ETSC YEARBOOK 2005

Safety and Sustainability

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The European Transport Safety Council

The European Transport Safety Council (ETSC) is an international non-governmental organisation which was formed in 1993 in response to the persistent and unacceptably high European road casualty toll and public concern about individual transport tragedies. Cutting across national and sectoral interests, ETSC provides an impartial source of advice on transport safety matters to the European Commission, the European Parliament and, where appropriate, to national governments and organisations concerned with safety throughout Europe.

The Council brings together experts of international reputation on its Working Parties, and representatives of a wide range of national and international organisations with transport safety interests and Parliamentarians of all parties on its Main Council to exchange experience and knowledge and to identify and promote research-based contributions to transport safety.

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Preface

The European Transport Safety Council (ETSC) is the sole independent European transport safety NGO offering research-based advice to EU policymakers. In 2005, ETSC publishes the first issue of its Year Book, a new series addressing contemporary problems in transport safety policy. The ETSC Year Books offer a unique possibility for both young and established researchers from all academic disciplines to contribute with innovative ideas to EU transport safety policymaking. The Year Books are located at the cross-road of science and politics and provide a platform for presenting applied safety-related research from all modes of transport. Submissions to the Year Book are refereed through an Editorial Board.

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Tom Brijs obtained a masters degree in Business Informatics in 1997 and a PhD in Applied Economics in 2002 both at Hasselt University (Belgium). From 1998 to 2002 he was a research fellow from the Fund for Scientific Research Flanders. Currently, he is a post-doctoral fellow from the Fund for Scientific Research Flanders and lecturer in the Bachelor-Master program in Traffic Studies at Hasselt University, where he teaches courses on Traffic engineering and Design techniques. His research focuses on Data Mining and statistical methodologies in traffic safety. His research has been presented at several international conferences (Annual Meeting of the Transportation Research Board, the European Transport Conference, International Conference on Urban Transport and the Environment, etc.), and in international scientific journals (Transportation Research Record, Expert Systems with Applications, Data Mining and Knowledge Discovery, etc.)

Frazer Goodwin

Frazer Goodwin studied Human Ecology receiving a BSc Huddersfield and a MSc from the Free University of Brussels in 1991. As well as working in retail management he worked on sustainable development issues with small NGOs before working for the European Commission. It was here that he began focusing on transport issues, and subsequently he worked with the European umbrella organisation T&E for NGOs working on transport policies for six years. He has been working as ETSC policy officer since November 2003. He has published both for T&E and as an author including a contribution to The Earthscan Reader on World Transport Policy and Practice, London 2003.

Thomas Krag

Thomas Krag is a private consultant, former director of Dansk Cyklist Forbund (1986-2000) and president of the European Cyclists' Federation (1993-1996). Since 1975 he has been working with a broad range of aspects connected to cycling, among these cyclists' safety. He first presented a comparison of positive health effects and negative safety aspects for bicycle users in 1989, and has made several studies and

statistical comparisons on safety impacts from road transport in general and from bicycles in particular. Thomas Krag has a Master of Science degree from 1979.

Karsten Krause

Karsten Krause studied Socio-Economics in Hamburg, Dar-es-Salaam (Tanzania) and Vaxjö (Sweden). Since 1998, he worked with innovation policy, maritime transport and environment. In 1999-2000 he was Project Manager for the Hamburg Green Shipping pilot project. From 2003 onwards, Karsten Krause has been Policy Officer with the European Federation for Transport and Environment (T&E) in Brussels. He is responsible for international transport and sustainable mobility policy.

Jörg Potthast

Jörg Potthast studied sociology at the Free University of Berlin. He contributed to several research projects in the domain of science policy studies (Social Sciences; Transport Research; Academic Spin-Offs). Jörg Potthast has received dissertation grants from "Deutsche Forschungsgemeinschaft" (DFG) and Frankfurt Airport Foundation. He had a research position at the Centre for Technology and Society (ZTG), a multidisciplinary research centre at the Technical University of Berlin (2003-2004,) and is currently a researcher at the Science Policy Studies Project Group at the Social Science Research Centre Berlin (WZB).

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Prof. Maurizio Tira is full Professor of town and regional planning at the University of Brescia, Faculty of Engineering, since 2002. He is specialised in mobility and planning, especially for Vulnerable Road Users, and in urban management and road safety. He has worked in the EU funded research programmes "Promotion of measures for Vulnerable Road Users" (PROMISING) and "Developing urban management and safety" (DUMAS), and is now working in the project "Ranking for European road safety". Author of more than 100 publications, he is member of the scientific committee of the International Review "Recherche, transports, sécurité", edited from the Institut National de recherche sur les transports et leur sécurité, in Paris. Prof. Tira is now Chair of ETSC's Working Party on "Evaluation of road safety policies".

Claus J. Tully

Priv. Doz. Dr. rer. pol. habil. Claus J. Tully is a lecturer at the Free University of Berlin and at the Free University of Bozen (Italia) as well as researcher at the German Youth Institute, Munich. In his research, he focuses on growing up in mobile and communicative worlds and on the impact of mobility on lifestyles of young people - topics on which he has published widely. He is also currently involved in a research project called "Alpine Awareness", addressing environmental awareness of young people in France, Italy, Germany and Austria.

Filip Van den Bossche

Filip Van den Bossche graduated in 1998 as Commercial Engineer in Management Informatics and Qualified Teacher in Economics and Applied Economics at the Katholieke Universiteit Leuven (Belgium). At the same university, he then obtained the degrees of Master of Science in Applied Economics (1999) and Master in Statistics (2002). In 2001, he started working at IMOB, the Transportation Research Institute of the Hasselt University in 2001 as a doctoral researcher. His activities are part of the Flemish Policy Research Centre for Traffic Safety. His research interests lie in the application of advanced time series analysis techniques in road safety. More specifically, he is working on the relationship between road safety and mobility evolutions. In this area, Filip Van den Bossche is author and co-author of diverse research reports and articles.

Geert Wets

Geert Wets has a degree as commercial engineer in business informatics from the Catholic University of Leuven (Belgium) in 1991 and a PhD from Eindhoven University of Technology (The Netherlands) in 1998. Currently, he is an associate professor at the Faculty of Applied Economics at Hasselt University (Belgium), where he is director of the Transportation Research Institute IMOB. His current research entails transportation modelling, traffic safety modelling and data mining. He has published his research in several international journals such as Accident Analysis and Prevention, Environment and Planning A, Geographical Analysis, Knowledge Discovery and Data Mining, Transportation Research Record and Information Systems.

Introduction

ETSC's Year Book 2005 places transport safety in the context of sustainable development, with a particular emphasis on environmental sustainability. Transport safety work, at all political levels, frequently encounters environmental issues, either finding possibilities for making the transport system both safer and environmentally sounder, or confronting negative and potentially harmful environmental side-effects of measures to make it safer. It is in particular this potential conflict between safety and the environment - as well as the various ways of trying to resolve it - that is of interest to ETSC.

The intention of the 2005 Year Book is to facilitate an integrated and systemic perspective on transport risks to life, limb, health and the environment. The individual papers identify synergies between safe and sustainable transport measures in order to help significantly reduce all transport risks alike. Although, accident/injury prevention and environmental protection are discussed predominantly in relation to road transport, ETSC has welcomed papers addressing these issues within the non-road modes.

The first paper, by Jörg Potthast, addresses the making of road safety research in France at the start of this century and raises the question whether and to which extent road safety research and research into sustainable mobility need to be better integrated. In doing so, the author subjects programme research in road safety to a test in an obvious and yet unusual way. This concerns a "real" test case, triggered by a massive change in the policy sphere of road safety. On 14 July 2002 Chirac declared "road safety" (along with "cancer" and "equality for the disabled") to be the highest national priority and thereby pulled off a coup. Everyone was surprised, including the transport research community. What effects did this declaration have for specialised research in this area? Has it been possible to translate this proclamation into research programmes, which in turn further an implementation of policy? How porous is the every-day practice in programme research for an abrupt change in external circumstances? How are these developments perceived, interpreted or co-designed?

Following this ground-breaking analysis of the link between road safety research and policy in France, the second paper by Frazer Goodwin explores the relationship between transport safety and sustainable development policies in a European context. Potential antagonisms between sustainable development and transport safety are described and the resulting competition for attention from decision makers by advocates from either camp is also reviewed. The author presents a detailed examination of both the concept of sustainable development and the state of the art in transport safety policy making. Examples are then used to develop the main contention of this paper: that a systemic approach utilising stakeholder participation is key to both sustainable development and transport safety. Furthermore, the author argues that synergies rather than antagonisms will result from application of a recent paradigm of transport safety – vision zero – to the sustainable development of transport policy. Finally, the implications this has for EU policy making are discussed.

While the first two papers review an integrated approach to safe and sustainable road transport policy-making in some form of policy analysis, the third paper by Maurizio Tira provides a "show-case" for how such integration can work with respect to urban transport. The author argues that as far as mobility in cities is concerned, a strategic issue on any political agenda is the need to co-ordinate traffic planning with urban planning – with safety at the top of these agendas. Pointing out that up to three quarters of road injury accidents occur in urban areas, with a disproportionately large number of vulnerable road users being killed by cars, the author stresses that injury accidents in urban areas are of major political concern. He then emphasises that reducing more serious accidents will require a focus on vulnerable road users, particularly pedestrians and cyclists. Tira concludes that important aspects of preventing injury accidents of vulnerable road users are the creation, maintenance and use of databases offering reliable information on accident causes. He stresses in particular that problems like data availability and accuracy, misclassification of accident severity and under-reporting 'as such' are need to be resolved when vulnerable road users are to better protected.

The forth paper by Thomas Krag again addresses vulnerable road users in that it discusses the "risks and benefits" of cycling. His point, first and foremost, is that bicycle use is healthy and non-polluting. He claims that the bicycle is probably the most sustainable transport means yet invented and that is has a tremendous potential to replace less healthy and more polluting car use in cities. The "downside" of cycling though, according to widespread convictions, is that cycling seems to be less safe when compared to driving. It is this increased risk of bicycle use that the author seeks to unravel. He questions the inappropriate use of certain risk measures and points out that areas with high levels of cycling also seem to be safer for everybody than areas dominated by cars. He presents statistical evidence suggesting that a non car-based lifestyle with lots of cycling can be associated with a smaller risk of getting killed in traffic than a car-based lifestyle and that the positive health benefits from cycling outweigh the negative health effects from bicycle accidents. Krag concludes, that cycle promotion is fully defendable from an ethical point of view, while it is disputable to promote traffic safety in isolation from other health effects of the traffic system.

The fifth paper by Filip Van den Bossche, Geert Wets and Tom Brijs further engages in the science of risk and presents a risk exposure analysis that sheds more light on the question of who is most at risk in traffic. The authors argue that while mobility and traffic safety are, by nature, related, traffic safety research is not always straightforward about how this relation can be clarified, and what available data is best suited to do so. In their study, the authors present a decomposition of road victims in exposure and risk. This decomposition is applied to data from travel surveys for Flanders (Belgium) leading to models that enhance the insights in risk and exposure differences according to the age and gender of road users, as well as to the modal split. The decomposition in time shows that the trend in the number of victims is not only determined by the increase in exposure, but also by the level of the risk over time. The decomposition by age and gender shows a lower risk and exposure for female road users, and a fluctuating pattern over the different ages. If modal split is considered, it becomes clear that the number of bicycle and pedestrian victims is mainly determined by a higher risk factor, while car user victims have a higher level of exposure.

The explorations in road safety science, politics and work in this Year Book are completed with a contribution by Claus J. Tully, who, in his paper addresses another user group exposed to (and often imposing) higher risks (onto others). In his social theoretical account of contemporary regimes of driving licensing, Tully argues for a reform of certain types of traffic safety education. To him passing a driving test alone does not qualify a driver to cope with the complex challenges of an auto-risk society. He stresses the need "to take responsibility instead of obeying rules" and calls for a comprehensive mobility socialisation of which driving, in unison with environmental education, is part of.

The final contribution to ETSC's first Year Book addresses an issue of tremendous importance for an integrated approach to maritime safety – the occupational safety standards in ship scrapping. The paper by Karsten Krause sets out to argue that the European Union's maritime safety policy with the phasing out of single-hull tankers has led to unintended consequences in terms of occupational safety because most end-of-life ships are dismantled in countries without adequate occupational safety standards. In these countries, workers are exposed to high accident rates from explosions, fire, suffocation, as well as falling steel beams and plates. The exposure to asbestos dust, lead, organotins and other harmful substances cause health risks. Workers are often not aware of the risks of their occupation. Following the EU ban, more than 2 000 single hull oil tankers will be taken out of the water and scrapped between 2005 and 2010. Most of these ships will be dismantled under poor environmental and health standards, if any. Voluntary guidelines are available but there is no incentive to apply them. Currently, the responsibility of beneficiaries from maritime transport does not consider themselves as responsible for end-of-life ships. The price of old ships is closely linked to the price of second hand steel. Furthermore the author points out that in the European Union a discussion on how to improve the situation has only just started and he concludes that a mixture of regulatory measures, information instruments and economic incentives are needed to internalise the problem into the shipping industry. In the long-term a take-back approach is needed to link the construction to the dismantling processes.

It is this contribution by Karsten Krause that once again highlights how important an integrated and systemic approach to transport safety is. It illustrates that without an appropriate consideration of unintended consequences in any kind of risk management – no matter whether it is within the environmental, safety or health sector – policies and measures designed to reduce risk, are merely outsourcing the threats they are meant to prevent.

"The times of natural progress are over" - road safety as the object of research and politics in France since 2002

By Jörg Potthast

1. Research into Programme Research

Programme research is based on fragile contracts between science and politics which vary from country to country and between subject areas. A generally accepted definition of programme research is not available except in functional terms: its core task is to mediate between actors of at least two different societal spheres, namely science and politics. Current analyses of the interface between science and politics tend to theorize this relationship in terms of principle-agent interaction (*Guston and Kenniston 1994, Meulen 1998, Guston 2000*).

This article adheres to this formulation, which allows raising and specifying dilemmas for intermediary organizations, and departs from an observation of diversity. It reviews and refines some results of a research project which intended to introduce a comparative perspective on research policy in the domain of transport. Alongside the initial focus of this project to "learn through international comparison", this contribution develops a comparative perspective on different subject areas within the field of transport research. It is based on a series of expert interviews, twelve of which focused on the current situation of road safety research in France. Interviews were conducted with science policy experts who have been involved in transport research for a considerable period of time and who represent (at least) one of the following institutional roles and perspectives: research institutes, ministries, car manufacturers and intermediary organisations ensuring the coordination of research programmes. As a second corpus of material, a large number of reports documenting and reflecting the interface between transport policy and research has been consulted (*Garrin-Ferraz 2002, Guyot 2002, Miquel 2002, Nouvier 2002, Pérez-Diaz and Spenlehauer 2003, Rousselot 2000, Ternier 2003*).[1]

Built on intermediary organizations between science and politics, programme research is always threatened to be absorbed by one of the named spheres of action. Either the principal regards programme research exclusively as a political instrument for decision making or the agent takes it all and produces nothing but academic reputation. To work out as a balanced arrangement, the organisation of programme research presupposes a highly developed role-specific understanding. Professionalism on the part of the researcher means, for example, not to overtax the partner-in-practice with presentations of complicated findings. For the partner-in-

[1] "Smartbench", a research project funded by the German Ministry of Research and Education (BMBF), was carried out by the Centre for Technology and Society (TU Berlin) and three Berlin-based partner institutions. Completed in September 2004, an extensive research report referring to road safety and research in France, „Die Zeiten des natürlichen Fortschritts sind vorbei" (Potthast/Dienel 2004), is available online (http://www.ztg.tu-berlin.de/). The author is indebted to Christian Reynaud and some 20 interviewees kept anonymous for explaining their view on transport research and policy in France.

practice professionalism can mean not to weigh the formulation of the areas of research down with short-term expectations or by taking the requirements of academic publishing into account. A prerequisite of programme research as "orientated research" is that a policy orientation is articulated without dictating the topic of research. Taken vice versa this demands of the research personnel on the one hand that they bow to the control of their peers, and on the other that they relativise disciplinary orientations when this appears to be advisable regarding a problem.

The statement that this tension is constitutive precisely for programme research and must somehow be balanced out is hardly original and too general to provoke opposition. More contestable are comparative studies referring to specific areas and their organisational and cognitive characteristics. This article will attempt to subject programme research in road safety to a test in an obvious and yet unusual way. This concerns a "real" test case, triggered by a massive change in the policy sphere of road safety. On 14 July 2002 Chirac declared "road safety" (along with "cancer" and "equality for the disabled") to be the highest national priority and thereby pulled off a coup. Everyone was surprised, including the transport research scene.

What effects did this declaration have for specialised research in this area? Has it been possible to translate this proclamation into research programmes, which in turn further an implementation of policy? How open is the every-day practice in programme research for an abrupt change in external circumstances? How are these developments perceived, interpreted or co-designed?

The aim of this contribution is to establish what factors guide these transformational attempts. It concerns itself with the typical patterns of reaction, not only in the field of road safety, that characterise how new political set conditions are dealt with. The section below will, with necessary simplification, sketch the basics of programme research in the field of road safety. This presentation will compare with the related but clearly separate research field of sustainable transport as a means of contrast. In the subsequent section patterns of reaction will be presented that affect the previously sketched status quo. On the one hand, these steps allow a depiction of the diversity of programme research, an understanding of which can be an important precondition for the recognition of scope for transformation. On the other hand, these steps make it possible to present a contextualised view on the French programme structure "PREDIT" which has proven itself durable, flexible and successful. As a conclusion, a general recommendation to learn from (or with) this programme architecture is coupled with a warning. While comparison between research areas is to be further encouraged, there is no reason or occasion to call for an integration of the research fields of road safety and sustainable transport.

2. A comparison of the research fields road safety and sustainable transport

A comparison of areas of research, particularly a comparison of neighbouring research areas, offers a privileged insight into the visions of research policies. The research fields of safety and sustainability in transport offer themselves because of

their different structures. The following presentation is based on the conditions prior to 2002, and consciously presents the comparison in an exaggerated and schematic form. As far as the comparison's relevance is concerned, it should be noted that both areas of transport research, that of environmental policy and safety policy, conform to a large extent to what we would understand as separate "communities".

By taking sustainability research as a standard the following points in road-safety research can be critically analysed:

Has road-safety research concentrated on too few projects that are too large and whose success, in certain circumstances, is particularly questionable? In the field of sustainable transport research it is not possible to distinguish such a concentration and long-term tying-up of resources.

Does the average older age of the personnel in road-safety research result in thematic inflexibility? The fate of aging personnel is not shared by sustainable transport research that enjoys the (nevertheless double-edged) advantage of being a comparatively young and less established field. To put the argument more precisely, the higher the average age of the research personnel, the higher the share of personnel costs. In a number of research institutes, this translates into a critical limitation of resources needed to engage in emerging subject areas.

Why has a welcoming of the formulation of questions from the social sciences been so long delayed? While research into sustainable transport has been counted as interdisciplinary from its beginnings and includes a remarkably large social sciences' component, until recently, no significant effort has been made to establish "road safety" as an object of research for the social sciences. In 2003, two social science based initiatives have taken shape. First, an operational group within the structure of PREDIT (programme of research and innovation in land transport) suggests extending institutional analyses undertaken in other fields of risk to the subject of road risk. Second, a "concerted action" launched by the Ministry of Research suggests to reframe the question of road safety within a broader context of a sociology of road uses.

Public research in the area of …	… Road Safety	… Sustainable Transport
Budget	Institutional funding (still) predominates.	Project-based funding predominates.
Projects	Small number of cost-intensive long-term projects.	High number of small projects of short duration (except for research in alternative energies).
Staff	Average age is high, researchers are predominantly male.	Balanced with regard to gender and age.
Disciplinary orientation	Engineering sciences, psychology, medicine	Variety of disciplines including urbanism, social and political science. Show-case of interdisciplinary research.
Science-(car) industry relations	Cooperation is limited. Industry-based research is generally centred on the safety of car users. For public research institutes involved in processes of standardisation collaboration with industry possibly implies conflicts of interests.	Cooperation is low. Matters of controversy persist.
Relationship between science and politics	Interface between research and politics is small and almost exclusively limited to government and national institutes (top-down), corresponding to an orientation towards technical innovation as a means of "natural progress".	Interface between research and politics comprises multiple levels of political action and a diversity of actors, including local and non-governmental organizations (bottom-up).

Table 1: Structural aspects of the transport research system in France, 2002.

How seriously are the indications to be taken of a problematic intertwinement between industry, research and organisations for standardisation in certain areas of road-safety research? Research into sustainable transport is generally considered to be more divorced from state and industry, hence this problem is foreign to it.

How can it be explained that NGOs have no voice in the articulation of research topics and programmes? At the risk of presenting a stylised and historically contestable simplification, one could say that while a "top-down" policy style is practiced in road safety, in sustainable transport research it is "bottom-up".

