

Research and road safety in Europe

M.J. Koornstra

RESEARCH AND ROAD SAFETY IN EUROPE

Introduction speech presented at the International Conference 'Road Safety in Europe', Berlin, 30 September - 2 October 1992.

Matthijs J. Koornstra

Vice-President of FERSI: Forum of European Road Safety Research Institutes;
Director of SWOV Institute for Road Safety Research, The Netherlands.

D-92-10

Leidschendam, 1992

SWOV Institute for Road Safety Research, The Netherlands

1. Introduction

Since the Treaty of Rome, the number of deaths in road traffic of the now twelve countries of the EEC has reached two million; the number of injured is over 40 million. The economic loss due to road accidents is very substantial and endangers the welfare in the community. Nowadays the macro-economic costs for the lack of road safety are about 70 billion Ecus per year in the countries of the EEC (depending on the calculation methods the estimate ranges between 45 to 90 billion Ecus). The fact that this figure is larger than the Gross Domestic Product of, for example, Greece, Ireland or Portugal, demonstrates the extent of the losses involved.

If we compare passenger transport on the road with air or rail transport than the fatality rate per kilometer passenger travel reveals that the risk to be killed on the road is much higher than for the other modes. Rail and air passenger transport are more than a factor of 200 times safer than passenger transport on our European roads.

Traffic mode	Area	Fatality rate
road 1)	EEC	3.5×10^{-8}
rail 2)	N-W. Europe	1.6×10^{-10}
air 3)	USA	0.4×10^{-10}

- 1) Gerondeau-report (1.3 pers. per vehicle)
- 2) Schopf (1989)
- 3) NTSB

Table 1. Risk per passenger kilometer for different transport modes

The comparison of the fatality rate per kilometrage for road traffic between the countries of the EEC on the one hand and United States of America and Japan on the other hand shows that road traffic is half less dangerous in the USA and about one-fourth less dangerous in Japan than in the countries of the EEC as a total.

Area	Motorkilometers ($\times 10^8$)	Fatalities (within 30 days)	Fatality rate
USA	34992	46405	1.3
Japan	6251	14595	2.3
EEC	19524	52689	2.7

Table 2. Fatality rates 1990 in USA, Japan and EEC.

There are also large differences in risk on the roads inside the European Community. Per million vehicles the Netherlands and Great Britain have a rate of road deaths which is less or about 250, while the rates in Spain, Greece or Portugal are 3 to 4 times higher.

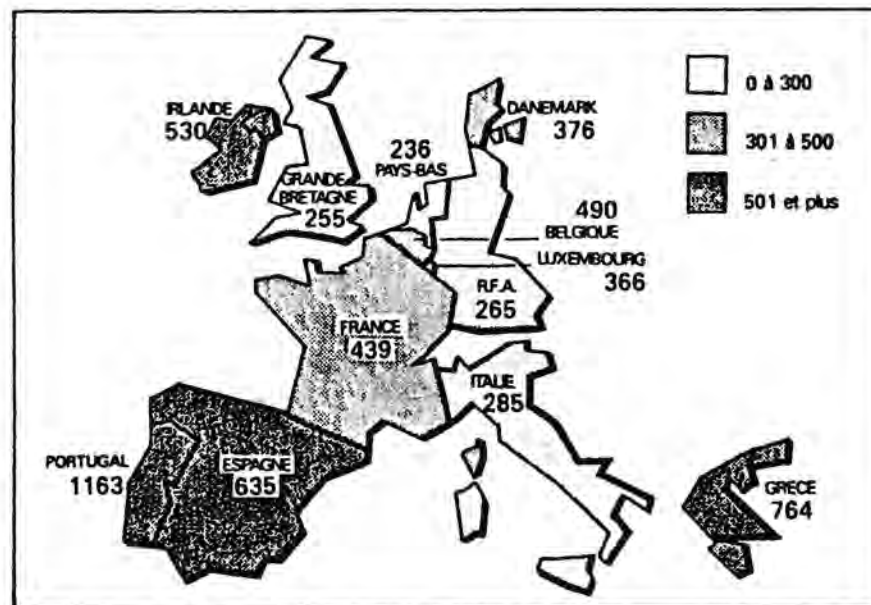


Figure 1. Fatalities per million vehicles in the EEC in 1988 (Source: Gerondeau, 1991).

