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The Nature of and the Reasons for the Worldwide Decline in Drinking and Driving

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THE NATURE OF AND THE REASONS FOR THE WORLDWIDE DECLINE IN DRINKING AND DRIVING

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INTRODUCTION

This circular reports on an important session that was held at the Traffic Safety on Two Continents International Conference, held in The Hague, The Netherlands on September 23, 1993. The session was organized by the Transportation Research Board Committee on Alcohol, Other Drugs and Transportation. The Committee put this session together so that a very significant worldwide reduction over the past decade in the incidence of drinking and driving could be discussed in an international forum. The presentations covered the nature of the decline and the reasons for it in Australia, United Kingdom, Canada, Germany, The Netherlands, Sweden and the United States. The pattern and reasons for the reduction vary from country to country. Some show large reductions among young drivers, others do not. Some show an improvement in the number of pedestrian alcohol fatalities and in other countries that is not the case. One might think that the reasons for the reductions would be similar from country to country, but after reading the papers it will be apparent that there is some similarity but there is also quite a bit of difference. Many of the presenters talked about the reasons for the reduction. Presenters also discussed alcohol consumption and the economic conditions in the various countries and what role they played. We were very pleased because we had some of the world's top experts in this field prepare papers and participate at the session to discuss this very important subject. In addition to the countries that made presentations, colleagues from France prepared a paper describing what occurred in their country. A summary of that paper is included in this circular. The circular also includes a summary of the general discussion that followed the formal presentations.

Barry M. Sweedler
Chairman
Committee on Alcohol, Other Drugs
and Transportation

DECLINE IN DRINK DRIVING AND ALCOHOL RELATED FATAL CRASHES IN AUSTRALIA

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ABSTRACT

In this paper, trends in road accident fatalities in Australia are presented in terms of both numbers and rates for the period from 1981 to 1992. The data for Australia as a whole in 1990 are then compared with similar data for certain other countries and for selected states and territories within Australia. Trends in fatalities by type of road user are also noted. Data for the past 11 years on the percentage of driver and rider fatalities with a blood alcohol concentration (BAC) above the legal limit are then presented for Australia and for selected regions. Particular attention is paid to the state of South Australia because roadside breath alcohol survey data are available over the period from 1979 to 1993 for the Adelaide metropolitan area. Such trends that are apparent in the percentage of fatally injured drivers and motorcycle riders with a BAC above 0.08 in that area are compared with changes in the percentage of non-accident involved drivers above 0.08 over the same period and considered in relation to various interventions which were intended to modify drink driving behaviour. The paper concludes with a discussion of the likely importance of these interventions.

INTRODUCTION

The largest number of persons to have died in one year on Australian roads was 3,798 in 1970. Since then there has been a reduction of 48 per cent to 1,977 deaths in 1992. (1) Most of this reduction (39 per cent) occurred in the last 10 years and more than half (29 per cent) since 1989, a period of depressed economic activity in Australia as in many other countries.

The fatality reductions have varied by type of road user. From 1981 to 1992 they were greatest for pedestrians (56 per cent) and motorcyclists (53 per cent) followed by pedal cyclists (44 per cent). The reduction in fatalities for vehicle occupants was the same for drivers as for passengers, at 36 per cent. (1)

The percentage reductions in both population based and distance travelled death rates have been greater than those based on numbers of fatalities alone. In 1970 there were 30.4 deaths per 100,000 population; in 1992 this rate was 11.2, a reduction of 63 per cent. (1) The earliest year for which distance travelled rates are available is 1976, when there were 3.6 fatalities per 100 million vehicle kilometres travelled; in 1992 this figure was 1.3, a reduction of 64 per cent. Figure 1 shows that the changes in these two rates since 1981 have been very similar.

These rates for Australia are placed in an international perspective in Table 1 (1). It can been seen that the population-based rate for Australia in 1990 was lower than that for the United States, similar to that for Germany and higher than those for Sweden and the United Kingdom. There was less difference in the distance travelled-based rates, with Germany being the highest at 1.7 deaths per 100 million vehicle kilometres travelled followed by Australia at 1.5 and Sweden the lowest of these five countries at 1.2.

Within Australia these two rates for some of the states and territories differ greatly from the national average. The Australian Capital Territory (ACT), which includes Canberra, had population and distance travelled based death rates of 9.0 deaths per 100 thousand population and 1.0 deaths per 100 million vehicle kilometres travelled, respectively, in 1990, whereas the corresponding rates for the Northern Territory were 42.9 and 7.2. These differences in road accident fatality rates can be attributed to a large degree to considerable geographic and demographic differences between the two territories. Canberra has been developed as a planned city and a high proportion of the population is employed by the Federal Government. The Northern Territory is one of the most sparsely populated regions in the world, with many of the demographic characteristics commonly associated with such regions. The two main highways are the only roads which have a sealed, all weather, surface and there is no open road speed limit.

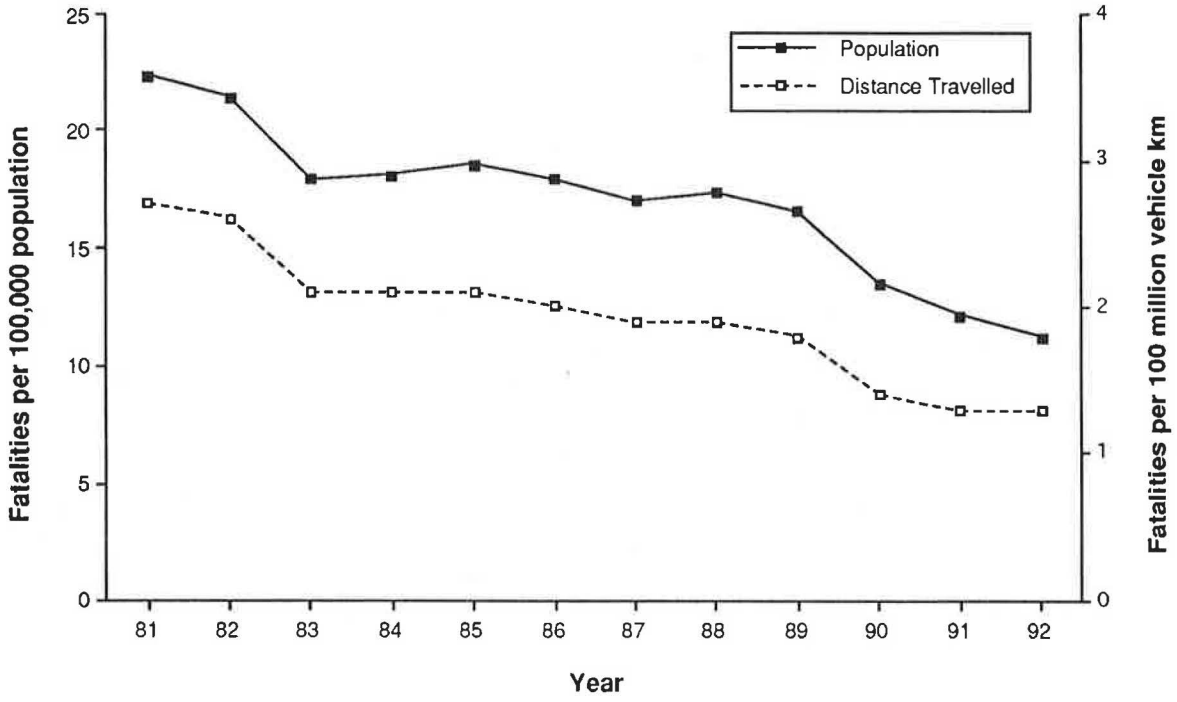

FIGURE 1 Fatality rates on a population and distance traveled basis, Australia; 1981 - 1992.

TABLE 1 Road crash fatality rates by country (1990)

	Fatality Rate	
Country	Population based [1]	Distance travelled based [2]
Australia	13.7	1.5
Germany	12.6	1.7
Sweden	9.0	1.2
UK	9.4	1.3
USA	17.9	1.3

Notes: [1] Deaths per 100,000 population per year
[2] Deaths per 100 million vehicle km travelled per year

Figure 2 shows the trend in the number of driver and motorcycle rider fatalities in the State of South Australia from 1979 to 1992. These data are also broken down into those fatalities that occurred in the Adelaide metropolitan area (population one million) and the remainder of the State (population 400,000). The total area of South Australia is greater than that of France and Germany combined and about 30 per cent greater than that of the State of Texas. As would be expected from the comparatively small population, the number of driver and rider fatalities has varied considerably from year to year since 1979. However, there has been a general reduction since 1985, a year in which there was a substantial increase in fatalities in the Adelaide metropolitan area compared to the preceding six years.

BLOOD ALCOHOL LEVELS: DRIVER AND RIDER FATALITIES

The percentage of Australian drivers and riders who had a blood alcohol concentration above the legal limit when they were fatally injured is shown for the past 11 years in Figure 3. (1) There has been a decrease from 44 per cent in 1981 to 30 per cent in 1992. It should be noted that these data refer to the legal blood alcohol limit for drivers in the state in which the fatality occurred. For most of this time period the more populous states had a limit of 0.05 g/100mL whereas the remaining states had a limit of 0.08.

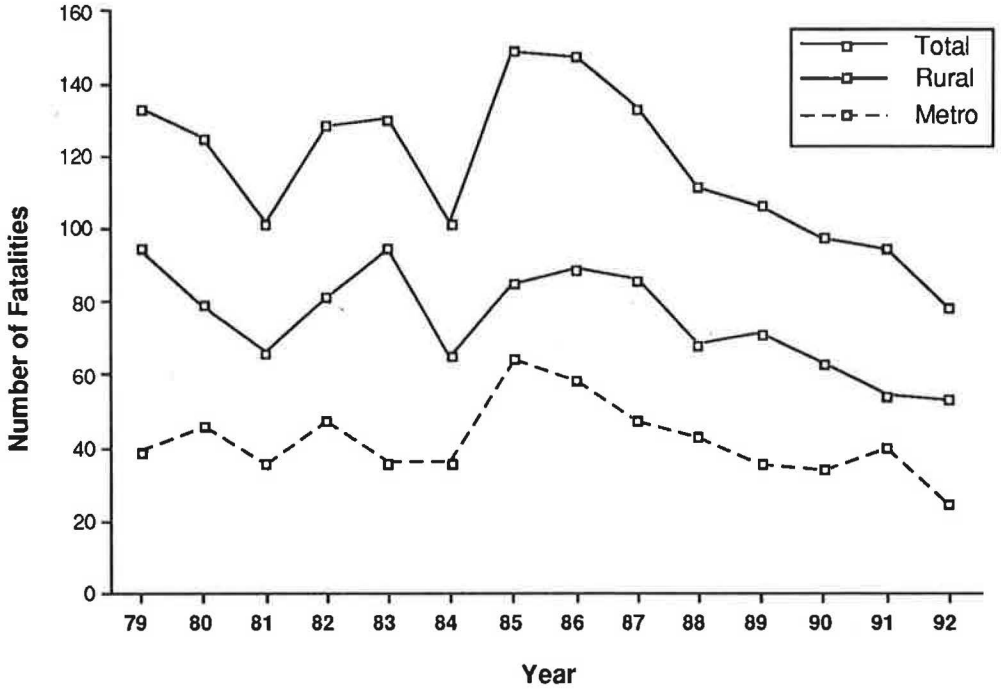

FIGURE 2 Number of driver and rider fatalities, South Australia; 1979 - 1992.

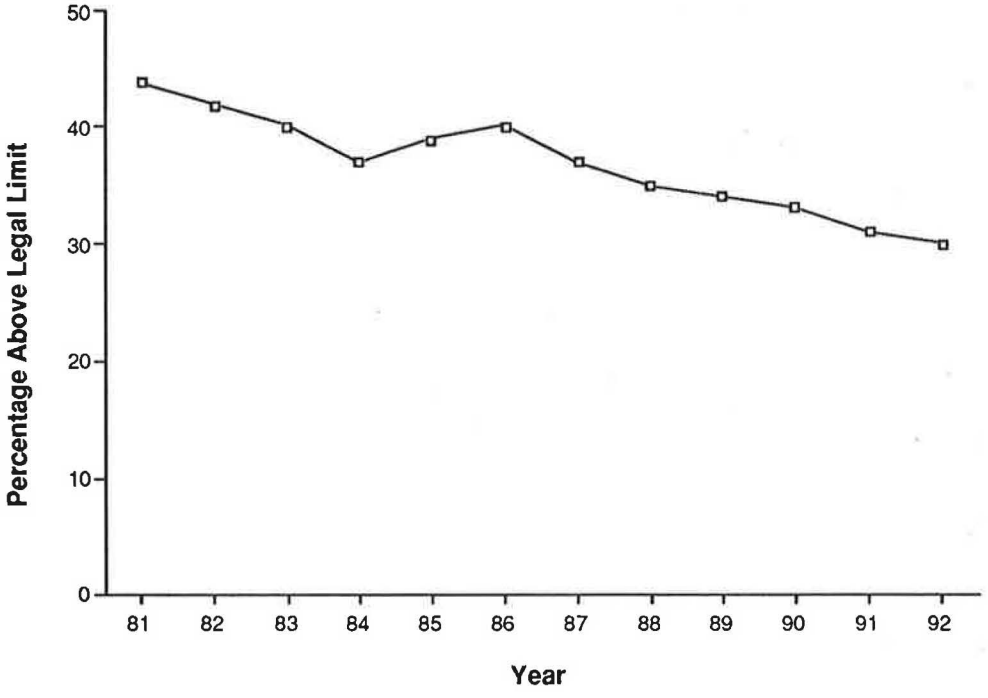

FIGURE 3 Driver and rider fatalities with BAC above legal limit, Australia; 1991 - 1992.

As with the data on fatality rates, the percentage of fatally injured drivers above the legal limit varies markedly between some of the states and territories. In Figure 4 it can be seen that the trend for the State of New South Wales (NSW) is similar to that for Australia as a whole, as shown in Figure 3. (1) However, the corresponding data for the Northern Territory ranges from 71 per cent of drivers and motorcycle riders with a blood alcohol

concentration above the legal limit in 1981 to 33 per cent in 1988, returning to 58 per cent in 1992. The considerable variability from year to year in these percentages for the Northern Territory reflects the comparatively small number of fatalities. For the same reason, the data for the Australian Capital Territory vary widely from a peak of 57 per cent in 1983 to zero for 1990 and 1991 (these data were not available for 1992). (The total number of driver and motorcycle rider fatalities in the ACT in 1992 was eleven.)

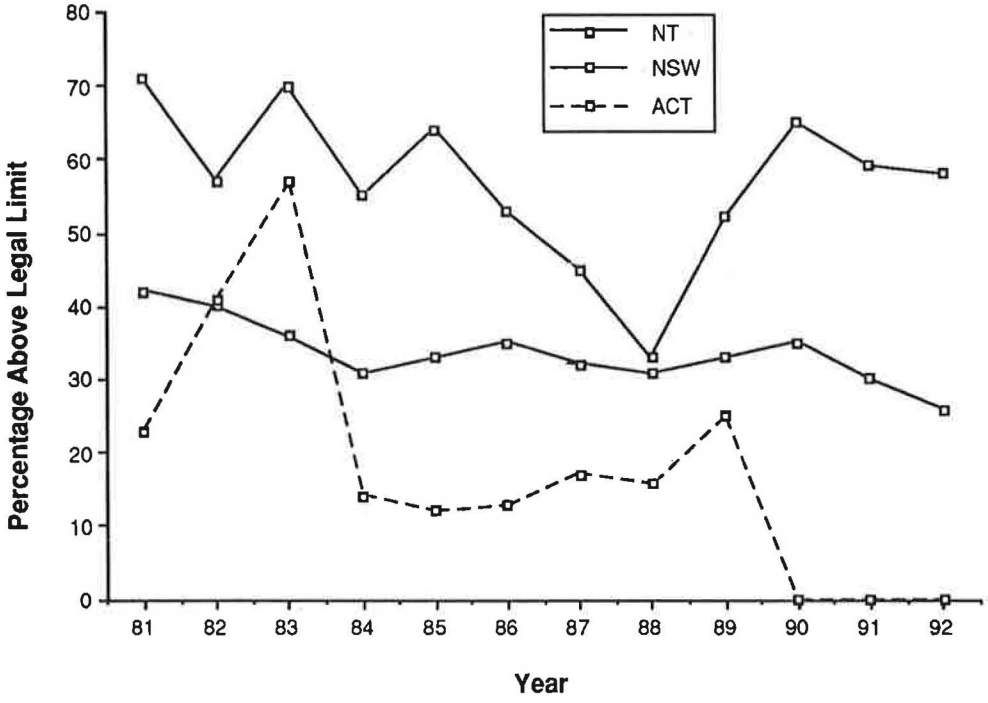

FIGURE 4 Driver and rider fatalities with BAC above legal limit.