This comparison presents a particularly rigid and too homogenous picture of road-safety research. It does not imply that this condition has changed dramatically with the new status of road safety as a "national priority". Neither does it claim that such a change can be shown in a simple model of cause and effect. As stated to begin with, the formulation and reorganisation of an interface between actors of different kinds are processes with manifold prerequisites. The next section presents information about which visions of research policy are suitable to remove the impediments in road-safety research.

3. Competing visions of road-safety research

The comparison between road-safety and sustainability research fields was suited to provide an overview of both "scenes", but fails to do justice to their internal diversity. Some important internal differences within the field of road-safety research are emphasised in the following comparison.

a) Vision of population ecology: Road-safety research is impeded by an unfavourable age pyramid. Young researchers have to be mobilised for the topic, not only in the engineering sciences.
b) Academic vision: Road-safety research is impeded by a small number of large projects. Basic research and technical innovation have to be separated from each other. Mechanisms of academic competition have to be established.
c) Interactive vision: Road-safety research is disciplinarily impeded by an artificial separation of its objects into the components "road", "vehicle" and "driver". Research projects have to latch onto to the interface between these components and understand them in their interactive context.
d) Social-constructivist vision: Road-safety research is impeded by a too narrowly (i.e. technically) conceived formulation of problems. The fact that numerous disputed risk definitions enter into the equations of road-safety policies, based on actors with very divergent interests, is often lost from view.

Table 2: Visions for road-safety research in France. Based on expert interviews carried out in May 2004.

It is these four visions which inform the reaction to the presidential initiative and the new political direction of a determined policy of "controls and sanctions".

(a) The vision of population ecology considers the social structure of the research personnel to be the decisive variable. The fact that the personnel in transport research is too old, too male and too engineering-orientated has earned it a reputation of being out-dated. The age structures of the large research institutions have been identified as the most visible tip of the problem. This (reversed) age pyramid, which has also indirectly been held responsible for thematic obstacles, can not be inverted with the instrument of institutional promotion. The aim of rejuvenation and renewal can only be reached through the enhanced diversification and interlinking of research programmes. This requires sufficient incentives, and not merely of the financial kind. A promising development would be, for example, if researchers from other disciplines could be persuaded, at least temporarily, to work on transport and road safety.

The supporters of this vision of population ecology see in the fact that road safety has been declared a national priority overnight a possibility for fund raising that should not be missed. They are committed to raising budgets, and see in this a chance to rejuvenate and thematically diversify the field of research.

(b) The vision of academic normalisation demands a clear divorce of science and political practice. The Ministry of Transport should not be permitted to treat the research institutions that are close to the state as their own research offices. The research personnel must be exposed to publication pressure. The vision of making transport research more academic or "disciplinary" claims to secure long-term

expertise in the field. In common with the previous vision, it demands that the field of road-safety research be enlarged and simultaneously demonopolised so that mechanisms of self-evaluation and self-regulation can take effect in the academic field.

The academic vision also remains likewise very general. It reacted to the unexpected political break with reserve. Research should not be allowed to make the mistake of tying itself to a political programme. Even small concessions in terms of autonomy threaten the potential, also in the long term, to offer good advice. Even in times when their research topics enjoy a favourable political climate, the individuals who tend towards this vision place emphasis on a continuity in formulating questions and in research projects. It is important to guarantee that the legitimation of this research does not become as transitory as the increased reputations of the politicians who shortly thereafter turn to another field of politics.

The worst-case scenario in the diagnosis of both of the above mentioned visions looks something like this: a largely civil-servant research personnel blocks resources without exposing themselves to the constraints imposed by peer reviewed journals. The career planning younger personnel face in project-based research is highly insecure. This mixture introduces a generation conflict into research institutions, the blocking effects of which we do not have to speculate about.

(c) According to the interactive vision, the decisive deficit in current research is a fragmentation of the object of research into its constituent parts, and its analysis under laboratory rather than real conditions. As opposed to this, interactive approaches emphasise that research related to infrastructure, vehicle and behaviour have to be connected, and this under real, existing conditions. A professionalisation of the corresponding expert roles is unavoidable for the long-lasting establishment of a "system viewpoint", and this in turn requires massive political support.

The supporters of the interactive vision express their anxiety that the unexpected political revaluation of the topic is more detrimental to such a complex way of looking at things. Policy has only one concern at the moment – to legitimise the regime of sanctions and controls with a favourable development in the accident statistics. At such point in time the notice given to insecure research projects sinks. The task of research threatens to shrink to the punctual delivery of the latest accident statistics. This fixation with numbers does not foster an interactive vision of road safety.

(d) The social-constructivist vision demands a paradigm shift. Research into road safety must urgently and systematically involve itself with the instances of definition: how are problems in road safety "manufactured" and how are they delegated, translated, linked and solved? This vision likewise claims the system concept for itself because it poses the question, what constellations of actors explain how problems are perceived and tackled?

It is not risk awareness that is elastic, but rather the object of risk itself. This was a lesson learnt from the sociological observation of other risk debates (*Short and Clark, 1993)*. Road accident fatalities can be explained by human failure, but in complex socio-technical systems such an explanation often assumes more than it explains (*ibid*., p. 387). For instance, fatal accidents can often be due to the quality

of the road or the vehicle, or due to the lack of alternative forms of mobility to individual motorised transport. Underlying this juxtaposition of explanations is the question who has the power to define? Who decides how transport risks are defined? On the basis of what definitions are policies formulated? In emphasising this aspect, the social-constructivist vision provides a commentary to the new political conditions behind road safety. It emphasises that, even when the policy implementation of the new priority with the tightening of controls and sanctions is successful, this does not verify the definition of the risk object.

These latter two visions clearly distance themselves from a linear model of research and innovation which one interviewee refers to as "natural progress". To simplify, the linear model of research and innovation assumes that, originating in research and development, innovations will then subsequently be implemented by means of political action. It is not denied that component innovations and tightened regimes of "sanctions and controls" have contributed to reduce the number of road casualties. But it is claimed that the contribution of programme research to road safety must involve taking precautions for the time after natural progress.

Conclusion

Both the comparison between research areas and the explication of strategic visions presented above draw on experiences and reflections which would not have been available without the platform of PREDIT, a French programme for research and innovation in land transport. Almost intrinsically, its construction clamours for comparisons between the areas of research to be carried out and that profit is made from their heuristic potential. PREDIT is set to run in four year tranches and in 2007 will enter its fourth round. At the moment PREDIT is divided into eleven operational groups, of which two each are working on questions of safety and sustainability. Provided that "the times of natural progress are over" (an interviewee) there is a reason to enhance programme research following the example of PREDIT. Some characteristics of this programme architecture are worth to be particularly mentioned (for detailed programme information, see *Drouet and Sachs 2004* and the PREDIT homepage http://www.predit.prd.fr/predit3/).

First, when compared to its German counterpart "Mobilität und Verkehr", there is a remarkable attention for scansion[2] (*Potthast and Dienel, 2003*). Calls for proposals, mid-term evaluation, final event, construction of a new thematic framework: A four years PREDIT cycle is marked by a clear and visible sequence, accentuating the two phases of the practice of programme research. Moments of launching and completion of programmes that are characterised by a high degree of reflexivity alternate with phases that are best described as "muddling through". To know how to launch and how to finish a research programme precludes that a good rhythm of muddling through and reflection has been found; a rhythm that can be scanned by all the participants.

[2] According to the Oxford English Reference Dictionary (2002) "scansion" has two meanings: „1. The metrical scanning of verse. 2. The way a verse etc. scans." Both meanings can be applied to research programs. On the one hand, a successful research program can be said to scan like a verse which is metrically correct. On the other hand, to run a research program requires metrical analysis. This paper suggests that reading research programs with the emphasis on their rhythm provides a common basis for a comparative analysis of research programs of different countries or subject areas.

A second reason to follow the French example and to start up research programmes à la PREDIT is that this programme redistributes research funds from four different ministries and two government agencies while escaping perverse effects of centralization. The programme architecture gives the operational groups a high degree of autonomy, although under the condition that they are financed on an inter-ministerial basis. Each of the operational groups is supported by at least two funding bodies and directed by an independent chairman (generally a distinguished researcher). Without having created the need for its own bureaucratic structure this construction has proven itself to be robust and receptive to reform. Established in 1990 (PREDIT 1; 1990-1994) and twice relaunched (PREDIT 2, 1996-2000; PREDIT 3, 2002-2006), its performance as an intermediary organisation between science and politics is outstanding with respect to both endurance and adaptability.

The history of PREDIT remains to be written. It would offer an interesting piece within the broad picture of a disappearing Colbertiste state since 1980 (*Mustar and Larédo, 2002*). Instead of reproducing a model which involved a public pilot and relied on the support of a national champion, its precursor (PRDTTT; 1985-1989) has clearly anticipated the age of decentralised "thematic research and technological innovation networks". Unlike most research programmes of comparable size, PREDIT managed to survive several changes of government. Public funds spent on each generation of the programme add up to the equivalent of some 300 Million Euro. In the 1960s the Ministry of Transport in France was the innovator of a comprehensive project of administrative modernisation ("rationnalisation des choix budgétaires"). Today, it houses the small secretaries' office of PREDIT. This research programme has taken on the characteristics of a brand and maybe suggests itself as a model for the harmonisation of national research programmes within the European framework.

Both within and beyond PREDIT no indication could be found that road safety and sustainable transport should be merged as areas of research. Pointers towards synergy potentials or frictions in the field of policy have been searched for in vain. Following the presidential announcement, two national newspapers in France (*Libération*; *Le Monde*) opened web forums to discuss issues of road safety and received some 300 contributions each within a few weeks. However, there is not a single mention of sustainability or the environment to be found. None of the contributions bring up frictions between safety and environmental aspects as a subject of discussion. The policy areas are not even linked when the connection is the explicit topic: A recent collection of papers from the European Ministry of Transport Conference has been dedicated to the subject "safety and sustainability" (*ECMT, 2003*), but what is in fact meant by this confluence is not even explained in the introduction. Only a single aspect is put forward, namely that the users of the most sustainable means of transport are particularly vulnerable. In view of the very meagre indications of policy innovations emerging from a linkage of road safety and sustainability, there is no reason for synergy expectations or demands for integration at the level of the research fields.

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Sustainable development and transport Safety – antagonismes or synergies?

By Frazer Goodwin

1. Safety and Environmental Protection Interactions

Historically, there have been a number of areas where the consideration of transport safety obviously strongly interacts with environmental policy making. Examples where this relationship is mutually supportive are those policy actions intended to prevent marine accidents resulting in damaging tanker spills, or environmental driving programmes that teach drivers more economical driving styles which also improve safety. But there are also many examples where there are apparent conflicts between environmental and safety objectives for transport policy. For example, decreasing the weight of vehicles to improve fuel efficiency, compromises efforts to improve the passive safety of vehicles. Promoting cycling and walking to decrease the environmental impact of personal mobility can conflict with efforts to reduce the casualty levels from these modes of transport, especially if the promotion of these modes is undertaken before safety improvements, such as increased cycle helmet use, are put in place.

There has therefore been a degree of tension within transport policy between efforts under the name of sustainable development or environmental protection and policy initiatives aimed at improving transport safety. Moreover, there is a degree of competition between the two policy communities. Those in the environmental community and those in the safety community understand that there is a limited time and resources budget for transport decision makers. Which community receives more attention by transport decision makers is thus frequently viewed as a significant indicator as to the relative priorities afforded to either environmental concerns or safety considerations.

There is one area where this *competition* between the safety and environmental community becomes apparent: the virtual debate as to which transport impact causes most death and injury- accidents or pollution. Environmentalists claim that pollution is transports biggest killer in their advocacy materials. They site the large figures of deaths that epidemiological studies attribute to elevated air pollution levels. These studies, they argue, demonstrate that traffic pollution is by far the most important transport problem to deal with, even killing more than traffic accidents.

Safety campaigners, on the other hand, advocate action to improve safety on the basis that accidents are transports largest cause of injury and death. Safety campaigners also counter the epidemiological claims of environmentalist's with assertions that highlight the number of "life years lost" by traffic accidents. For accidents the victims are predominantly young, compared to those affected by pollution where they are frequently the elderly or infirm. Naturally this virtual debate is extremely difficult to resolve to the satisfaction of either side, especially when the sub text of the debate is considered. The reason *why* each of the two policy communities ever deploys such arguments is that "success" in this virtual debate merits a greater priority being

afforded by decision makers to actions targeting either safety or environmental sustainability.

Yet the clamour to receive priority attention from decision makers with claims of large numbers of deaths and injuries poorly serves the message of what remedies are needed for both environmental sustainability and transport safety. Indeed, these arguments promulgate a low level of understanding about both sustainable development and transport safety policy making. Both the environmental and safety problems of transport require a systemic approach from decision makers. Both require numerous individual policies which tackle the complex range of factors contributing to both of these problems. It is relatively unimportant whether the front (accidents) or the back (pollution) of a car is the most dangerous compared to the fact traffic causes deaths and injuries through both pollution and accidents. And it is only policy making overall that can alter the nature of this traffic.

It is therefore necessary to revisit both the concept of sustainable development and the state of the art in transport safety policy making to examine what potential there really is for synergy or antagonism.

2. The Concept of Sustainable Development

Sustainable development as a concept emerged from efforts to reconcile the seemingly disparate goals of securing environmental protection whilst fostering the economic and social development required for much of the worlds poorer nations. Environmental protection gained international prominence in the 1970s, with the first global conference on protection of the environment in Stockholm in 1972[3]. This happened following the burgeoning of environmental concerns in industrialised countries towards the end of the 1960s. Works such as Silent Spring by Rachael Carson highlighted the dangers to health and the environment posed by modern society, in this case the industrialisation of agriculture. A seminal work by the Club of Rome – "The Limits to Growth" crystallised the predominant environmental view of time that resource depletion or pollution would lead to an ecological doomsday. This neo-Malthusian strand of environmentalism only antagonised further those developing nations with the most poverty and fastest growing populations. It led Indira Ghandi at the Stockholm UN conference on the human environment to pose the question: "Are not poverty and need the greatest polluters?"[4]

Throughout the rest of the 70s and the 80s more and greater environmental threats were identified, for example climate change, a dangerous hazardous waste trade, ozone depletion and deforestation. Yet at the same time events such as the 1984 Ethiopian famine highlighted the urgent need for global development. To reconcile these two goals the United Nations established a World Commission on Environment and Development led by the Norwegian ex-Prime Minister Gro Harlem Brundtland[5]. It

[3] The United Nations Conference on the Human Environment 5-16th June 1972 in Stockholm was the first gathering of worlds politicians on the environment, and the spur to the creation of many environment ministries and ministerial Portfolios on the environment. See "The World Environment 1972 – 1992 Tolba *et al*, UNEP 1992.

[4] Indira Ghandis speech to the United Nations Conference on the Human Environment was the only one made by a visiting Head of State as she was the only one to attend the meeting apart from the host Olof Palme.

[5] The Commission was established by a United Nations General Assembly resolution UNGA 38/161 in 1983.

was this commission that defined and popularised the term sustainable development in their report, *Our Common Future,* 1987.[6]

Defining sustainable development as a "development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs" (*ibid*., p.43) enabled them to demonstrate how environmental protection could be fully compatible with social and economic development. The much quoted definition is rarely accompanied by the explanation of what the WCED believed it meant – which was a priority to addresses the most needy of today and the limitations imposed by technological development and social organisation[7].

The WCED report to the UN underpinned the main output of the United Nations Conference on Environment and Development held in Rio twenty years after the Stockholm conference. In addition to international conventions covering biodiversity and climate change and a statement of principles on forestry, the Earth Summit adopted a forty chapter handbook on applying sustainable development – Agenda 21. This handbook outlined not just *what* sustainable development is, but *who* is key to its application[8], and *how* a stakeholder approach would implement sustainable development.

3. Sustainable Development and Transport

Unfortunately, despite covering a whole range of issues and sectors, Agenda 21 didn't explicitly cover transport. Yet by this time the environmental problems of transport had been evident for decades from the Amoco Cadiz to the problems of leaded petrol and air pollution from traffic. Moreover, transport policy making was also failing in other ways. There continued to be a large scale problem of road traffic safety, or rather continued high levels of road risk. Furthermore, the large increases in automobility in OECD nations had not provided improved mobility. Indeed in several respects automobility has created autoimmobility (see box 1). It is not as though policy makers have ignored all of these problems – they have not. But single or independent policy approaches to transport's problems appear to have had only marginal effects. Thus, whilst banning leaded petrol and requiring ever strict emission standards for new cars reduced pollution per kilometre, it has had a much smaller impact on overall levels of air pollution from growing levels of traffic[9]. Indeed, traffic still produces air quality

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[6] Although the popular paperback book published by the WCED was "Our Common Future" the formal report of the WCED was titled "Environmental Perspectives to the Year 200 and Beyond" and was addressed to the United Nations General Assembly convening in 1987.

[7] The passage normally quoted is followed by: "It [sustainable development] contains within it two key concepts:

- the concepts of 'needs', in particular the essential needs of the worlds poor, to which overriding priority should be given; and
- the idea of limitations imposed by the state of technology and social organisation on the environment's ability to meet present and future needs".

In *Our Common Future*, Oxford, Oxford University Press, 1987, page 43.

[8] Agenda 21 identified 9 major stakeholders as key to implementing sustainable development. These were called "Major Groups" and were identified as: Women, Children and Youth, Indegenous People, Non-governmental Organizations, Local Authorities, Workers and Trade unions, Business and Industry, Scientific and Technological Communities, Farmers.

[9] The latest standards applicable to passenger cars (the second stage of EC Directive 98/69/EC) Euro IV allow less than 5% of the emissions permitted by the first European emission Standard (Directive 70/220/EEC). The lower emission allowed have required complex exhaust after treatment, engine management and higher quality fuels. Yet the simplistic test cycle utilized allows ample scope for "cycle beating" and "chip tuning" where cars passing the emissions test have on road emissions that are substantially above the test requirements.

dangerous to health in cities[10] a situation projected to continue into the foreseeable future[11]. And whilst massive road building and improvement schemes have been continually revised to meet ever increasing forecasts for traffic growth, congestion continues to be problematic[12]. Or whilst planning guidelines are changed to stem the tide of out of town retail development, the market share of dominant large retailers continues to climb.

There has also been recognition for the need for more comprehensive, holistic, or systemic approaches. Declarations and statements from high level political leaders have frequently reiterated the need for such an approach[13]. Moreover, these declarations and policy statements recognise several recurring themes and principles. The polluter pays principle is one such widely recognised principle that as yet is not applied to transport. A further related principle is the internalisation of external costs and the user pays principles. Application to some extent of all of these principles is widely seen as necessary to transform transport towards sustainable development[14]. Yet despite this consensus in statements and declarations, application remains to be undertaken. Other policy objectives have also been widely endorsed in declarations and policy statements. The need to achieve modal shift away from dangerous and polluting modes of transport to safer and less polluting modes for example. There has even been widespread recognition of the need to take "demand side" measures to decouple economic growth from transport growth[15]. There is therefore somewhat of an unfortunate gap between declarations and statements of intent from transport's political leaders, and their record of implementing systemic approaches applying their stated principles[16].

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[10] Widespread scientific consensus on this is demonstrated by European Environment Agency TERM report: "Overall the decrease in emissions does not appear to have a significant influence on the air quality and the increase in the number of vehicles is off-setting the technological and fuel quality improvements", for more detail see: http://themes.eea.eu.int/Sectors_and_activities/transport/indicators/consequences/TERM04%2C2003.09/index_html

[11] See the final report of the Auto Oil II Programme: "The results of the modelling of air quality in 2010 suggested that of the targeted pollutants, neither carbon monoxide nor benzene would pose challenges in any of the AOPII cities. Exceedences of the objective for nitrogen dioxide were predicted only for two cities. Exceedences of the PM10 objective would be more widespread, affecting possibly half of the cities. These conclusions were broadly supported by the generalised empirical approach applied by the European Environment Agency to a large sample of European cities. Further scenario analysis by the JRC demonstrated that road transport would still have a major influence on urban air quality in those cases where exceedences were predicted". See http://europa.eu.int/comm/environment/autooil/auto-oil_exsummary_en.pdf

[12] This is in fact unsurprising as an unwanted affect on the provision of extra road space is creation of additional travel demand. See Roads and the Economy – the UK Standing Advisory Committee on Trunk Road Assessment 1992.

[13] There are numerous declarations transport Ministers have signed up to from the 1987 UNECE Vienna Declaration through the 1999 London Declaration on Transport Environment and Health to the EU Gothenburg process and the Gothenburg Council Conclusions of June 2001, or the White paper on the Common Transport Policy November 2001 and the Council and Parliament reactions to it (2003).

[14] The need for the application of user pays and polluter pays principles was acknowledged in the White Paper on the Common Transport Policy "Time To Decide" adopted September 12 2001.

[15] Also prominent in the White Paper on the Common Transport Policy are the need for modal shift and demand management to decouple transport growth from economic growth.