The fatality rate per motorized kilometrage differs even more with a factor up to 7 for these countries (UK and NL about 1.4; Portugal 10.5; per hundred million vehicle kilometers).

In view of the above figures and the differences between countries it can be concluded that road safety it is not an unavoidable corollary to the increasing motorization. On the contrary, authorities and their policies can, if not to abolish, at least reduce the number and seriousness of road accidents. In this matter, so states the High-level Expert Group in their report to the High Commissioner of Transport for the European Economic Community (Gerondeau, 1991, p. 15):

"the authorities have a fundamental part to play, through the action which they do (or do not) take:

- they are responsible for the road network and its equipment;
- they are responsible for the standards applying in building and controlling vehicles;
- they are responsible for organizing assistance;

- lastly, they are to a very large degree responsible for the opinions and the behaviour of road users, whom they can influence through education and training, information, traffic regulation, enforcement and penalties".

The Gerondeau-report acknowledges that individual mistakes or bad conduct can be demonstrated in 90% or more of road accidents, but warns not to draw the wrong conclusion from that point. It states that:

"the behaviour of every road user is in fact largely dependent on circumstances of his journey outside his control (road network characteristics, other users' behaviour, the regulations, the degree of enforcement, etc.)."

A convincing illustration can be found in the fatality rate on motorways which is many times lower than on other main rural roads; it is hardly acceptable to assume that the responsibility of drivers on these roads is suddenly changed. The frequency of road user failures and the consequences vary considerably with the characteristics of the elements of the road traffic system he uses.

The Gerondeau-report concludes: "Whilst the part played in accidents by individual faulty actions of large numbers of users is often used as an excuse for inaction, there is a need for the awareness that, in spite of the appearances, the responsibility for taking action against traffic accidents is primarily collective and that it falls firstly on the various public authorities which might take such action. ... Progress is only possible through this approach, as is shown by the experience of those Community countries which have achieved the best results. ... Of course, other groups besides the authorities should and can take action on road safety: the car makers, the insurance companies, the media (etc.). And voluntary bodies also can play an important part in attaining public awareness and in changing attitudes in any coherent action, their potential support must be sought. Nonetheless, there is a fundamental need for a commitment of preventing accidents, from all the public authorities involved. That includes a commitment from the Community.

2. European Policy and Road Safety

The Gerondeau-report states three general objectives for a European strategy for road safety:

- Firstly, set a quantified multi-year target for the whole of the Community, such as a reduction of between 20% and 30% in the number of victims in road accidents by the year 2000.
- Secondly, establish gradually a European Road Safety and Road Traffic Zone by harmonization of the safety levels in the Member States, encouraging the countries with the worst problems of low safety to catch up without delaying progress in the countries more advanced in the field.
- Thirdly, set the target of promoting a behaviour model for road users mindful of others, a model of driving calmly and unaggressively, both on urban and rural roads.

These three objectives can be reached, according to the Gerondeau-report, by adopting measures which have shown to be effective in reducing the number and seriousness of road accidents, but which are not applied in all Member States. This is a very pragmatic and realistic strategy which does not lean on modern innovations or propagate until now unapplied measures. It does not concentrate on modern electronics and telematics, despite the potential value which such measures may have. Nearly all the concrete proposals in the Gerondeau-report are already at least applied in one of the Member States with positive results on road safety which are judged to be also effective in the other Member Countries. The only innovations were some combinations of varieties of similar measures which were judged to yield a more optimal effect. The Gerondeau-report lists 64 proposals for such concrete measures. Not all proposed measures regard the European level, but on the level of the European Community action toward the national and regional levels can be taken by dissemination of knowledge and the pooling of experience in Member States. The EEC should actively facilitate the adoption of proposed measures and issue recommendations for actions, and if necessary, urge the adoption of some measures by Member States. For this active role of the European Economic Community, the Gerondeau-report presents 14 proposals of a more process and organization oriented nature.