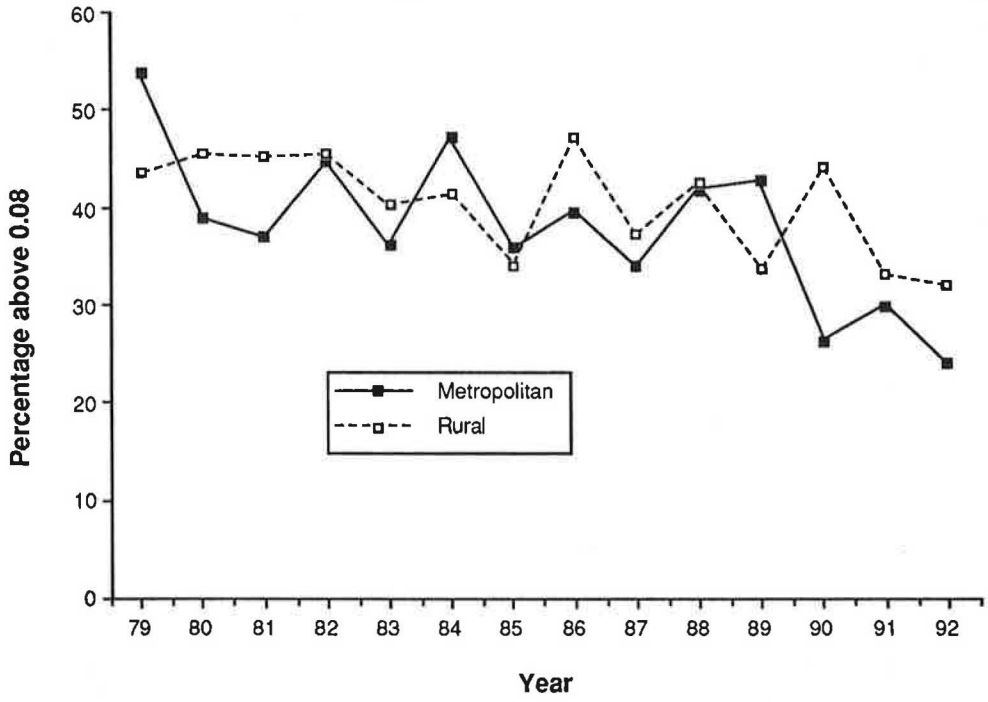

FIGURE 5 Driver and rider fatalities BAC above 0.08, South Australia; 1979 - 1992.

The percentage of fatally injured drivers and motorcycle riders with a blood alcohol concentration above 0.08 is shown in Figure 5, for urban and rural areas of South Australia. Once again there has been considerable variation from year to year. Nevertheless, in the Adelaide metropolitan area there was a marked reduction from 1979 to 1980 and 81 and a similarly marked reduction from 1989 to 1990-2. Overall, from 1979 to 1992 the percentage of fatally injured drivers and motorcycle riders who had a BAC above 0.08 decreased by more than 50 per cent.

BLOOD ALCOHOL LEVELS: DRIVERS NOT IN ACCIDENTS

Since 1979, the Road Accident Research Unit at the University of Adelaide has been conducting roadside breath alcohol surveys in the Adelaide metropolitan area, mostly between the hours of 10 pm to 3 am. Figure 6 shows the distribution of BACs for drinking drivers as measured in these surveys in three categories: greater than zero, above .05, and above .08. (2 to 5) It can be seen that, with the exception of the early 1980s, there has been a steady decrease in drink driving in all of the three BAC categories; the change in the percentage of drivers above 0.08 largely mirroring the positive It should be noted that the sample size for the 10 pm to 3 am period in the 1979 roadside survey, which was designed to sample 24 hours a day, seven days a week, is small compared to that of subsequent years when each survey covered about seven thousand drivers. Consequently the confidence band of the estimate of the percentage of drivers who were above 0.08 is comparatively wide for the 1979 survey. Nevertheless the consistency in the trend of positive BAC's from 1979 to the early 1980s, suggests that the percentage above 0.08 shown for the 1979 survey is unlikely to be misleading.

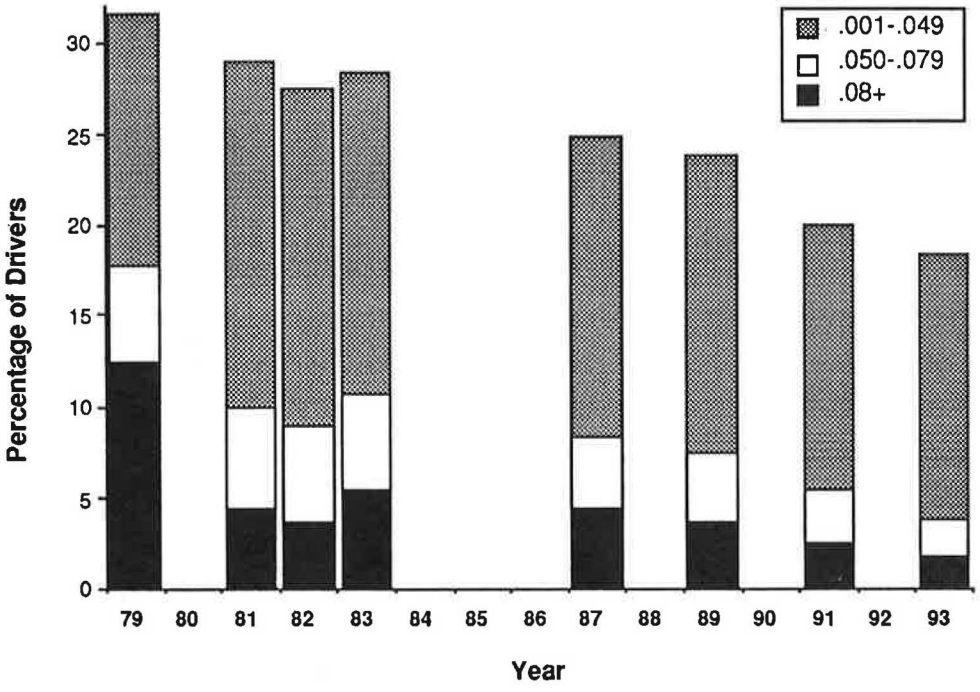

FIGURE 6 Night time drink driving by year 10 p.m. - 3 p.m.; Adelaide, South Australia.

In Figure 7, the percentage of drivers above 0.08 in these roadside surveys is plotted by year, together with the percentage of fatally injured drivers and riders who were above the same BAC level in the Adelaide metropolitan area from 1979 to 1992. There is considerable variability from year to year in the fatality data, and many of these fatalities would have occurred outside the hours of 10pm to 3am when the roadside surveys were conducted. Nevertheless, there is a general correspondence between the decrease in fatalities and the decrease in the percentage of drivers above 0.08 from 1979 to 1992.

DRIVER AND RIDER FATALITY BACs AND ROADSIDE SURVEY

In Figure 8 the data which were shown in Figures 6 and 7 for the percentage of drivers in the roadside surveys who were above 0.08 are reproduced, together with annotations on the timing of various interventions. These interventions comprised the introduction of random breath alcohol testing (RBT) by the police, a widely publicised increase in the level of enforcement of RBT, a publicity campaign, and a reduction in the legal blood alcohol limit for drivers from 0.08 to 0.05.

The introduction of random breath testing in 1981 was preceded by vigorous public debate extending over a period of more than a year. (3) It is thought likely that the media publicity engendered by this debate resulted in a considerable reduction in the level of illegal drink driving. If this surmise is correct, it could provide some explanation for the comparatively small reduction in illegal drink driving observed in the six months following the introduction of random breath testing.

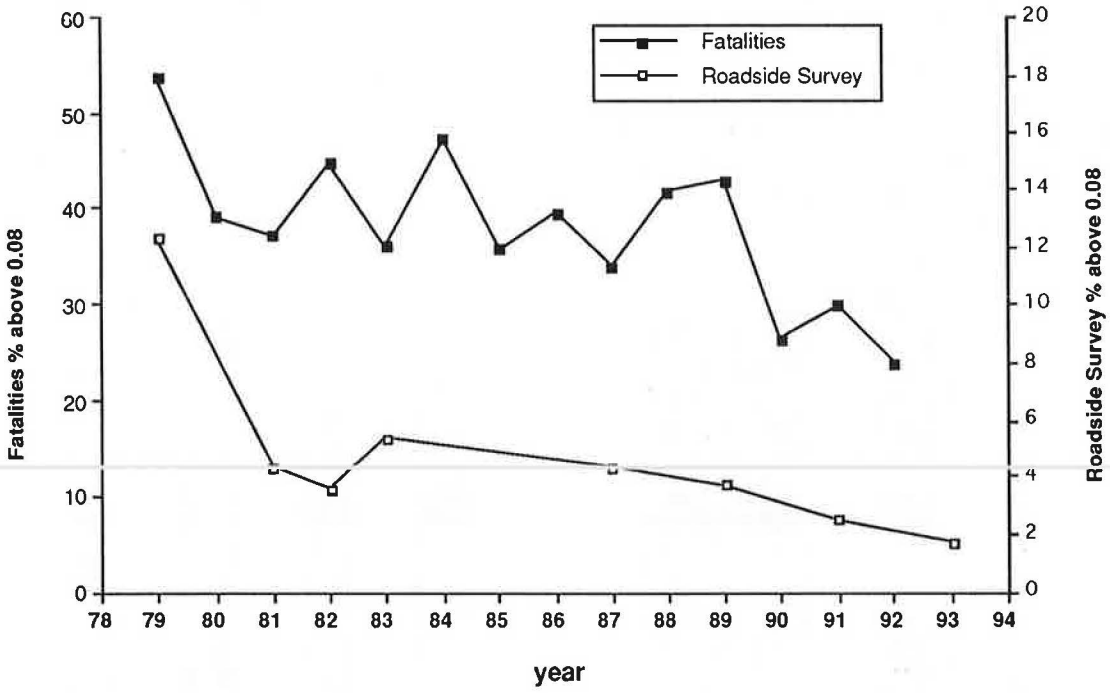

FIGURE 7 Driver and rider fatality BACs and roadside survey BACs, metropolitan area, South Australia; 1979 - 1993.

For largely political reasons, when random breath testing was introduced in South Australia, it was conducted at a minimal level, with only one unit operating in the Adelaide metropolitan area. The police were also constrained by the legislation of the time to operate only on major arterial roads. Consequently, police random breath testing operations were able to be seen from some distance away on the long straight roads which are characteristic of the Adelaide area. It therefore soon became known to drivers that it was possible to see the police RBT check points in time to avoid them.

At the NHMRC Road Accident Research Unit, we were able to demonstrate that this was the case. (6) Prompted by the finding that in our roadside surveys we were detecting three times the percentage of drivers above the legal limit as were the police, we stationed an observer in an unmarked car one block before the random breath testing check points and recorded the proportion of vehicles which changed direction, or sometimes simply stopped and waited, to avoid passing the check point. A week later we returned to the same site when the police were not there and conducted similar counts of vehicles changing direction, and so on. In this way we were able to show that the difference in percentages from the police data to our roadside survey data could be entirely accounted for by this phenomenon.

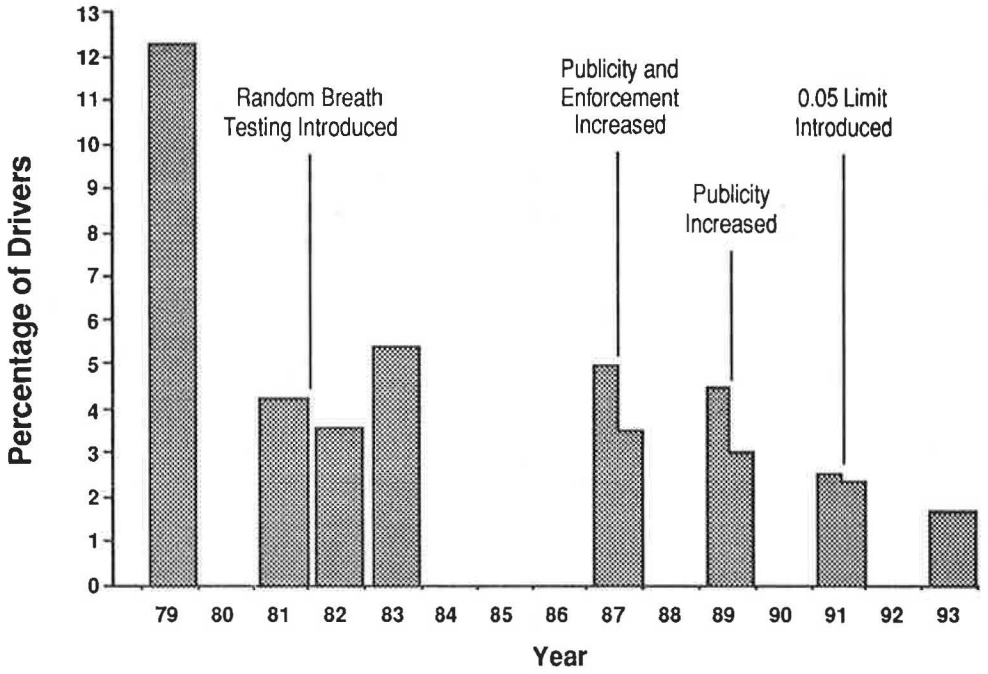

FIGURE 8 Percentage of drivers above 0.08 by various interventions, 10 p.m. - 3 a.m., Adelaide, South Australia.

We also found that in the 18 months following the introduction of random breath testing there was no reduction in late night single vehicle casualty crashes in Adelaide. However, there was a substantial shift in the location of these accidents from arterial roads to the back streets where random breath testing was not conducted. (6) It seems that many drivers soon came to realise that the risk of encountering a police RBT check point was minimal and that even if they did it was easy to avoid. It was therefore not surprising that the decrease in illegal drink driving which followed the introduction of RBT was short lived. By 1983 the level of illegal drink driving was greater than that which had existed during the debate two years earlier on whether or not to approve random breath alcohol testing by the police. (3)

No further surveys were conducted until 1987, when we were advised that resources had been made available for the police to increase the level of random breath testing to approximate that in operation in the State of New South Wales which, on average, meant that one driver in three would be tested each year. This change was not publicised in advance but was accompanied by, in South Australian terms, a major publicity campaign. The 1987 roadside survey was designed to evaluate the effect of these changes. As can be seen in Figure 8 there was indeed a substantial reduction in illegal drink driving. (4)

Two years later another survey was conducted at the same time of the year. We found that the level of illegal drink driving had increased during the intervening two years from 1987 and that, once again, there was a substantial decrease following, on this occasion, a publicity campaign. (5)

In 1991 the legal blood alcohol limit for drivers was reduced from 0.08 to 0.05 g/100mL in South Australia. As with the introduction of random breath testing, this change was preceded by considerable public debate which may have contributed to a reduction in the level of illegal drink driving which we observed in a roadside survey we conducted before the lower limit was actually introduced. Immediately following the introduction of the limit we conducted a second roadside survey, again over a three month period. In the first half of that survey we observed a reduction of more than 27 per cent in the proportion of drivers who were above 0.08. However, in the second half, the residual reduction was about six per cent.

Figures 6 to 8 also show that in the most recent survey, conducted earlier this year, the percentage of drivers who were above 0.08 was the lowest yet. (This blood alcohol level is referred to here for consistency in the assessment of time trends in drink driving, even though it is no longer the legal limit for drivers in South Australia.)

TRENDS IN ALCOHOL CONSUMPTION

The observed decline in drink driving has been accompanied by a decline in alcohol consumption. The apparent annual consumption of absolute alcohol per person aged 15 years and over in Australia decreased by 26 per cent from a peak of 12.7 litres in 1981-83 to 10.1 litres in 1991. The consumption of beer, which is by far the alcoholic beverage most likely to be associated with illegal drink driving, decreased by 22 per cent. (7,8)

There has been a marked change in beer drinking from the mid 1980s. Low alcohol beer (about 2.4 per cent alcohol by volume compared to about 4.8 per cent for regular beer) has assumed an increasing proportion of beer sales. Consequently the per capita consumption of alcohol in the form of beer by persons over 14 years of age has decreased by 29 per cent from 1980 to 1991. There are indications that this trend towards the consumption of "light" beer in preference to regular beer is accelerating. A recent survey in the Northern Territory concluded that light beer accounted for 52 per cent of the beer consumed in 1992, up from 27 per cent in 1991. (9) These changes, and a longer duration trend towards the sale of packaged beer rather than by the drink, are consistent with the decline in drink driving but they obviously do not in themselves provide an explanation for the reduction in either drinking or drink driving behaviour.

THE RELEVANCE OF RANDOM BREATH TESTING

The South Australian experience of random breath testing by the police in some ways provides more information on the relevance of RBT than does the initially more successful program in New South Wales. This is not simply because roadside survey data are available for the period before and following the introduction of RBT in South Australia but rather because the program clearly did not achieve the aim of reducing road accident fatalities during the first few years. When the level of enforcement was increased to about the level which had existed from the inception of RBT in NSW, there were clear signs of an effect on illegal drink driving and an accompanying reduction in fatalities. This does not mean that RBT was the only factor influencing drinking drivers. It is almost certain that publicity, both formal and informal, about drink driving and its possible consequences, is of comparable importance. Nevertheless, most of the drink driving publicity seen in South Australia since 1980 has been associated with RBT.

There are, of course, other approaches to influencing the behaviour of the drinking driver. In NSW, when RBT was introduced there was an almost immediate reduction of about one quarter in the road accident fatality rate, stabilising to a reduction of about one fifth four years later. In the State of Queensland, which did not introduce RBT at that time, there was a similar reduction of one fifth in the fatality rate over the same four year period (10). However the police in Queensland had a little publicised program known informally as "target testing". A plain clothed police officer in an unmarked car parked in a hotel car park would radio to a patrol car to watch for a particular vehicle leaving the hotel, based on the behaviour of the driver as he or she "walked" to their car (11). Queensland now has an RBT program, but the above comparison suggests that there are obvious benefits in both random and specific testing (for a thorough and detailed dissertation on general and specific deterrence of drink driving in Australia, see reference 10).