[16] The most notable example of this is the failure to apply the pricing principles agreed to under numerous declarations in the Eurovignette Directive (the charging / road taxation scheme for HGVs), or indeed as of June 2005 agree to a final deal on this dossier.

Large increase in modern society's automobility has created many related problems. Ironically, many of these problems have led to reduced mobility or reduced access to the goods and services mobility should provide. Increase in automobility has spurred problems of autoimmobility. For example, average speeds in cities such as London were the same or slower in the 1980s than the 1880s. Congestion had meant that personal automobility had led to personal immobility - , as people sat in traffic jams and slow traffic on a daily basis. Moreover this auto-immobility extended beyond the immobility of congestion. Most obviously those incapacitated by both accidents or pollution. Ultimately those who die in accidents or with pollution related disorders suffer a great deal of auto-immobility. But beyond those permanently immobile and those temporarily immobilised either in hospital or at home, there are those who suffer auto-immobility in different ways. Widespread car dependence has led to low income households using high proportions of their incomes on owning and maintaining a car in order for the breadwinner to commute to work. However this often leaves the young, the elderly and homemaker or child carer without access to transport. The car dependent economy has resulted in reduced public transport service provision, and lower levels of community based shops and services in many large urban areas. Thus those without access to the family car suffer great levels of auto-immobility. Moreover, there are great segments of the population who cannot drive for a whole range of reasons – reduced vision, other medical conditions, or simply a great fear of modern traffic from older people accustomed to calmer traffic conditions. The increasingly car dependent society and economy has disenfranchised participation in many aspects of the automobile society and produced a situation of auto-immobility for them.

4. Transport Safety Policy

Unfortunately, it has also been the experience in the road safety area that the results of numerous policy initiatives undertaken so far have fallen short of ideal levels of safety. These initiatives include actions to improve the passive safety of the vehicle (improved crash worthiness standards, as well as advances such as ABS) and the behaviour of the driver (mandatory seat belt use, stricter enforcement of drink driving rules as well as lower blood alcohol levels and speed limits) have reduced the number of fatal and serious accidents. Yet the total number killed and injured remains at very high levels, and fears remain for steep increases in mortality and morbidity in those countries about to embark on the automobility revolution. By the end of the 80's road safety was viewed as requiring a systematic approach to ensure that infrastructure, vehicle and driver all contributed to reducing risk. It is this broad systems approach that marks the current predominant paradigm for road safety policy making (*OECD, 2002)*

In Sweden by the mid 90's there was a realisation that an even more comprehensive approach was necessary to further reduce road risk. This realisation saw the development of "Vision Zero". This approach represents somewhat of a new paradigm[17] for road safety policy making in two respects. Firstly in that it establishes the objective of avoiding road casualties as the priority for policy making overall, not

[17] A paradigm was defined by Thomas Kuhn in 1962 as "that constellation of values, beliefs and perceptions of empirical reality, which, together with a body of theory based upon the forgoing, is used by a group of scientists, and by applying a distinctive methodology, to interpret the nature of some aspect of the universe we inhabit" (*The structure of Scientific Revolutions*, 1962). Kuhn later retracted this definition, replacing it with a definition of a paradigm as an exemplar. Nonetheless, it is the author's contention that Kuhn's initial notion that a framework of ideas, beliefs and approaches structures the nature and thus content of a branch of science including its application remains valid.

just transport policy making and secondly in that it accepts that in a human system mistakes will be made. Therefore, those responsible for designing and managing *the system* (mainly transport policy makers) need to not only restrict and control "mistakes" (inappropriate speed, etc.) but they must also enable the system to be "forgiving". One mistake should not be a driver last before his journey to the morgue. For Vision Zero to be implemented all relevant aspects and actors of policy making should contribute - from politicians and planners to road managers and traffic police, as well as safety organisations and the users. This is therefore a total framework (or *gestalt* in Khunian terms) approach, producing a road safety paradigm that integrates and synthesises the elements of the system towards the common objective of zero fatalities.

Vision Zero therefore potentially marks a *paradigm shift*[18] in transport safety policy making, a paradigm shift that for sustainable development needs to be replicated for the *gestalt* of transports other impacts on society. The contention is that if a systemic, integrated and holistic approach is applied to "sustainable" transport policy making, then there will be synergies with safety and vision zero rather than antagonisms.

5. Transport Safety and Sustainable Development Synergies

Two examples will now be explored to examine this contention further. The first of these will highlight how the seemingly antagonistic sustainability and safety goals would both be served with a full application of a systemic approach to dealing with the impacts of sports utility vehicles (SUVs). The second example, urban speed limits, will highlight how the concept of stakeholder participation, central to sustainable development and Agenda 21, has been harnessed in vision zero to gain environmental, social, and safety benefits.

The debate surrounding SUVs underscores a potential antagonism between road safety and environmental objectives for transport: the relationship between vehicle weight, and fuel efficiency or passive safety. It has long been argued that the features necessary to enable improved occupant protection inevitably come with the price of increased vehicle weight and thus lower fuel efficiency. Moreover, the vehicles that *subjectively* offer the greatest occupant protection with their bulky design features and high ride position, SUVs, are those that provoke the greatest ire among environmental campaigners for their fuel profligacy. This hostility is so pervasive that several local authorities are exploring ways in which SUV use may be prohibited or penalised within their locality. Yet in reality SUVs highlight how the weight to safety Vs fuel efficiency debate may be resolved. Firstly, the *objective* safety performance of SUVs is rather weak compared to a subjective view derived from their appearance. Their Euroncap scores for occupant protection, a test that assumes collision with a similar vehicle, are not more impressive than those for other vehicle classes. Indeed they are outscored most of the time by other types of family car[19]. The "bulky" appearance of SUVs is thus

[18] A paradigm shift in that it shifts the focus away from just the fields traditional for the transport policy maker (vehicles, infrastructure, driver behaviour) to include broader considerations and engage wider participation by actors previously outside the safety policy making community.

[19] EuroNCAP ratings for large SUVs are on average 3.9 (out of five), for small SUVs 3.5 but family cars tested over the same period (since 2002) have an average rating of 4.3. None of the top 10 cars tested to date are SUVs the top ten being:

1. Citroen C5 (36, 8)

more of a styling feature than an objective safety component. Moreover, SUVs are more likely to be involved in single vehicle roll-over accidents than other car classes (*Safety report 2002/2003*).

Secondly the biggest safety concern for SUVs relates to their bulk and height. In collisions with smaller lighter vehicles they present a higher risk than other smaller lighter vehicles. It is this issue of compatibility within the fleet of road vehicles that makes SUVs problematic from a safety perspective. Thus the physical characteristic that makes them feel safer – and allows the driver to be a "boss of the road" - actually provokes rather than solves a safety issue. How this issue of an increasingly polarised fleet of heavy and lighter cars may be resolved remains to be resolved[20], but the fact is that the weight necessary to improve vehicle occupant safety does not pose as great an emissions threat as the "upsizing" that has resulted from more subjective desires for *feeling* safer.

Finally the overall environmental objective of reducing carbon dioxide (CO_2) emissions from cars needs to target total road traffic emissions, rather than just new car fuel efficiency[21]. The impact that safety features such as improved occupant protection, or indeed other initiatives such as day time running lights, are rather marginal in comparison to the other ways in which new cars can be made more fuel efficient and total road CO_2 emissions curbed[22]. Just as for safety, this environmental objective requires a systemic approach if it is be resolved rather than single or independent policy actions. The approach also needs to engage all of the relevant stakeholders. An important stakeholder is the motor manufacturers who must be provided with a different profitable option to the SUV. At present the manufacturers hide behind the argument that SUV sales are consumer led, when they spend a large part of their marketing budget on making this demand a reality, and the policy makers are providing no profitable alternatives. This should change if the problem is to be resolved both by making the SUV less attractive financially to consumers and by sending more positive price signals on other more sustainable vehicles.

The second example underscoring the contention that a systemic approach to "sustainable" transport policy making would see synergies with vision zero is urban speed limits. The Commune of Trollhätten in Sweden examined ways in which as a local authority it could implement vision zero. In partnership with the Swedish National Road administration it redesigned road infrastructure both within the urban area and

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2. Citroen C4 (35, 22)
3. Ford Focus (35, 15)
4. Toyota Corolla Verso (35, 11)
5. Renault Espace (35, 10)
6. Volvo S40 (34, 18)
7. Peugeot 407 (34, 15)
8. Toyota Prius (34, 13)
9. Renault Laguna (34, 12)
10. Renault Scenic (34, 11)

The best SUVs tested are:
11. Volvo XC90 (34, 10)
12. VW Toareg (34,7)
20. BMW X5 (33, 2)

[20] The issue of increasing vehicle polarisation will form the subject of a forthcoming ETSC publication where the scale of the problem and potential policy options will be reviewed.

[21] The EU has developed an entire policy area on the fuel efficiency of new cars, but has not outlined nor taken other actions to reduce overall road transport CO_2 emissions.

[22] AOPII projections for CO_2 emissions, even if the voluntary agreement is maintained.

on interurban roads within its boundary. But a more important partnership for the success of the project was with the people of Trollhätten. At each stage of the process there was full consultation with residents allowing road design options to be debated and evaluated by those to be most effected. The result was that even though urban speed limits had been reduced, something which polls had demonstrated lacked public support prior to the scheme, following completion the scheme they were favoured by a majority of residents. Moreover a continued consultative process allowed the authorities to refine the design after a period to account for some of the more negative comments received on the scheme. Overall the scheme was not just about safety *per se*, but about improving the quality of life in Trollhätten and improving the feel and appearance of the town. Nevertheless, since the scheme was introduced there have been no fatal or serious accidents in Trollhätten, where previously there had been several each year. Overall, pollution levels, noise levels, and accidents all dropped as speeds fell and the appearance of the city improved.

The experience of Trollhätten highlights how implementing lower urban speed limits is so much more than merely replacing signposts, both in terms of the process and the result. The redesign and construction of the street architecture and infrastructure in conjunction with an in-depth consultation process with those most effected not merely changes the posted limit, it reduces speeds and improves the quality of life. The *modus operandi* (or "MO") of sustainable development is the application of a systemic approach via stakeholder participation. And vision zero applied by a local authority utilised exactly this MO.

Moreover other policy instruments that lower speeds and thus have positive effects on both the environmental safety of impacts road transport also benefit from a participatory approach to their implementation. Traffic calming schemes and Intelligent Speed Adaptation (ISA) are two such policies. Traffic calming measures were an element of the Trolhätten scheme, but can also be used to reduce speeds even when the speed limit itself is not reduced. Even in this application more is gained by extensive consultation and engagement with the local residents rather than more draconian schemes imposed upon them. Moreover, numerous ISA trials have demonstrated that persuading a sceptical motoring public of the benefits of ISA and adopting informative rather than controlling technologies can greatly improve acceptability of the technology[23].

6. Sustainable Development in EU Environmental Policy Making

More generally, the experience of the stakeholder participation approach across the field of environmental policy making is that it has paid dividends. For example, environmental quality standards for air pollution have been attained by actively engaging all the stakeholder groups alongside the provision of detailed environmental information to citizens. Air quality legislation now requires Member States to warn the public by TV radio and other media when pollution levels threaten health. This legislation also requires Member States to take actions to reduce air pollution to safe levels over a specified time.

[23] For example see the results of the Swedish National Roads Administration ISA trials at: http://www.isa.vv.se/novo/filelib/pdf/isarapportengfinal.pdf or the results from Dutch trials at: http://www.rws-avv.nl/avv/us/prosper/isa_tilburg.pdf.

The process that developed this legislation saw extensive stakeholder consultation with many working-groups consisting of representatives of Member State governments, industry bodies, environmental NGOs all aided by scientific input guided by the European Commission. Furthermore, all of these individual stakeholder groups were treated as equals in the process and this led the process to have a shared ownership. This greatly enhanced the potential for Member States to agree to bind environmental quality standards following their proposal by the Commission.

And in the related policy of air emission limits for road vehicles another stakeholder participation process has been similarly productive. The Auto Oil Programme initially combined the input and expertise of the oil refining and automotive industries, alongside the Commission, to aid revision of vehicle emission limit values and proposed new fuel quality standards. The second round of the programme engaged all of the relevant stakeholders, including environmental NGOs and Member States, a process which greatly facilitated the adoption of these new standards.

Under the Clean Air For Europe (CAFE) programme the twin processes of developing and monitoring air quality legislation on the one hand and revising emission standards on the other have now been combined[24]. But here again the stakeholder approach has been harnessed with all those engaged treated as equals. Moreover, it is not just in the field of air quality that this approach has been used. Stakeholder participation has been prominent in the development of water quality legislation too. Here again a long and in-depth process of stakeholder participation is allowing the EU to adopt a series of environmental quality standards that apply to all aspects of water e.g. drinking water, bathing water, and surface waters. Moreover it is important to recognise the scale of the stakeholder community impacted by these initiatives. Air and water pollution policy affects all branches of the economy and all sectors of society. Rather than stymie policy making the stakeholder approach, treating all affected as equals, has facilitated progress.

Stakeholder participation is therefore one area where the MO of sustainable development has been successfully harnessed in the environmental policy field. The environmental policy making experience of using the stakeholder approach to harness all affected parties as equals in order to obtain binding quality standards now needs to be replicated in the safety domain.

This could be achieved by using a stakeholder process, with all participating as equals, that applies a systemic approach to establishing *road risk quality standards*. These quality standards would be analogous to the air quality limit values prescribed by European air quality legislation. These standards are based on a scientific evaluation of the health risks of human exposure to air pollution. The relative merits of what air pollution levels constituted acceptable risk levels was then debated within an open process that engaged all stakeholders before the proposals were presented to the

[24] "Clean Air for Europe (CAFE) is a programme of technical analysis and policy development which will lead to the adoption of a thematic strategy on air pollution under the Sixth Environment Action Programme by mid 2005. The major elements of the CAFE programme are outlined in the Communication on CAFE ((COM(2001)245). The programme was launched in March 2001. Its aim is to develop a long-term, strategic and integrated policy advice to protect against significant negative effects of air pollution on human health and the environment. The integrated policy advice from the CAFE programme is planned to be ready by the beginning of 2005. The European Commission will present its Thematic Strategy on Air Pollution during the first half year of 2005, outlining the environmental objectives for air quality and measures to be taken to achieve the meet these objectives." (Quoted from DG Environment air quality web site: http://www.europa.eu.int/comm/environment/air/cafe/index.htm)

European Parliament and Council for approval. The resulting air quality limit values require Member States to ensure pollution does not climb above certain levels on their territory, but leaves them freedom under the subsidiarity principle in deciding which policies to pursue to achieve this. This process of establishing what risk levels are deemed acceptable for society as a whole and then allowing Member States freedom to decide how to reduce risk to these levels should now be applied to road risk by establishing *road risk quality standards*.

This could be undertaken in the context of the third road safety action programme, following its mid term review. The Commission would thereby utilise the MO of sustainable development as harnessed in both Trollhätten and EU environmental policy making.

It would also enable the Commission to follow through with its commitment to explore "other means" of achieving the target of halving road fatalities by 2010. It would enable the promotion of a systemic approach to safety, whilst allowing Member States freedom in adapting this to national circumstances. They would retain their sovereignty in this area of shared competence by defining how this *road risk quality standard* is to be achieved, thus diminishing subsidiary concerns in the same way that environmental legislation has.

7. Lessons for the EU

But the lessons of vision zero and sustainable development for EU policy making do not stop here. The process of integrating environmental and sustainable development considerations needs to be refined and improved. Firstly the efforts undertaken so far need to be strengthened such that documents such as the Third Road Safety Action Programme need to make explicit connections to related EU environmental objectives. Secondly the process needs strengthening such that environmental policy initiatives, such as the urban environment strategy need to take explicit account of EU safety objectives such as those in the 3rd Road Safety Action Programme.

There is also a much more sophisticated approach to providing information to citizens within environmental policy making than is the case for road safety. Moreover, the TERM[25] process initiated to serve the integration process enables progress to be monitored by the European Environment Agency and provides valuable information to stakeholders and Member States. The Community Road Accident Database - CARE and the Road Safety Observatory should utilise and replicate this valuable experience.

Additionally the monitoring and reporting requirements of environmental legislation, including alerts to citizens, ensure that the profile of the problem remains in public view. By so doing it facilitates those actions that would otherwise provoke uninformed hostility and diminishes the scale of such reactions. This dual approach of monitoring impacts and publicising quality standards could be usefully replicated in the safety arena ensuring that need to take action to improve safety is regularly reinforced.

[25] Transport and Environment Reporting Mechanism has published three reports. The first (TERM 0) established the indicator set to be utilized and TERM1 and TERM 2 have applied these indicators to monitor transports progress in environmental impact with specific reference to enlargement. See: http://reports.eea.eu.int/term2001/en and http://reports.eea.eu.int/environmental_issue_report_2002_24/en.

Greater efforts are required by all of the EU institutions to promote this systemic approach so as to maximise its benefits. There have been initiatives by the Commission that attempt to promote a more systemic approach to transport policy making which have been somewhat neutered by the Council and the European Parliament. For example the Commission developed over a number of years a framework for charging for transport infrastructure so as to "internalise" the current "external costs". There was even a lengthy process of consultation with a Green Paper being followed by a White Paper and input received and reviewed from stakeholders and a high-level group. This led to a consensus approach that would internalise external costs in five areas, one being accident costs. Yet when the Council and Parliament reviewed the first proposal to emerge from this process, on charging heavy duty vehicles for using road infrastructure, accident costs were removed from this framework.

The removal of accidents costs from this dossier undermines both the systemic approach and the stakeholder process that had developed the initial proposal including them. It is disappointing that the Parliament in particular failed to support the output of such a process and the systemic approach in this new policy area. Indeed, compared to revising all other existing policies, the fact that transport pricing is a "new" policy tool should allow easier application of the systemic approach of both sustainable development and vision zero. Moreover, the early results of the somewhat rudimentary London scheme provide optimism for the potential contribution this policy lever offers to implement a systemic approach. This is particularly so given the higher degree of sophistication envisaged for future schemes both in London and elsewhere.

With specific regards to the Commission, the structures set in place for "integration", requiring the Commission to evaluated decisions for environment or sustainable development implications, do not initiate a process with the goal of securing the *paradigm shift* needed for the EU *gestalt* (i.e. the *acquis communautaire*). It is important to recall why the integration process was undertaken in the first place. The EU and EC Treaties required it. They still do, and the EU Constitution, if it is to be adopted, would require the EU to *"work for the sustainable development of Europe based on balanced economic growth and price stability, a highly competitive social market economy, aiming at full employment and social progress, and a high level of protection and improvement of the quality of the environment*."[26] At the moment the integration process does not pro-actively *work* towards sustainable development. Rather it merely acknowledges that policy initiatives should *take account* of it. Greater efforts are thus needed to comply with the EU Treaty objectives.

In transport policy making it is important to recognise that there has been acceptance in numerous fora for the applicability of sustainable development principles to transport policy. Moreover, the overall sustainable transport *debate* has been similarly systemic to the approach of vision zero. For example the UNECE Vienna Declaration on transport and the environment, or the WHO London Declaration on Transport Environment and Health, or even the conclusions of the ninth UN CSD. But the *application* of sustainable development has been rather more limited. It has been largely characterised either by independent environmental initiatives by environment decision makers (lower emission standards, higher quality fuels etc) or by the adoption of the language of sustainable development by transport policy makers in declarations.

[26] Treaty Establishing a Constitution for European, Part I, Title I, Article I-3.2. *The Unions Objectives, emphasis added*

Transport policy makers, however, are yet to implement the necessary policies that would fundamentally revise the transport policy *Gestalt*.

A paradigm shift is therefore required that operationalises the systemic sustainable development approach in transport policy making. Or, alternatively, there should be efforts to reverse the integration process so that environmental, health, and social policy makers begin to adopt decisions to alter transport. Without either of these two developments autoimmobility will continue to blight all our lives and sustainable development remain unobtainable for transport.

Conclusion

This paper has reviewed the compatibility between sustainable development and transport safety policy making. The main contention has been that both sustainable development and transport safety policy making are characterised by a need to implement a systemic approach to policy making via stakeholder participation. The paper has also highlighted the degree to which any antagonisms between individual policy strands of sustainability and transport safety are subsidiary to the potential synergies to be gained from applying such a systemic approach. There are specific lessons that can be learned for EU level policy making in order to move from declarations of intent to concrete action. In particular road risk quality standards need to be elaborated. Sustainable development will require improved transport safety and systemic policy making is required to achieve this which engages all stakeholders. The policies required to achieve this are known, now it is time to invest the necessary political capital to implement them. This is not an unusual conclusion for both those who follow sustainable development and those who follow transport safety. The one thing at the top of both agendas is some political leadership. It's delivery is overdue.

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Sustainable management and design of urban mobility networks and public space … as if safety for vulnerable road users' mattered

By Prof. Maurizio Tira

1. Introduction: the need of new concepts on safety to promote walking and cycling

The most traditional approach to safety is that of treating the 'clustered' accidents. Analysing the police reports and the accidents locations leads experts to identify so-called 'black spots' (better said 'most dangerous spots'). Engineering solutions are then available which research has shown to work in a variety of environments. However, local conditions often prevent them from being fully implemented or completely effective.

