mr. H. Knoflacher

The Kuratorium für Verkehrssicherheit is the international representative within the DIR documentation, and it sends permanent representatives to the research groups of the OECD. Almost all research teams of the OECD include one member of the Kuratorium who cooperates in the several chapters of the research report which the OECD research groups are supposed to produce. In addition, the Kuratorium has representatives in ECE and is in close contact with the PRI and IRF and maintains permanent contacts with research groups abroad just like any other scientific body.

Directions for Future Research in Traffic Safety

A. Afifi

The study of traffic safety, we believe, can benefit from the system-analytic approach due to the complex nature of this field. Previous attempts in this direction have tended to describe traffic as a driver-vehicle-environment system. Some add "organization" as a fourth component.

Some of the factors affecting the driver are:

- education,
- demographic factors,
- physical and mental fitness,
- judgment under stress,
- licensing procedures,
- age limits on driving.

Factors affecting the vehicle include:

- body design,
- operational controls,
- safety devices,
- motor power,
- condition,
- inspections.

Among the environmental factors are:

- road condition and design,
- traffic density,
- pedestrians,
- animals,
- weather conditions,
- air and noise pollution,
- traffic laws and enforcement.

It is clear that these areas are overlapping and that many factors belong to more than one area.

The question is how to describe the effects of each of these factors and the interactions among them. To illustrate the complexity of the answer to this question we select a fairly simple task, namely, steering a car in a particular geometric path (a road) on a plane. Hoffmann [14] attempted a systems analysis in this task. He states:

> In this system the driver views the road in front of him and decides what action is necessary for him to follow the road curve. The driver may use his past experience in deciding this action and thus may reduce the time delays in the system due to his reaction time, decision time, etc. .... [H]is movements and applied forces are fed via the steering system...to the front wheels of the car. The tyres develop side forces and after a short interval...the vehicle responds to the driver's steering wheel input.... The driver obtains information about the output, or response, of the car, from several sources. These sources are...(a) the driver's view of the road ahead.... (b) Those inherent in the car only. The driver's information...comes from...the lateral force on the driver and his visual sensations of angular velocity... [and] (c) comparative measure...i.e. the relative bearing between the vehicle's actual path and its intended path. The driver uses this feedback information to compare the state of the system with that which he desires. If a difference exists, the driver can make further corrections so that the error between his desired path...and the path of the vehicle is minimised.

He then proceeds to describe the many variables which affect the components of the system and the interactions (of various orders) among them.

If we multiply this task many fold, we begin to realize the magnitude of the problem we have chosen to study here. Indeed, some systems analysts doubt that conventional techniques are applicable, without modification, to traffic safety. Experienced researchers in this field are convinced that no single factor can be studied in isolation. Each is affected by and interacts with some other factors.

Against this background, we shall point out selected areas in which future systems research may be promising

and refer to some previous research efforts. The selection of the areas is based on the special importance we attach to them.

Drivers Training and Education

There is consensus that much attention must be given to research into drivers training programs. For example, the OECD [23] report entitled "Driver Behaviour" suggests three major research programs, with one exclusively devoted to "tasks and methods of driver education." Marek and Sten [20], Goldstein [9, 10], A.D. Little [17], Forbes [8], McGuire [18] and numerous other administrator and researchers all concur. However, there is no consensus as to the effectiveness of drivers education programs.

Skelly [25] compared the accident records of three classes of first year drivers: those trained in driving schools only, those trained by friends and relatives only, and those trained by a combination of the two methods. He found that the lowest average number of miles driven per accident occurs with the group trained by driving schools. McGuire [18], after long study of accident records, noted that while official records indicate the superiority of formal training, examination of confidential interviews reveals no significant difference between formal and private training. Goldstein [9], on the other hand, criticized McGuire's, and others', work for being nonexperimental and, sometimes, quasi-scientific. Thus, he concludes that there is no "case" against drivers education but recommends that more research work be carried out.

Several proposals have been put forward to update and improve existing educational programs. For example, Marek and Sten [20] suggested a program which stresses the systems nature of traffic. Goldstein [10], after reviewing the literature, urged tailoring educational programs to individual needs and concentrating on factors probabilistically related to safety. A different approach to drivers education is motivated by the fact that the rate of occurrence of accidents, as a function of years of driving, is very high in the first four years, tapering off around the sixth or seventh years. Munsch [21, 22] argues that it may be possible to bypass these early high-risk years by adopting a built-up (Aufbau) program, commencing in the preschool years and continuing throughout the life of the driver. Two other aspects of drivers training are the adoption of provisional licenses and the question of first-aid education.