CHANGES IN THE RISK OF ACCIDENT AND INJURY

Finally, when attempting to relate drink driving countermeasures to changes in fatality rates over a long period, it is appropriate to note that there have been many other changes, unrelated to drink driving, which have reduced the road accident fatality risk. In Australia, seat belt wearing rates, at least in urban areas, are now close to 100 per cent. Older cars, which were not fitted with seat belts, are rarely seen on the roads. In addition to vehicle safety measures, the safety of the road and traffic system has also improved. It is possible that these changes may have been of particular benefit to the drinking driver, if one accepts a positive association between such drivers and older, and hence cheaper, cars and the well established link with single vehicle crashes.

REFERENCES

1. Federal Office of Road Safety. Road fatality statistics Australia: monthly report. Canberra: Department of Transport and Communications, 1993.

2. McLean AJ, Holubowycz OT, Sandow BL. Alcohol and crashes: identification of relevant factors in this association. Adelaide: Road Accident Research Unit, University of Adelaide; 1980.

3. McLean AJ, Clark MS, Dorsch MM, Holubowycz OT, McCaul KA. Random breath testing in South Australia: effects on drink-driving, accidents and casualties. Adelaide: NH&MRC Road Accident Research Unit, University of Adelaide; 1984.

4. McCaul KA, McLean AJ. Effectiveness of random breath testing related to enforcement level and publicity. In: Perrine MWB, editor. Proceedings of the International Conference on Alcohol, Drugs and Traffic Safety. Chicago: National Safety Council, 1990:721-727.

5. McLean AJ, Kloeden CN, McCaul KA. Drink-driving in the general night-time driving population: Adelaide, 1989. Aust J Public Health 1991;1 5:190-193.

6. McLean AJ, Holubowycz OT. Side effects of random breath testing by the police. In: Noordzij PC, Roszbach R, editors. Alcohol, Drugs and Traffic Safety - T86. Amsterdam: Elsevier Science Publishers (Biomedical Division) 1987: 441-442.

7. Commonwealth Department of Community Services and Health. Statistics on drug abuse in Australia 1989: an information document for use in association with the National Campaign Against Drug Abuse. Canberra: Australian Government Publishing Service, 1990.

8. Department of Health, Housing and Community Services. Statistics on drug abuse in Australia 1992: an information document for use in association with the National Campaign Against Drug Abuse. Canberra: Australian Government Publishing Service, 1992.

9. d'Abbs P. Alcohol use in the Northern Territory February-March 1992: report on a survey conducted by the Alcohol Policy Unit, Department of the Chief Minister. Darwin: Menzies School of Health Research, 1992.

10. Homel R. Policing and punishing the drinking driver: a study of general and specific deterrence. New York: Springer-Verlag, 1988.

11. McLean AJ. Alcohol, drugs and road accidents. Med J Aust 1983;1:596-597.

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DECLINE IN DRINKING AND DRIVING CRASHES, FATALITIES AND INJURIES IN GREAT BRITAIN

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INTRODUCTION

Great Britain introduced breath-testing of suspected drink/drivers in 1967, creating an offence of driving with more than 80mg of alcohol per 100ml of blood. This level (and the equivalents for alcohol in breath and urine) have remained unchanged. However, during the 1970s, the drink/driving laws had little effect on driver behaviour and drink-related accidents. Since the early 1980s therefore, a series of governmental measures have been introduced which were designed to improve the enforcement of these laws, or to revise the penalties on conviction. These include:

- The introduction of evidential breath testing devices, resulting in increased police enforcement levels; in fact the number of police screening breath tests increased from 206,000 in 1982 to 530,000 in 1992.
- Clarification of anomalies in the drink/driving laws.
- The introduction of the "High Risk (drink/driving) Offender" scheme, which requires offenders to pass a medical test before driving licences are recovered.
- Increased penalties, including imprisonment, for drinking drivers who caused death by careless driving.

Schemes for the rehabilitation of drink/driving offenders have also been developed. There are no plans to introduce random breath testing. In parallel with the legislative changes, a continuous programme of anti-drink/driving publicity has been sustained, aimed at changing public attitudes to drink/driving.

This paper outlines the profile of known drink/drivers, and indicates how trends in alcohol related road accidents developed through the 1980s and early 1990s. Although the number of injury accidents involving drinking has fallen substantially over this period, it is nevertheless estimated that over twenty thousand road casualties still result annually in Great Britain from such behaviour; of these approximately seven hundred are fatal, (Department of Transport, 1992). Public attitudes to drink/driving and enforcement have also changed markedly since the early 1980s, and the findings of research designed to monitor these developments are presented.

GENERAL ACCIDENT TRENDS

Trends in the overall distribution of road accident fatalities and injuries (extracted from a Department of Transport publication, 1993) are listed in Table 1; the fatality statistics, which include accidents to children, have fallen markedly through the decade. In view of the increasing traffic levels on Britain's roads, this is a most encouraging result, which in part reflects improvements in vehicle and road design, as well as changes in legislation and training. Certainly the requirement to use seat belts (for front seat occupants since 1983, and for all passengers since 1991) had a significant impact on injury levels to car users - as did the revised motorcycling regulations introduced in 1982.

Estimates of the number of accidents involving illegal alcohol levels, and the associated injuries, are shown in Table 2. (These data have recently been revised, and incorporate different grossing assumptions than were previously employed by the Department of Transport, 1993). In total, road user fatalities are estimated to have fallen by over 60 per cent between 1982 and 1992, serious injuries having fallen by 59 per cent. The reduction among those slightly injured, although significant, was less marked (at 38 per cent). Although the causes of the general decrease in the injury statistics outlined above will have been important in achieving this result, there is no doubt that a significant reduction in the scale and level of drink/driving has also been witnessed.

The results of an analysis of the blood alcohol concentrations of various categories of road users killed in road accidents in 1990 is given in Table 3; data for earlier years, although not presented, are available. The information was obtained from Coroners and Procurators Fiscal, and is summarised in a Transport Research Laboratory (TRL) leaflet (1993), which also outlines the age distributions of the victims.

TABLE 1 Trends in road accident casualties: Great Britain, 1981 -1991

Year	Killed					Injured
	Pedes-trians	Pedal Cyclists	TWMV * Users	Others	All	('000s)
1981	1,874	310	1,131	2,531	5,846	319
1982	1,869	294	1,090	2,681	5,934	328
1983	1,914	323	963	2,245	5,445	303
1984	1,868	345	967	2,419	5,599	319
1985	1,789	286	796	2,294	5,165	312
1986	1,841	271	762	2,508	5,382	316
1987	1,703	280	723	2,419	5,125	306
1988	1,753	227	670	2,402	5,052	317
1989	1,706	294	683	2,690	5,373	336
1990	1,694	256	659	2,608	5,217	336
1991	1,496	242	548	2,282	4,568	307

* Two wheeled motor vehicles

TABLE 2 Estimates of casualties in accidents involving illegal alcohol levels: Great Britain, 1982 - 1992

Number

Year	Accidents				Casualties			
	Fatal	Serious	Slight	Total	Fatal	Serious	Slight	Total
1982	1,300	5,420	12,070	18,800	1,550	8,010	20,660	30,220
1983	950	4,750	11,430	17,130	1,110	6,800	18,610	26,520
1984	1,000	4,790	11,540	17,330	1,170	6,820	19,410	27,390
1985	900	4,900	11,460	17,260	1,040	6,810	19,380	27,220
1986	850	4,590	11,510	16,940	990	6,440	19,220	26,650
1987	780	4,220	10,560	15,560	900	5,900	17,670	24,470
1988	680	3,660	10,190	14,520	790	5,100	16,860	22,740
1989	700	3,390	10,300	14,390	810	4,790	16,620	22,220
1990	650	2,910	9,650	13,210	760	4,090	15,550	20,400
1991	570	2,590	8,530	11,690	660	3,610	13,610	17,880
1992*	510	2,400	7,940	10,840	610	3,280	12,840	16,720

* Provisional data

TABLE 3 Blood alcohol levels in fatalities in Great Britain, 1990

Total killed aged 16 and over		Percentage with BAC exceeding (mg/100ml)					
		9	50	80	100	150	200
Motor vehicle drivers (excl 2-wheelers)	1584	29	20	18	17	13	8
Motorcycle riders	587	28	21	19	17	12	7
Vehicle passengers	976	38	28	23	21	11	6
Pedestrians	1452	49	35	32	30	25	17
Pedal cyclists	197	16	8	8	7	6	6
All road users	4796	33	22	22	21	15	10

ALCOHOL LEVELS AMONG CAR DRIVERS

Driver Fatalities in 1992

The most recent data relating to car drivers (also obtained from Coroners) are given below. In 1992, 30.4 per cent of fatally injured car and taxi drivers had been drinking prior to their accident, (i.e. they had blood alcohol concentrations (BACs) >9mg/100ml), while 19.0 per cent were over the legal limit of 80mg/100ml, and 6.8 per cent were over 200mg/100ml. Expressed another way, among known drinkers, 63 per cent had BACs above the legal limit of 80mg/100ml, and 22 per cent above 200mg/100ml; of drivers over the legal limit, 64 per cent had BACs over 150mg/100ml and 36 per cent over 200mg/100ml.

Trends in Fatalities During the Last Decade

The proportion of car drivers over the legal limit when killed has fallen significantly through the 1980s, from a high of 38.2 per cent in 1982 to 19.0 per cent in 1992. A similar reduction has been observed among those over 200mg/100ml BAC, the proportion falling from 15.4 in 1980 to 6.8 per cent in 1992 (see Figure 1). The associated reduction in the estimated total numbers of drinking driver fatalities are also shown. These figures are subject to some uncertainty however as they are based on totals grossed proportionately to represent cases where BACs were not known - possibly because of exsanguination or blood transfusion, or where death occurred long after the accident.

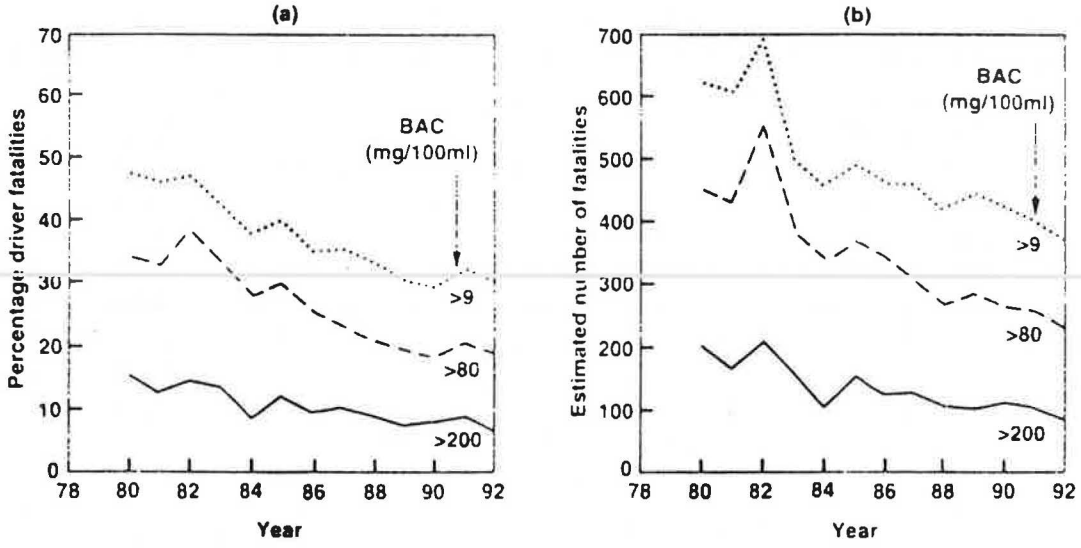

FIGURE 1 Trends in the percentages and numbers of car/taxi driver fatalities, as a function of blood alcohol concentration.

Distributions of car drivers' fatalities as a function of blood alcohol concentrations are illustrated in Figure 2 for periods at the beginning and towards the end of the last decade; a distribution of the most recent data available (for 1991 and 1992) is also illustrated. At very low BAC levels there is some evidence of a modest increase in the number of driver fatalities over the decade. At all other levels the number of drinking drivers reduced significantly, the proportionate reductions being most marked for BACs between the legal limit and twice this level. Moreover in the 1991/1992 data, the incidence of fatalities among drivers having BACs between 200 and 300mg/100ml is also seen to have fallen markedly.

The proportion of all car driver fatalities having BACs in the bands between 80 and 200mg/100ml fell from approximately 25 per cent to 10 per cent over the decade (i.e. 330 to 150 fatalities per annum). With the exception of those with BACs less than 20mg/100ml, the peak incidence over the 1988-90 period was approximately 180mg/100ml BAC. This bimodal distribution, with a minimum just over the legal limit (80mg/100ml), was initially

those who chose to flout it. However the most recent evidence, in indicating a reduction in fatality rates among heavy drinkers with BACs in excess of 200mg/100ml, suggests that some accelerated improvement among this group may also have occurred in the last year or so. It is concluded that a combination of legislative measures, including the introduction of the new High Risk Offender Scheme in 1990, together with sustained publicity, has been effective in informing the public of the dangers and consequences of driving after drinking - even after having drunk quite modest quantities of alcohol.

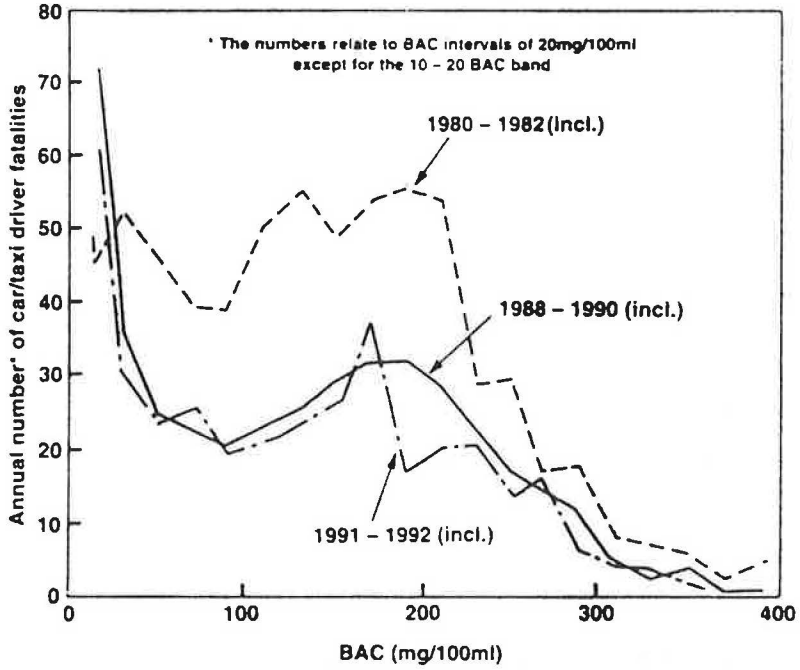

FIGURE 2 Distribution of driver fatalities by BAC.

Age Distributions

The numbers of car driver fatalities with BACs above the legal limit are illustrated in Figure 3a as a function of age; corresponding percentages are shown in Figure 3b. Although the number of drink/driving fatalities is greater among those in their early or mid twenties, the highest percentage of fatalities which involved drinking above the legal limit tended to occur among slightly older age groups. Marked reductions in the number of driver fatalities, and also in the percentage of drivers over the legal limit, have occurred during the 1980s; the reductions were particularly significant between 1982 and 1986, and also among drivers under twenty-five years of age. Among car drivers in their thirties, although major reductions in drink/driving fatality rates occurred between 1982 and 1986, the improvement in the late 1980s was modest. However the most recent data suggest that a newly developed reduction in drink/driving has occurred among this group; it is clearly too early to speculate whether it will be sustained. The annual number of drink/driving fatalities for drivers aged over fifty is relatively small. However, although a general reduction had been observed through the 1980s in the proportion of such drivers over the legal limit, the statistics suggest a modest increase occurred in 1991.

Estimates have also been made of mean fatality rates for drivers over the legal limit per 10^8km driven; the results are presented in Figure 3c. In interpreting these data however it must be stressed that the distance driven for each age band considered was based on known behaviour of all drivers of that age; unfortunately the more relevant data describing the distances driven by those injured in drink/driving accidents are not available. Within this limitation it is seen that in general the greatest risk per kilometre driven of being killed when over the legal limit occurred among those under twenty years of age. However the incidence of such an event has fallen significantly over the decade, particularly among younger drivers. Indeed data for 1991 suggest that the peak incidence per kilometre driven now occurs for drivers in their early twenties.

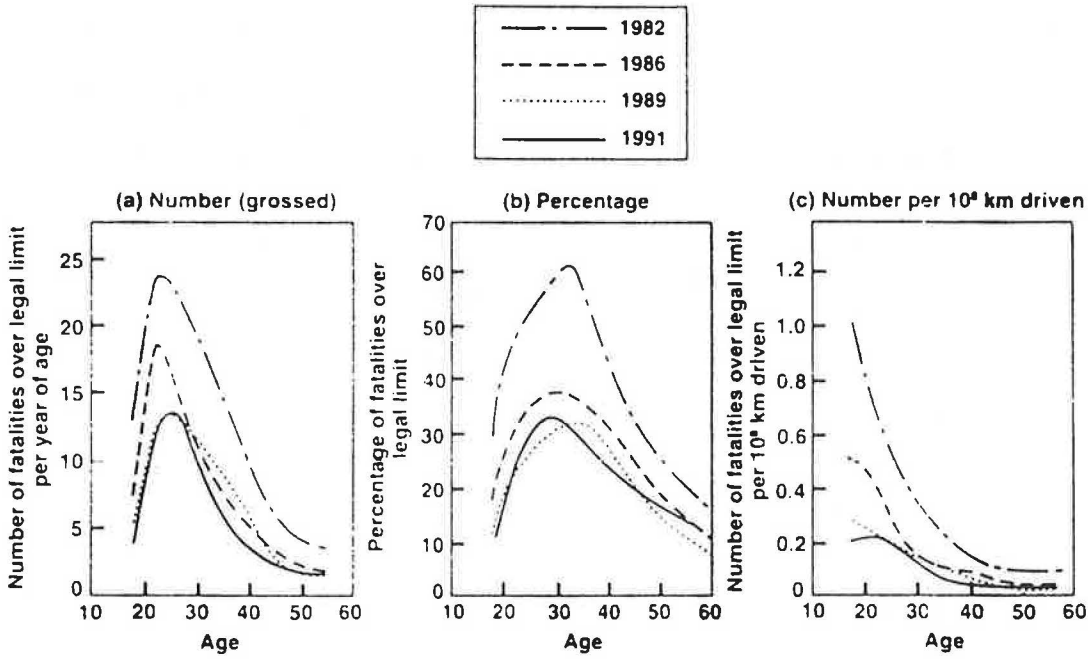

FIGURE 3 Driver fatalities over the legal limit.