Here it is not the place to elaborate on the 64 concrete proposals, but I shall highlight and illustrate some general ideas beyond the scope of the 14 organizational measures which are directed to the level of the European Economic Community. The main basis for the proposals of the Expert Group towards the level of the Community is the belief that there should be a

coherent policy across the continent of Europe, and that the Community must involve itself in new ways of road-accident prevention expressed by four chief aims:

- to improve knowledge;
- to produce technical reference material gradually;
- to establish a European 'Highway Code';
- to support road safety policy.

Since the Treaty of Rome it has been unclear what the authority of the European Commission was with respect to road safety, but since in its extension of Maastricht it has become a duty of the European Community to improve European road safety and to establish a harmonized and optimized transeuropean network of motor freeways. The authority of the European Parliament on transport issues is increased especially on matters concerning road safety and this transeuropean network. In Brussels the Ministers of Transport have agreed to put the topic of road safety on their agenda and so they have done earlier for the agendas of their meetings in the CEMT.

It can envisaged that the Gerondeau-report will become, and partly is already, a source for action on the level of the European Community. Among the recommendations which are in discussion now the Gerondeau-report identifies four schemes for the improvement of knowledge:

- sharing individual Member States' experience;
- establishing a detailed database of road accidents;
- introducing more suitable instruments of measurement;
- identifying European research programmes.

Moreover, the report recommend:

- a periodical organization at the Community level of a major conference on road safety, at which researchers and decision-makers from individual Member States might meet to monitor changes in accidents and the effectiveness of remedial action.

More specific the Gerondeau-report does not recommend the exclusive use of mandatory actions, but the coverage of road safety topics by the organization of advise to the national, regional and local levels of authority.

That advise is thought to cover the following aspects:

- analysis of experience and action implemented in individual Member States in order to reveal the lessons of common benefit;

- initiation of new and participation in existing research programmes;
- publication of periodical surveys, information material and technical studies aimed at the public or specialists;
- compilation and monitoring developments in road safety, making use of a network of bodies in the Member States;
- production of recommendation or preparation of decisions at the request of Member States, the Commission, the Council or European Parliament;
- support to non-governmental bodies working on road safety.

3. Forum of European Road Safety Research Institutes

It is exactly in this spirit that this conference on Road Safety in Europe is organized in cooperation with FERSI: the Forum of European Road Safety Research Institutes. It is aimed by FERSI that this conference will grow out to the proposed major Road Safety Conference of the European Community. Now the members of FERSI are national road safety research institutes of 12 countries in the EEC or EFTA coming from:

- Austria, Kuratorium für Verkehrssicherheit (KfV);
- Belgium, Institut Belge de Sécurité Routière (IBSR);
- Denmark, Rådet for Trafiksikkerhedsforskning (RfT);
- Finland, Valtion Teknillinen Tutkimuskeskus (VTT);
- France, Institut National de Recherche sur les Transports et leur Sécurité (INRETS);
- Germany, Bundesanstalt für Strassenwesen (BASt);
- Netherlands, Institute for Road Safety Research (SWOV);
- Norway, Institute of Transport Economics (TØI);
- Portugal, Laboratorio Nacional de Engenharia Civil (LNEC);
- Sweden, Statens Väg- och Trafikinstitut (VTI);
- Switzerland, Schweizerische Beratungsstelle für Unfallverhütung (BFU);
- United Kingdom, Transport Research Laboratory (TRL).