The foregoing discussion indicates that many of the issues related to drivers education are by no means settled.

Furthermore, promising innovative programs must be subjected to scientific testing before any benefits may be ascertained.

Driver Licensing

Policies regarding issuing and renewing driving licenses vary widely in different countries. For example, while most US states and some countries require a reexamination to renew the license, none is required in most European countries. In spite of the urgent need to evaluate the effects of these policies, very little, if any, rigorous scientific examination, comparative or otherwise, exists. However, traffic safety administrators are compelled to make decisions using whatever information that is available to them. An attempt to systematize the decision process regarding licensing policies was described by Chapman [3]. He reported the findings of a seven-man committee which consisted of scientists and practitioners representing law, systems analysis, psychology, sociology, education, and driver licensing administration. The study group

> ...recommends, for continuing evaluation of driver-licensing programs, a planning-feedback-change (PFC) plan, that resembles the planning-programming-budgeting systems (PPBS) now being used by many federal and state agencies.
>
> The PFC approach is by no means an easy cure-all but, as a management technique, it provides the potential for several vital accomplishments:
>
> - o Focusing programs on specific public goals,
> - o Reorienting everyone's viewpoint (including the public at large) toward the public goals,
> - o Integrating the functions of all agencies concerned,
> - o Continuing feedback to show program effectiveness and costs,
> - o Exposing the cost/effectiveness characteristics of alternative practices by means of technical analysis.
>
> Moreover, PFC methods can provide the decision maker with a wider range of meaningful alternatives from which to choose:
>
> - o By expanding the time frame in which he can act,
> - o By building an explicit framework in

which issues can be argued on a progressively more factual basis.

The committee argues that

1. The NHSB's [US National Highway Safety Bureau] need for getting answers of immediate value to help solve the growing traffic safety program is recognized, but ready answers are just not available.

2. Research findings to date show: that improving traffic safety is a system problem; that there is a lack of definitive research results for defining variables of driver proficiency and for influencing and controlling driving behavior; and that there is a need for positive methods for improving driving behavior.

3. The current status of driver-licensing programs indicates: that there are many troublesome practical problems (lack of conformance to traffic laws; a significant fraction of the public drives without licenses, with illegal licenses, or with licenses suspended or revoked; almost half the accidents involve drivers with legal licenses and no violations on their recent driver record); that the public expects government agencies to administer necessary social controls with a minimum of interference with individual freedom; and that there are many diverse strategies for improving driving behavior.

4. Among the considerations in selecting an evaluation plan are: it must be diagnostic in the context of the total traffic safety program; it must deal with compartmentalized, static programs that do not sufficiently emphasize traffic safety: it must reconcile differences between practitioners and scientists; it must improve programs by gradual development; it must find more effective ways of influencing and controlling driving behavior; it must make the problem of controlling driving behavior more researchable; and it must have sufficient impact on management to initiate a systematic, rational process of change.

5. The reasons for selecting the PFC approach to evaluation include: that it deals with the considerations in 4 above; that it has potential for initiating and maintaining a process of social change; and that it takes a practical approach to overcoming, political, legal, and social obstacles to improvement.

6. The short-term implications of using the PFC approach to evaluation are: that it offers the possibility for greater participation of professions and disciplines in the development process; that it orients evaluation locally; and that it provides a better basis for federal state relations.

7. The long-term implications of using PFC methods are: that the PFC approach encourages the use of technical analysis; that it makes possible rational planning for the future; and that it can enhance the quality of life provided to the driving public.

8. In order to mobilize human resources for improving driver-licensing programs, it is necessary to: reorient driver-licensing personnel and upgrade their qualifications; make an R & D program an integral part of driving licensing; establish a planning board for effective coordination to the activities of state agencies concerned with traffic safety and other professions and disciplines; and provide explicit and visible information feedback to other agencies, professions, and change agents in society.

We agree with the committee about the need for basing decisions on scientific evaluation and feedback. Unfortunately, the committee leaves the question of "how" unanswered.