Drivers Involved in Injury Accidents

Data from breath tests of car/taxi drivers suspected of drinking show that although the accident involved driver population increased by 21 per cent between 1980 and 1991, and the testing rate has almost trebled, the number of positive screening tests has reduced by 30 per cent over this period; the greatest reductions occurred among drivers under twenty five years of age, and those over fifty. The distribution of positive breath tests in 1990, as a function of age, is illustrated in Figure 4a. The peak incidence occurred for drivers in their low twenties. Also shown are results for drivers breath tested, but who were found to be below the legal limit. It is clear that there is a lower likelihood of a positive test result being registered for drivers in their teens or aged over about forty.

Drivers Breath Tested at the Roadside

Roadside surveys conducted on weekend nights throughout England and Wales, which sampled drivers at random, have defined the underlying patterns of drink/driving (Everest et al., 1991). The work was carried out during the summer of 1990 on Thursday, Friday and Saturday nights (and early the following mornings) between 7 pm and 2 am. More than 13½ thousand drivers were approached, and valid breath samples were obtained from 98.4 per cent of the total. Of these, there was evidence of alcohol being present in 11.7 per cent; 3.2 per cent were over half the legal limit, 1.02 per cent were over the legal limit, and 0.17 per cent over twice the legal limit. Only eleven per cent of those over the legal limit were female. Age distributions of those tested are illustrated in Figure 4b. Although a large number of drivers in their early twenties were breath tested, the peak incidence of drink/driving was observed for drivers in their late twenties; a significant proportion of drivers in their thirties having breath alcohol (BrACs) exceeding 65μg/100ml (equivalent to 150mg/100ml BAC) were also recorded.

The proportion of car drivers over the legal limit was established in detail for the hours of the survey, reaching a peak rate of over four per cent of the drivers involved in the early hours of Saturdays and Sundays, when traffic volumes were very low; no information is available to describe drink/driving levels at other times of day. Although smaller scale surveys were carried out in different areas in 1988 and 1989, no relevant information is available from which to establish reliable trends; there are no plans at present for further roadside surveys in the future. This implies that drink/driving trends will necessarily have to be monitored on the basis of fatality data as already discussed, in conjunction with information which can be derived from police reports of injury accidents. Since police breath testing criteria vary from force to force, and also through time, the use of drink/driving prosecution records

is not entirely reliable for establishing trends; nevertheless the monitoring of drink/driving prosecution records, and also hospital reports, offer additional information on drink/driving behaviour - albeit subject to difficulties of interpretation due to sampling. Space does not allow a detailed statement of the results of such studies. However a brief summary of the age profiles of drink/drivers derived has already been reported (Everest J T and Lynam D A, 1992).

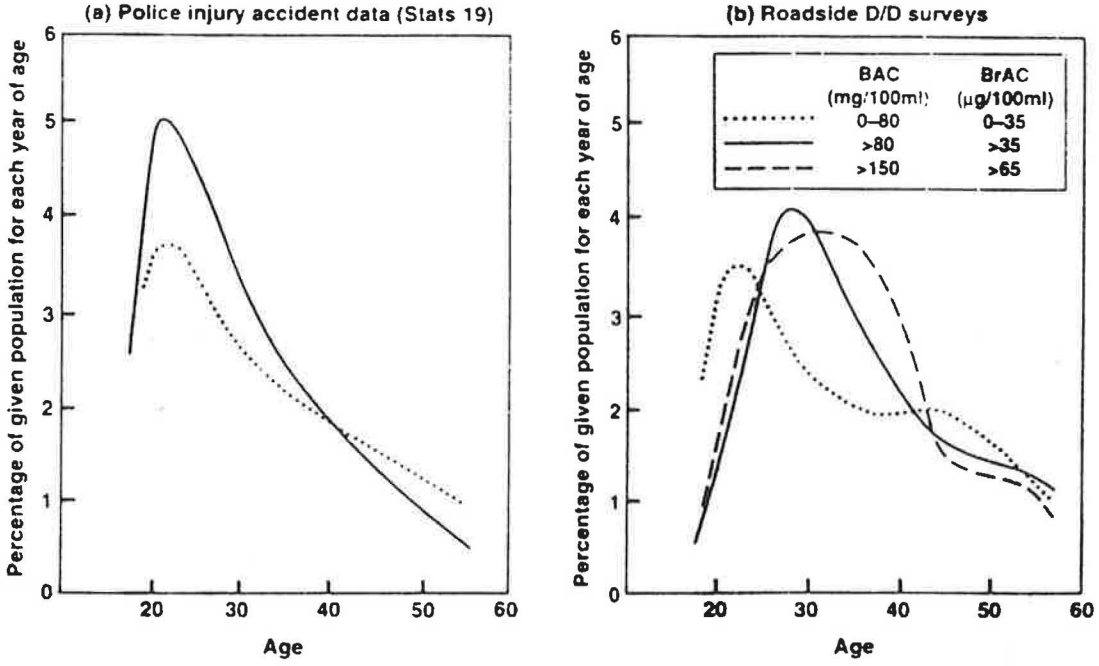

FIGURE 4 Age distribution of drivers.

ALCOHOL LEVELS AMONG PEDESTRIANS

The role of alcohol in pedestrian accidents has been recognised for over thirty years since the pioneering work of Haddon et al. (1961). A major controlled study in Birmingham (Clayton et al., 1977) attempted to quantify the risk of fatal accident-involvement at various BAC levels. Using a similar methodology to that employed in Borkenstein's Grand Rapids study, it was found that, at BACs within the range 120-159mg/100ml, the relative risk of accident involvement was around three times that for a sober pedestrian, and rose to nearly 15 times for BACs at or above 160mg/100ml. Impaired pedestrians (BAC>=120mg/100ml) comprised 27% of the male and 7% of the female pedestrian fatalities. Amongst males, impairment appeared to be over-represented amongst unmarried, divorced or separated persons and semi-skilled or unskilled workers.

Unlike drink/driving casualties, there appears to be an increasing alcohol involvement amongst adult pedestrian casualties (Table 4). In an aggregate analysis of data for the period 1985-1989, Everest (1991,1992) found that nearly 40% of pedestrians killed had been drinking prior to their accident; 30% had BACs above 80mg/100ml and 16% were in excess of 200mg/100ml. The greatest incidences of alcohol-related fatalities occurred between 10pm and midnight on Fridays and Saturdays . The peak age groups tended to be 16-21 and 33-44 years, 80-85% of the drink-related fatalities being males. Although fatality rates among elderly pedestrians are very high overall, the proportion who had been drinking was relatively low. Results from an associated hospital study in Oxford showed that amongst injured pedestrians, 27% had BrACs above 35µg/100ml compared to 6% for drivers. This difference became even more marked at higher BrACs. Other results suggested that the problem was most severe amongst single men, and those in the age range 30-40. These latter results were broadly confirmed by Bradbury (1991) who found that pedestrian injuries comprised 28% of road traffic accident injuries admitted to an Accident and Emergency Department in Edinburgh. The group affected by alcohol were predominantly male and young whereas the group unaffected by alcohol included a considerable number of elderly people.

TABLE 4 Percentage of adult fatalities exceeding stated BAC level, by road user category

Year	Vehicle drivers*		Pedestrians	
	>80 mg/100ml	>150mg/100ml	>80 mg/100ml	>150mg/100ml
1982/83	34	22	28	21
1986	25	18	31	23
1990	18	13	32	25

* Excluding motor cycle riders

Source: Road Accidents Great Britain.

REASONS FOR THE CHANGES

Any attempt to identify precisely the reasons for the decline in drink/driving casualties is fraught with difficulties. In simple terms, a model may be conceived by which legislative and enforcement changes, coupled with increasingly effective publicity, led to changes in knowledge and attitudes and, eventually, behaviour amongst the target group. Overlaying this model are the general changes in drinking habits that have occurred.

Legislation and Enforcement

Over the past decade, the main significant change in legislation has been the introduction of evidential breath testing in 1983 together with a general simplification of enforcement procedures. These changes appeared to stimulate the police enforcement effort substantially. The annual number of police screening tests increased by more than 2½ times between 1982 and 1992.

Although the imprisonment of a drink/driving offender for up to six months has been possible for many years, longer prison sentences for drivers have recently been introduced for causing death by careless driving when under the influence of alcohol. This offence carries a maximum prison sentence of five years, which is shortly to be increased to ten years. However Government has so far firmly rejected proposals for Random Breath Testing (RBT), arguing that the police already have sufficient enforcement powers, and that their resources will be put to better use if targeted on those whose behaviour give reasonable grounds for suspicion of drink/driving.

Publicity

In parallel with the changed enforcement patterns, the Department of Transport has maintained a steady programme of anti-drink/drive publicity, initially mainly over Christmas periods. More recently, campaigns have been extended to include other times of the year, particularly the summer. Pressure groups such as the Campaign Against Drink/Driving (CADD) have also been effective in pressing their points of view. In addition, there has also been a great deal of local publicity generated by various road safety organisations and the police, much of it designed to influence school children and the young. The work of the Portman Group, in promoting sensible drinking on behalf of the brewing industry, has also been most valuable in changing public attitudes.

Public Attitudes

There is increasing evidence of a hardening of reported attitudes towards drinking and driving; this can be illustrated using unpublished data collected for the Department of Transport through the 1980s, primarily to monitor the effectiveness among male drivers of Christmas drink/driving publicity campaigns. However the material presented below, having been collected prior to any given campaign programme, could not have been influenced by that campaign.

A summary of leading trends for the period 1980 to 1992 is given in Figure 5. In 1980, almost half of all males surveyed stated that they drove after drinking; by the early 1990s the proportion was a third. More significantly, while fifteen per cent of the total in 1980 stated that they had driven after drinking more than six units of alcohol in a given

session, the proportion who had recently done so had fallen to nine per cent by 1992. Assessments were also made of charges in the driving habits of these sub populations of drinkers who stated that they drank more than six units of alcohol; in 1980, 35 per cent of these declared that they would drive after six units, but the proportion had fallen to four per cent by 1992. Although there is some volatility in the data, in general the trends have been consistently downward. These changes mirror those found in surveys of reported actual drink-driving behaviour, undertaken in 1987 and 1989 (Goddard, 1991). However, these latter findings could be due, at least in part, to an increased reluctance to admit to driving after drinking. Such a reluctance would, in itself, mark a change in attitudes.

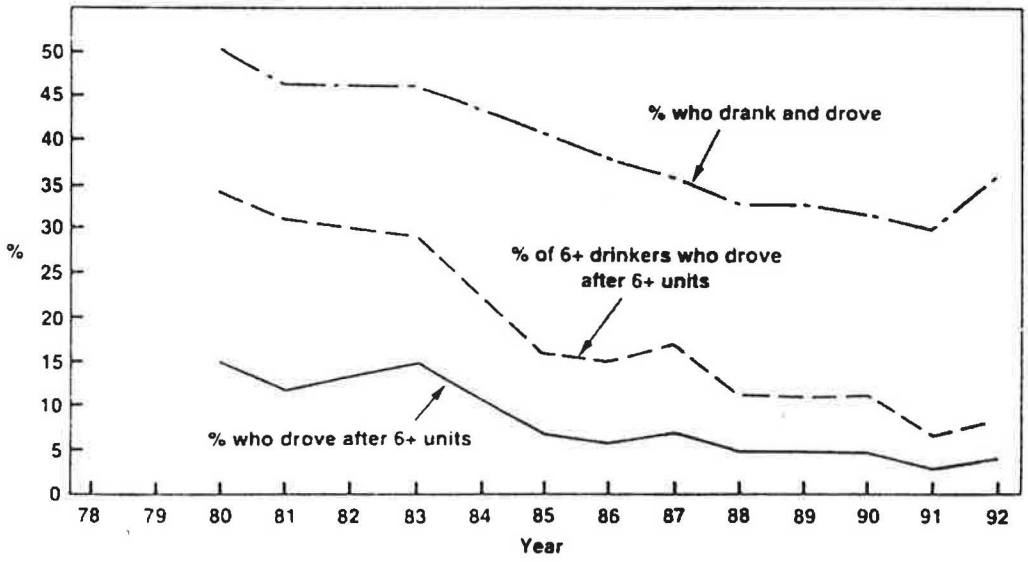

FIGURE 5 Drink/driving trends among males (based on interview statements).

Changes in drivers' attitudes are summarised in Table 5. Since detailed differences were introduced as the questionnaire developed, the intervals considered are variable, ranging between four and fourteen years. Nevertheless those aspects chosen for inclusion in the Table demonstrate that significant changes in attitudes to drink/driving have occurred in recent years. For example, it is clear that there is now an increased recognition that police enforcement has improved, that accident risk increases after drink, and that drink/driving is both unnecessary and anti-social; by 1992, over two thirds of those interviewed declared that people who drink and drive should be sent to prison - in fact such an outcome would be most unlikely except in extreme cases involving fatality or after repeated offences where drivers were already disqualified.

It is believed that the attitudes expressed reflect a change in social pressure felt by potential drink/drivers, which undoubtedly represents a major deterrent. Even among hardened offenders, it is likely to reduce the incidence and scale of the journeys made, and thence reduce accident risk. Methods of increasing the social pressure generated by the members of an offender's family, particularly close relatives such as wives and partners, have been central to government publicity programmes in recent years, and the evidence presented suggests that this contribution to the reduction of drink/driving has been particularly effective. However to work, the publicity has to be credible and has to be supported by a range of other countermeasures - particularly efficient police enforcement.

Changes in Drinking Habits

The past decade has been marked by some major changes in the drinking habits of adults. Estimates of per capita alcohol consumption suggest that it rose quite markedly during the 1970s but less so during the 1980s. However, in the early 1990s, recessional influences appear to have caused a slight downturn (The Brewers' Society, 1992). A more detailed analysis of individual drinking habits suggested that between 1978 and 1987 consumption fell amongst younger men but increased slightly amongst older men. For all age groups of women, except the youngest, consumption rose. (Goddard, 1991).

TABLE 5 Changes in attitudes to drink/driving in the 1980s among males

Statement tested	Initial year tested	Percentage agreeing	Percentage agreeing in 1992	Number of years between surveys	Change in percentage agreeing
The Police are catching more drinking drivers	1980	60	74	12	+14
If I drive more carefully after drinking, I am not likely to be caught	1980	39	20	12	-19
I think it's bad luck if someone is caught drinking and driving because lots of people do it	1978	54	18	14	-36
It is difficult to avoid some drinking and driving if you are going to have any kind of social life	1979	61	29	13	-32
When you're out drinking it can spoil your evening if you have got to drive	1984	64	50	8	-14
People I know seem to criticise drinking drivers more often these days	1983	58	81	9	+23
Drinking a little over the legal limit does not really make me more likely to have an accident	1979	33	21	13	-12
Most car accidents that happen to people who have been drinking would probably happen anyway	1978	32	13	14	-19
If you feel all right to drive it is probably quite safe, even if you have drunk a bit over the limit	1987	18	13	5	- 5
I think people who drink and drive should be sent to prison	1978	29	68	4	+39

More importantly, perhaps, the past decade has seen a major shift in the place of drinking, away from the public house, to the drinker's own home (Goddard and Ikin, 1988). Although this effect may be due in part to concerns about drinking and driving, economic factors have also played their part. The cost of alcohol in a public house has increased substantially more that the cost of purchasing the same drink in a supermarket or off-licence. Whatever the reasons, alcohol consumption at home has become identified as a leisure pursuit in its own right, often combined with eating or television or a video (Key Note Market Review 1993).

Other Initiatives

A limited programme of voluntary rehabilitation schemes, some of which have been run by the probation service for offenders on probation, have been operating for some years. However following legislation in 1991, Government approved rehabilitation schemes were initiated for an experimental period early in 1993 in selected Court areas, which are likely to run until the end of 1997. Research is currently being carried out to establish changes in re-conviction rates; in addition, improvements in offenders' attitudes towards drink/driving and knowledge of the effects of alcohol are being monitored. However at this early stage these developments can have had little effect on drink/driving behaviour; they will nevertheless enable the anti-drink/driving message to be sustained into the future.

CONCLUSIONS

It is clear that substantial savings in the scale of alcohol related road accidents and trauma in Great Britain have been achieved in recent years. It would seem that the savings resulted from a fundamental change in public opinion regarding the hazards of heavy drinking and of drink/driving. The mechanism for this change is not clear, although in part it may reflect trends towards more healthy living generally. Certainly the media took an active interest in the topic and generated a wide public debate of the issues involved. In fact, it has been suggested that a "virtuous spiral" developed in which the increase in successful drink/driving prosecutions convinced magistrates of the magnitude and seriousness of the alcohol problem, which in turn led to greater press comment and public pressure demanding further increases in enforcement and higher maximum sentences.