The objectives of FERSI are in line with the recommendations of the Gerondeau-report and are achieved by:

- regular exchange between member institutes of information, experience, trends and new initiatives in research;
- the identification of research needs and opportunities for collaboration;
- undertaking joint research projects and sharing top-expertise and special (large and expensive) research facilities;

- furthering the development of European requirements and standards in the field of road safety;
- dissemination of the results of research by all possible means to policy makers, administrators, professionals and researchers in road safety and to the general public;
- encourage of exchange of researchers and of the set up and maintenance of appropriate data-bases.

Under the umbrella of FERSI the initiative is taken to propose some joint research projects for the oncoming second programme of European Research on Transport (EURET II) of the EEC. Some proposals (the numbered ones below) are worked out now by members of FERSI, while other ones are only suggested areas of interest.

It concerns the areas of:

- Road User Behaviour

1. Europinion (periodic comparative inquiry on road safety attitudes)
2. Improvement of novice training and reduction of novice accidents
3. Legislation, enforcement practices, influence penalty levels
4. Effects of speed and speed control.

- Vehicle Safety

- (* Assessment of passive safety
- (* Improvement of frontal impact test
- 5. Lighting configuration.

- Unprotected Road Users

- (* Efficiency of regulations and policies for vulnerable road users
- 6. Child pedestrian accidents.

- Accidentology

- (* European observatory and 'road safety barometer'
- (* Improved data collection and analysis on the European level
- 7. European accident causation databank
- 8. Harmonization of definitions of accidents.

- Prospective Analysis

9. Modelling developments, forecasts and interventions
10. Trans-European goods transport
11. Tourism and foreigners.

The organization of FERSI will be the basis for formation of consortia of top-experts from the member institutes in order to perform the needed

research on the highest quality level and with the most general validity of application in European countries. The only fact that the outcomes of collaborative research and their recommendations will now become explicitly shared by the leading national institutes, is of great importance for the impact on national and European policies for road safety.

4. Improved European Road Safety

Also the Gerondeau-report mentioned comparable area's as most beneficial for the improvement of the European road safety. I can not discuss all the concrete measures that has been proposed in the Gerondeau-report. However, beyond the proposals by FERSI and the measures proposed in the Gerondeau-report, it has been realized that human behaviour is not infallible and also that no one really wants to become involved in an accident by ones own behaviour. The frequency of the seldom failures of millions of road users, nonetheless, results in the enormous amounts of losses in road safety. The opportunity for failures is largely dependent on the human made traffic system. Since one can not create an infallible human being by measures, the reduction of that failure frequency must be sought in an improved traffic system which elicits less opportunity for failure. Such failure opportunities, however, are also elicited by the behaviours of other road users. Some of the concrete proposals concern the improvement of road user behaviour with respect to the others directly. The idea beyond them lies in the fundamental principal that human behaviour is conditional to circumstances and individual backgrounds as well as to the expected utility of the outcome of that behaviour. The individual background is mainly shaped by public information, education and training as well as by the experience in traffic which are conditioned by stimuli from the physical traffic structure as well as by traffic laws or regulations and their enforcement and penalties. The behavioural proposals are directed to these domains which condition the road user behaviour. However, it are not the "stand alone proposals" which are the most important ones. We can regard, apart from the European harmonization in the proposals, the integrated scope of the proposals for

- (a) graded licensing in combination with accompanied learner driving,
- (b) speed regulations and
- (c) specific and general enforcement practices

as the most important behavioural proposals for an effective road safety strategy in both the proposals of FERSI and the Gerondeau-report.

If the proposals on the training and licensing of drivers would lead to an application throughout the Community, then the risks of young drivers could be reduced considerably. The French experience with such a procedure shows that skills and knowledge alone are insufficient for safe driving by youngsters, but that danger perception and responsible driving can be learned in a very practical way. If the French results apply in general then the risks reduction of young drivers can even be reduced by a factor of seven times, which in the Member States would mean more than 10% less serious accidents, that is more than 150.000 injured and about 5.000 fatalities per year less and a gain of 7 billion Ecus for the whole of the Community. A very cost-effective and important life saving measure indeed, which only depends on their proposed research validity for other countries and the political willingness of their adoption.