Moreover, the proportion of 'scattered' accidents (accounting sometimes for 50% of the total) increases the importance of area-wide techniques. In this context, an 'area-wide safety approach' is of particular interest and obliges us to take into consideration 'urban features'. More generally, conventional approaches to the promotion of the safety of walking and cycling emphasise the development and improvement of dedicated facilities for pedestrians and cyclists (see, for example, the EU funded projects ADONIS, WALCYNG, PROMISING, PROMPT and COST Action C6).

This latter approach has had unintended safety benefits. Many studies show that the increase in the use of cycling goes together with improved safety for cyclists (*Jensen et al., 2000*). This fact seems counter-intuitive, in that increase in activity would normally increase risk. However, the underlying phenomenon is clear: there is a multi-faceted link between safety, the number of cars and the number of non-motorised road users.

The issue of car dependence has been tackled among others by Dupuy (2002). From the point of view of safety, it is clear that, when there are fewer cars, speeds tend to be higher and risks increase for pedestrians and cyclists. Conversely, congestion in car traffic increases safety because vehicles are slower.

In both cases, a higher number of pedestrians and cyclists is usually a positive factor, acting as a signal to car drivers to drive more carefully. The blend of lower speed and a better mix of modes becomes an important factor in improving safety for cyclists and pedestrians. But the modal shift is then to be faced, being an effect of strictly related different characters of cities. For example, walking and cycling create a sense of moving in a shared space. All the five senses are active and give pedestrians and cyclists the feeling of sharing an urban environment with others.

The perception of space from a car is totally different. Drivers and passengers have the feeling of being in a private cell moving on a dedicated track. There is a strong sense of separation from the outside environment. Even though the road is a public domain, it is perceived as an exclusive place. An accident is perceived as a conflict between two

opposing 'private users' for the use of this exclusive space. We can therefore see a very different attitude towards urban space between cyclists and pedestrians, on the one hand, and car drivers on the other (even when they are the same people).

Going deeper into the phenomenon we discover that indeed the attitude of city users towards their living space is made by the space itself, by its maintenance. This attitude reflects a very different perception of the relationship between public and private interests, but also a spontaneous feeling for urban quality and comfort. Looking at different European member States several evidences show how town layout and landscape influence mobility and road users' behaviour.

It could be then said that good public space design promotes walking and cycling and, at the same time, one of the main consequences of promoting walking and cycling is that of returning urban space to citizens and shaping towns for them (*Busi and Ventura, 1995; Tolley and Thomas, 2001; Bonanomi, 2002*).

As an example, the implementation of traffic calming measures, such as classifying the whole of town centres as 30 km/h (20 mph) zones, not only helps to manage speed and safety, but has the side effect of reclaiming urban space as shared space (*CETUR, 1990; 1992*). The main concept behind these solutions is that of mixing all the different road users within a context of overall speed restriction. Such solutions can provide more space and more safety to pedestrians and cyclists than just the provision of dedicated pedestrian walkways or cycle tracks separate from roads (*Premartin, 1990; CERTU, 1994*). A key issue in identifying and implementing these much broader safety measures (the 'area-wide safety approach') as a 'town planning' strategy, the only possible strategy to achieve sustainable commitments.

2. A safer mobility for a safer town

'Urban areas form a complex, dynamic system in which various factors inter-relate in many different ways. What is the place of road and transport safety within this system and how does it link with other system components?' (*Dumas, 1999*). Several key issues referred both to mobility and town can be listed such as, transport network, urban structure, traffic management practices, planning policies, transport policies, parking strategies, public transport and local public opinions, employment, social policies, town image, environmental concerns. These issues correspond to political processes that are critical to urban development and hence the safety of the road network (*Fleury, 1998*).
There is now a considerable effort to combine the planning of land use and transport in many European countries, but mainly because pollution in the form of car-emitted gases, noise, water and land pollution, have become crucial issues. This fact can often be used as a catalyst for change and it may lead to a reduction in car trips that can benefit road safety and vulnerable road user comfort. It is worth reflecting on what could be a strategic lever to start those different processes bringing to a safer town.

Several different ideas are today included in the up-to-date concept of sustainability: they could influence the management of urban public space of European towns in the XXI Century. One of the main concern is still urban quality (i.e. architectural quality, quality of materials, etc.), but it seems that the same emphasis given to the housing demand after the second world war is nowadays allocated to the environment

preservation, meaning by urban environment mainly public space and common heritage.

Urban public places in the meantime become increasingly the space for mobility, where the room for cars has the greatest proportion. In that space, public transport networks, cycling lanes and pedestrian facilities are meant to develop modes of transport alternative to car.

Like housing demand has been the lever of urban development, marking a great portion of actual urban public space, mobility management and road safety can play the role of a lever for decision-making in town management, where both the procedures to prepare the project and the way decision is made at the urban Institution level are crucial. Some reasons why safety is generally not yet a main concern when considering different ways of moving and consequently different schemes for planning have already been defined. In the following chapters a delineation of a possible way out is given, as taken from the experience of the DUMAS project.

3. The 'Urban safety management (USM)' concept

Urban Safety Management (USM) is an area-wide approach to road accident prevention and casualty reduction that integrates all the disciplines found in town planning and management (*IHT, 1990*). These include traffic management, enforcement, education, public transport, town planning, etc, as well as road safety.
By bringing all parties together to tackle the safety problem, a far larger range of possible solutions is available. Effective USM goes further than the integration of professional disciplines by utilising two more sets of key players - the politicians and the public. It identifies fundamental principles for working on an 'area-wide' or town-wide basis, which include:

- the inter-dependency of safety and mobility;
- the 'knock-on' effect of changes in one part of the town to neighbouring areas;
- the effect on safety of different policies such as engineering, education, enforcement, traffic management and transportation (*OECD, 1990*).

The USM framework treats an urban area as a series of local area safety schemes (*IHT, 1990*). Each of these schemes considers issues under two headings: safety strategy (such as enforcement and the implementation of technical measures) and other policies influencing safety (such as road construction and maintenance, public transport, environment, land use, health, welfare and education). The need to fit in with existing programmes is also a key issue in balancing safety and other objectives. At the base of this last process, a new perception of social acceptable safety level must be set.

The analysis phase
This phase looks at the current situation in the city and links with the formulation of the strategy to set the casualty reduction targets and the strategic direction. Generally it will follow a standard safety accident analysis process, where accident data for the city and immediate surrounding area is analysed under different headings, including road user type, type of road, accident type and road condition (wet etc). This type of analysis allows common types of accident to be identified and measures designed to reduce them.

As well as accidents, the analysis phase will also need to consider traffic flows and speeds. Data will need to be collected if it is not already available. Safety can easily be improved at the expense of mobility (especially of pedestrians and cyclists and - among them - of the disabled first), so this trade-off is a vital part of the strategy formulation. Is the aim to improve safety whilst keeping flows at existing levels, or are reductions desired?

A key step in this process is the analysis of road hierarchy, which considers the design of the road, the existing flows and the desired function and flow levels. It is common for cities to have roads used inappropriately – usually higher flow levels than the road was designed for – due to weak links between the planning process and travel demands.

The strategy phase

Having analysed the accidents, road function, speed and flow data, the strategy can then be formulated. Following this, targets can be set and the design process started. As stated above, the main factors when considering the strategy are:

- the overall casualty reductions
- casualty reductions by road user group
- casualty reductions by area
- changes in flows to attain the required road hierarchy
- casualty reductions by discipline (i.e. those achieved by publicity, safer routes to school etc).

The strategy should also link to other urban objectives, such as environmental improvements.

The strategy should also consider timescales, be realistic in defining objectives and include the monitoring phase which is seldom undertaken in practice, which is a great shame. Without proper monitoring it is difficult to establish robustly those programmes which do work and therefore should be put forward as best practice. The procedures of 'safety audit' and 'safety review' in which the impact on road safety is systematically assessed at the decision stage (audit) and at every improving of the existing network (review), might be useful tools for the monitoring process. Implementing safety schemes is a time-consuming and costly process, with the supply of funds and expertise being limiting factors. In order for a scheme to succeed, it must have local backing. This will involve a great deal of consultation, which will inevitably slow down the process.

Political will and public opinion

Experience has shown that getting the support of local politicians for a safety programme is one of the most important requirements for success. Implementing measures will not always be popular, so it is vital that safety remains a high priority with the decision makers, compared to public criticism or votes. Actions for safety should be a relevant issue when searching for votes, so time spent convincing the important local politicians to support the programme is time well spent. Getting local politicians support can be made a lot easier if there is general support for safety at central Government level.

It is unlikely that local political support can be achieved without first getting public interest in and support for casualty reductions. Experience has shown that in many towns and cities, people know very little about the accident risk and underestimate some risks over others. Fear of being attacked, for example, is felt to be a much higher

risk by the elderly than being the victim of a road traffic accident, even if it accounts for far fewer victims.

Setting up the management structure

Bringing the diverse skills together is the first step in setting up the management process. Historically, in many countries, the safety department has been separate from the road building and maintenance departments, which in turn have been separate from the building and planning departments. These barriers must be broken down and staff from all these areas formed into a team. Often the best safety task force is shaped from personnel from different areas and backgrounds.

This is a necessary first step and it is vital that all parties are involved from the start, especially in the formulation of the objectives and targets for the project. As well as the design, implementation and assessment should directly involve other parties, including at the local level residents, disabled associations, businesses, bus operators, taxi representatives, the press, parking suppliers, emergency services, health providers and action groups.

A strong alliance between the political leadership and the technical management team is crucial, but indeed influenced also by the Institutional and legal frame of each Country, namely:

- the institutional framework at national, regional and local level;
- the legislative framework;
- the rules and regulations for technical measures.

These characters influence responsibilities and then decision making at all levels.

Conclusion

The comprehensive approach to urban safer mobility and planning is successful because it reclaims urban areas as a shared space for pedestrians and cyclists. Increasing levels of walking and cycling paradoxically improve levels of safety as motorists adapt their behaviour to accommodate their cycling and pedestrian partners.

Success can only be built on a multi-disciplinary approach and broad consultation within a clear strategic framework.

The USM approach both enables interested parties to agree on the right targets and measures, and makes it more likely that these will have the support, resources and planning to be effectively implemented.

Safety could then be the lever for a new era of urban planning, a sustainable planning as far as men's life is the matter!

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Taking Responsibility and Comprehensive Mobility Education or, is Traffic Safety an adjustable Concept? An Approach from the Viewpoint of Youth Sociology

By Claus J. Tully

1. Mobility and everyday youth experience – a crucial topic?

Why should we think about youth mobility? There are undoubtedly numerous reasons. Mobility is a central need in youth and an important indicator to describe societies. The main dimensions are economic, ecological, social, demographic and safety-related aspects.

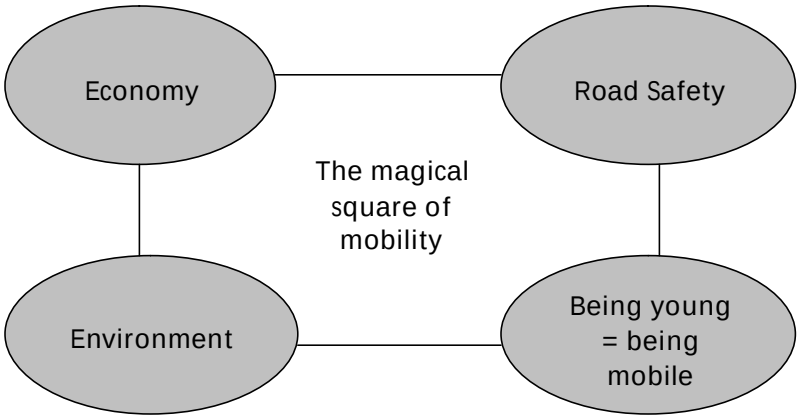

Table 3: The magical square. Source: Tully, 2003

Environment: Road traffic is the largest producer of carbon monoxide and nitrogen oxides. Equally, road traffic is responsible for a large part of the emissions of carbon dioxide, fine particles and volatile organic compounds. Road traffic is responsible for a large proportion of the measurable environmental pollution (noise, light, land use). In our study "U-Move", over 70 % of the youths questioned agreed with the statement "Car traffic is a large problem for the environment" (*Tully, 2002*). Despite insights like this, a more environmentally-friendly mobility practice is by no means a matter of course. Priesendörfer (*Umwelteinstellung und Umweltverhalten in Deutschland, 1999*) alerts us to the particular difficulty. The reorganisation of one's own mobility demands a comprehensive change in behaviour and in terms of rational choice belongs to the high-cost fields of action. Whereas for instance rubbish separation – an environmental activity practiced by most youth today – demands lesser behavioural changes (low cost).

Traffic plays a decisive part in economic wealth: According to the Federal Statistics Office, approximately a fifth of the social wealth (gross national product – GNP) is generated in trade, hotels and restaurants and in traffic. Every sixth job is directly or indirectly dependent on the car industry. Besides the jobs in the car industry itself, other indicators are meaningful. The current economic activities of the flight and travel

industries could be highlighted, together with the peripheral transport services associated with them such as car rental, public transport etc. Travel and tourism is the largest industry world wide – they generate over 10% of the world's GNP.

Traffic safety: Children and youths are amongst the groups of especially endangered traffic participants. Young drivers, both male and female, are frequently found to be driving dangerous, particularly the 15 to 25 age group.

Youth travel a lot: They travel to places of recreation, to visit their peers, to do sport, to their place of training or education, to shop, etc... Mobility is both an expression and condition of participating in particular events. Mobility can become an essential part of the experience-orientated recreational activities themselves, and has manifold functions for the creation of identity in the phase of self-definition and the dissolution of emotional ties. (*Tully, 1998*)

Youth as a phase of life – what has changed?

In essence the paper argues as follows: driving lessons continue to be structured as if the aims were to gain technical knowledge and an understanding of rules, and this is false. Why? Today, more than ever, driving is a relative action. The density of traffic and the frequency with which we are mobile underscore this fact. In contrast, the current demands of traffic safety and the traffic instruction based on these demands emphasise a concept of socialisation more relevant to the 1960s and 1970s (the era of 2CVs, Beetles or Renault 4s) than to the contemporary situation in which we find ourselves. But changes have not only taken place in road traffic – being young as a phase of life has altered. Education lasts longer and work qualifications are obtained later. Equally, the commencement of regular work and entering a stable relationship are drawn out. Society has become flexible – there are neither fixed working hours any more nor a planned transition from school to job. Education and training are changing. Only when it comes to mobility do we still consider everything as unchanged. The driving licence is the only regulated qualification in relation to participation in every-day mobile life. In any event, the driving licence hardly represents an education in mobility. And how has driving instruction responded to the biographical and social changes?

What is not required now, is just the mere practice of technical skills. Driving is a socially-related action. This has hardly been touched upon in driving schools to date. Driving instruction acts as if nothing profound had happened in relation to youth and the world in which they grew up. What this means in practical terms will be illustrated by examining the current debate on the driving licence for 17-year-olds and the phased driving licence.

The driving licence at 17 and the phased driving licence: models to improve driving safety

Essentially two models are under discussion in Germany for the instruction of learner drivers: the phased driver's licence and the driver's licence at 17.
With the so-called phased driving licence (second driving instruction phase) the basic driving instruction is followed by a phase of group learning. This second phase of

driving instruction, a voyage of discovery either alone or with friends under the motto "new experiences – have fun", is a specific, pedagogical mixture of group meetings in a seminar room and practical elements in road traffic and on a training course under the competent direction of professional supervision. In a time frame of two to eight weeks, groups of six to twelve young drivers attend three group meetings, each lasting 1 ½ hours. The practical elements are two meetings. Firstly, a training and observation drive in open road traffic in small groups of two to three young drivers with an effective driving time of an hour per driver, alongside practical safety exercises for beginners in the same group. Secondly, in the group meetings of four hours on a private driving circuit.

The German system of the second phase of driving instruction is voluntary, but young drivers can shorten the length of their provisional licence from two years to a maximum of a year by participating. Fundamentally, all measures are welcome that break the mould of a one-off test procedure and base driving instruction on a number of supporting structures.

Accompanied driving means that driving instruction commences aged 16 ½ at the earliest (as opposed to 17 ½ to date) in a driving school. The learners take part in theoretical driving instruction as usual, and complete the normal number of driving hours. However, the driving examination can at the earliest be taken a month before the learner's 17th birthday. After this the learner is allowed to drive if accompanied.[27]

The initiatives are basically founded on outdated learning premises (training minus insight) and are based, for example, on the idea that young people can acquire a car licence early (at 17), but until their 18th birthday are allowed to drive only if accompanied (the original means something completely different). The main argument of the advocates of accompanied driving is that in the first year of driving the learner accumulates far more road experience before he or she is left to their own devices in motorised road traffic.

The opponents of the idea fear that at 17 a person lacks the necessary maturity, or better said driving ability, for a driving licence, and that precisely due to the new regulation the number of accidents could rise. The training effect explicitly set out for the model driving licence at 17 occurs anyway, even if the driving licence is first obtained at 20.

2. What remains relatively constant?

Everything that characterises the transition to adulthood today is in flux. Instead of money and work, the right to drive stands for something for which it was not intended. Whoever has a driving licence can act as if they were an adult. In the past, taking responsibility (precisely the quality that is crucial to participation in road traffic)

[27] According to the current debate, the federal driving licence is to be issued to persons under 17 on the condition that they are permanently accompanied by a named person aged at least 30 and who has had their own driving licence for at least five years (hence "accompanied driving"). The accompanying person may have lost no more than seven points from their driving licence under the German system of infringements, and prior to accompanying the younger driver must attend an introduction to their responsibilities. For further information see: www.fahrtipps.de/verkehrsregeln/fuehrerschein-mit-17.php.

occurred in other spheres, for example in the work place. Therefore today's driving school has to provide something that it can not.

Acquiring a driving licence – what must one be able to do

The driving licence is a certificate, a right to drive, and something with which the permission to drive is dispensed. Whoever possesses such a document is entitled to drive a motor vehicle. Legal regulations dictate when the necessary exams can be taken and the timing is therefore pre-determined. In this sense the driving licence is still what it was 30 years ago. But are young people who get their "papers" at 18 comparable with the 18-year-olds of the 1970s?

Well into the 1970s growing up took place within a relatively well-ordered framework. Secondary school was followed by predictable forms of further education or employment. In the 1960s for example, three quarters of all 15 to 20-year-olds were bound to the job market, either as apprentices or as employees, whereas in 2000 it was less than a third. To be tied to the job market also means that one takes responsibility for others. Given, today's youth does take on more responsibility for planning their own lives (career and education), but does so to a lesser extent for others. Social locations where responsibility is taken for others are, besides in the case of peers, the sports club, voluntary work (technical emergency service, voluntary fire brigade, youth work, school representation) and political or union engagements or, as mentioned, at work.

To act, and this applies as much to driving as to work, is a social or relative deed. It is bound up with specific contexts and combines individual standards with social value systems. But who is aware of this? In driving instruction, the case in point, it is hardly considered an issue. To a far greater degree road traffic appears as a mass of unrelated subjects. Trust is placed in routine actions. The vehicle-driving subjects are hardly even aware of each other. This however contrasts with the factual necessity for a continuous relation to one's own actions in each and every traffic event. This in turn requires an indispensable basic social qualification – to be able to change perspective, to empathise with others and to act out of tolerance and not frustration.

Traffic-safety education – driving as compliance with rules

Traffic education programs and programs to modernise traffic participation are, as a rule, directed towards specific groups (parents, children, youth or the aged). Their aim is to increase traffic safety through behavioural recommendations.

The central starting point is effective driving instruction. As is well known, those who have recently received their driving licence belong to the groups especially at risk. Every year there are in Germany 120,000 accident victims alone in the age group 18 to 25. The aim of instruction is to reduce the willingness to take risks amongst new drivers, but also to school them in safe driving through training. This means safety in the sense of foresighted driving – braking correctly, the perfection of evasive actions or regaining control of a skidding car. Besides formal driving instruction, there are numerous institutions dedicated to the promotion of road safety, for instance the German Road Safety Council (*Deutsche Verkehrssicherheitsrat* – DVR) and the automobile clubs

(*Allgemeine Deutsche Automobileclub* – ADAC, *Automobileclub Europa* – ACE, etc.). Safety awareness campaigns and traffic education are also undertaken by the German Road Watch (*Deutsche Verkehrswacht*) and the police.

The DVR, for example, was founded in 1969 as a non-profit making organisation and has made it its responsibility to support measures for the safety of all road users. Its main focuses are questions of traffic technology, education, information, law and surveillance. Coupled with this, the idea of partnership and the strengthening of a sense of the individual's own responsibility are part of the DVR's professed philosophy.