The problem of alcohol and the pedestrian continues to cause concern. Legislation would appear to be an inappropriate option. Rather it may be necessary to rely upon the promotion of sensible drinking by means of publicity, education and training, coupled with more effective treatment programmes for alcohol misusers. Care must

be taken to ensure that any countermeasures against the drinking pedestrian do not adversely affect the present reduction in drink/driving casualties.

The approach adopted by Government in supporting the commendable results referred to earlier has been steady and sustained. The balance between enforcement and publicity has been designed to lead public opinion while avoiding excessive conflict with powerful lobbies or pressure groups. In a phrase, the timing has been right. However there is no room for complacency, and sustained efforts to target the hard core of persistent offenders remain imperative. It is also vital that young drivers are encouraged to retain their generally good drink/driving records as they enter middle age, and that the next generation of young drivers are trained and educated to maintain that tradition.

REFERENCES

Bradbury, A. Patterns and severity of injury sustained by pedestrians in road traffic accidents with particular reference to the effect of alcohol. *Injury*, 1991, 22, 132-134.

Clayton A B, Booth A C and McCarthy P E. (1977). A controlled study of the role of alcohol in fatal adult accidents. Department of Transport, TRRL SR332: Transport and Road Research Laboratory, Crowthorne.

Department of Transport (1993). Road Accidents Great Britain 1992. Government Statistical Service, London.

Everest J T, Davies C H and Banks S (1991). Roadside surveys of drinking and driving; England and Wales 1990, Department of Transport, TRRL Report 319, Transport Research Laboratory, Crowthorne.

Everest J T (1992). The involvement of alcohol in fatal accidents to adult pedestrians. Department of Transport, TRL RR343, Transport Research Laboratory, Crowthorne.

Everest, J T (1992). Patterns of pedestrian injury accidents and their associated measured blood/breath alcohol concentrations. Paper presented at 12th International Conference on Alcohol, Drugs, and Traffic Safety, Cologne.

Everest, J T (1992). The involvement of alcohol in fatal accidents to adult pedestrians. London: HMSO, Road Accidents Great Britain, 1991, 41-50.

Everest J T and Lynam D (1992). Drinking and driving amongst modest and heavy drinkers in Great Britain. Twelfth International Conference on Alcohol, Drugs and Traffic Safety, Cologne, September 1992.

Goddard E (1991). Drinking in England and Wales in the late 1980s. London: Office of Population Censuses and Surveys.

Goddard E and Ikin C (1988). Drinking in England and Wales in 1987. London: Office of Population Censuses and Surveys.

Haddon W, Valien P, McCarroll J and Umberger C J (1961). A controlled investigation of adult pedestrians fatally injured by motor vehicles in Manhattan. Journal of Chronic Diseases, 1961, 14, 655-678.

Key Note Market Review (1993). UK Drinking Habits. 6th Edition. London: Key Note Market Review.
The Brewers' Society (1992). Statistical Handbook. London: The Brewers' Society,

Transport Research Laboratory (1993). Blood alcohol levels in fatalities in Great Britain 1991. Department of Transport, TRL LF2058, Transport Research Laboratory, Crowthorne.

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DECLINE IN DRINKING AND DRIVING CRASHES, FATALITIES AND INJURIES IN CANADA

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ABSTRACT

This paper documents the most prominent trends in drinking and driving that have occurred in Canada over the past two decades and considers some of the major factors that may have contributed to these changes.

Several indicators were used to assess trends in drinking and driving, including measures of the behaviour itself -- determined from roadside surveys -- as well as measures of the consequences of drinking and driving, such as the frequency and quantity of alcohol found among drivers killed in road crashes.

Overall, the evidence suggests that there has been a significant decrease in the magnitude of the drinking and driving problem in Canada over the past decade. Numerous activities such as new legislation, increased enforcement of impaired driving laws, greater numbers of awareness and education campaigns and community-based programs all occurred simultaneously during the 1980's making it difficult to determine which factors were responsible for the observed decrease.

INTRODUCTION

In North America, concern over drinking and driving periodically waxed and waned for several decades (Douglas 1982). The vacillation between concern and complacency was interrupted in the 1980s -- in many ways, this decade has been a watershed for continuous concern, commitment, and action to prevent driving after drinking and thereby reduce the frequency and severity of alcohol-related crashes (Simpson and Mayhew 1991).

In Canada, early in the 1980s, following their counterparts in the United States, citizens' groups, formed by victims of drunken drivers, (e.g., Mothers Against Drunk Driving [MADD], Remove Intoxicated Drivers [RID]), ushered in an unparalleled period of concern. Governments responded with new, tougher laws, stricter enforcement programs, and stiffer penalties for offenders. Education and awareness programs, including mass media campaigns, proliferated. Treatment and rehabilitation re-emerged as an integral component of a comprehensive approach to the problem and new technological innovations, such as ignition interlocks, emerged.

In Canada, the response to the drinking-driving problem seemed strongest from 1983 through 1987 (Beirness et al. 1993). For example, in December 1985, amendments to the Criminal Code of Canada proclaimed new, more serious offences: the new offences of impaired driving causing bodily harm, and impaired driving causing death, carried maximum of 10 and 14 years in prison respectively. As well, mandatory court-ordered driving prohibitions were introduced. Many provinces supplemented these provisions in the Criminal Code with greatly increased periods of driver licences suspension, especially for second and subsequent impaired driving offences. Indeed, a mandatory suspension for a minimum of one year became the norm for a first offence.

This unprecedented level of countermeasure activity directed at drinking-driving naturally raises questions as to whether or not it has been associated with change in the magnitude and/or characteristics of the problem. This paper addresses these issues -- its purpose is to document, describe, and discuss the most significant trends in drinking and driving in Canada during the 1970's and '80s to determine whether what happened in the 1980s was somehow unique. In so doing, we focus on two fundamental aspects of drinking-driving: (1) the behaviour itself (i.e., driving after consuming alcohol -- especially driving with an illegal blood alcohol concentration); and (2) the major outcomes or consequences of the behaviour (i.e., involvement in traffic crashes and impaired driving charges).

It is also the purpose of this paper to examine changes in the characteristics of the problem over time. It is important to determine whether the changes have been more pronounced for specific segments of the population or only for certain indicators of the problem. It is possible that such analyses will facilitate the identification of areas where significant improvement has occurred as well as areas that are in need of further attention.

Finally, we consider some of the major factors that may have contributed to the changes in the drinking-driving problem over time (e.g., new laws, countermeasure campaigns, economic conditions).

DEFINITIONS, MEASUREMENT AND DATA SOURCES

This section briefly examines some of the key methodological issues pertinent to an examination of "trends in drinking and driving." As well, sources of data used in this paper are identified and described as is their adequacy for assessing trends in drinking-driving.

Defining and Measuring the Problem

The magnitude of the problem and, by extension, changes in it over time can be measured in terms of the behaviour itself or its outcomes. This paper examines trends both in drinking-driving behaviour as well as in the consequences of that behaviour.

Measures of the Behaviour. Information on alcohol use obtained from drivers using the road provides the most direct and objective data on the incidence of driving after drinking. This type of roadside survey involves stopping drivers at predetermined locations, usually during nighttime hours (typically on the weekend) and requesting them to provide voluntarily a sample of breath for analysis of alcohol content. The principal advantage of this approach is that it provides reliable data about the incidence of drinking-driving and information about drinking-drivers who avoid detection and other adverse consequences of their behaviour.

There are, however, limitations to roadside surveys. Because of the restricted times during which these surveys are conducted, the results cannot necessarily be generalized to other times of the day, week, or year. As well, drivers must provide breath samples voluntarily, thereby introducing a degree of bias from drivers who refuse to participate. Refusal rates typically vary between 4% and 7%, depending on the time of night, survey location, and gender of the driver. Whereas some researchers have argued that drivers who have consumed alcohol are more likely than non-drinking drivers to refuse to provide a breath sample, experience in surveys conducted in Ohio (Foss and Perrine 1989) and Minnesota (Foss, Voas, Beirness and Wolfe 1991) indicates that drivers who refuse to participate do so for a variety of reasons, most of which are not related to recent alcohol consumption. Hence, provided that non-response rates remain low, the degree of bias introduced by those who refuse to participate in the survey should not compromise the overall validity and utility of the information gathered (Warren and Simpson 1980).

Several roadside surveys have been conducted in various jurisdictions across Canada beginning in 1974 with a National Roadside Survey, undertaken by Transport Canada (Smith, Wolynetz and Wiggins 1976). Since then, surveys have been conducted periodically in Saskatchewan, Ontario, and Quebec. The similarity of the survey methods permits comparisons of the findings and these data are examined in this paper to document the *incidence* of drinking-driving behaviour during late night hours to determine if any consistent and notable changes have occurred in the past decade.

Outcome Measures. This paper makes use of data from three principal sources to determine changes in the magnitude and characteristics of the consequences of drinking and driving: the TIRF Fatality Database; Ontario Master Accident File; and the Canadian Centre for Justice Statistics. These are described below.

- The Fatality Database. The completeness and reliability of data on alcohol use among crash-involved drivers depend on the severity of the crash and the severity of injuries sustained by the drivers. The more severe the crash, the more likely drivers are to be tested for the presence of alcohol (Simpson and Vingilis 1992). In Canada, *fatally injured drivers* are routinely tested for the presence and amount of alcohol. At present, however, the frequency of testing for alcohol among less severely injured drivers is not known. Thus, alcohol use among crash-involved drivers is *routinely and reliably* determined for only one subgroup of drivers -- i.e., those who are fatally injured.

Since 1973, the Traffic Injury Research Foundation of Canada (TIRF) has collected and maintained a database containing the results of tests for the presence and amount of alcohol performed on fatally injured drivers in seven provinces. (The seven provinces are: British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, New Brunswick, and Prince Edward Island). In 1987, the Fatality Database was expanded to include all 10 provinces and the two territories. Rates of testing for alcohol vary somewhat among jurisdictions but on average, about 80% of drivers of highway vehicles who died within 6 hours of the crash are tested for the presence of alcohol each year. Because the basic unit of analysis is *the fatally injured driver,* not drivers involved in fatal crashes, the data cannot be used to address questions about the number of people killed in alcohol-related crashes. Nevertheless, given high rates of testing, statistics based on these data provide accurate and valid estimates of alcohol use among all driver fatalities.

Information on the presence and amount of alcohol in fatally injured drivers since 1973 in seven provinces is used in this paper as one of the primary indices of the alcohol fatal-crash problem in Canada. Trends in the problem are examined using a variety of indicators derived from the fatality database.

Other information contained in this database, such as the age and gender of the driver are used to examine specific trends in the characteristics of the problem.

• Ontario Master Accident File. Although crashes involving *nonfatal* injuries are much more numerous than those resulting in death and, therefore, comprise a potentially more important segment of the alcohol crash problem, the rate of testing for alcohol among injured drivers is considerably less than it is among fatally injured drivers. As a consequence, the information available on this aspect of the problem is less reliable. For drivers who are not tested for alcohol, it is necessary to rely on the judgments of investigating police officers concerning the use of alcohol. In the province of Ontario, police accident report forms require the investigating officer to indicate a "driver condition" code that implies the amount of alcohol consumed or the degree of the effects of alcohol -- i.e., *had been drinking, ability impaired, or apparently normal.* These data provide at least some indication of the extent of alcohol involvement in casualty crashes.

Unfortunately, reliance on police officers' judgments of driver alcohol use are far from ideal. Several experimental studies have demonstrated that medical practitioners and trained police officers often fail to detect the presence of alcohol even in subjects with high BACs (Beatty 1984; Langenbucher and Nathan 1983; Pagano and Taylor 1979). Studies on injured drivers reporting to hospital have also shown that alcohol use by injured drivers often fails to come to the attention of the police (Rockerbie 1979; Warren et al. 1981). These findings support long-held beliefs among experts that figures based on police-reported data *underestimate* alcohol involvement in casualty crashes.

Having identified the limitations of police-reported information on alcohol involvement in casualty crashes, it must nevertheless be acknowledged that no other source provides any better data on alcohol use by drivers involved in casualty crashes. In fact, the *primary* indication of alcohol use among the great majority of crash-involved drivers is the reported judgment of investigating officers as coded in provincial accident databases. If these data can be accepted at least as a reliable index of *changes* in the problem, they can be used to examine trends in the use of alcohol by drivers involved in casualty crashes.

In this context, Mercer (1985) has argued for the *reliability* of police-reported data. He contends that while police may underreport alcohol involvement in casualty crashes, they do so consistently. Mercer considers police-reported data a valid measure of alcohol-related casualty crashes, even if one cannot estimate the use of alcohol.

Accordingly, this paper makes use of police-reported data but limits it to the province of Ontario where reliable practices have been in place for several years. Historical records on police reported alcohol involvement in motor vehicle crashes are available from 1980 through 1991 in Ontario. They are used in this paper to describe more recent trends in alcohol use among drivers involved in casualty crashes.

• Charges for impaired driving offences. The Canadian Centre for Justice Statistics (CCJS) at Statistics Canada compiles data from police detachments across Canada on the number of persons charged with an impaired driving offence. These data reportedly comprise a count of the "most serious charge" laid. As reported by CCJS, the "number of persons charged does not represent an unduplicated count of individuals charged in a year." Thus, persons charged on more than one occasion will be counted every time they are charged by the police with an impaired driving offence. Impaired driving offences include: driving while impaired, having a BAC in excess of 80 mg%, and failing or refusing to provide a breath sample -- for the years 1974-1985 -- and, for 1986 through 1991, the additional offences of impaired operation of a motor vehicle, vessel, or aircraft, (including impaired operation causing death and causing bodily harm), and failing or refusing to provide a breath or blood sample.

Questions raised previously about the reliability and validity of police-reported data on alcohol use among crash-involved drivers seem minor when compared to issues concerning the meaning of enforcement statistics. Rates of detecting, let alone charging, drivers with an impaired driving offence are widely acknowledged to be very low; police may charge only one out of every 500 to 2,000 drivers on the road who are impaired. Changes in enforcement statistics, whether measured as actual numbers or population rates, do not necessarily reflect changes in the incidence of impaired driving. Variations in the level of enforcement and differences in the charging practices of individual police forces across Canada may be but two possible explanations for changes in the number of persons charged.

Despite these limitations, data on the number of persons charged with an impaired driving offence are considered in this paper as another index of the consequences or outcome of impaired driving behaviour.

RESULTS

The first part of this section examines general trends in drinking-driving in Canada as reflected by data from each of the major sources described previously. The second part of the section looks at changes in the characteristics of the problem over time.

General Trends

Measures of the Behaviour. Surveys of alcohol use among drivers on the road during late night hours provide an indication of the incidence of drinking-driving behaviour. Such surveys have been conducted periodically in various jurisdictions across Canada since 1974 (Smith, Wolynetz and Wiggins 1976). The first National Roadside Survey found approximately 20% of drivers had a positive BAC -- nearly 9% had positive BACs, below 50 mg%; 5.4% had BACs between 50-80 mg% and 6.2% had a BAC in excess of the legal limit.

Since then, several roadside surveys have been conducted in various provinces, with Saskatchewan, Ontario, and Quebec having been surveyed most often. All three were surveyed in 1974, as part of the National Roadside Survey; Saskatchewan and Quebec were surveyed a second time in 1981. Most recently, Quebec and Ontario were surveyed in 1986 and Saskatchewan in 1987 (Lawson et al 1982; Stewart and Lawson 1987). The methods used in all three surveys were sufficiently similar to permit comparisons and to make inferences concerning trends.

TABLE 1 Percent of Drivers in Roadside SurveysAccording to BAC

	BAC	
	50-80 mg%	Over 80 mg%
Saskatchewan		
1974	5.6	5.6
1981	2.7*	3.3
1987	2.1*	3.6
Ontario		
1974	5.6	6.3
1986	1.9*	4.6
Quebec		
1974	5.3	5.3
1981	3.1*	5.9
1986	3.9	3.6

#Saskatchewan was included in the Prairie aggregate in 1974.
* BAC range reported in 61-80 mg%.

Table 1 presents the percentage of drivers in each survey according to BAC group. Note, also, that the limits of the moderate BAC category vary from 50-80 mg% to 61-80 mg% depending on the province and year. Until such time as results based on equivalent categories become available, it is difficult to determine the extent of changes in driving with a moderate BAC.

It is, however, apparent that all three provinces showed a substantially lower percentage of impaired drivers in 1986 than in 1974. Indeed, there was a 36% decrease in the incidence of impaired driving in Saskatchewan, a 27% decrease in Ontario and a 32% decrease in Quebec. These results show that the prevalence of impaired driving was lower in the 1980s than in the 70s. The next section examines whether these changes were reflected in the incidence of alcohol-related crashes.

Outcome Measures. This section examines trends in various measures of alcohol-related crashes as well as trends in charges for impaired driving.

- Driver fatalities. One of the most frequently used measures of the magnitude of the drinking-driving problem is the percent of fatally injured drivers who tested positive for alcohol. These data are presented in Figure 1 for the years 1973 through 1991.