The level of mean speed given the road type and the variation in speeds are important factors in traffic safety. The variation in speeds on the road (also between categories of road users) determines to a large extent the number of accidents. If the standard deviation of speeds is reduced, then theory says that the number of accidents approximately can change nearly by a quadratic effect of that reduction. The absolute level of speeds determines also quadratically the seriousness of the outcomes of a given accident with the particular masses of vehicles involved. Since generally variation of speeds reduces with a reduction of absolute mean speed, it follows that mean speed reduction easily can have a fourth power effect on safety, which for example means that a reduction or increase of 10% in mean speed (factor .90 or 1.10) can change the number of fatalities by a reduction of 34% (factor $.90^4 = .656$) or an increase of 46% (factor $1.10^4 = 1.464$). These considerations are confirmed by a Swedish study (Nilsson, 1982) and are also in line with results from speed limit changes on motorways in the USA and France in 1974 (See Figures 2 and 3).

But not only on motorways this relations between speeds (and speed variations) and accidents holds, also the Danish actual speed reduction from the urban speed limit change of 60 km/h to 50 km/h and the Dutch results on the so called "woonerf" by traffic calming measures in living areas which reduce speeds from 50 km/h limit to speeds below 30 km/h affirmed these relations between speeds and accidents. The network related proposals on speed limits, speed enforcement and automatic control,

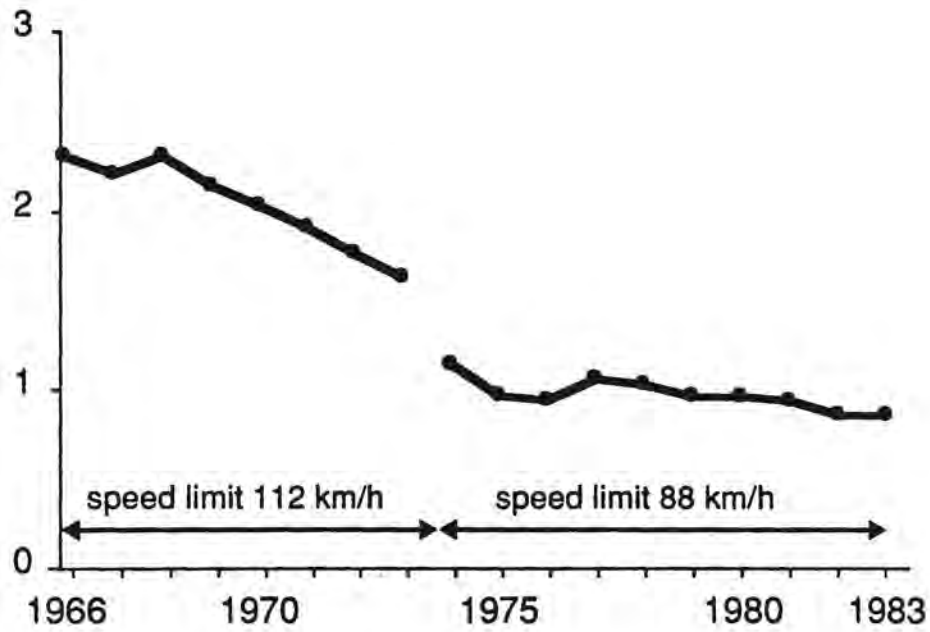


Figure 2. Fatality rates on US Interstate highways, in relation to the speed limit change in 1974.