One of the related, and much debated, questions is whether to base licensing policies on the drivers' accident records. A study of "accident proneness and driver license programs" was reported by Campbell and Levine [2]. They emphasize that the past drivers' accident record is of very little use in identifying drivers involved in future accidents. For example, in the state of North Carolina, drivers involved in an accident during the years 1969-70 constituted 11 percent of all licensed drivers. Those 11 percent accounted for only

19 percent of the accidents occurring in the next two years; still 81 percent of the accidents were not accounted for by the past accident record. More elaborate "accident proneness" profiles yield similarly ineffective predictions. They conclude, as many others have done, that

> ...some people have more than their share of accidents in consecutive time periods. However, these people are a small part of the total problem, and cannot be identified with enough accuracy. Despite the appeal in searching for a relatively few drivers whom we might erroneously assume are causing a large part of our problem, we must continue the systematic programs aimed at the road, the car, and above all the normal but fallible driver.

In this spirit, the OECD report [23] recommends several behavioral studies aimed at a task analysis of the traffic system in order to possibly identify certain patterns in need of modification. Another topic related to licensing is that of initial and periodic medical examinations of drivers. Many researchers have studied the effects of certain medical conditions on the drivers' fitness (cf. Haddon et al. [12]). However, little systematic evaluation of the relationship between medical fitness and traffic safety has been carried out. This area should be subject to further research, including the procedure for stating the license applicant's physical and mental health status.

Traffic Safety Campaigns

Propaganda is an obvious possible means of influencing driving behavior. Safety campaigns relying on mass media of communication have been employed occasionally with the hope of effecting specific or general changes in drivers' behavior. For example, a "Safe Driving Campaign" was launched in 1955 on the initiative of the then US President Eisenhower (see Blumenthal [1]). The campaign appealed to the moral and social duty of road users to ensure safe driving behavior. The high point of the campaign was a "Safety Driving Day." Griep [11] wrote,

> For a month before the Safety Driving Day and during the month that followed, no expense or effort was spared to bring the message of 'a day with no accidents' home to every road-user through the media of press, radio, TV, posters, stickers, match boxes, buttons, bracelets and even 'Safety Day' balloons.

> The results all over the country were rather disappointing. On Safety Day itself there was one road death more than on the corresponding day in the previous year; and over the whole campaign period (November and December) the number of deaths was 10-12% up to the same months of the preceding year.
>
> The difficulty with this campaign was that the theme in fact told the driver nothing. The message that was being put over did not remove uncertainty in his mind (in the sense that the person hearing it now ended up knowing whether he was acting 'for' or 'against' safety on the road).
>
> Even if this were so, the message--which was appealing solely to the motivation--gave no information on what the desirable line of behaviour was.

On the other hand, a similar mass campaign was launched in Sweden during the period of changing traffic from a left-handed to a right-handed system (1966-1967). A dramatic drop in accident rates was observed in the year following the change. However, too many factors were interacting with driver behavior to allow the conclusion that the drop was due to the safety campaign.

Evidence of the effectiveness of "horror appeals" in special-purpose campaigns is similarly inconclusive. Early reports, e.g. Janis and Feshbach [15], suggested that this tactic actually reduced the effectiveness of the campaign. More recent studies (e.g. Fischer et al. [7]) indicated a favorable effect, while others (e.g. Higbee [13]) found no compelling evidence either for or against this technique. Mackie and Valentine [19], in an attempt to resolve the question, conducted a controlled experiment in which interviews and observations were carried out. They state:

> In conclusion then it has been shown that although subjects think that the more horrifying material would be more effective, observation studies of actual behaviour have shown that this is not the case, that in fact a straightforward presentation of the facts, at least in the context of road safety, can be equally and possibly more successful in bringing about a behaviour change.

On the more general question of the effectiveness of traffic safety campaigns, Griep [11] makes the following remarks:

> 1. Knowledge of the psychology of driving behaviour is incomplete and does not in fact deserve the name if it is to be limited to conditions existing 'inside' the driver.
>
> 2. Compared to other opportunities for influencing driving behaviour, in particular those involving 'external' circumstances, present-day road safety propaganda offers little hope of bringing about any appreciable reduction in traffic accidents.
>
> 3. It is assumed that safety propaganda can be effective with road-users in increasing their knowledge and appreciation of the circumstance that affect driving behaviour (and thus road safety).
>
> 4. The circumstances that have an effect on this behaviour are not, however, exclusively under control by the road-user; if road safety propaganda is to be carried out, it must not be directed (solely) towards the road-user.
>
> 5. Where there is lack of adequate knowledge as to driving behaviour and the circumstances that influence it, then propaganda should create opportunities for increasing this knowledge.
>
> 6. Knowledge on road behaviour and the circumstances that influence it can be gained from scientific research.