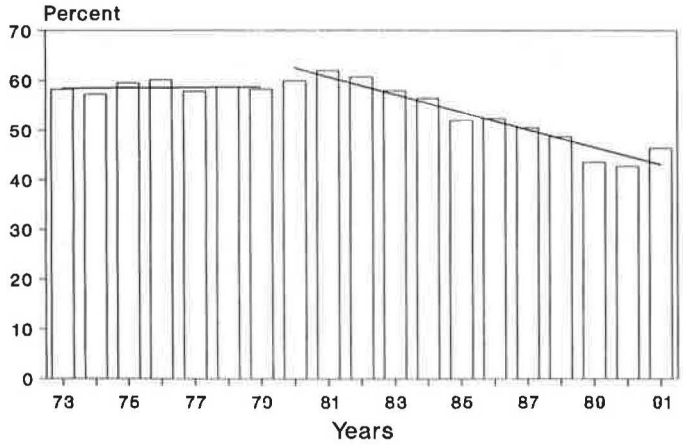


FIGURE 1 Trends in percent of driver fatalities testing positive for alcohol.

As can be seen, from 1973 through 1980, little change was evident -- drinking drivers accounted for between 57% and 62% of all-fatally injured drivers tested for alcohol. Since 1981, however, this percentage has dropped steadily, reaching its lowest point, at 43%, in 1990. Visual inspection of the data suggest that the changes occurring during the 1980s were indeed different from those that occurred during the 1970s. To test this, the series was divided into two parts (i.e., pre and post 1980) and subjected to a trend analysis -- essentially a regression discontinuity or simple time series design (Judd and Kenny 1981) in which the dependent or outcome variable (i.e., percent of driver fatalities testing positive for alcohol) is predicted from time (i.e., year), a dummy variable representing the cut-point in the series (i.e., pre and post 1980' and the interaction between time and the cut-point. A significant interaction term indicates that the regression lines for the series before and e the cut-point are not parallel -- i.e., their slopes differ significantly.

When this approach is applied to these data on the percent of driver fatalities who tested positive for alcohol, the interaction term between time and the cut-point is highly significant ($p<.001$). This finding indicates that the trend during the 1970s is different from that during the 1980s. During the 1970s, there was virtually no change in the percent of fatally injured drinking drivers. By contrast, the 1980s were characterized by a significant and consistent decline in the incidence of fatally injured drinking drivers.

Another commonly used indicator of the drinking-driving problem is the percentage of all fatally injured drivers who had a BAC in excess of 80 mg%, given that this level legally defines impaired driving in Canada. Figure 2 presents this indicator for each year from 1973 to 1991. From 1973 through 1980, approximately 50% of driver fatalities had a BAC over 80 mg% -- the percentage varied from 46% to 49%. However, since 1981, this consistency has disappeared -- the percent of fatally injured drivers with BACs over 80 mg% has declined progressively, reaching its lowest level (35%) in 1990. The regression lines clearly highlight the difference in trends evident during the 1970s and 1980s -- the interaction was highly significant ($p<.001$).

Another measure of the drinking-driving problem is the ratio of the number of drinking drivers to the number of non-drinking drivers. Although this measure, called the Problem Index, conveys much the same information as the percentages described above, it does so parsimoniously and has considerable communication advantages.

The ratio of drinking to non-drinking driver fatalities permits a more direct assessment of the extent to which the number of drinking driver fatalities has changed, relative to the number of non-drinking driver fatalities. This ratio (multiplied by 100) has been called the Problem Index.

Figure 3 plots the Problem Index from 1973 to 1991. The value of 100 represents the point at which the number of drinking and non-drinking driver fatalities would be equal. Values above the line indicate that the number of fatally injured drinking drivers exceeded the number who were not drinking. In this regard, during the 1970s the number of drinking driver fatalities greatly exceeded that of non-drinking drivers and the Problem Index remained largely unaltered. But the Index began to decline after 1981 and, in 1988, for the first time in 15 years, the Problem Index fell below 100 -- the number of drinking driver fatalities in that year was lower than the number of non-drinking driver fatalities.

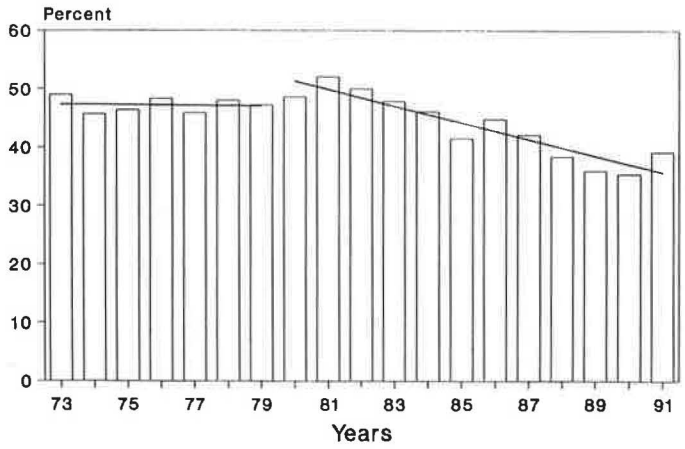


FIGURE 2 Trends in percent of fatally injured drivers with BACs over 80 mg%.

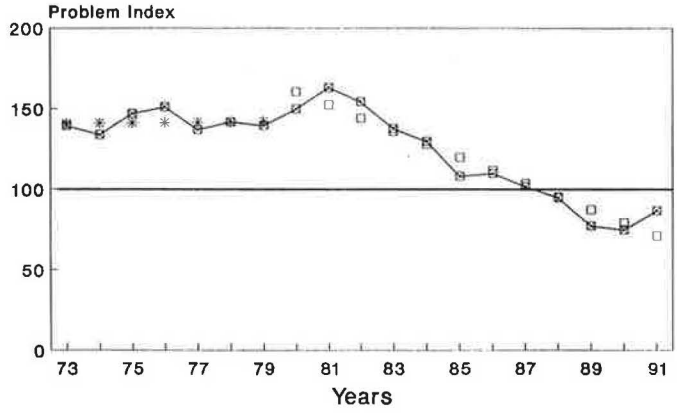


FIGURE 3 Trends in the Problem Index: ratio of the number of fatally injured drinking to non-drinking drivers.

The trend lines for the Problem Index are entirely consistent with this description -- virtually no change was evident in the 1970s but a significant and consistent decrease in the drinking-driving problem occurred during the 1980s.

As a further means of assessing the nature of these changes, monthly values of the Problem Index were determined from 1973 through 1991. These data are plotted in Figure 4 and identified as the "actual" values. The series shows a pronounced seasonal pattern -- the Problem Index is always lower in the winter months than in the summer. Also shown in the figure is the time series representing the predicted values of the Problem Index using 1980 as the intervention point. As can be seen, the actual time series in 1980 departs quite radically from what is predicted on the basis of past experience. A clear departure from the predicted levels of the Problem Index is evident beginning in the mid 1980s.

• Drivers involved in injury collisions. As indicated previously, collisions that result in injury are much more numerous than those that involve one or more deaths. Unfortunately, historical data for the 1970s are unavailable so only trends during the 1980s can be examined. As was the case with fatalities, while the number of non-drinking drivers involved in injury crashes has been increasing, the number of drivers reported by the police to have been drinking (at the time of the crash) has declined by 44% in 12 years.

This means that a measure such as the Problem Index should be used to track the trends and Figure 5 plots the ratio of drinking drivers to non-drinking drivers involved in injury crashes. As can be seen by the fact that the Problem Index is well below 100, the number of drinking drivers involved in injury crashes has always been less than the number of non-drinking drivers (the reverse of the situation for fatal crashes). Perhaps more noteworthy is the consistent and visible decline in the index during the 1980s -- signifying a decrease in the drinking driving problem.

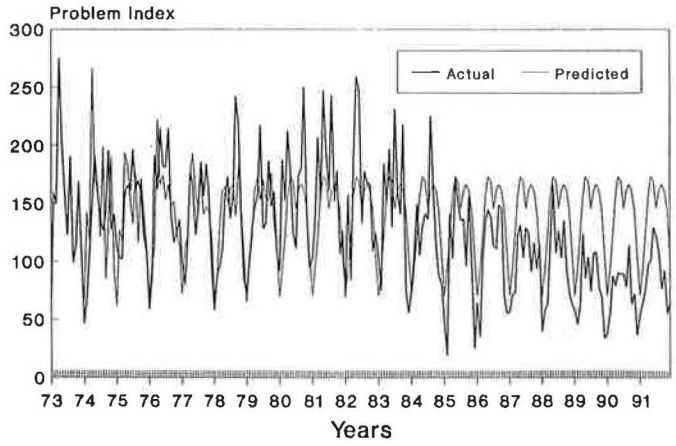
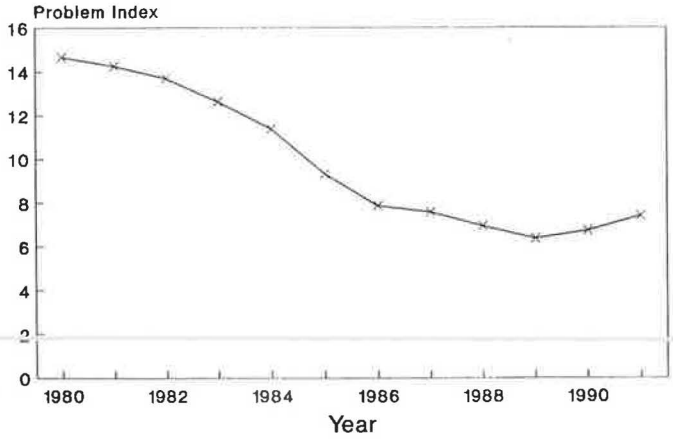


FIGURE 4 Actual and predicted values of the problem index.



Ontario, 1980-1991

FIGURE 5 Problem Index for drivers involved in injury collisions.

● Impaired driving charges. The annual number of persons charged with a drinking-driving offence in Canada from 1973 through 1991 is shown (by the bars) in Figure 6. From 1973 to 1991, there was actually an increase in the number of persons charged, reaching a high rate of 162,048 in 1981. During the rest of the 1980s, however, the number of persons charged dropped progressively -- in 1991 the number of persons charged reached its lowest level (111,307) since 1974.

However, when the number of charges are standardized against the number of licensed drivers (rate) a somewhat different picture emerges. The rate of charges was relatively constant throughout the 1970s but it declined rapidly and significantly during the 1980s, presenting a pattern that is quite consistent with what was shown previously for alcohol related crashes.

Summary. It is apparent that there has been a general improvement in the drinking-driving problem in Canada. The percentage of fatally injured drinking drivers as well as those with BACs in excess of 80 mg% has decreased. As well, the ratio of drinking to non-drinking driver fatalities has also decreased. These changes appear to be restricted and unique to the 1980s. During the 1970s, virtually no change in any of these indicators was evident. But in the 1980s consistent and systematic decreases in the problem occurred.

Moreover, by 1988, for the first time in the recorded history of the drinking-driving problem in Canada, the number of drinking driver fatalities fell below the number of non-drinking driver fatalities. As well, fewer drinking drivers are becoming involved in injury collisions and fewer are being charged with a drinking-driving offence.

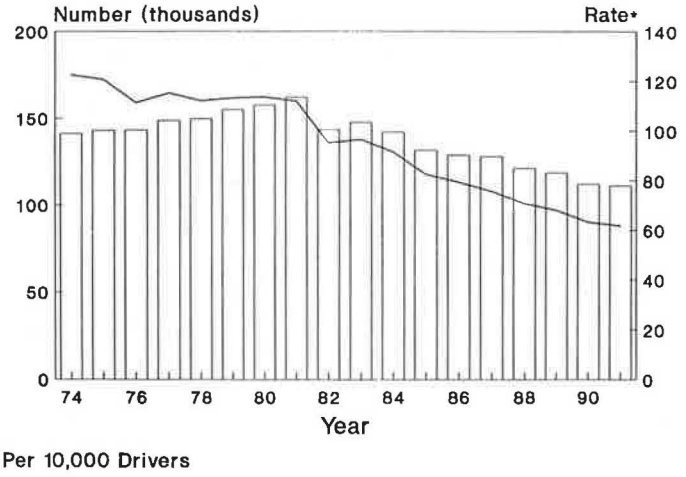


FIGURE 6 Number and Rate* of charges for impaired driving.

Consistent with these trends, roadside survey results also indicate that the incidence of driving while impaired (BAC over 80 mg%) has decreased.

Specific Trends in Drinking-Driving

As shown in the previous section, a variety of indicators suggest that decreases in the overall magnitude of the drinking-driving problem did occur during the 1980s in Canada. The present section examines changes in the characteristics of the problem to determine whether the general trends are descriptive of various subgroups of drivers or whether certain subgroups or types of crashes have shown differential changes.

To facilitate comparisons of the trends between and among the various subgroups, one measure of the problem (the Problem Index) will be used throughout because it presents a considerable amount of information, parsimoniously.

Sex of Driver. Figure 7 shows the Problem Index for fatally injured male and female drivers from 1973 through 1991. The most obvious difference is that the index for males is much higher than it is for females. Indeed, among fatally injured male drivers, the number who were drinking has always exceeded the number who were sober except in 1989 and 1990. The reverse is true for females; there are always more sober driver fatalities than those who have been drinking.

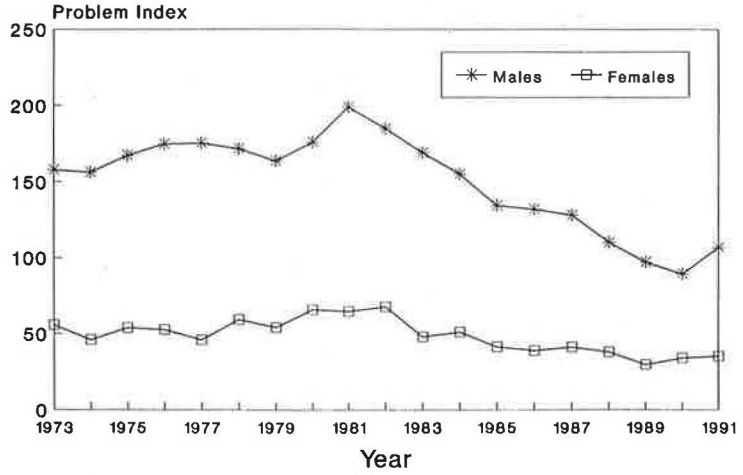


FIGURE 7 Problem Index for fatally injured drivers according to gender.

Changes in the drinking driving problem are evident for both groups. Among both males and females, the Problem Index showed little change during the 197Os, increasing somewhat in the early 1980s. Since then it has declined quite consistently showing an ever decreasing proportion of drinking driver fatalities.

It is to be noted again that the Problem Index does not convey the whole story. For example, it does not indicate the absolute magnitude of the problem involving the groups being compared. It does not reveal that in 1991 the number of fatality injured male drivers who were drinking was about 10 times greater than the number of female drivers who were drinking.

Age. The Problem Index for various age groups is shown in Figure 8. There are clear differences among the groups. First, the magnitude of the problem varies as a function of age, since the Problem Index is generally highest among 16-25 year olds, followed by 26-45 year olds, 46-55 year olds, and is lowest among drivers over the age of 55. Indeed, historically among drivers over the age of 45, the Problem Index has usually been below 100 -- i.e., among the two oldest age groups shown in the figure, the proportion of sober drivers has exceeded that of drinking drivers. And, the overall trend among these two groups has been downward, toward an ever diminishing proportion of drinking drivers.

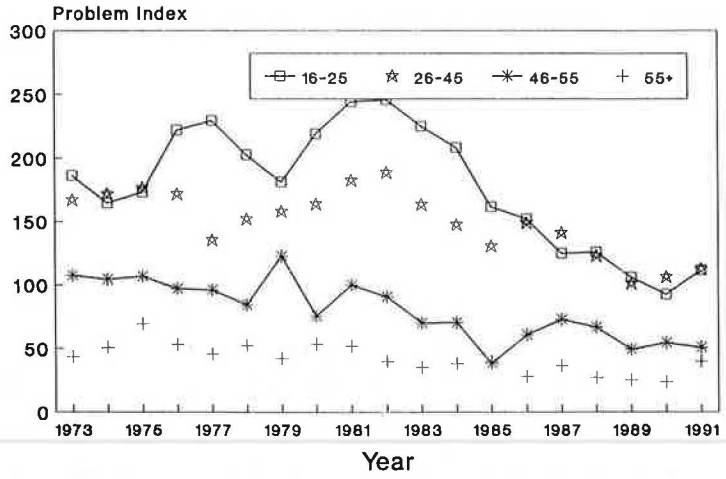


FIGURE 8 Problem Index for fatally injured drivers according to age.

Among the two youngest groups (16-25 and 26-45) the Problem Index has traditionally exceeded 100 -- there has always been more drinking drivers than sober ones in these age groups. Neither groups showed any downward change in the 1970s but early in the 1980s the drinking driving problem began to decline consistent among these groups. Indeed, by 1989, the index had approached 100 in both groups for the first time in 16 years.

Summary. The general trends described earlier appear to be characteristic of various subgroups of drinking drivers as well.

DISCUSSION AND CONCLUSIONS

Overall, most indicators suggest that the magnitude of the drinking-driving problem decreased during the 1980s in Canada and that this decline represented a significant departure from the trend in the 1970s. The changes in drinking-driving were both dramatic and significant.

The central question, of course, is why these changes occurred -- what countermeasure(s) accounted for the decrease in the drinking-driving problem. It should be recognized at the outset that attribution of change to a single factor is most unlikely, for several reasons.