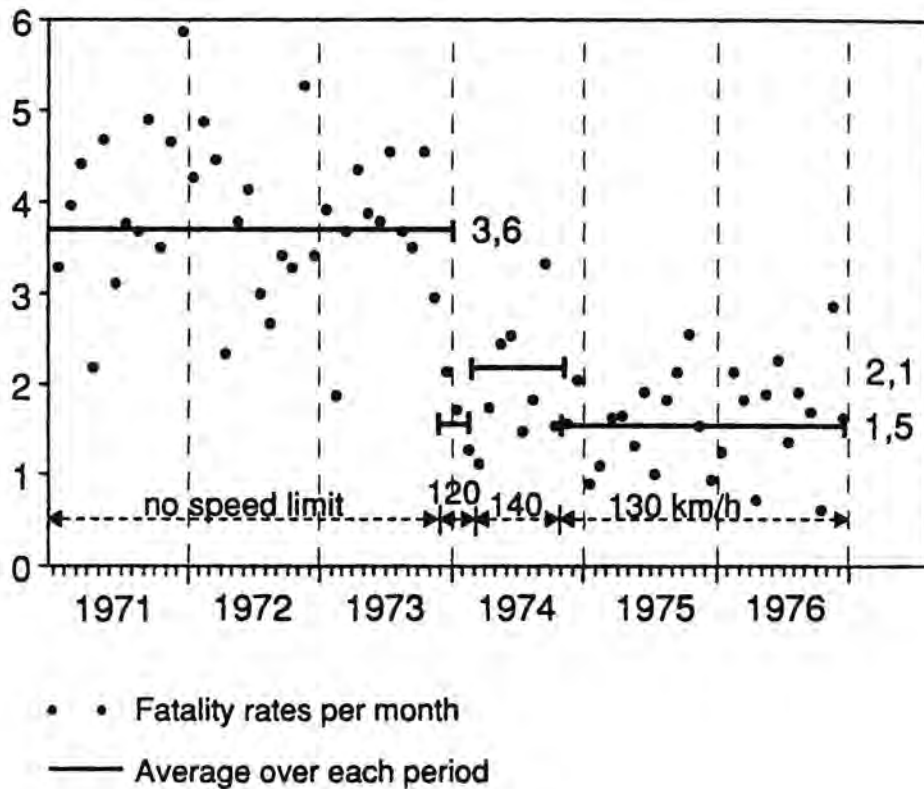


Figure 3. Fatality rates on rural motorways in France in relation to the speed limit changes in 1974.

therefore, are of utmost importance. Their application in a harmonized way to all types of roads in the Member States could save many thousands of lives and also reduces billions of Ecus in the Community. This includes their application to the German motorways and rural roads; speed limits on these roads could stop the increase of fatalities which is observed in the last five years on the German motorways and also can reduce the increasing share of traffic fatalities from rural roads in Germany.

The importance of the proposals for a renewed enforcement practices of specific and general police control can be illustrated by the results of the intensified random breath testing in New South Wales in Australia (Arthurson, 1985). These results show that a high density of testing of about one out of three license holders per year leads to lasting reduction of about 25% of the number of fatalities. Such a high density also is still cost effective since it yields a return rate of 2 for 1 cost unit as Dutch research has shown.