Road-user Errors

A promising area of research is the analysis of common road-user errors. An interesting study is reported by Clayton [4]. A team containing a medical engineer, a surgeon, a traffic engineer and a psychologist investigated 210 accidents sampled from those which occurred between 8 a.m. and 12 midnight in Worcestershire, U.K. Their on-the-scene investigations usually took place within twenty minutes of the occurrence of an accident and concentrated on finding those road-user errors which most likely contributed to causing the accident. They classified the main errors and their frequency as follows:

Type of Error	Percent of Occurrence	Average Age
Failure to look	15	36
Misperception	10	36
Excessive Speed	14	25
Panic Reaction	5	25
Other	10	36
Total Error	54	32
No Error	46	36

Although more sensitive techniques could have been used for data analysis, this approach seems to be a good opening for a promising research area. Furthermore, study of "near-accidents" may also be highly informative.

Accident Reporting

In most countries of the world, accident data, when they exist, are scattered among police authorities, hospital, and insurance companies. Even in a tightly organized country such as Sweden, Erlander [5] observes marked disarray of statistical data, with only half of the injured persons recorded by hospitals being reported to the police (Thorson [26]) and only 20 percent of the accidents reported to insurance companies being reported to the police (Larusson and Rempler [16]). Similar, and often worse, situations exist in other countries (see, e.g. Scott and Carroll [24]).

There are also variations among countries in the data source used for compiling statistical reports. While most countries utilize the police reports for statistical purposes, Italy relies on data compiled by the regional statistical authorities. The police reports, in turn, are sometimes based on their own investigation only and sometimes incorporate hospital investigations as well (see Table 1).

Glaring inconsistencies in basic definitions also exist. For instance, Belgium defines a traffic fatality as one occurring on the scene of the accident and Canada allows a full year, while most European countries use a 30 day cut-off period (see Table 2).

Table 1

Country	Statistics based on		Police Reports based on		
	Police	Other Sources	Own Only	Own + Hospital	Other
Austria	X			X	
Belgium	X			X	
England	X			X	
France	X		X		
FRG	X			X	
Italy		Regional Statistical Authority			Police Investigation in Hospital
Netherlands	X			X	
Norway	X			X	
Spain	X			X	
Switzerland	X		X		
Yugoslavia	X			X	

Table 2

Country	Traffic Fatality if Death within (days)
Austria	3
Belgium	0
Canada	365
France	6
Italy	7
Portugal	∞
Spain	1
Switzerland	0-∞
9 Others	30

It is in this area that constructive suggestions to remedy the confusion may be easiest to formulate. For example, a conference on uniform definitions relating to traffic accidents, in the manner in which road signs were standardized, may be fruitful. An amalgamation of police, hospital, and insurance records may be effected. The use of probability sampling may also be adopted to gain a more representative picture of the accident population (see, e.g. Erlander [5]). However, the difficulty lies in implementing such theoretically useful plans. It may well be that better organization of traffic safety efforts is the first constructive step toward traffic safety.

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R. Andréasson

Mr. Andréasson discussed some other areas in need of additional action and research. On the subject of first aid, he said that many accident victims are dead on arrival at the hospital, perhaps because elementary first aid procedures were not administered to them in time at the scene of the accident. He reported that it had been estimated by WHO that 20 percent of the lives of traffic accident victims can be saved if proper first aid is given on the spot. He mentioned the results of a study showing that a lower percentage of drivers in Sweden carry first aid kits in their cars than in Germany, presumably because in Germany there is a law requiring this, but not in Sweden. Furthermore, he said that public opinion polls indicated acceptance of this law in Germany and acceptance of the idea of introducing such a law in Sweden. However, Mr. Andréasson noted that a majority of the drivers felt that they have inadequate knowledge of the use of first aid procedures and that they would welcome further education on the subject. He thus suggested that first aid should be a standard part of driver education and examination.

Mr. Andréasson then moved to the subject of medical conditions. He mentioned that illnesses are seldom reported as the cause of an accident. In spite of some objections, he feels that medical examinations should be administered to prospective drivers in order to identify possible hazardous conditions. For example, in most European countries, diabetics are allowed to drive private cars but not trucks or buses since they must adhere to a treatment and diet schedule. However, it was found that diabetic drivers, once informed of this condition, tended to drive only when they felt fit. Mr. Andréasson said that this warning to the drivers can be extended to several medical conditions and should be the responsibility of the physicians. He stated that guidelines as to policies regarding medical conditions should be incorporated into new rules and what the medical condition means from the point of safe driving must be subjected to system-analytic research because the knowledge on this subject is very limited.