First, significant changes such as new legislation, increased enforcement of impaired driving laws, the community level never occur in isolation. Indeed, the initiatives mentioned in the previous sentence, which are but a few of those targeted at drinking-driving the 1980s, occurred concurrently. Disaggregating the impact of a specific measure, therefore, is challenging to say the least. Second, the context in which initiatives occur is a dynamic one -- the amount of the initiative being applied, as well as the intensity and form of other initiatives, is seldom consistent or uniformly

applied. Third, while there appears to be a distinct change from the 1970s to the 1980s, within the 1980s there are no abrupt or catastrophic changes that could be time-linked to some specific initiative -- the changes were more gradual. Thus, the introduction or launch of a particular countermeasure will not be easily detected in the data. Hence, the very nature of most countermeasure activities actually defies the expectation of an abrupt impact.

Notwithstanding the difficulties inherent in determining why change occurred, it is necessary to underscore how important it is to know why. Indeed, it could be argued that identifying the principal contributing factors is more than important; it is essential! At the very least, it is necessary to know which tactics should continue to be applied if change is to be sustained as well as which should be eliminated if they have no impact on the problem. Regrettably, as Hauer (1985) has stated about many countermeasures -- we do much but learn little in the doing. This most certainly applies to the drinking-driving field. *Much was done in Canada in the 1980s and this activity appears to have been associated with positive gains but we have learned very little about which of the many measures contributed to the change.*

Thus, while it is possible to identify factors (e.g., programs, community-based initiatives, etc.) that may have contributed to the changes witnessed in the 1980s, it is not possible to assert which of them actually had an impact and which of them did not. There is a greater purpose to emphasizing this fact than simply to lament its existence. It is to signal that *extreme caution must be exercised in accepting unqualified claims about the effectiveness of various initiatives in changing the drinking-driving situation in Canada. Most of these claims are simply unfounded, since the impact of specific initiatives cannot be discerned from the data.*

And the list of potential contributing factors is quite extensive indeed, including the emergence of groups of organized victims of impaired drivers -- such as Mothers Against Drunk Driving MADD), Remove Intoxicated Drivers (RID), People to Reduce Impaired Driving Everywhere (PRIDE), Citizens Against Impaired Driving (CAID), and People Against Impaired Driving (PAID) -- that served to bring the issue of drinking and driving to the forefront of public and political concern.

If nothing else, citizen activist groups, not only made legislators and the public attend to the issue of impaired driving, they helped change the way society viewed the problem. Impaired driving could no longer be considered a "folk crime" -- it was a serious, criminal offence.

Associated with the emergence of victim groups and the growing interest of health agencies in the problem came a recognition of the role of community-based, "grass-roots," initiatives. Numerous communities across the nation established committees of concerned citizens to deal with impaired driving at the local level.

Significant legislative and regulatory changes also occurred during the 1980s. In Canada, in 1984, the Department of Justice announced changes in the provisions of the Criminal Code dealing with impaired driving offences. The amendments broadened impaired driving to include impaired operation of any motor vehicle. Minimum penalties for a conviction were increased and impaired driving causing death and impaired driving causing injury became offences punishable by up to 14 years in prison. These changes took effect in December, 1985. Many individual provinces also responded by increasing the period of license suspension for an impaired driving conviction. Temporary license suspensions for driving with a BAC between 50 and 80 mg% also became commonplace in many provinces.

During the 1980s, enforcement also increased. The use of police checkstops became increasingly prevalent in Canada. Many provinces, together with local police forces, instituted random checkstop programs, usually involving the use of portable alcohol screening devices. Initially, these were largely restricted to the year-end holiday season but such enforcement activities have proliferated and now occur throughout the year.

Increased police enforcement did not produce a corresponding increase in the number of persons charged with impaired driving. Arresting more impaired drivers was not necessarily the primary objective of police checkstops. High profile enforcement "blitzes," involving numerous teams of police officers, did undoubtedly serve to increase the probability of detection. But, perhaps more significantly, such efforts also served to increase the public's *perception* of the probability of arrest. Believing there is a reasonable chance of being stopped for driving after drinking may be a powerful deterrent of drinking-driving behaviour. By reinforcing this belief, police checkstops may be preventing driving after drinking.

The intensity and scope of activities undertaken to reduce drinking and driving during the 1980s was also reflected in a proliferation of public education and information programs. Governments, groups brought the anti-drinking and driving message to the media advertising and awareness programs. The number of magazine and newspaper stories on drinking and driving increased dramatically during the 1980s. Radio and TV spots became frequent; billboards displaying anti-drinking and driving messages emerged; newspapers and magazines carried feature articles about drinking and driving as well as advertisements; bumper and window stickers appeared on cars; and, pamphlets and booklets full of facts and information about drinking and driving were produced and widely distributed.

Public awareness of these anti-drinking and driving messages became widespread. In a nation-wide survey conducted in 1984, 73% of respondents indicated that they had read, seen or heard an advertisement dealing with the

subject of drinking and driving (Goldfarb Consultants 1984). Several years later, the National Survey on Drinking and Driving 1988 reported that 93% of Canadians aged 16 to 69 could recall having seen or heard advertisements related to drinking and driving (Health and Welfare Canada 1989).

No single factor can be cited as being primarily responsible for the change in the drinking-driving problem that occurred during the early 1980s. It is most likely that all the above-mentioned factors played a role in changing both public awareness about the problem and drinking-driving behaviour. Countermeasure programs -- including media campaigns, community-based programs, legislative changes, and increased enforcement -- combined to produce an unprecedented level of anti drinking-driving activities.

But it would be inappropriate and decidedly unscientific to leave the assessment there. While it might be comforting to speculate that the observed changes in the magnitude of the problem were somehow induced by the combined impact of all the drinking and driving initiatives, it is also possible the changes were unrelated to them.

To illustrate how plausible this might be, we compared the incidence of alcohol among fatally injured drivers in Canada to that in the U.S. from 1980 to 1991. To ensure that the same states were included in the time series and that these states had alcohol testing rates of 80% or above, we limited the analysis to 12 states. The ratio of drinking to non-drinking driver fatalities -- the Problem Index was calculated for each year and the results are shown in Figure 9, which also presents the same data for Canada.

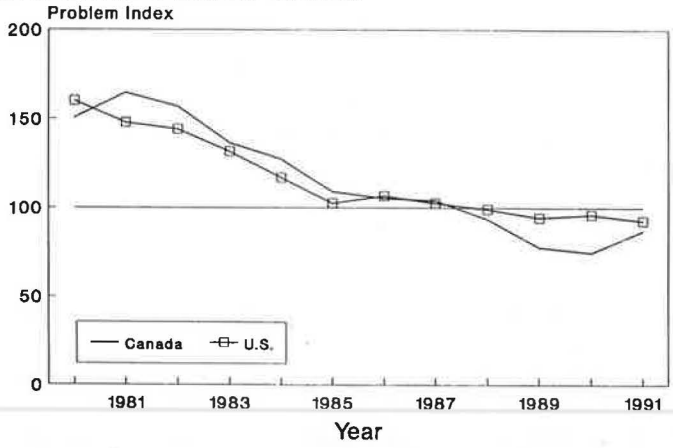


FIGURE 9 Problem Index for Canada and the United States.

As can be seen, the results are remarkably similar. On the one hand, it could be argued that such similarity is to be expected, given that the problem received similar attention in both countries. On the other hand, there were strikingly different approaches taken in the two countries as well. For example, the drinking age increased to 21 in all states but remained at 18 or 19 in all Canadian provinces.

It is, therefore, possible that more "global" forces -- such as economic conditions, shifting demographics and trends in alcohol consumption -- were affecting the drinking and driving problem.

In general, when unemployment is high, traffic fatalities fall, and vice versa (e.g., Hedlund 1985; Mercer 1987). In this context, it is important to consider that during 1980-81, Canada experienced a period of economic strength which was followed by a severe economic recession in 1982. Unemployment rates peaked in 1982. Trends in traffic fatalities shifted accordingly. In 1982, there were more than 1,100 fewer traffic fatalities in Canada than in 1981. When examined over a longer period, during the 5-year period 1977-81, an average of 5,478 persons died in road crashes each year in Canada, compared to an average of only 4,187 per year during the period 1982-1986 -- a decrease of 24%. The correlation between the percentage of persons unemployed and the number of traffic fatalities each year is strong and negative ($r = -.65$), indicating that as the percentage of persons unemployed increases, traffic fatalities in Canada decrease. Although other factors are undoubtedly involved, the influence of economic trends on traffic safety must be considered.

Because drivers of different ages are unequally represented among drivers involved in traffic crashes, shifting demographics must also be considered as a factor in trends in traffic crashes. For example, young drivers age 16-24 are overrepresented in collisions. This age group comprises about one-quarter of the driving-age population in Canada but accounts for 31% of all driver fatalities and 34% of all impaired driver fatalities (i.e., BAC over 80 mg%). Changes in the age distribution of the population could affect the number of traffic fatalities as well (Mayhew et al 1986).

In this regard, persons aged 15-24 years have gradually declined as a percentage of the driving-age population in Canada from 1970 to 1991. Decreased representation of drivers in high risk age groups, combined with increased numbers of lower-risk age groups (e.g. 25-44), should have a beneficial effect on traffic safety. Indeed, the correlation between the proportion of the population aged 15-24 years and the number of traffic crashes is both strong and positive (r =.76), indicating that as the proportion of 15-24 year-olds in the population rises, so too does the number of traffic fatalities -- and vice-versa.

The extent to which factors such as demographic shifts in the population and economic fluctuations have contributed to the changes in the drinking driving problem is unclear but their influence cannot be ignored, underscoring once more the need to accept with considerable caution claims about the success of specific programs in changing the problem.

Finally, changing patterns of alcohol consumption may have had an impact on the extent of the drinking-driving problem. From 1970 to 1983, per adult consumption in Canada increased steadily to a peak of 10.6 litres of absolute alcohol. Thereafter, average annual consumption of alcohol declined steadily to its present level (1991) of 9.16 litres. Of greater importance, there is a strong positive correlation (r=.91) between per capita consumption and the percent of fatally injured drivers who were drinking. While it might be tempting to conclude that this represents a clear casual linkage it must be recalled that many other factors described above show a strong relationship with the incidence of alcohol-related crashes.

The final conclusions are quite simple. (1) The magnitude of the drinking-driving problem in Canada decreased significantly during the 1980s. (2) This decrease appears to be unique to the 1980s, since no similar changes were evident in the previous decade. (3) It has not yet been determined why this unprecedented decline occurred.

REFERENCES

Beatty, W.W. 1984. Discriminating drunkenness: A replication. *Bulletin of the Psychonomic Society* 22(5): 431-432.

Beirness, D.J., Simpson, H.M., Mayhew, D.R. and Wilson, R.J. 1993. Canadian trends in drinking driver fatalities. In H. Utzelmann, G. Berghaus and G. Kroj (Eds) *Alcohol Drugs and Traffic Safety.* Cologne: Verlag TÜV Rheinland, 1062-1067.

Beirness, D.J. 1989. Female Drivers in Canada: Trends in Accident Involvement. In: *Women, Alcohol Drugs and Traffic,* ed. M.R. Valverius. pp. 23-32.

Douglas, R.L. 1982. Repeating cycles of concern and complacency: The public interest and political response to alcohol--related traffic accidents. *Abstracts and Reviews in Alcohol and Driving* 3(4): 3-5.

Foss, R.D.; and Perrine, M.W. 1989. *Safety belt use among high risk drivers: A nighttime roadside survey.* Presented at annual meeting of American Public Health Association, Chicago, Illinois.

Foss, R.D.; Voas, R.B.; Beirness, D.J.; and Wolfe, A.C. 1991. *Minnesota 1990 Statewide Drinking and Driving Roadside Survey.* Landover, MD.: National Public Services Research Institute.

Hauer, E. 1985. The effect of traffic safety measures: What we have learnt and what we don't know yet. Background paper. In: *Evaluation 85,* eds. M.B. Biecheler, C. Lacombe, and N. Muhlrad. France: ONSER. pp. 135-140.

Hedlund, J. H. 1985. Recent U.S. traffic fatality trends. In: *Human Behavior and Traffic Safety,* eds. L. Evans and R.C. Schwing, pp. 7-19. New York: Plenum Press.

Howland, J. 1988. Social Norms and Drunk Driving Countermeasures. In: *Preventing Automobile Injury. New Findings from Evaluation Research,* ed. J.D. Graham. Dover, MA Auburn House Publishing Company. pp. 163-188.

Langenbucher, J.W.; and Nathan, P.E. 1983. Psychology, Public Policy, and the Evidence for Alcohol Intoxication. *American Psychologist:* 1070-1077. October.

Lawson, J.J., Arora, H.R., Jonah, B.A., Krzyewski, J.W., Smith, G.A., Stewart, D.E. and Hieatt, D.J. 1982. 1981 Night-time surveys of drivers' alcohol use. In: 26th Annual Proceedings of the American Association of Automotive Medicine, pp 375-388. Ottawa: AAAM.

Mayhew, D.R.; Donelson, A.C.; Beirness, D.J.; and Simpson, H.M. 1986. Youth, alcohol and relative risk of crash involvement. *Accident Analysis and Prevention* 18(4): 273-287.

Mercer, G.W. 1985. A note on the reliability and validity of police reporting of alcohol involvement in casualty traffic accidents on the British Columbia Motor Vehicle Department traffic accident report form (MV104). In: *CounterAttack Traffic Research Papers 1984,* pp. 4-11. Vancouver, British Columbia: Ministry of Attorney General.

Mercer, G.W. 1987. Influences on passenger vehicle casualty accident frequency and severity: Unemployment, driver gender, driver age, drinking driving and restraint device use. *Accident Analysis and Prevention* 19(3): 231-236.

Pagano, M.; and Taylor, S. 1979. Police perceptions of alcohol intoxication. *Journal of Applied Social Psychology 10:* 166-174.

Rockerbie, R.A. 1979. *Blood Alcohol in Hospitalized Traffic Crash Victims.* Vancouver, British Columbia: Ministry of the Attorney-General.

Simpson, H.M. 1987. Community-based approaches to highway safety: Health promotion and drinking-driving. *Drug and Alcohol Dependence* 20: 27-37.

Simpson, H.M. and Mayhew, D.R. 1991. Trends in alcohol use among fatally injured drivers in Canada. In M.W. Perrine (ed.) Alcohol Drugs and Traffic Safety. Chicago, Illinois: National Safety Council, 319-324.

Simpson, H.M. and Mayhew, D.R. 1993. The hard core drinking driver. In H. Utzelmann, G. Berghaus and G. Kroj (Eds) *Alcohol Drugs and Traffic Safety.* Cologne: Verlag TÜV Rheinland, 847-853.

Simpson, H.M. and Virgilis, E. Epidemiology and special population surveys. In S.D. Ferrara and R. Giorgetti (Eds) Methodology in Man-Machine Interaction and Epidemiology on Drugs and Traffic Safety. Padova, Italy: Addiction Research Foundation, 51-93.

Smith, G.A.; Wolynetz, M.S.; and Wiggins, T.R.I. 1976. *Drinking and Driving in Canada: A National Roadside Survey of the Blood Alcohol Concentrations in Nighttime Canadian Drivers.* Report No. TP 1311. Ottawa, Ontario: Department of Transport, Canada.

Stewart, D.E. and Lawson, J.J. 1987. Results and inferences from the 1986 night-time surveys of drivers' alcohol use. In: Proceedings of the Canadian Multidisciplinary Road Safety Conference V, Calgary.

Warren, R.A, and Simpson, H.M. 1980. Effects of measurement assumptions on estimations of the risk of collision. *Accident Analysis and Prevention,* 12, 143-150.

Warren, R.A.; Simpson, H.M.; Buhlman, M.A.; Bourgeois, L.A.; and Chattaway, L.D.; 1981. *Alcohol in Patients Reporting to Hospital for Treatment of Traffic Related Injuries. The New Brunswick Study.* Ottawa, Ontario: The Traffic Injury Research Foundation of Canada.

ALCOHOL-RELATED ROAD ACCIDENTS IN THE FEDERAL REPUBLIC OF GERMANY

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(Paper presented by Ekkehard Brühning)

DATA FROM THE FEDERAL REPUBLIC OF GERMANY (WEST)

In the period from 1975 to 1990 in the Federal Republic of Germany (West) alcohol related injuries and fatalities in road traffic decreased continuously:

- The alcohol related accidents with injuries decreased obviously (32%) (see Table 1 and Figure 1). On the contrary the non alcohol-related accidents with injuries increased between 1975 and 1990 (6%).

TABLE 1 Time series of alcohol-related road accidents with injuries versus road accident with injuries in the period from 1975 - 1900 in West Germany, and in 1991 in West and East Germany

accident category / years	1975	1980	1985	1990	1991[1)]
road accidents with injuries	337 732	379 235	327 745	340 043	385 147
alcohol-related road accidents with injuries	48 346	49 210	35 775	32 814	41 603
share of alcohol-related road accidents with injuries	14 %	13 %	11 %	10 %	11 %

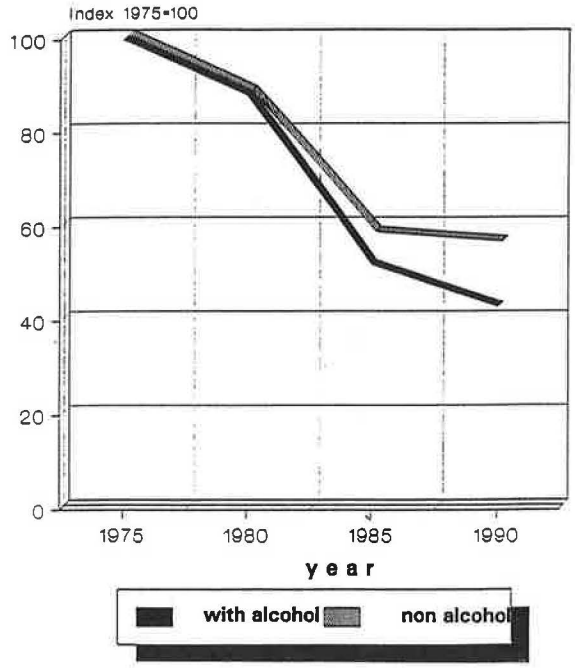

Figure 1 Road accidents with injuries, Federal Republic of Germany/West.