The development of target-group programs and further measures lie at the heart of the DVR's work. These programs are realised through the membership bodies, among which company road safety enjoys a particular emphasis. The perspectives for the future road-safety projects of the DVR are determined by the context of the current mobility discussion and its central idea of the demand for an ecologically and economically rational use of motorised vehicles. Together with vocational students and apprentices, the DVR has developed a number of programs especially aimed at youth target groups - "everything under control?", "safely on the way", "pub crawls and racing off", "tanked up and driven up the wall"[28]. "Everything under control?" is intended to touch upon the lives of young drivers and to offer possibilities to develop accepted behavioural alternatives and strategies of action.

The automobile clubs, including the ADAC, also view road safety for all age and target groups as an important part of their responsibilities. Particular emphasis is placed on school education, whereby it is intended to sensitise children and youths to the dangers of road traffic. The aim is "to prepare them for an independent, safe and responsible participation in traffic situations". The result of the numerous efforts is the marked reduction in the number of road fatalities by some two thirds in the last thirty years. Traffic safety work is based on four cornerstones – vehicle technology, infrastructure, traffic education and rescue services. The aim is to avoid accidents, to ensure that the driver can still have an active influence on unavoidable accidents and to protect those involved in accidents as much as possible.[29]

3. The world has changed

Decisive for correct behaviour on the road is to be aware that every action in traffic directly or indirectly effects others. All actions relate to other persons or groups of persons and influence the environment.

Does one learn what it means to act responsibly in driving school? This is more likely to occur in sport, at work, during training or in a voluntary post. In order to play tennis or football one needs team-mates, and it soon becomes apparent that an organisational prerequisite is necessary, such as a club (grounds maintenance, collection of dues, organisation of competitions). Similarly those who perform voluntary or honorary service, for example with the voluntary fire brigade or the technical emergency service, practice a form of social involvement and take on responsibility for others.

[28] For further information see www.dvr.de

[29] http://www.vda.de/de/vda/intern/organisation/abteilung/files/VDA_Verkehrssicherheit.pdf

But in contrast to this, as a rule social relations are increasingly replaced by the use of technology. Trust is placed in technological security, and artefacts (from the mobile phone to internet) in general stand for "comfort and joy". The more one moves in virtual worlds the less one is conscious of one's own actions as socially related or even that one is obliged to be conscious of them as such. Virtual worlds are an invitation to individualisation. Individualisation does not mean the pursuit of one's own interests, rather taking responsibility in relation to oneself and the ability to form one's own life. Obviously this is relatively easy to achieve when it concerns making information available. Technical aids are an ideal support for the behavioural tendencies of youth to be inquisitive and to try things out. They enable the use of communicative strategies, open up various new and individual qualities of experience (e.g. "testing the limits", "flow" or "thrill"), serve "sexual" advertisement and improve social status within reference groups. Driving can still serve as an outlet or a compensation for frustration and aggression and there is no doubt that driving can mediate a certain "flow experience". From our investigations for example, we know that "technology fans" (mainly male and under educated) drive differently and more dangerously. (*Tully, 2002*)

Growing up and live in the risk society

The sociologist Niklas Luhmann has introduced a distinction between risk and danger. In this he explains that the classification of events in terms of concrete individual actions is not clear, and is as such risky. The concept of danger still implies an effective connection between action and the results of an action. Insecurity and risk decisively mould our current every-day lives. A secure future is not possible in an environment of choice and insecurity. More than at any point in the past our future is open and changeable. Therefore action always produces insecurity, but in each case can be played out differently, in turn making the gauging of actions and their results more difficult. The fact that people nowadays live with numerous safeguards should not be equated with a continuous increase in security. Far more we are faced with a new situation with a mixture of security and insecurity. New insecurities correspond to our increased abilities to rule over nature, obliging us to consider other political, social and biographical security discourses. (*Beck and Bonß, 2001, p. 149*)

The modern society of our times means that the subject has to take on responsibility for how he or she lives their life. The freedom of choice may be comparatively larger today, but so too are the risks of making wrong decisions. With the shift from danger to risk the scope for actions also changed.

Taking responsibility instead of obeying rules

The concept of traffic safety is appropriate to social relations which are based on rules and acting with rules as we know it from the industrial society. To prevent and to handle danger the industrial society was analysing the situations and figured out rules to act in such dangerous situations. This was the form of management for dangerous situations. The specific is that danger appears controllable. Today in contrast, the issue is to deal with the side effects of actions and measures. That means on respect of traffic safety to learn to act in uncertain situations and in situations which are constructed by

side effects. The development is pointed towards a new form of mobility socialisation to complete the basic intention of traffic safety.

The concept of mobility socialisation is becoming maybe more important than the classical concept of traffic instruction. This does not mean that the concept of traffic safety is redundant. In future we will need certain forms of training to get adapted reactions which are habituated and facilitate the form of action and reaction in current traffic situations. The current risk discourse is representative of insecurity and the importance of effects and side effects remarkable in all social situations of everyday life. However, the unpredictable remains too unspecific to effectively protect against. To this extent permanent vigilance and a continuous weighing-up between the intentions of actions and their results are indispensable. The subject is becoming his or her own planning office. If this is social reality how might it be possible to exclude the development of traffic safety? People arrange their every-day lives and their biographical projects, always under the omen of their own possible failure. Viewed from the perspective of sociological risk and safety discourses it can be noted that the possibility of failure, loss and defeat are necessarily present in a competitive world[30].

Acting responsibly for one's own person includes dealing with these insecurities. In this respect contingency is the basis of action. Luhmann speaks of the *obscuration* of expectations (i.e. the process of making them ambiguous)[31]. Emotions and objective decision-making mutually interact.

4. A new orientation for traffic-safety education

The central point of this paper is the call for a comprehensive mobility socialisation instead of traffic instruction based on obeying rules. In this sense mobility socialisation includes multi-modality. Multi-modality makes it clear that what is being dealt with is the organisation of movement in society and not merely (car) driving.

Driving is a habit formed act. Drivers do not permanently check speeds or distances, rather to a greater extent are in a position to undertake judgments based on routine and experience, and thus to act reliably. Traffic-safety instruction trains such individual skills, but does not practise relative actions and therefore does not teach lasting mobility behaviour.

Modern and pre-modern conditions sometimes become mixed up. For example driving instruction orientates itself on the educational concepts of days gone by. But everything has become more complex, including the every-day life of youth. Being young is a more subjective phase of life, moulded by inner developments and the formation of personal identity and influenced by social norms and structures. Youth is confronted with manifold tasks linked to the development of personality (sexuality, breaking emotionally with parents, forming friendships, job and future, norms and values, social responsibility). All these tasks are linked to identification with society, with one's roots in the world – everything appears socially malleable.

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[30] Zinn J. and Esser F., *Herstellung biographischer Sicherheit in der reflexiven Moderne*, p. 11 and Beck U., *Die Risikogesellschaft: Auf dem Weg in eine andere Moderne*, p. 217.

[31] Lehmann N., *Soziale Systeme: Grundriss einer allgemeinen Theorie* , p. 418.

Against the background of the social development of personality, with all its challenges and tasks, youth mobility is more than merely a participation in road traffic. Even the act of driving is not exclusively the movement from "A to B", but is rather an immenent part of growing up to adulthood. For many it is a motorised search, "cruising" or "(event) hopping". Every-day youth existence is intrinsically mobile.

Conclusion

And how does the story end? After the accident the young driver not only experienced what it means to be injured, but he became aware of the fact that he had not only seriously harmed himself but above all his friends. Unlike his friends, he is no longer allowed to drive a car, even though already at 17 he is qualified to drive when "accompanied". Particularly in rural areas this is a distinct disadvantage. His driving instruction obviously failed to prepare him for what it means to take responsibility for himself and for others. He was not prepared for the situation. Only the accident made him realise what he was responsible for. Obviously the court suspended his driving licence and the court fined him, but what do the injuries inflicted upon oneself and others mean?
In this concrete example the person most badly injured decided not to press charges against the young driver and thus waived all compensation. Instead a penance was demanded of him. A short time later he had to take part in a night-time procession and attend the ritual in the rain. As he later told me in the interview, the ritual had given him a lot of time to reflect. The later court judgement no doubt gave him equal cause to contemplate his own actions and their consequences for others.

It remains important that driving is a socially-embedded phenomenon, a basic fact that should not be overlooked in all the learning of rules and behavioural training.

What can be recommended in terms of driving instruction?

- 1. Driving could be seen as part of a comprehensive mobilisation socialisation, in unison with environmental education and basic learning about economics and safety technology.

- 2. Composure is recommended. Mobility is too important than that it can and may be organised without reference to the changing world in which youth grows up. Youth does not have to drive at a younger age, rather with more competence and equipped with the knowledge that there are various mobility options, and that each option entails specific effects and side effects.

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Zinn J. and Esser F., 'Herstellung biographischer Sicherheit in der reflexiven Moderne', manuscript in *Zeitschrift für Biographieforschung, Oral History und Lebenslaufanalyysen* (BIOS).

b) Internet sources:

http://www.vda.de/de/vda/intern/organisation/abteilung/files/VDA_Verkehrssicherheit.pdf (download 8 November 2004).

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http://www.fahrtipps.de/verkehrsregeln/fuehrerschein-mit-17.php (download 8 November 2004).

Cycling, safety and health

By Thomas Krag

1. A few words on terminology

Cyclists are often described as "soft", "weak" or "vulnerable" road users. Seen as individuals, regular bicycle users are however usually tougher than those, who do not benefit from regular physical exercise. The term "unprotected road users" therefore gives a better description of the fact that cyclists are subject to severe injuries in crashes.

Care should also be taken when using the term "cyclist". In the following the term is used solely for a road user, who is riding a bicycle in a given moment. Those, who sometimes or often cycle, are called bicycle users.

2. The injury risk

The injury risk is often calculated and used in connection with engineering considerations. Generally, the risk is calculated as the number of undesired incidents divided by a measure for the amount of transport involved.

The number of undesired incidents used in the numerator can be:

- the number of accidents
- the number of injuries or the number of injured persons
- the number of severe injuries or the number of severely injured persons
- the number of deaths.

There are also several possibilities for which figure to put in the denominator, e.g.:

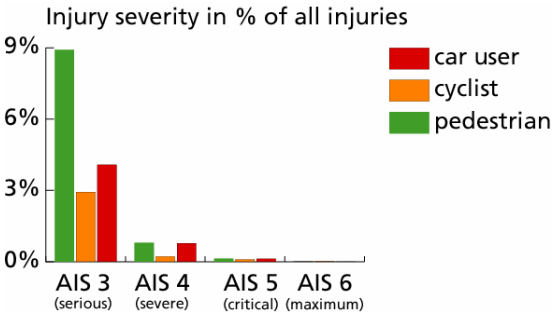
- the number of kilometres travelled
- the number of trips carried out
- the amount of time spent in transport.

This gives the possibility to calculate a lot of different figures, and a good degree of care should be taken in which of them to be used in which connection.

Usually the number of injured, severely injured or killed persons is used for risk calculations. This is preferable for using the number of accidents, as each accident can involve one or several persons. One person can, on the other hand, be hit by one or more injuries in one and the same accident, and for this reason the number of injured persons is usually a more relevant figure than the number of injuries.

Traffic injuries are of a very different nature. Cycling is known to cause several injuries of which there are a relatively small number of serious, severe and critical injuries than found in other transport means. This is reflected in a smaller number of hospital bed

days per person treated at the hospital casualty department[32]. The tendencies are shown in the graphs below. The full data of the AIS-scores is furthermore shown in two tables.



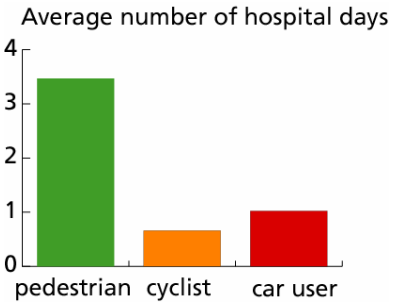


Table 4: Data on injury severity and on hospital days for each road user category

AIS is "Abbreviated Injury Scale", the share in each road user group is shown.

Injury severities in numbers		*AIS 1*	*AIS 2*	*AIS 3*	*AIS 4*	*AIS 5*	*AIS 6*	*total*
	pedestrian	540	137	67	6	1	0	751
	cyclist	7151	1303	256	19	8	1	8738
	car user	3576	457	173	33	5	0	4244

Injury severities in per cent for each road user category		*AIS 1*	*AIS 2*	*AIS 3*	*AIS 4*	*AIS 5*	*AIS 6*	*total*
	pedestrian	72%	18%	8,9%	0,80%	0,13%	0,00%	100%
	cyclist	82%	15%	2,9%	0,22%	0,09%	0,01%	100%
	car user	84%	11%	4,1%	0,78%	0,12%	0,00%	100%

Table 5: Injury severities in numbers and in per cent for each road user category

The usual accident statistics are known to have a significant under-reporting of cycling injuries, part of the reason being that many single accidents with cyclists are never reported to the police[33]. This all makes it a difficult task to make a fair comparison of injury risk figures calculated for different transport means.

When it comes to the number of killed persons, however, accident statistics are usually quite reliable. By using fatalities one also avoids the discussion on the severity of the injuries and their impact on the persons involved.

The figure used in the denominator for risk calculations is often the number of kilometres travelled. This can be relevant for some purposes but disputable for others. The number of kilometres travelled has been growing year by year for most western societies while the time spent in transport and the number of trips has been found to be much more stable. When calculating risk on a society level the latter figures will thus be a better choice than the number of kilometres travelled.

[32] AccidentAnalysisGroup: *Accident victims treated at the A & E department*, 1998-2000.

[33] *Ibid*.

The following graphs show the difference when calculating the person's own risk of being killed in transport for walking, cycling and car driving using respectively distance, number of trips and time as measure for the amount of transport

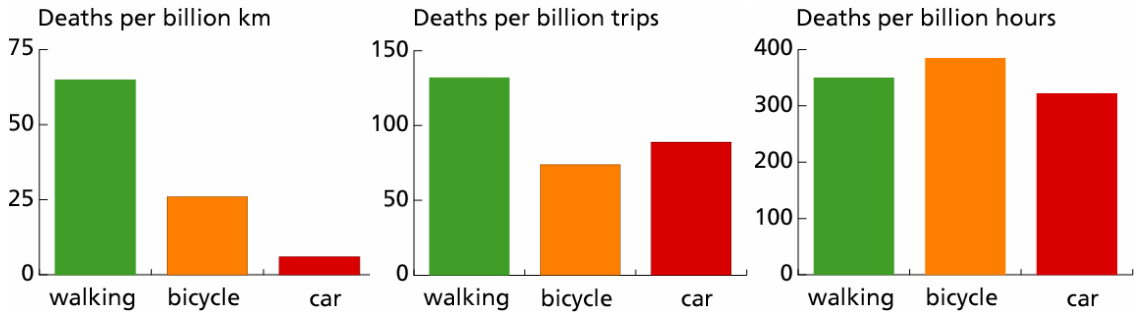


Table 6: Risks of being killed in transport for walking, cycling and car driving[34]

From the graphs one can conclude, that only when kilometres are used as a measure, significant risk differences between the three modes appear. Cycling in this case turns out to be 4-5 times as risky as car use, while walking is more than 10 times as risky. For risk measured per trip or per time spent in transport the three modes walking, cycling and car driving do not differ significantly.

The risk imposed on other road users is not taken into consideration here, which would render the car relatively more risky than the other means in the graphs shown above.

If, instead of fatalities, injuries had been used as a measure, cycling would have turned out to be relatively more risky than the other transport means in the graphs above. This is due to the fact that only a relatively smaller part of the injured cyclists are killed in traffic accidents.

3. The risk is not a constant

There is quite a different problem associated with the calculation of transport risk as, say, number of severe injuries per kilometre travelled. Thus, such risk-figures often lead to the idea, that the number of injuries can be forecasted from knowledge of the kilometres to be travelled.

For the traffic system as such this is known not to be the case. The majority of western countries have experienced a decrease in the total number of injuries in the transport system at the same time as the number of kilometres travelled has increased significantly[35].

[34] Data used from Thomas Krag, in *Safer without the car*, 1996. The figures used are from Statistics Denmark 1992 for ages 16-74 year.

[35] See for example European Transport Safety Council (ETSC), Transport safety performance in the EU - a statistical overview, 2003 (www.etsc.be/documents/statoverv.pdf); and IRTAD/BASt, 2003 (www.bast.de/htdocs/fachthemen/irtad/utility/p127.pdf).

This shows two things:

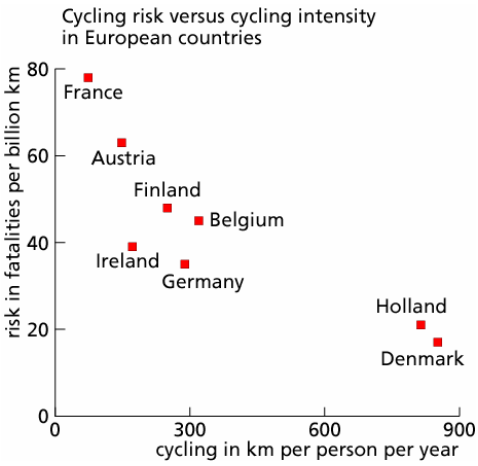
- Several countries have been successful in reducing the risk of being killed in traffic accidents.
- An assumption of constant risk, measured as fatalities per kilometre travelled, can indeed not be used for forecasting traffic deaths over a span of years.

More cycling is associated with a smaller accident risk

If an assumed constant risk of cycling could be used for forecasting bicycle injuries from the amount of cycle traffic, one would expect a proportional increase in traffic accidents, if bicycle traffic was promoted successfully.

Several studies however conclude that the risk of cycling decrease the more cycling there is[36]. This means that an increase in cycling may be associated with an increase in cycling injuries, but that the increase will be less than what would be predicted from the initial risk.

The graphs below reflect some of the findings.



Cycling risk versus cycling intensity in European countries. Risk of cycling tends to be lowest in the countries with the most cycling.[37]

[36] See WALCYNG, a project carried out under the EU 4th Framework Programme.
Ekman L., *On the treatment of flow in traffic safety analysis - a non-parametric approach applied on vulnerable road users*. Doctorate, University of Lund, 1996:10.
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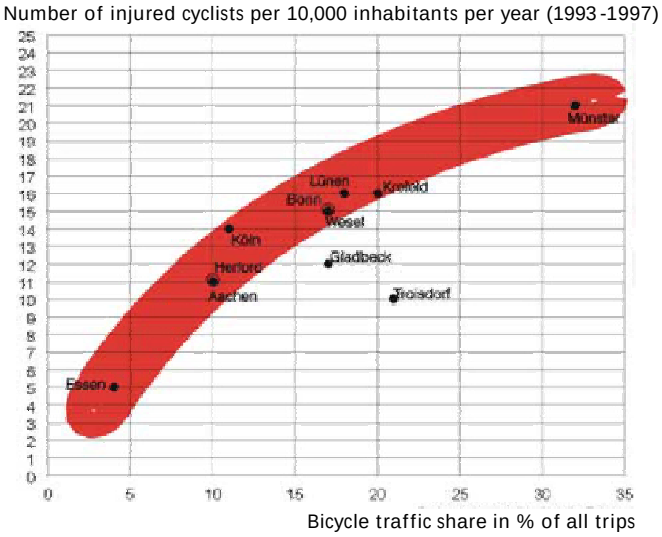
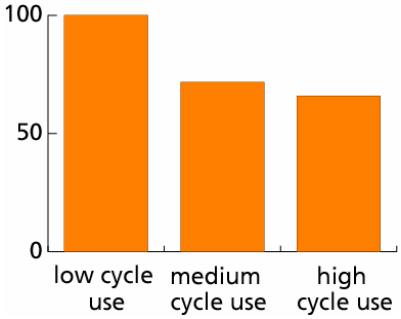
[37] Transport Demand of Modes not covered in International Transport Statistics, UITP/ European Cyclists' Federation (ECF), December 1997 (data presented graphically are from 1994).

Walking and cycling in 68 Californian cities in 2000[38].



Selected cities in Nordrhein-Westphalen, Germany. The relative number of injured cyclists versus the amount of bicycle traffic. The increase is not proportional, and risk decreases with bicycle use[39]



Relation between cycling use and cyclists' relative injury risk, according to Dutch figures[40].

Table 7: Cycling risks versus cycling intensity

The inverse relationship between cycling and cyclists' risk is usually explained by motorists' behaviour: If there are many people cycling, the motorists will also expect to see them in traffic and take better care not to collide with them.

[38] Jacobsen P.L., Safety in numbers: more walkers and bicyclists, safer walking and bicycling, 2003.

[39] Ministerium für Wirtschaft und Mittelstand, Energie und Verkehr des Landes Nordrhein-Westphalen, "Fahrradfreundliche Städte und Gemeinden in NRW - Maßnahmen- und Wirksamkeitsuntersuchung", 2001.

[40] Boggelen O. van and Borgman F. *Hoog fietsgebruik good voor verkeersveiligheid*, 2003.