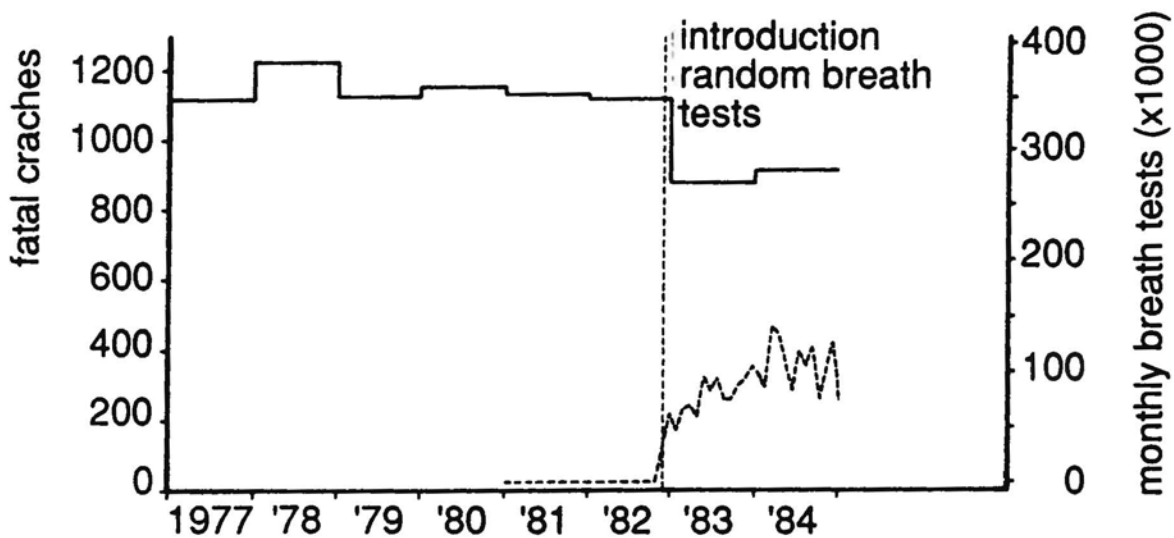


Figure 4. Annual fatal crashes and number of random breath test in New South Wales (after Arthurson, 1985).

Up to now the research proposals formulated by FERSI are not so much directed to the safety aspects of the infrastructure of the road network. In the Gerondeau-report there are 12 proposals for infrastructural measures. The ideas beyond these infrastructure proposals are based on a hierarchical categorization of roads in the network with homogeneous

characteristics along the routes within each category and a uniform layout of connection links within and between types of roads. Our road system evolved gradually from the network that was originally fitted for carriage and pedestrian travel. The road transport system has never been designed in such a way that the opportunity for accidents is prevented a priori, like it has been in the rail- and air-transport systems. Despite the gradual upgrading of the road system nowadays the network of roads still constitutes a more or less unpredictable concatenation of a nearly infinite variety of road sections by an also nearly infinite variety of cross-connections. The result is a road system which is too complex for the road user to allow reliable predictions for the next oncoming situation. Only the layout of the motorway system permits relative reliable predictions. Since this road category is relative well predictable and because speed variation there is relative low it is a relative safe type of road, in spite of the high speeds driven. The fatality rate per kilometrage on motorways approximates the safety of rail and air transport. An acceptable level of safety also holds for well designed traffic calming areas, where speeds are so low that the variation in speeds is also low.

Road type	Max. km/h	Mixing fast/slow	Level crossings oncoming traffic	Injury rate per million veh. km.
calming area	< 30	yes	yes	0.20
resid. street	50	yes	yes	0.75
urban arterials	50	yes/no	yes	1.33
rural roads	80	yes/no	yes	0.64
rural motor road	80	no	yes	0.30
rural motor road	100	no	no	0.11
motorways	100/120	no	no	0.07

Table 3. Injury rates for road categories in the Netherlands, 1986.

This can be derived from Table 3 with the injury rates on Dutch roads, which together with the British and Swedish networks belong to Europe's most safe road networks. All road types other than motor roads and calming areas have considerable high injury rates. The lack of safety varies with the combination of the level of speeds and the amount of variation in speeds due to discontinuities (level crossings and oncoming traffic) and mixture of slow and fast categories of road users on the road type. The rural main roads and the urban arterial roads are the most dangerous ones. The redesigning of the road categories between motorways and residential calming areas to limited number of categories of self-explaining roads with well predictable uniform layouts of routes and crossing types is most urgent. This is a major long term task which should be undertaken in a coordinated way on a European level, since diversity in the Community increases the unpredictability for the foreseen increase of cross-national travel of road users in Europe.