The third subject discussed by Mr. Andréasson was that of the provisional drivers license. He mentioned the fact that some European countries grant a temporary license to

drive for a certain period of time, after completion of which a permanent license is granted if the driver's interim record is satisfactory. Mr. Andréasson felt that this can be a helpful mechanism for assessing the drivers' behavior early enough to remedy possible accident-causing tendencies, a step which may significantly reduce the number of accidents occurring early in the drivers' careers. He also mentioned the idea of making it mandatory for the driver to drive certain distances and pass a final test before the permanent license is granted. Mr. Andréasson emphasized that this question is part of the larger question of licensing procedures in general and that the systems approach should be applied to settle the question and come up with uniform procedures to be adopted in Europe, because traffic safety is no longer a national concern as the road traffic has become increasingly more international.

M. Thompson

The following is a classification of safety research within the policy context. It is designed to structure the open areas of road safety research with respect to its ultimate goals of reducing the incidence and severity of accidents. The various open areas identified by previous speakers may be gauged against the criteria underlying this classification scheme.

1. Hypothesis generation. We have stressed the need for an inventive, unconstrained search for possible policy remedies to the causes of accidents. Imagination here is essential and is usefully abetted by planned and structured inquiry into the factors involved or interconnected in accidents. Such searches might comprise statistical demographic explorations focusing on accident involvement or non-involvement. Alternatively, in-depth interviews with accident participants might provide valuable clues for potential policy guidance. The immediate object of the searches cannot be firm understanding of accident causation but will instead be identification of plausible hypotheses concerning that causation. The types of hypotheses that might be generated would cover: suggested outlines of personality profiles prone to accidents; indications that certain driver habits, pre-driving activities, or momentary actions during driving lead to accidents; possible car modifications that might reduce accident damage; and hints that common environmental features are linked to patterns of accident occurrence or severity.

2. Hypothesis confirmation. The generation of hypotheses should be followed by testing to determine their validity. Optimal testing brings into play a battery of procedures which are sequentially employed until adequate information for acceptance or rejection of the hypotheses is obtained. The choice of appropriate test at a given time depends on the current state of knowledge and upon the costs of alternative methods. One should never spend more upon any research trial than the expected informational benefit in policy terms taking into account the probability that the hypothesis is true and the probability that effective policy actions can take advantage of this knowledge. Generally, the initial test should comprise assessment of already available knowledge

and data upon the hypothesis. When a firmer understanding is required before action can be taken or the hypothesis is rejected, the safety researcher must choose among alternative ways of obtaining further information. Laboratory experts, driving simulations, an interview series, or targeted data-gathering efforts may each in various circumstances represent the most cost-effective way to verify the hypothesis.

3. Policy experimentation. Even before a hypothesis is finally confirmed or rejected, policy experimentation may be undertaken to determine whether its possible validity can be the basis for corrective policy measures. If, for example, it is suspected that fatigue is a factor in accidents, research might investigate whether various ways of combatting fatigue--perhaps eating candy to increase blood sugar or listening to anti-soporific music or insuring a flow of fresh air--are effective. Other instances of policy experimentation are the actual car crashes with dummy occupants designed to test whether seat belts or air bags can reduce the injuries incurred. In the case of alcohol, the basic hypothesis of its contribution to accidents has been so solidly confirmed that further studies upon the hypothesis are no longer useful. Instead emphasis should be placed upon inventing and testing out ways for controlling the traffic hazard it poses.

4. Policy evaluation. The only level at which conclusive verification that a policy is beneficial may be obtained is the assessment of its actual implementation. Thus even if it is shown that candy reduces fatigue or that seat belts limit injury, policies built around these facts are not automatically effective. The candy may not be eaten or the seat belts not fastened. Even if motorists do comply with the policies, they may be sufficiently emboldened by knowledge of their greater security to drive just enough faster that no reduction of accident injury is achieved. The statistically ideal test is through random separation of the population--perhaps by individual, perhaps by locality--whereupon alternative policies are implemented and their effects measured. Unfortunately, the expense of this procedure--in terms of money, time and procedural complication--often renders it infeasible. When one policy is believed safer, social decision makers are understandably averse to testing out the apparently less safe alternative. This situation requires that analysts make the most of information becoming naturally available. Changes in policy should be scrutinized over time to see whether they effect improvements in various types of accidents. Municipalities vary in their traffic codes, automobiles are differently engineered, and the traffic environments are not homogeneous. Meticulous examination of these differences may often reveal the effects of various laws, automobile construction, and road planning.