Another reason could be that conditions, generally, are safer in those places where a lot of cycling occurs. It is thus known that more care is taken to include the needs of cyclists in the traffic planning in countries and cities with many cyclists.

A single reference suggests that the behaviour of the cyclists could also play a role[41]. It is to be expected that the risk of cycling accidents is smaller for experienced bicycle users than for the less experienced ones. The mentioned reference suggests experienced riders to be four times safer than the less experienced ones. One could also expect a generally higher experience level for the bicycle users in areas with a lot of cycling. Only a little research in this area is however known.

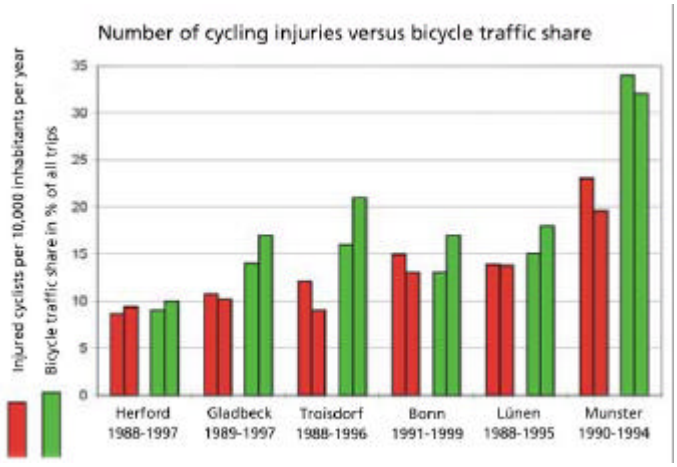
Whatever the explanation is, the findings demonstrate that the risk of cycling varies a lot and generally decreases with increased cycle traffic.

More cycling and less cycling accidents

Since the risks for bicycle users tend to decrease with increasing cycling, one needs not be quite as concerned for the cyclists' safety, as the number of injuries would increase proportionally with bicycle use.

There are however still good reasons to be concerned. An increase in cycling, thus, still means some increase in accidents with cyclists if no other actions are taken.

Interestingly, examples show, that it is possible to increase cycling and at the same time improve cycle safety to an extent, which more than balance out the effects of more cycling. Some of these examples are shown in the graphs below[42] [43]



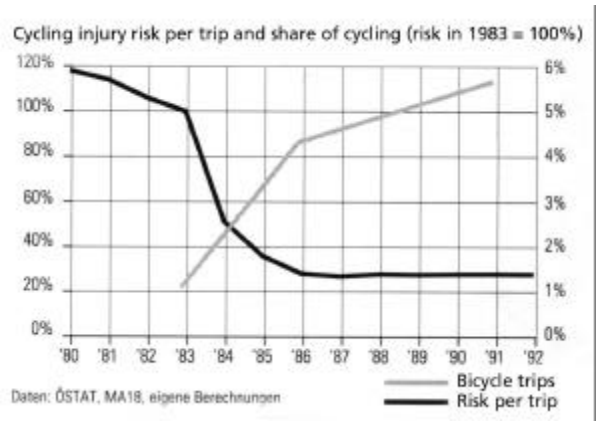
Model cycling cities in Nordrhein - Westphalen, Germany. Over a time span most cities experience fewer injuries and more cycling [44].

[41] Bikewest, *Western Australia: Bike Ahead - Bicycle Strategy for the 21st Century, page 2.*

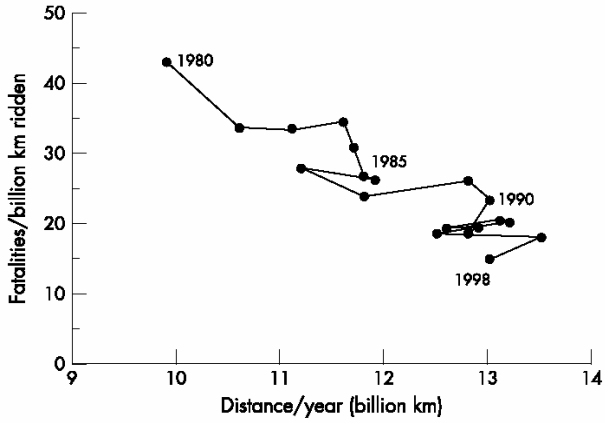
[42] Jensen S.O., *DUMAS: safety of pedestrians and two-wheelers*, 1998

[43] Transport Demand of Modes not covered in International Transport Statistics, UITP/ European Cyclists' Federation (ECF), December 1997 (data presented graphically are from 1994).

[44] Ministerium für Wirtschaft und Mittelstand, Energie und Verkehr des Landes Nordrhein-Westphalen, "Fahrradfreundliche Städte und Gemeinden in NRW - Maßnahmen- und Wirksamkeitsuntersuchung", 2001.



Figures on cycling and cycling risk from Vienna 1980-1992. Huge increase in cycling and an associated three fourth decrease in accident risk [45].



Bicycling in the Netherlands 1980-1998. A 30% increase in cycle traffic is associated with a two-third reduction in risk, i.e. a decrease of the total number of fatal cycling accidents[46].

Copenhagen, Denmark, 1990-2000. The trend generally shows an increase of cycle traffic and a decrease in the number of seriously injured cyclists[47].

Table 8 : Examples of increased cycling and decreased cycling accidents.

In the graphs above attention is not paid to the injury risk of other roads users. It can however be assumed, that an increase in cycling will be associated with a decrease of the number of injuries of other road users, part of the reason being a smaller number of people in the other road user groups (since there are more bicycle users), another part being a reduced speed level and a more friendly traffic environment.

[45] VCÖ Verkehrsclub Österreich, "Strassen zum Radfahren", 1995.

[46] Jacobsen P.L., "Safety in numbers: more walkers and bicyclists, safer walking and bicycling", 2003; pp. 205-209

[47] Bicycle Policy 2002-2012. Municipality of Copenhagen, 2002 (available at www.vejpark.kk.dk)

It is beyond the scope of this article to discuss what safety measures were taken in the above mentioned cities. In none of the examples, however, has increased cycle helmet wearing made a notable contribution to the reduced injury numbers. Furthermore, none of the cities have chosen a 100 per cent separation strategy. Even Copenhagen, where a substantial network of along roadside cycle tracks are found, cars and cyclists meet each other at all intersections.

The examples show that it is not only possible to reduce cycling risk by increasing cycle use, it is even possible to increase use and reduce the number of injured cyclists at the same time. Should a calculated cycling risk be used for forecasting the number of bicycle injuries, one would have to deal with a negative, marginal risk in these examples.

This all adds to the fact that the risk of cycling can be reduced if cycle use is increased. If, however, the resulting risk is still bigger than the risk of driving, one can still question the sensibility of cycling.

A non-car lifestyle is not necessarily unsafe

With a higher risk of cycling than driving, one should from a personal point of view expect to be subject to a higher risk of traffic accidents when basing one's life on cycling than when primarily going by car.

It is however somewhat theoretical to assume the majority of car trips of a normal person to be replaced by bicycle trips. A typical cycle trip is 3-4 km, while a notable part of car trips have a length of at least 10 km, a distance which a few but the most dedicated bicycle users are ready to cycle.

Those who use bicycles on the shorter trips will, if they have no car available, typically use public transport for longer distances. Since public transport is a safe mode - much safer than the car - this combination might turn out to be as safe as using a car for a long trip.

Some simple examples are shown in the table 9, which includes examples of a skilled public transport user, who saves time by biking to a train station, thereby not having to wait for a bus for the first part of the trip.

While it - from a personal risk point of view - apparently seems to be beneficial to choose the car for the short trip, combinations of walking, cycling and public transport produce safer results for the long trips.

Travel survey data makes it possible to study this in greater detail. From Danish data, where the number of cars available per household is recorded, one can separate the population in groups with significantly different lifestyles as far as bicycle and car use is concerned. In the population studied, people aged 16-74 year, there were respectively 22, 61 and 17 per cent living at households with no car, one car, and more than one car available.

Fatality risk for various means				
	walk	bicycle	car	PT
risk (deaths/10^9 km)	50	25	5	0

Fatality risk for various trips					
	walk (km)	bicycle (km)	car (km)	PT (km)	resulting risk (deaths/10^9 trips)
short walking trip	3				150
short bicycle trip (km)		3			75
short car trip			3		15
short PT trip	0,5			3	25
long bicycle trip		20			500
long car trip			20		100
long PT trip	0,5			20	25
long combined PT trip	0,2	3		20	85

Table 9: Fatality risks for various means and for various trips

Not surprisingly, the bicycle and public transport were found to be used more and the car much less in households without a car.

What is more surprising, is that when multiplying the average number of kilometres travelled with the per kilometre fatality risk, this adds up to a higher figure in the part of the population who cycle least.

The graph 10 show the daily average transport distributed over various means, and the resulting risk of being killed in transport, with the contribution from the different means shown. "Other" is a mixture of moped, motorbike, taxi, ferry and airplane. Public transport has a zero contribution to the fatality risk. The figures are from 1997.

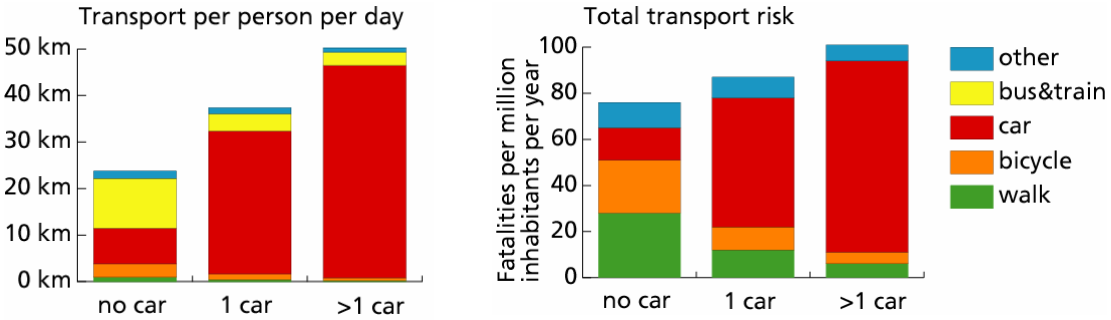


Table 10: Transport per day and transport risks. Source: Krag, 1999

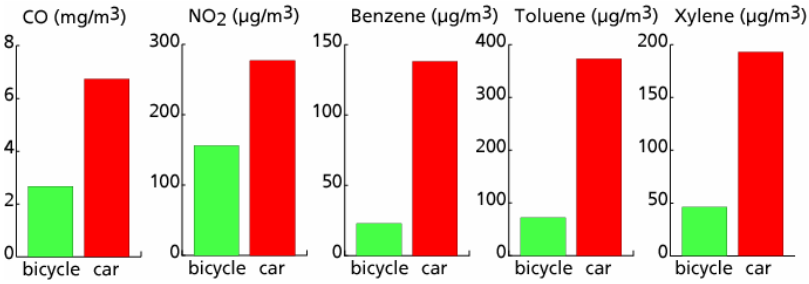
From the graph 10 it is obvious, that those without a car consume less kilometres per day, and thus - if mobility is set equal to kilometres - can be said to be less "mobile". They are, however, if the number of trips is used as a mobility measure, almost as mobile as those with cars.

The way of calculating can of course be discussed. The method is safe for under-reporting of transport means in household surveys, if under-reporting is the same for the groups compared. It assumes, however, that risk is constant. This is not the case. Long driving trips, with the major part usually taking place on the safest roads, will for example be safer than the average driving trip. One could also argue that those who cycle or drive a lot will become more experienced, and therefore will have a lower risk than the average (which, as stated previously, also seems to be the case for bicycle users). It is however most probable that the general picture will remail the same after a more thorough analysis.

One can thus conclude that it is safest not to base one's life on a car, if you live in Denmark. If, on the other hand, one already has and needs a car, it seems still to be unwise to switch some of the shorter trips from car to bicycle. But is it so?

Cycling and health

Besides safety, pollution is a point of concern. It is regarded unhealthy to cycle in an urban atmosphere. There are, however, no reasons to be especially concerned about this. A number of studies indicate that cyclists are not more exposed to dangerous fumes than other road users[48] [49] [50]; one of the reasons for this being, that the concentration of exhaust fumes are higher inside cars than where cyclists breathe.



Studies indicate that cyclists are less exposed to urban pollution than car users. The example shown is a Dutch study[18].

Table 11: Exposure to pollutants in an urban atmosphere depending on transport mode

From a societal point of view cycling is desirable: no pollution, little demand for space, independent transport of children.

Safety remains however an issue of concern. What is stated in the previous paragraphs indicates that it is possible to reduce the injury risk of cycling substantially, and that successful promotion of cycling in itself contributes to such a risk-reduction. In most cases, however, one will still find that cycling safety risk is greater than the risk of car use. Unless a total change of lifestyle is achieved, and long car journeys are switched to public transport, shift from car to bicycle can result in an increased personal injury risk.

From a strict safety point of view one would consequently not recommend cycle promotion, unless cycle use could be made as safe as car use. So cycling immediately

[48] Waldman M., Weiss S. and Articola W .: A Study of the Health Effects of Bicycling in an Urban Atmosphere, 1977.

[49] Van Wijnen, Verhoeff, Henk and Van Bruggen: The exposure of cyclists, car drivers and pedestrians to traffic-related air-pollutants, 1995, pp.187-193.

[50] Rank J., Folke J. and Jespersen P. H., Differences in cyclists and car drivers exposure to air pollution from traffic in the city of Copenhagen, pp. 131-6.

seems to be a social dilemma: It is beneficial for the society but disadvantageous for the user.

The user, however, has positive health benefits of cycling due to the physical exercise, he or she gets. Piles of research reports point out the sedentary lifestyle as a risk factor, and about as much research find that even moderate physical exercise as part of the daily life will give significant health benefits for the individual. For the same reason several national health programmes recommend physical activity as a health promoting activity. Norway can be chosen as example[51].

Attempts have been made to compare the positive health effects from cycling with the negative health consequences of bicycle accidents. Early studies conclude that the positive health effects are 10-20 times as important as the negative accident impacts[52] [53]. Later findings using epidemiological data confirm a significant, positive net-effect on health from cycling to work. Relative risk of mortality adjusted for numerous factors (age, sex, education, smoking etc.) is found to be 28% smaller for people cycling to work than for the average[54], even though they may have an increased risk of cycling accidents.

A Norwegian cost-benefit study on infrastructure investments concludes provisions for walking and cycling to be much more cost effective than traditional car infrastructure, the main positive component being positive health effects from walking and cycling[55].

A study of the cycling city of Odense, Denmark, suggests significant healthcare savings to be a result of local cycle promotion activities. The savings are found to be bigger than the total investments in campaigns and infrastructure[56].

Another study of the bicycle user behaviour in Odense finds, that those who cycle are also more physically active in other ways[57]. There is thus no reason to expect a person, who takes up cycling, to compensate by becoming less physically active overall.

A Danish report sums up numerous studies of health, exercise and cycling and concludes that significant potential savings can be achieved by cycle promotion[58].

International health policies in favour of cycling

The convincing documentation for the connection between physical activity and health has lead to international agreement on favouring the physically active forms of

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[51] Strømme S.B., Anderssen S.A., Hjermann I., Sundgot-Borgen J., Smeland S, Mæhlum S. et al. Fysisk aktivitet og helse - anbefalinger. (Recommendations on Physical Activity and Health, Norwegian Council of Nutrition and Physical Activity).

[52] Thomas Krag: *Safety - the Achilles' Heel for Cycling*. Velo-city Conference in Copenhagen, 1989.

[53] British Medical Association /Mayer Hillman i bogen "Cycling – Towards Health and Safety", 1992.

[54] Andersen L.B., Schnohr P., Schroll M., Hein H.O.: *All-cause mortality associated with physical activity during leisure time, work, sports, and cycling to work*, 2000 June 12; pp.1621-8.

[55] Kjartan Sælensminde: Gang- og sykkelvegnett i norske byer. Nytte- kostnadsanalyser inkludert helseeffekter og eksterne kostnader av motorisert vegtrafikk. TØI, Norway, Report 567/2002.

[56] Evaluering af Odense - Danmarks Nationale Cykelby. Odense Kommune, 2004.

[57] Jens Troelsen: Mobil på cykel - en refleksiv analyse af kvaliteter og barrierer for cykling som transportform. Ph.d.-afhandling, Institut for Idræt og Biomekanik, Syddansk Universitet, 2004.

[58] Chritian Ege, Thomas Krag, Søren Dyck Madsen: Cykling, miljø, motion og sundhed. Økologisk Råd, 2005 (with a summary in English, the report is available at www.ecocouncil.dk > publikationer).

transport, cycling and walking. The ministers and representatives of the European member states of WHO, the World Health Organization, signed a charter about transport, environment and health in London in 1999. According to the charter *"we will promote safe and environmentally friendly cycling and walking by providing safe infrastructure and networks, implementing measures for traffic management, enforcing speed controls and speed limits that are appropriate to local circumstances, and designing roads and settlements taking into account the needs of pedestrians and cyclists."*

It has thus been internationally accepted, that it is beneficial overall to promote cycling in a safe environment. Several activities have since been carried out in the area of walking and cycling and health impact assessment of transport.

Conclusion

There are reasons to be concerned about cyclists' safety, and one should be careful in providing a safe infrastructure for cyclists, whether this is in the form of separate cycle routes or by integrating cycle traffic in the already existing road network.

Concerns should however not be exaggerated. The fatality risk of cycling per hour or per trip is not bigger than for car driving, and the contribution to traffic deaths from long car trips is considerable. The individual, who replaces the car with public transport and cycling, will be exposed to a reduced risk for being killed in traffic.

It seems moreover to be almost a general law, that the risk of cycling is lowered the more cycling there is. Experiences also show that it has been possible to increase cycle use without experiencing more cycle injuries.

When the positive health benefits from physical exercise are also taken into account, cycling will in any case turn out very positively. There is no reason to wait for a traffic safety per kilometre level as low as that for motoring, before one can promote cycling from an ethical point of view.

There are, on the contrary, reasons to warn against a strictly sectoral approach to traffic safety. Traffic safety is a highly relevant concern of the health impacts from the traffic system. If, however, one only takes the direct, negative health consequences from traffic accidents into account, one is missing a major part of the full picture.

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The Use of Travel Survey Data in Road Safety Analysis[59]

By Filip Van den Bossche, Geert Wets and Tom Brijs

1. Introduction

In Flanders (Belgium), people make 2.8 trips per day on average (*Zwerts and Nuyts, 2002*). On one day, they travel 33 kilometres in about 70 minutes of time. In itself, this is not problematic. It is impossible to do all activities at home. Mobility has become part of our social life, and we can't do without it. People have to travel to go to school, to go to work or to participate in any social or cultural activities. In fact, this is a favourable thing: the more people can move, the more they can participate in all sorts of activities, and the more they can broaden their horizons.

On the other hand, traffic also has negative consequences. As long as people travel along public roads, there have been road accidents and victims. Although the local and federal governments in Belgium put in a great effort to increase traffic safety, also in the context of their sustainable transport policy, Belgium is still one of the most unsafe countries in Europe as far as traffic is concerned. Traffic accidents restrict people in their own social activities, and they limit other road users in their mobility. Not to mention the high material and immaterial costs associated with accidents.

In many countries, the main difficulty when studying the relationship between mobility and traffic safety is the availability of appropriate data. This is the main reason for writing this paper. Given the available data in Belgium and in Flanders, we investigate the possibilities to study the relationship between mobility and traffic safety. In this paper, we introduce a relatively simple model to enhance the insight in the relation between road safety and mobility. More specifically, we present some possible exploratory analyses that combine mobility and traffic safety data. In a first part, we use the yearly number of vehicle-kilometres and fatalities to decompose the traffic safety problem in a risk measure and an exposure measure. Next we use Flemish travel survey data (*Zwerts and Nuyts, 2002*) and accident data for the year 2000 to study the factors of mobility that determine traffic safety.

2. Background

The basic pieces of information needed for traffic safety research are the number of accidents, the number of victims and a measure of exposure. In the literature[60], a decomposition of the number of victims is proposed in terms of exposure and risk. The classical decomposition is as follows:

[59] This study is supported by the Flemish Government via a research grant offered to the Policy Research Centre for Traffic Safety.

[60] Directorate General for Transport (1999), *COST329: Models for Traffic and Safety Development and Interventions. Final Report of the Action*, European Commission.

$$victims = exposure \times \left(\frac{victims}{exposure} \right) = exposure \times risk$$

If exposure and risk are modelled separately, then the model is called "indirect". Estimations for the number of victims are then obtained by recombining these two parts. This approach is also followed in Bijleveld and Commandeur, *The basic evaluation model,* 2004, where the authors propose an evaluation model that is based on the decomposition of fatalities in exposure and risk, using a special case of state space methods for the analysis of time series. The advantage of an indirect approach is that the number of victims can be seen as the upshot of two forces working at the same time. The outcome of an accident results from the exposure to the risk and the probability of an accident, given a certain level of exposure. Even if the risk has decreased over time, the number of victims may still be high because of an increase in exposure. Using a direct approach, these forces remain hidden.