The ingredients of such a redesigned road network ask for more research on safer layouts, but some elements are known already. Separation of slow and fast traffic and traffic with large mass differences is one of the safe design principles. This means only pedestrians on sidewalks and cyclist on separated cycle paths, while crossings for pedestrians and cyclists on rural main roads and arterial urban roads preferably should not be designed as level crossings. It also may mean special truck routes for inter-regional heavy good transport and limitation of masses of trucks in urban areas, where delivery by smaller vans from just-in-time transit centers outside towns can be foreseen. Separation of tracks for oncoming traffic on rural main roads and urban arterial routes is also needed, combined with increased safety on reconstructed crossings and accesses to these roads. British research and research in France and the Netherlands has shown that the British round-about with priority for round-about traffic is a much safer level crossing than sign-regulated or unregulated crossings. Reductions to even 10% of the accidents has been observed after reconstruction of crossings to roundabouts in the Netherlands. The relative low share of fatal car-car accidents in the UK, compared to other Western European Countries may perhaps be explained by the frequency of the British roundabouts in their road network. On the other hand the British authorities could learn from other countries how their relative high share of fatal pedestrian accidents can be reduced by safe roadside and crossings constructions for these road users.

5. Policy for Sustainable Road Safety

There is a long way to go before the next generation of road users is educated to behave safely and before a consistent road categorization can be established. One first step, according to the proposals in the Gerondeau-report, is the conceptual creation of the hierarchical structure of the categorized and homogenized road network and the clarification of its principles on a European level. It has been proposed to begin with the introduction of a periodically systematic and compulsory external inspection of the safety of the road system and with the preparation and dissemination of reference material with all the principles and rules for an upgrading to the safest-possible road network by building new roads and rebuilding and modified maintenance of the existing road network. It must be possible to achieve such a safer road network in a time scope of the next 30 years. But we must begin now otherwise there will be 1.5 million Europeans killed on the roads in the Community in the next 30 years.

In view of the sad record of European road safety, compared with other industrialized continents as well as compared with other modes of transport, there clearly is a need for an active road safety policy. The Gerondeau-report has expressed the opinion that road accidents are too often seen as the inevitable price for the utility of travel and transport. And hence the possibility of an active road accident prevention policy is ignored. Such an active policy, however, can be possible on the basis of research and recommendations discussed above. The Gerondeau-report asks the European Community, that is the European Parliament, the Council and the Commission, to provide assistance in the work undertaken by the Member States against road accidents, because the Community is in the right position to do so. It has done so in matters of environmental protection and the advancement of science and technology in Europe. The Community should surely take a comparable action in a matter to which its citizens are highly sensitive, since it concerns the preservation of life itself and the safety of millions of its citizens. It seems not a too ambitious task to bring the level of road safety in the whole of the Community below the level of the USA, which is already nearly the level of safety in some of the more advanced countries in the Community; this would save more than 20.000 lives and over half a million injured on a yearly basis. In the achievement of such a target the national States (and their

regional and local authorities) still have to play a major role, but on the Community level the promotion of and assistance to the implementation of a common transport policy within which road safety is an integrated major element should be undertaken without further delay.

At present there is no entity on the Community level that matches these tasks and the establishment of such an organization, comparable to the European environment or technology organizations, is needed barely in view of the economic and human problem of the lack of road safety in Europe. The organization of FERSI is a first step which has to be followed by an organization for a European policy on road safety. It is, however, not only a matter of organization and political dedication. In a democratic Europe the basis for common action and their resource allocation is based on public support. The Community, therefore, should promote the need for a common road safety policy by an active social marketing and defeat the unjustified belief that road accidents are an inevitable phenomenon of motorized transport. Road transport is a man-made technology and this man-made technology can be made much safer. The know-how is partly there and can be further obtained by creative research, the organization for that improved safety and the measures for its realization can be proposed in concrete terms. The Forum of European Road Safety Research Institutes is ready to provide the research based scientific input to policies and practices for an improved road safety of intergovernmental bodies and central and local governments in Europe, the response to the appeal has to come from these responsible bodies in the Community.

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