The main objective of these models is to monitor the evolutions in traffic safety. For policy makers, it is important to explain the trends in traffic safety and, if possible, to quantify the impact of other influencing factors. These models allow predicting the trends in the number of accidents and victims, giving an indication of the effectiveness of their policy. Insight in the road accident system can be seen as a critical success factor to realise sustainable mobility and safety. In order to develop a sustainable policy towards traffic safety, trends in traffic safety should be depicted.

It is well-known that different user groups (in terms of transport mode, age and gender) can have different patterns of traffic and a corresponding level of risk and exposure. When sustainable transport modes are promoted, policy makers have to make sure that these are safe and useful for the target group. It is important to find out whether a transport means is unsafe for a given user group because of a high level of exposure, or rather because of a higher level of risk. The models presented in this paper therefore try to analyse the traffic safety problem by an indirect approach in terms of exposure and risk. Examples of decomposition in time and decomposition using travel survey data will be presented. Note, however, that others methods for deriving a risk indicator are available, as demonstrated for example in deLeur and Sayed, *Transportation Research Record* , 2002.

3. Data

For the studies in this paper, we have various sources of data at our disposal. First, we have accident data from 1973 up to 2001. These are the official numbers, published by the National Institute for Statistics. They include the number of accidents and victims, split up according to the severity of accidents. If more details on accidents are required, we can use data from the detailed (Flemish) accident database, containing all information from the accident report, including gender and age of the victims.

Second, data on the mobility of road users are needed. Researchers use various indicators of exposure like the total distance travelled, the duration of travel or the number of trips. For Belgium, we have the yearly number of vehicle-kilometres from 1970 up to now. If, however, more detailed mobility data is desirable, travel surveys can

be used (*Wolfe, 1982*). In the Flemish travel survey 2000-2001 (*Zwerts and Nuyts, 2002*), trips of road users (car drivers, car passengers, pedestrians, bike and motorbike riders, public transport users) were registered in the period from January 2000 to January 2001. It is based on a random sample of 2823 households, including 7638 people who were more than 6 years old. In total, 21031 trips were registered.

All people in the survey were given diaries to record the details of trips made during two specified days of the survey period, but only the data of the first registration day is used in the analysis. Since data was recorded on the person level, the age and gender of the respondents are also available. Based on the data in the travel survey an exposure measure (the number of kilometres travelled) is derived for various user groups based on the average daily number of kilometres and available population statistics (population density for each age-gender combination).

Given the accident statistics and exposure measures, it seems that all necessary ingredients for a traffic safety analysis are on hand. However, there are still some remarks. First, mobility and accident information are two different data sources. Usually there are no mobility data available related to the exact place and time of an accident. Therefore it is not always possible to find a clear link between both. Second, travel surveys consist of samples of road users, while accident counts are observed statistics. Both sources have their own problems and limitations.
For surveys, it is sometimes difficult to guarantee that all groups of road users are present in the same proportions as in the population. Accident counts are distressed by problems of under-registration and wrong or incomplete accident information. Third, travel surveys are conducted with the objective to gain an insight in the travel habits of citizens, and rarely if ever to increase (the knowledge on) traffic safety. Some questions will be irrelevant for traffic safety research, and other important questions will not be asked. Fourth, depending on the frequency of the surveys, not all kinds of safety analysis can be conducted. If the surveys are not repeated on a regularly basis, they are useless in evolutionary studies of mobility and traffic safety, as is typically done in time series analysis (*Directorate General for Transport, 1999, Van den Bossche, Wets and Brijs, 2005*).

4. Classical decomposition in time

The exposure, the risk and the number of victims in Belgium, for the period 1973 – 2001 are presented in Table 17. The solid lines are the observed values. The exposure is the yearly amount of vehicle kilometres, calculated by the Federal Government Service for Mobility and Transport[61]. The risk is calculated as the ratio of the number of victims and exposure. Starting from the curves for the number of victims, the exposure and the risk, we can model the relationship between these dimensions.

Oppe[62] describes the number of fatalities as the product of mobility and risk. For the exposure V_t he uses a logistic function of time. It is assumed that exposure will still continue to grow, but at a lower and lower pace. Because of practical reasons, there must be a sort of "maximum capacity" for the traffic system. That is why an S-shaped curve like the logistic is interesting. The fatality rate R_t is assumed to be exponentially

[61] Directoraat-generaal Mobiliteit en Verkeersveiligheid, Directie Mobiliteit, *Verkeerstellingen 2002*, 2003.

[62] Oppe, S. (1989), Macroscopic models for traffic and traffic safety. *Accident Analysis & Prevention*, Vol. 21, pp. 225-232.

decreasing over time. This may be seen as a collective learning process (*Directorate General for Transport, 1999*), caused by the ever-increasing knowledge of the traffic safety problem and the constant improvement of the safety performance of the road transport system. In comparison with some decades ago, cars and roads are better equipped, traffic safety education has improved and legislation and enforcement have increased. The number of fatalities is then modelled as the product of exposure and risk.

This approach has been applied to the yearly Belgian data on the number of persons killed and seriously injured (F_t), the exposure in terms of vehicle-kilometres driven (V_t) and the risk (R_t), being the ratio of the number of victims and exposure. The fitted curves for risk and exposure are as follows:

$$\left.\begin{aligned} R_t &= e^{at+b} \\ V_t &= \frac{V_{\max}}{\left(1+e^{ct+d}\right)} \end{aligned}\right\} \Rightarrow \quad F_t = R_t \times V_t$$

The values *a*, *b*, *c*, *d* and V_{max} are parameters to be estimated, and *t* is an indication of time (1973 is put equal to 1). The estimated values for the parameters are given in Table 12 together with the standard error and a 95% confidence interval for the parameter.

Parameter	Estimate	Standard error	95% confidence limits
a	-0.0629	0.0017	[-0.0664; -0.0594]
b	4.3957	0.0168	[4.3611; 4.4302]
c	-0.0614	0.0057	[-0.0730; -0.0497]
d	1.2187	0.1201	[0.9719; 1.4655]
V_{max}	145.7	15.9784	[112.8; 178.5]

Table 12: Parameter estimates for exposure and risk (Flemish data, 2000)

The results are shown in Table 13. The dashed lines are the estimated outcomes from the models. The curves show the decisive factors in the evolution of traffic safety. While exposure is still increasing, risk is going down. As a result, fatalities are going down, but the decrease is getting smaller. The better the traffic safety situation, the more efforts are needed to make further improvements.

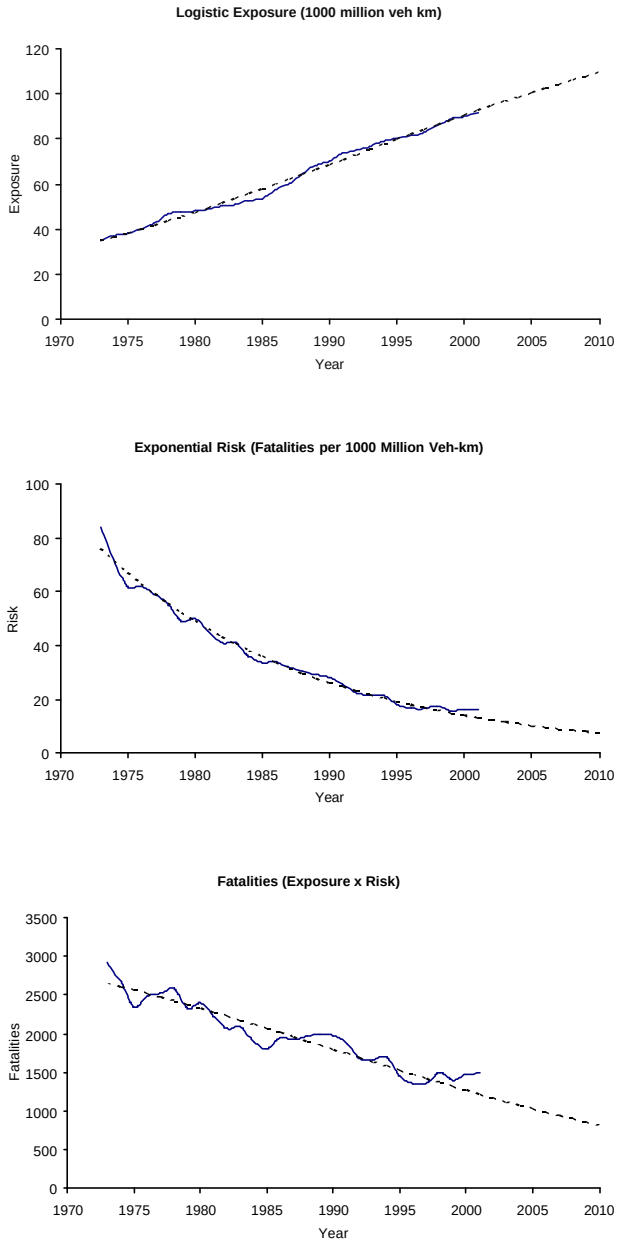


Table 13: Decomposition of the number of victims in time (Belgian data, 1973-2001)

The graph also shows the predictions up to the year 2010. The European Commission[63], as well as the Federal and Flemish government in Belgium[64 65], formulated the objective to reduce traffic fatalities by 50%. Looking at our model, the estimated number of persons killed or seriously injured for the reference year 1999 is 1315. In 2010 this number amounts to 815, which is still more than the target. This shows that it will require a great deal of effort to achieve the objectives.

[63] European Commission, *European transport policy for 2010 : time to decide*, White Paper, 2001

[64] *Staten-Generaal voor de Verkeersveiligheid*, http://www.wegcode.be/aktueel/archief/akt18.htm (2001).

[65] *Ontwerp Mobiliteitsplan Vlaanderen* (2001), http://viwc.lin.vlaanderen.be/mobiliteit, Ministerie van de Vlaamse Gemeenschap

5. Travel Surveys and Road Accidents

When data over time are not available, it is impossible to study trends as was done above. However, even without time series data, interesting aspects of the relationship between exposure and risk can be discovered. In this section, we show that the decomposition principle can also be applied to criteria other than time. For example, if we are interested in the distribution of fatalities over age and gender, we can calculate a measure of exposure and an indicator of risk for each age-gender category. The product of exposure and risk will again provide an estimate of the fatalities. This approach can be useful to extend the insight in the accident generating process for a given age category. A similar study was presented (*deLeur and Sayed, 2002 and Toomath and White, 1982*), where information on driving patterns is used in association with reported injury accidents to determine exposure-adjusted accident rates by age and gender group.

Using the data of travel habit surveys for Flanders (*Zwerts and Nuyts, 2002*), we can create a measure of exposure for different age and gender groups for the year 2000. Together with the road accident records for the same period, a risk indicator can be constructed, and the decomposition should again be valid. For example, the product of risk and exposure for male persons of 25 years old should result in a corresponding number of victims. In comparison with the decomposition over time, the curve-fitting exercise is more complex. It is expected that exposure will be higher for the working category of people, and lower for younger and older persons. Therefore, a normal curve as a function of age is fitted. Also the risk will not be continuously decreasing, but will be higher for younger and older people and for vulnerable road users in general. In this study, a curve based on a ?² function is used for the risk. The structure of the model, in terms of age and for each gender separately, is then as follows:

$$\left.\begin{aligned} R_{age} &= C_1 + \frac{C_2 \exp\left(-\frac{age}{2}\right) age^{\left(\frac{?}{2}-1\right)}}{2^{?/2}\,\Gamma\left(\frac{?}{2}\right)} \\ V_{age} &= C \exp\left(-\left(\frac{age-\mu}{s}\right)^2\right) \end{aligned}\right\} \Rightarrow \quad F_{age} = R_{age} \times V_{age}$$

In these expressions, V_{age} and R_{age} are the exposure and the risk for a given age respectively. The values C, C_1, C_2, μ, s and ? are parameters to be estimated, and *age* is an indication of the age of the road user, starting at 10 and ending at 69 (due to data restrictions in the travel survey). The symbol ? indicates the Gamma function. Table 14 contains the parameter estimates for exposure and risk, for both male and female road users.

Group	Parameter	Estimate	Standard error	95% confidence limits
Male	μ	38.6518	0.7176	[37.2148; 40.0889]
	?	21.3642	0.5961	[20.1704; 22.5580]
	s	23.7191	1.1712	[21.3739; 26.0644]

	C	952.1	34.9714	[882.1; 1022.1]
	C_1	0.0696	0.00798	[0.0536; 0.0855]
	C_2	3.5204	0.2940	[2.9317; 4.1091]
Female	μ	34.3825	1.0446	[32.2907; 36.4742]
	?	19.8873	1.4655	[16.9527; 22.8219]
	s	26.4649	1.8076	[22.8452; 30.0846]
	C	592.2	26.5383	[539.1; 645.4]
	C_1	0.0688	0.00829	[0.0522; 0.0854]
	C_2	1.4484	0.2995	[0.8486; 2.0482]

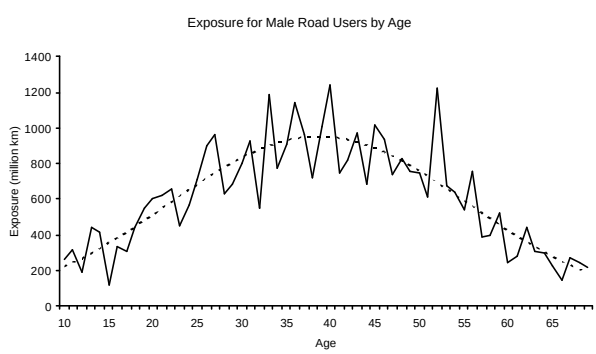
Table 14: Parameter estimates for exposure and risk (Flemish data, 2000)

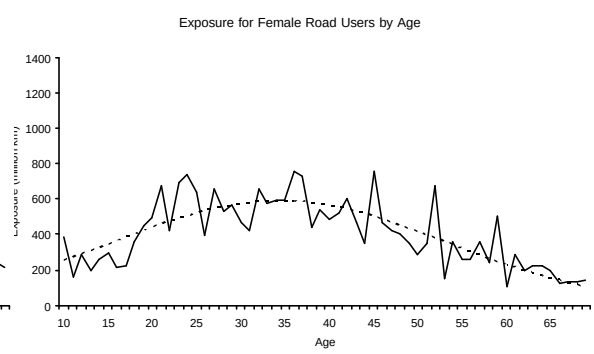
Table 15 shows a decomposition of the number of victims in risk and exposure, for each age and gender combination. The curves give an acceptable fit with the data. For exposure, it is reasonable to assume that both younger and older people are less exposed to risk, because of their lower frequency of travel. The estimate for the victims is again the product of the estimates for exposure and risk. Some interesting insights can be gained from this decomposition.

First, persons between 15 and 25 years old are high risk road users. The risk stays at more or less the same level from age 40 up to age 60 and starts going up then for the elderly. Even if their exposure is lower, they have a higher probability of being killed or seriously injured. These risk pictures clearly show how vulnerable the younger and older road users are.

Second, the highest exposure is found for people between 30 and 50 years old. This is the class of people who is working and is at the same time socially active. Their activities result in a higher number of kilometres driven. For this group of persons, the number of victims is more determined by exposure than by risk.

Third, the risk and exposure for female road users is lower than for male road users of the same age. This indicates that women are less frequent road users, and if they are, their probability of being killed or seriously injured in an accident is lower.





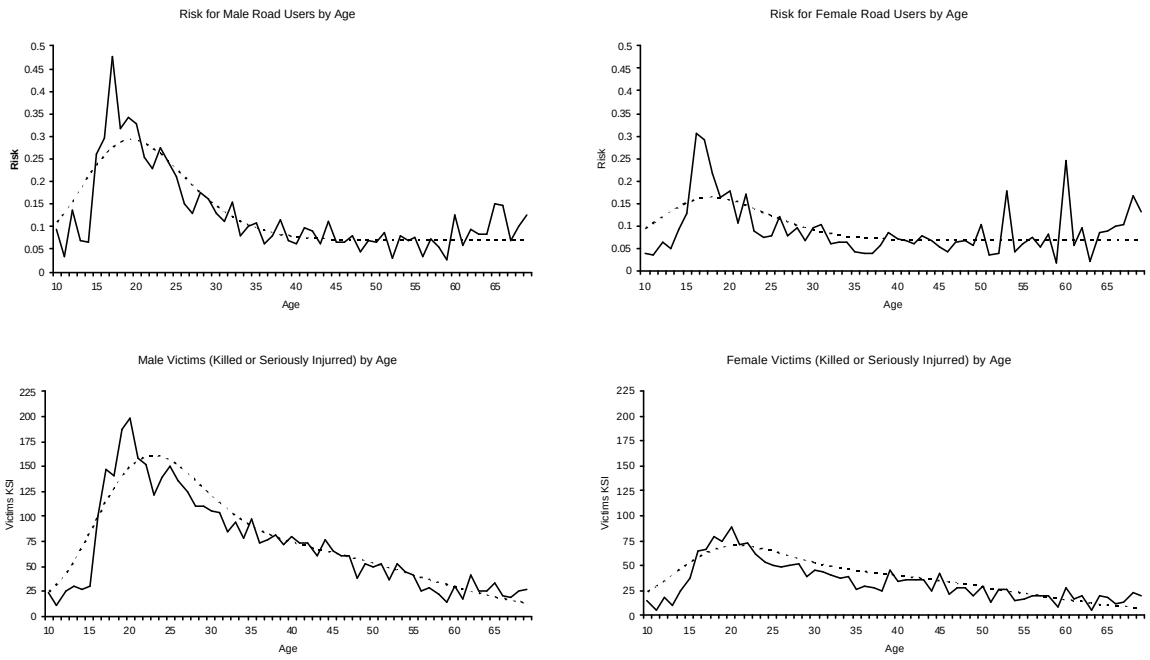
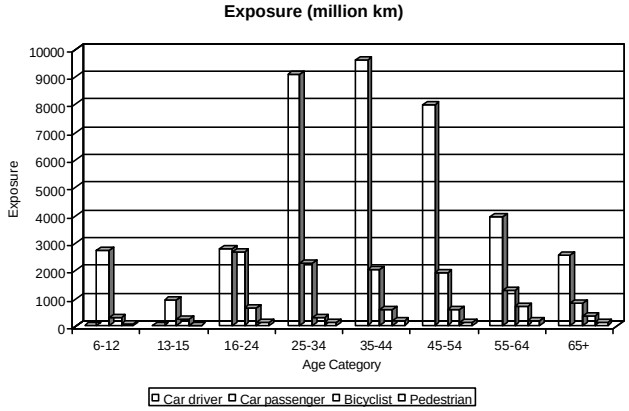
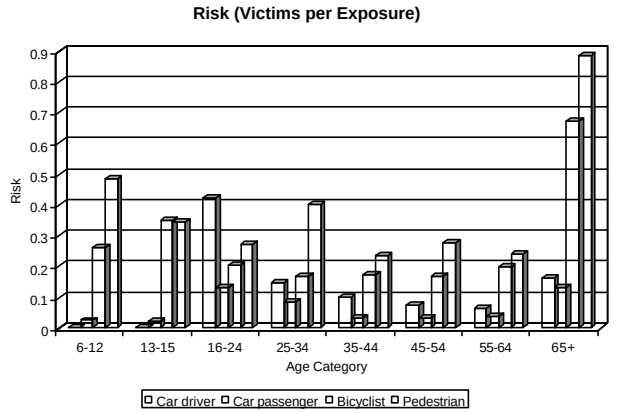


Table1 5: Decomposition of the number of victims by age and gender (Flemish data, 2000)

6. Modal Split and Road Accidents

Another advantage of travel surveys is that detailed information on travelling choices is available, like for example the modal split, for each category of age. It is expected that younger people will travel more as a passenger of a car, while at later age they will go by bike or drive a car themselves. This information can also be linked with the number of victims of the various modes of transport. In Table 16, we show the risk, the exposure and the number of victims for car drivers, car passengers, bicyclists and pedestrians, split up by age. Because of the higher level of detail, and in order to reduce sampling errors, we use categories of ages instead of the ages themselves. The victims are again the number of killed or seriously injured people, while exposure is the number of kilometres travelled using a specific mode of transport.





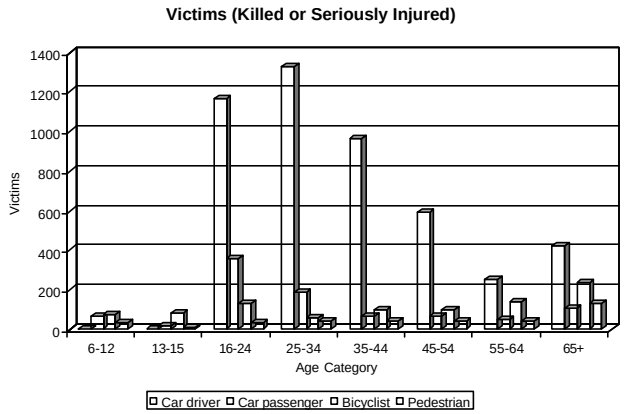


Table 16: Decomposition of the number of victims by modal split (Flemish data, 2000)

Some interesting results are found. First, car drivers have the highest number of victims. Exposure is largest for drivers between 25 and 54 years old. The risk is higher for young drivers, but decreases with age. This is probably a kind of learning effect, showing that older drivers are more experienced than younger ones. On the other hand, elderly people show a higher risk. Although studies have shown that specific driver performance skills decline with increasing age[66], indicating that they become less proficient in driving a car, it is reasonable to assume that the higher risk of elderly drivers stems from their reduced ability to survive injury crashes.

As explained by Evans (2004), the risk of being killed in a crash is higher for older than for younger drivers. Older drivers involved in a crash are more likely than younger drivers to suffer serious injury or death. The number of victims is higher for younger people, mainly because of higher risk. For the working category of drivers, the number of victims is more determined by the higher level of exposure.

Second, car passengers show high exposure in the youngest age category. Very young children are mostly taken by car to their social or educational activities. Children of age 13-15 are seen less as passengers. They probably prefer the bike or go on foot. From the next age category on, car passengers are again more frequent, but their level decreases further with age. The risk for car passengers is highest for young (16-24 years old) and elderly people. Many young people travel together and passengers of this age

[66] Warshawsky-Livne L. and Shinar D. (2002), Effects of uncertainty, transmission type, driver age and gender on brake reaction and movement time, Journal of Safety Research, 33, pp. 117-128.

category will probably be accompanied (and driven) by peers. The highest number of car passenger victims is found for youngsters between 16 and 24, mainly because of the higher risk. Third, bicyclists and pedestrians show a relatively low level of exposure over all ages. The number of victims is especially high for older bicyclists and pedestrians. Their number is still relatively low compared to car users, but the risk of vulnerable road users is remarkably high. Evans (2004) showed that, after the age of 60, the risk of pedestrian death per person increases steeply, and then again declines, likely reflecting reduced walking. The increasing involvement of elderly people in pedestrian crashes may reflect the decreasing perceptual skills and agility (*Evans, 2004*).

These findings are interesting for policy makers who should promote bicycle use and walking as examples of sustainable means of transport. As long as the risk of these road users is high, these modes of transport may be less attractive than any other alternative.

Conclusions and Further Research

For many traffic safety researchers, the main problem is finding the right sources of data. The indicators needed for traffic safety analysis are exposure, risk and the number of victims or accidents. In many countries, these data are not always available in a format that is needed for specific modeling purposes. Exposure data in particular is mostly not gathered with the objective of analyzing traffic safety.

In this study, we presented some examples of the use of travel survey data for the analysis of traffic safety. Starting from the classical decomposition of the number of victims in exposure and risk over time, we extended this approach to decomposition for traffic safety by age and gender. Instead of trends in time, this analysis shows the impact of the main indicators of traffic safety for different ages of road users. From the classical decomposition, as well as from the decomposition based on travel survey data, interesting conclusions can be drawn. For each year, or for each age-gender combination, the number of victims can be explained as the result of exposure to risk and the risk itself.
The models also show which factor is most determinant. Typically for age categories, it is possible to highlight the high-risk groups. Also, exposure measures based on travel surveys are mostly more detailed than the exposure measures based on traffic counts. They allow the analysis to be split by socio-demographic characteristics like age and gender. As shown in the paper, they are better suited to point out the safety differences in the various modes of transport.

On the other hand, the approach has some limitations. First, the travel survey data are based on a sample of road users, who registered their travel behavior for a few days. Sampling errors may influence the results, and for some subcategories by age and gender, the number of respondents may be too low to allow valid extrapolations.
Second, the sample of the travel survey is by no means in accordance with the observed accidents and victims. It is quite possible that there were no accidents registered among the road users in the travel survey sample. Instead, we can only match the extrapolated sample data of the travel surveys with the observed accident counts. It is then implicitly assumed that the exposure, calculated from the travel surveys, is also representative for the exposure that (partly) causes traffic accidents.

Third, the availability of travel survey data determines the possibilities for analysis of the traffic safety situation. If trends in the number of victims are to be studied over a long period of time, we have to make sure that the travel survey is conducted on a regular basis.

In Flanders, travel surveys are only available for two separate years, namely 1995 (*Hajnal ad Miermans, 1996*) and 2000 (*Zwerts and Nuyts, 2002*), excluding the possibility of a reliable evolutionary study. For Belgium, only one travel survey study is known (*Hubert and Toint, 2002*). Given the interesting conclusions that can be drawn on the basis of this kind of analysis, there is a clear incentive to extend the frequency of conducting travel surveys in Flanders, as it is done in other countries such as the Netherlands.

Based on the results of this study, some topics appear interesting for further investigation. Instead of only looking at age, gender and modal split, it might be interesting to take into account the reasons for travel or the transport mode choice. Also, the inclusion of different types of exposure and risk in an accident analysis will provide better insights in the accident generating process. An accident between a bicyclist and a car is influenced by both the exposure and the risk of the bicyclist and the car. For a tailor-made analysis of various kinds of accidents, this information may be of high value.

The use of travel survey data, which are typically mobility-related, can greatly improve the knowledge of the relationship between mobility and traffic safety. Given the importance of exposure in traffic safety studies, this does not come as a surprise. Therefore, this relationship should be further investigated. If mobility data are gathered on a regular basis, and directed towards traffic safety, these data can provide useful insights that would remain hidden if only less detailed information is used. For policy makers, this information can steer their campaigns, and determine what kind of transport mode should be made safer and more attractive for specific groups of road users.

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End-of-Life Ships - Linking European Maritime Safety to Occupational Safety on Asian Scrap Yards

By Karsten Krause

1. Introduction

Oiled birds on the beach, men in white overalls cleaning rocks, and politicians promising tough political initiatives. Shipping accidents are not only a catastrophe for marine ecosystems; they are also media events and have often been the starting point for improvements in maritime safety legislation.

The sinking of the *Exxon Valdez* in Alaska in 1989 marked the beginning of an end for an entire generation of oil tankers. Vessels equipped with a double hull have been recognised to provide higher safety margins than vessels with a simpler structure. The central element of the political response in the United States was the *Oil Pollution Act* of 1990, which was to introduce a ban on single-hull oil tankers within US waters.
Following the sinking of the oil tankers *Erika* and the *Prestige* in European waters, the ban on single-hull tankers also became an element of the European maritime safety legislation. The International Maritime Organisation (IMO) agreed in 2003 that the final phasing-out date for single-hull tankers would be 2010.

While only a small number of those vessels could still be used to transport other commodities, the majority of the phased-out vessels will have to be dismantled on a scrap yard within the next years. Following the ban, more than 2 000 single hull oil tankers will be taken out of the waters and scrapped between 2005 and 2010 (*Greenpeace, 2004*). There is not sufficient capacity to recycle the ships in an environmentally sound and safe manner. Green recycling facilities will not be able to provide for more than a third of the predicted future scrapping demand in most years and even less in the peak demand years (*European Commission, 2004, p. 149*). Most of the ships will be dismantled under poor environmental and health standards, if any. This practise exports environmental risks and toxic waste products from the EU. Workers' safety on end-of-life ships is the neglected side effect of maritime safety policy.

2. Safety and environmental risks

An end-of-life ship contains a number of recyclable materials but also a range of toxic substances. In Europe, such materials are subject to special monitoring and their disposal is highly regulated and expensive. Most of them are already defined as hazardous under the Basel Convention.

The primary product is ship steel, which is turned into mild steel by cold rolling. In industrialized countries, rolled steel is banned from structural use for quality reasons (*Bode, 1999*). Copper is produced by burning cables in open fires. A ship provides tons

of cheap supplies for second hand markets. Ventilators, mattresses and various building materials are disembowelled from the ships.

Depending on size and function, ships weight between 5,000 and 40,000 tonnes. About 95% of this is steel, coated with up to 100 tonnes of paint containing lead, cadmium, organotins, arsenic, zinc and chromium. Shipbuilding materials also contain other hazardous wastes: sealants containing PCBs and, on each ship, up to 7.5 tonnes of various types of asbestos in pure and processed form (*Bode, 1999*). In addition, there are several thousands litres of oily waste from engine fuel, bilge oil, hydraulic and lubrication oils and greases. Tankers additionally hold up to 1,000 cubic metres of residual oil.

In the last 20 years, the shipbreaking industry and the applied safety standards have changed dramatically. In the 1970s, ocean-going vessels were scrapped at the docks in the United Kingdom, Taiwan, Spain, Mexico and Brazil with prescribed technical procedures and mechanical aids. Since the early 1980s, shipbreaking activities have migrated to low-payed Asian countries. In countries such as India or Bangladesh, old ships are dismantled on open beaches with minimal technical assistance and under inhuman working conditions. In addition to bare hands, torch beams are the main tools.

In some regions ship scrapping created an important industry, creating employment for tens of thousands of young men and women. Most of the workers endure hard physical labour, working in shifts and under highly unsafe conditions. An average of 360 deaths a year are reported in Alang alone, the world's biggest ships' scrap yard in Gujarat, India (*Bode, 1999*). The causes of death are explosions, fire, suffocation and falling steel beams and plates. More indirect and long-term by nature are the health effects of the exposure to asbestos dust, lead, organotins and other harmful substances both on the job and in the sleeping quarters close by. The workers know nothing of the risks their work causes to their health.

In summary, the accelerated phasing-out of end-of-life ships reduces the risk of accidental maritime pollution in EU waters. Nevertheless from a global perspective, the impact of scrap yards on safety, health and the environment is likely to outbalance the positive effects.

3. Economics of Ship Recycling

As within any other transport industry, scrapping of old vessels is an integral part of the industry‘s business cycle. The total world merchant fleet consists of 41,000 freight and passenger vessels, among these are 10,000 oil tankers (*Hader and Monden, 2002, p. 71*). The operational lifetime of a ship varies between 20 and 30 years, often longer.

About 16,000 ships have an operational lifetime of more than 25 years, among these is a significant share of oil tankers. In the late sixties and early seventies, investments in oil tankers had been considered as a very promising market. By the time the ships entered the market, the situation had changed and profits dropped dramatically below the investors’ levels of expectations. Most tanker’s new builds had been ordered well before the 1970’s Oil Crisis. Orders to the building yards have been placed well before

the demand for oil products dropped. The chances to react to the new situation have thus been limited.

The financing of investment is the biggest share of total costs. For a 10 year old ship, almost 40 percent of annual costs have to be used for capital costs. Only a third of the costs is actually variable and depends on the utilisation of the vessel (*Stopford 1998, p. 160*).
Over the lifetime of a ship, the cost structure changes after capital costs are covered. Ship management and maintenance are getting more important in the cost structure over the years. So are the economic benefits from less inspections and shorter time in repair yards. Despite of the control system of classification societies and Port State Control, about 15 percent of all ships have competitive advantages of about 10% of the daily operation costs by neglecting health and safety standards (*Clarkson Research Studies, 1999, p. 6-11*).

In maritime transport, a clear division between legal and substandard competition is not feasible due to different legal practises in the port and flag states (*Haralambides, 1999, p. XXIII*). Nevertheless, these problems are linked to the age of the ship. To avoid the stricter controls of the EU, some of the unsafe ships do not operate in European waters. Here regional maritime safety policies have led quite often to outsourcing of problems to poorer regions. The dismantling of end-of-life ships being one of the worst.

The phase-out of single-hull tankers minimised the earning potential for single-hull tankers. Only a small number of these could be used for other transport services or were able to operate in the substandard market. It is expected that up to 2,000 ships will enter the demolition market between 2005 and 2010 (*Greenpeace 2004*). However, there is no sufficient capacity available for safe and environmentally sound ship breaking. Moreover, there is no incentive to change the current practise of lowest cost scrapping. The ship owner simply chooses to scrap the ship at the ship-breaking yard offering the highest price.

The sale from steel creates the main income for ship scrappers. This therefore determines the demand for end-of-life ships demolition, the latter increasing with the steel prices. Recycled steel from ships may form only an insignificant share of global steel production. Nevertheless, for regional markets such as India and Bangladesh it is a very important resource, in contrast the demand for recycled steel and other reusable items from ships is lower in the EU. The economic boom in China and the prospering building industry in Asia have lead to rising prices levels for steel and other metals. Resources from ship scrapping-yards are sold in the local currency and therefore not affected by oscillating exchange rates. During 2003 and 2004 the scrap prices have tripled from a level of 125 USD/LDT in the beginning of 2002, to a level close to 400 USD/LDT in the beginning of 2004 (*European Commission 2004, p. 70*). In addition to the almost insatiable need for steel in China, a strong freight market in almost all shipping segments has limited the supply of vessels for decommissioning.

Despite the price levels for steel and other reusable items from ships, labour costs play a crucial role in the ship breaking industry. Furthermore the costs of decommissioning large waste quantities for disposal are an issue. Those costs are closely linked to the levels of health, safety and environmental legislation. Theoretically, global uniform standards could bring significant improvements but in practise these are not

enforceable. Stricter regulation will increase the costs of scrapping a ship. Health, safety and environmental issues are often implemented locally, whereas the market for demolition of ships is global. Hence, it is likely that national regulation will only affect a fraction of the ship scrappers.

Higher standards would be linked to the introduction of more technical equipment into the scrap-yards and to training workers. Those would increase the cost of a scrapping yard. Capital costs may, however, play a crucial role when evaluating the potential demand for ship scrapping in industrialised countries, as economic feasibility of ship scrapping in "high cost" areas depends on efficient non-labour intensive techniques (*European Commission 2004, p. 51*).

The cheapest, most polluting and unsafe scrapping yards use a beaching method to dismantle ships. Vessels head at high tide with full power towards a flat sand beach. Arrived there, the dismantling process is carried-out by swarms of workers and a minimum support of cranes. An alternative is to scrap docks where dismantling operates in dry docks. Generally speaking, docks give the workers more technical support and allow for higher safety standards. The currently applied practice only requires a suitable beach, plenty of labour and a hinterland force requiring steel - all of which seems to be readily available in large quantities in some of the developing countries in Asia. In the past 10 years, about 75 percent of the total volume of ships scrapped has been concentrated in India, Bangladesh, and Pakistan. Another 15 percent has occured in China and less than 2% of the ship scrapping seen in the period of 1994-2003 has taken place in Europe, in which Turkey alone accounted for more than 85% (*European Commission 2004, p. 56*). Well over 100,000 workers are estimated to be employed at shipbreaking yards world-wide (*Bode, 1999*).

4. Initiatives towards Green Recycling

With no restriction to the ship owner's decision on where to scrap, the latter is determined by which ship scrapper offers the best price to the owner. Ship scrappers with "high costs", for example, for costs of labour and/or high disposal costs, have no chance of competing in the market as long as ship scrappers with "low costs" have the capacity of processing the ships supplied to the industry.

Any initiative by one scrap yard or one scrapping country to improve the safety situation beyond a cost-neutral way will drive them out of the market. The extra cost for performing green recycling is related to a demand for infrastructure, more technical equipment and worker's training. Furthermore, the proper handling of hazardous waste increases the disposal costs.

Concerns for the environment, workers' health and safety issues have resulted in the development of several guidelines for ship recycling, which have recently been developed and adopted in the context of the IMO, the Basel Convention and the ILO respectively. More voluntary guidelines and code of practice have been prepared by industry or by the United States Environmental Protection Agency. Yet, until now the guidelines have had little impact on improving the working and health conditions in countries where the ship recycling industry is concentrated (*European Commission 2004, p. 10*). A current factor for green scrapping facilities is linked to initiatives of individual companies like P&O Nedlloyd. The Anglo-Dutch container line operator

started, following NGO protests, to work together with ship yards towards the objective to scrap single-hulled tankers "with zero emissions".

In the long run, such a zero emission objective could be combined with a take-back approach for construction yards. Whether such concepts could ever find support within the IMO remain an open question, as well as a mandatory implementation of IMO guidelines in ship scrapping nations.

5. Future EU Policies for End-of-Life Ships

For the European Union, its Member States and Accession Countries, the political challenge is to work towards such global solutions and to realise in the short term, dramatical improvements on all scrap yards and to promote green scrapping facilities. Its influence on companies outside its territory is limited to subsidies, knowledge transfer and raising awareness. European policy instruments should be focussed on end-of-life ships, before they leave the port for their final journey. The key question of any initiative is, who pays for the extra costs for green recycling – now and in the future. In order to find an answer, a combination of regulatory, information-oriented and economic policy instruments are needed, this in addition to voluntary guidelines and best practise. It is unlikely that any non-mandatory instrument will create a sufficient push and change the end-of-life economics of the shipping markets.

Given the international character of the shipping industry, the scope for regulatory instruments at the EU level is considered to be rather limited (*European Commission 2004, p. 142*). Ship scrapping as a land-based activity has been considered a matter of national authorities and no responsibility has been placed on the ship owner in that respect. Although the Basel Convention and the European Waste Shipment Regulation already applies to the scrapping issue, it has been very difficult to prove a ship owner's intent to dispose. In the long run a take-back approach is necessary, that is to link the construction of ships to the dismantling phase. The mandatory removal of the most dangerous material from ships before they depart on their last journey is a short-term alternative. Experts applying appropriate occupational safety standards could carry out the “cleaning” of a vessel.

A first step towards the take-back approach is the introduction of information on risks about end-of-life vessels. Before the departure on its last journey, manuals could indicate toxic material and safety risk on the vessel. Translated into the language of the designated scrapping country, the safety awareness of the workers could be improved. Another approach would be to give safety training to workers on the spot.

Economic instruments could help to provide an incentive for training, information and green recycling. The development of a "take-back" approach could be linked to a charging regime. A “dismantling” fund could be linked to a global charge on waterborne transport or a global fuel tax. In the short-term, subsidies could be used to improve the situation in Asia, i.e. by financing training courses on occupational safety.
Given the budgetary restrictions, subsidies could only be useful to kick start projects. The polluter-pays principle should be applied, in order to link the financial burden to the owner’s and user’s responsibility. In the context of maritime pollution, different concepts have been proposed. The political economy of the shipping markets makes it unlikely that a concept such as a global charge on waterborne transports or bunker

fuels could find support in the short term. However, they provide a starting point for the discussion on EU policy instruments that has just begun.

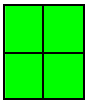
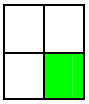
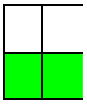
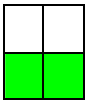
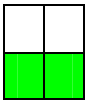
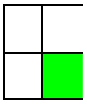
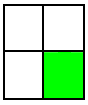
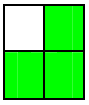
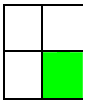
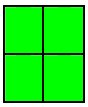
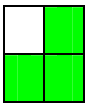
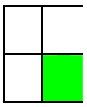
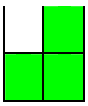
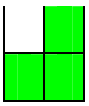
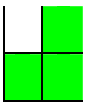
	Regulatory Instruments	Information Instruments	Economic Instruments
	short-term: - EU Waste Shipment Directive - Basel Convention long-term: - 2 stage dismantling - take-back approach	short-term: - risk manual - training courses	short-term: - subsidies long-term: - differentiated shipping dues - global fund
Evaluation	environmental efficiency		
			
	cost to ship owners		
			
	political support		
			
	improving situation on Asian scrap yards		
			
	creating a market for green scrapping		
			

Table 17: Evaluation of Policy Instruments

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Appendix

Members of ETSC's Main Council

Austrian Road Safety Board (KfV) (A)
Automobile and Travelclub Germany (ARCD) (D)
Belgian Road Safety Institute (IBSR/BIVV) (B)
Birmingham Accident Research Centre, University of Birmingham (UK)
Centro Studi Città Amica (CeSCAm), University of Brescia (I)
Chalmers University of Technology (S)
Comité Européen des Assurances (CEA) (Int)
Commission Internationale des Examens de Conduite Automobile (CIECA) (Int)
Confederation of Organisations in Road Transport Enforcement (CORTE) (Int)
Czech Transport Research Centre (CDV) (CZ)
Deutscher Verkehrssicherheitsrat (DVR) (D)
Dutch Safety Investigation Board (OVV) (NL)
European Federation of Road Accident Victims (FEVR) (Int)
Fédération Internationale de Motocyclisme (FIM) (Int)
Finnish Vehicle Administration Centre (AKE) (Fin)
Folksam Research (S)
Fundación Instituto Tecnológico para la Seguridad del Automóvil (FITSA) (E)
Institute for Transport Studies (ITS), University of Leeds (UK)
Irish National Safety Council (NSC) (IE)
Motor Transport Institute (ITS) (PL)
Nordic Traffic Safety Committee (Int)
Parliamentary Advisory Council for Transport Safety (PACTS) (UK)
Prévention Routière (F)
Road and Safety (PL)
Swedish National Society for Road Safety (NTF) (S)
Swiss Council for Accident Prevention (bfu) (CH)
Traffic Safety Committee, Fédération of Finnish Insurance Companies (VALT) (Fin)
University of Lund (S)
Vehicle Safety Research Centre, University of Loughborough (UK)