• The alcohol-related injuries also decreased dramatically in this period (37%), meanwhile the non alcohol-related injuries only decreased slightly (4%) (see Table 2).

TABLE 2 Time series of alcohol-related injuries in road accidents versus injuries in road accidents in the period from 1975 - 1990 in West Germany, and in 1991 in West and East Germany

accident category / years	1975	1980	1985	1990	1991[1)]
injuries in road accidents	472 667	513 504	430 495	456 064	516 835
alcohol-related injuries in road accidents	72 444	71 353	49 764	45 936	58 609
share of alcohol-related in road accidents	15 %	14 %	11 %	10 %	11 %

• The alcohol-related fatalities in road accidents decreased from 1975 to 1990 more (57%) than the total amount of fatalities in road accidents (44%) (see Figure 2 and Table 3).

TABLE 3 Time series of alcohol-related fatalities in road accidents versus fatalities in road accidents from 1975 -1990 in West Germany, and 1991 in West and East Germany

accident category / years	1975	1980	1985	1990	1991[1)]
fatalities in road accidents	14 870	13 041	8 400	7 906	11 300
fatalities in alcohol-related road accidents	3 318	2 919	1 719	1 414	2 229
share of alcohol related road accidents	22 %	22 %	20 %	18 %	20 %

In 1973, the critical BAC-limit of 0,8 permille was introduced as on offence which by statutory definition carries a fine (S 24a Road Traffic, Act, StVG). In this year 83 of 1,000 injured vehicle drivers and 60 of 1,000 injured pedestrians were intoxicated by alcohol (Statistisches Bundesamt, 1991). Since this time the figure decreased until 1990 to 50 intoxicated of 1,000 injured drivers and increased on the other hand to 69 per 1,000 injured pedestrians (see Figure 3).

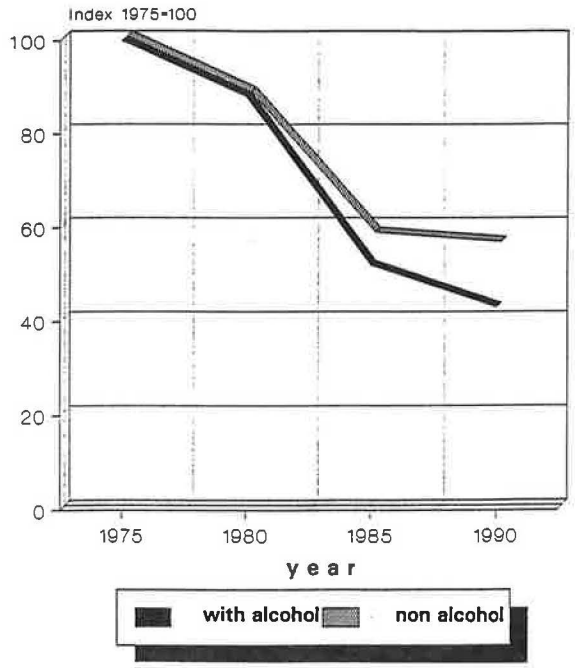

FIGURE 2 Fatalities in road traffic, Federal Republic of Germany/West.

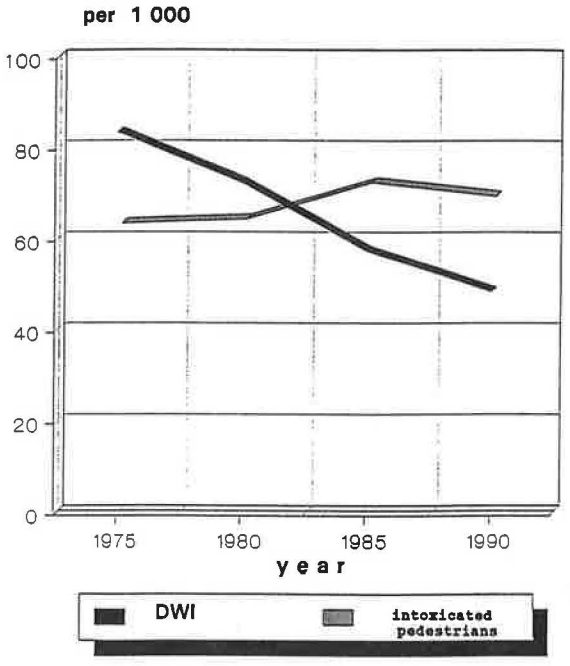

FIGURE 3 Intoxicated drivers and pedestrians per 1,000 injuries, Federal Republic of Germany/West.

COMPARISON WITH DATA OF THE FORMER GERMAN DEMOCRATIC REPUBLIC

In the German Democratic Republic up to 1989, the trend of the development of alcohol-related accidents was similarly favorable: compared with 1980, 14% fewer alcohol-related accidents were counted in 1989 and 25% fewer fatalities in alcohol-related accidents, whereas the number of casualty accidents not involving alcohol even rose by 3% in that time. The number of fatalities also decreased, but only by 8%, clearly less than in the alcohol-related accidents. (The year of 1990, in which the number of alcohol-related accidents and accident fatalities rose considerably in GDR, cannot be used for comparison purposes because of the opening up of the borders and the atypical traffic conditions associated therewith). (Kretschmer-Bäumel).

The relation between alcohol related accidents with injuries and non-alcohol related accidents with injuries was nearly the same as in West Germany (10%) in the three years before the unification (1986 to 1989). The relation between alcohol related fatalities and fatalities in road accidents also was similar (FRG 18%; GDR 17%).

These figures are very surprising considering the different legal BAC limits in both former German states (FRG: 80 mg/100 ml; GDR: 0 mg/100 ml) and the different police enforcement strategies. Since January 1993, all parts of Germany have the same BAC-limit of 80 mg/100 ml is legal.

But the road accidents increased dramatically in the New Länder (former GDR) after the unification. The alcohol related road accidents with injuries increased 72 percent from 1989 to 1990; by comparison the overall road accidents with injuries increased 44 percent.

In the first 4 months of 1991 in the New Länder, 77 of 1,000 drivers who were involved in an accident with injuries were intoxicated by alcohol. By contrast, in West Germany 49 of 1,000 drivers in accidents were intoxicated.

CONCLUSION

In the period from 1975 to 1990 there can be seen a favorable and continuous drop of alcohol-related road accidents in Germany. This relatively favorable development among alcohol-related accidents is accompanied by a slight drop in alcohol consumption: 11.8 liters of pure alcohol per capita were consumed in 1990-compared to 1980, a decrease of 10%. In addition, a steady increase in soft drinks was found: from 405.2 liters in 1980 to 513.0 liters in 1990, i. e. an increase of 26.6% (Kretschmer-Bäumel).

Since the unification in 1990, in the New Länder, accidents in general and especially those concerning alcohol, have increased. The recent figures, for 1992, which are still not official, show a stabilization and slight improvement in the New Länder.

PERSPECTIVES

In this situation once more the effectiveness of police controls, legislative and educational measures and above all their interaction should be considered. Alcohol as a drug has been known for thousands of years and intensively consumed for centuries. The motor vehicle has been in use for about one hundred years, and on a widerspread basis for only about forty years. In Germany it has seriously affected the lifestyles of not more than two generations. The process of social reorientation to change dominant attitudes and to practice new behaviour modes of drinking-driving control will presumably be long and difficult.

In view of the complicated structure of social control, a solution to the problem may be found by concentrating on primary prevention. Most drivers (up to 95 percent) today probably remain below the legal BAC limit of 80 mg/100 ml (Stephan, 1989; Müller, 1993). A denser network of police controls would probably not increase the "yield" of undetected offenders much beyond the present level - according to surveys not higher than to 2 percent (Kerner, 1985).

Present efforts in the Federal Republic of Germany toward a more systematic integration of driver improvement programs into the existing legal and administrative framework seem to provide a more promising route to traffic safety in the medium term than do demands for radical changes in sanctions (Winkler, Kroj, 1993). Driver improvement programs can already be considered as making an important and irreplaceable contribution to road safety in the Federal Republic of Germany. However, they cannot be seen as a substitute for legal sanctions and measures.

REFERENCES

Kerner, H.-J.: Gesetzgebung, Polizeiliche Überwachung und Strafgerichtsbarkeit in der Bundesrepublik Deutschiand. H. 115 Forschungsberichte der BASt, Bereich Unfallforschung, Bergisch Gladbach, 1985.

Kretschmer-Bäumel, E.: Drinking and Driving in Germany: Behavioural Patterns and Influencing Factors-- a temporal and cross-cultural comparison. Proceedings "Alcohol, Drugs and Traffic Safety-T'92", Vol- 2., Verlag TÜV Rheinland, Köln, 1993, 1011-1016.

Kroj, G.: Rehabilitation of drunken drivers in the Federal Republic of Germany. Proceedings "Alcohol, Drugs and Traffic Safety - T'92", Vol. 1, Verlag TÜV Rheinland, K81n, 1993, 378-384.

Müller, A.: Fahrerlaubnisentzug, Eignungsbegutachtung, Nachschulung und Therapie bei Trunkenheitstätern. In: Blutalkohol Vol. 30 No. 2, 1993, 65-95.

Statistisches Bundesamt: Alkoholunfälle im Strassnverkehr 1990, Auszug aus Fachserie 8, Reihe 7 "Strassenverkehrsunfälle", Wiesbaden, 1991.

Statistisches Bundesamt: Fachserie 8, Reihe 7 "Strassenverkehrsunfälle 1985-1990", Wiesbaden, 1992.

Stephan, E.: Wirksamkeit der Nachschulungskurse bei erstmals alkoholauffälligen Kraftfahrern. H. 170 Forschungsberichte der BASt, Bereich Unfallforschung, Bergisch Gladbach, 1988.

Winkler, W., Jakobshagen, W., Nickel, W.-R.: Rückfälligkeit von Teilnehmern an Kursen für wiederholt alkoholauffällige Kraftfahrer nach fünf Jahren. H. 224 Forschungsberichte der BASt, Bereich Unfallforschung, Bergisch Gladbach, 1991.

DECLINE IN DRINKING AND DRIVING IN THE NETHERLANDS

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INTRODUCTION

Drinking and driving in the Netherlands has declined in recent years. This has been reported before (Mathijssen & Noordzij, 1993). The main sources of information have been a series of road side surveys (including breath testing) and accident statistics. In addition to this, information is available on factors that may have contributed to this decline. An explanation proved to be difficult due to the quality of the information and to the gradual or combined introduction of a number of countermeasures. In this paper a more detailed analysis of the available information will be given.

ROAD SIDE SURVEYS

Since 1970, SWOV has carried out a series of road side surveys. The design of these studies has been to draw a random sample of car drivers during weekend nights (Friday and Saturday, 22.00-04.00 o'clock). These drivers are interviewed and breath tested. The main result of each survey is a distribution of BAC's in two or more classes for all drivers and for subgroups based on age and sex (among others).

Figure 1 shows the results for BAC's over 0.2 and 0.5 % respectively. The legal limit, which was introduced in 1974, is 0.5% and caused a drastic short term effect, followed by a modest long term decrease in positive BAC's. For about ten years, the level of drinking and driving remained stable with ca. 24% of the weekend night drivers with a BAC over 0.2 % and ca. 12% over the legal limit. Unfortunately, there were no surveys between 1983 and 1987. In retrospect this period is interesting because it was the start of a decline in drinking and driving. It is impossible to decide from this information when the decline started exactly. The 1991 and 1992 surveys result in only 10% of the drivers with a BAC over 0.2 and 4% over 0.5 %.

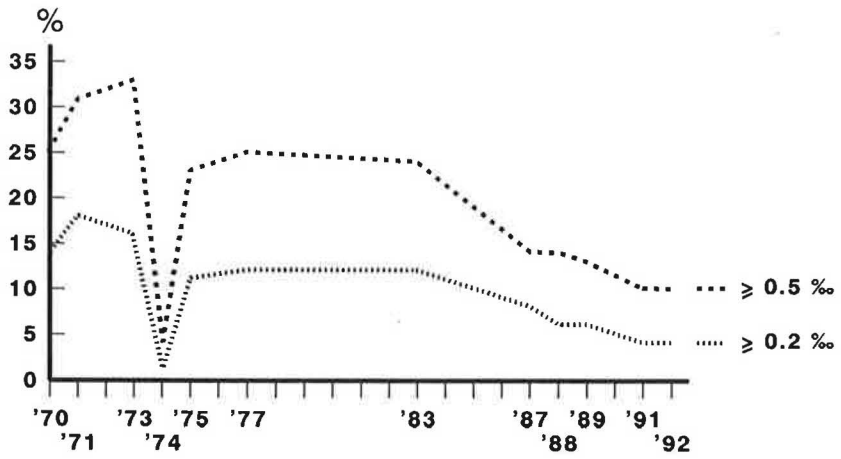

FIGURE 1 BAC of car drivers (weekend nights).

Interestingly this decline is found for positive BAC's both over and under the legal limit, for all age groups and for both sexes. There is a characteristic age pattern with the lowest percentage of positive BAC's for young drivers (15-24 years), the second lowest for old drivers (50+ years) and the highest for the middle ages. This pattern holds for 1983 as well as for 1992, but at a much lower level (see Table 1).

TABLE 1 BAC of car drivers by age (weekend nights)

	Age	% over 0.2 percent	% over 0.5 percent
1983	15-24	21	10
	25-49	27	14
	50+	19	12
	total	24	12
1992	15-24	7	3
	25-49	12	5
	50+	9	3.5
	total	10	4

Drinking and driving has always been much more of a problem for males than for females. But again, the level for both sexes is much lower in 1992 than it was in 1983 (see Table 2).

TABLE 2 BAC of car drivers by sex (weekend nights)

	Sex	% over 0.2 percent	% over 0.5 percent
1983	male	27	14
	female	15	8
	total	24	12
1992	male	11.5	4.5
	female	6	2
	total	10	4

ACCIDENT STATISTICS

Knowing the relation between drinking, driving and accident involvement, the decline in drinking and driving must also show in accident statistics. However, drinking is one of many factors contributing to accidents and the registration of drinking for drivers involved in crashes is far from complete. As a result there is no direct and simple way to determine the effect of a change in drinking and driving on crashes.

One way is to use a so called surrogate measure: car drivers involved in serious crashes at night as a percentage of all drivers (day and night) involved in such crashes. The idea behind this measure is that drinking is much more prominent during nights than days. If drinking and driving changes, this will cause a shift in the percentage of (drivers involved in) nighttime crashes. This idea holds if:

- Most of the drinking is done during nighttime and very little or none during daytime; and
- Other factors equally contribute to crashes during day and night.

Neither of these two points is very realistic. The absolute number of drivers involved in serious crashes during weekday nights gradually declines over the years. However, the daytime number declines at about the same rate. As a result the surrogate measure does not show a trend for weekdays (see Figure 2). For weekends the nighttime percentage is slightly over 30% till 1985, and slightly under 30% after 1985. This can be taken as a weak indication of a decline of alcohol involvement in serious crashes during weekend nights only.

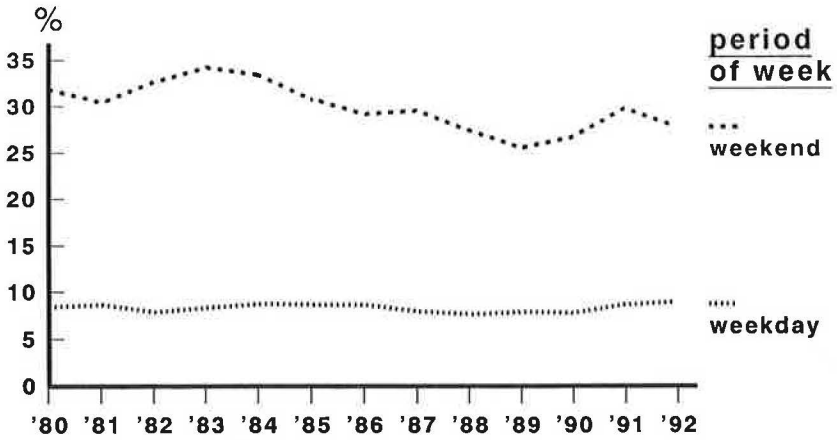

FIGURE 2 Percentage of car drivers in serious crashes at night.

Another way to determine the effect of a change in drinking and driving on crashes is to use alcohol consumption as reported by the police. Since there may be other factors contributing to all (alcohol involved and other) crashes, the measure has to be relative:

- Car drivers involved in serious crashes with alcohol, as a percentage of all drivers involved in such crashes.

In Figure 3 this percentage is given for four periods of the week. For weekend nights the percentage is between 35 and 40 in the early eighties and changes rather abruptly to between 25 and 30 since the middle eighties. For weekday nights the decline is from 30% to almost 20%. The daytime percentages are much lower, but at close inspection they show a similar decrease over the years. The decline in alcohol involvement as shown by this measure has to be taken as an indication rather than as proof. As mentioned before, the registration by the police of alcohol is far from complete and not necessarily stable over time.

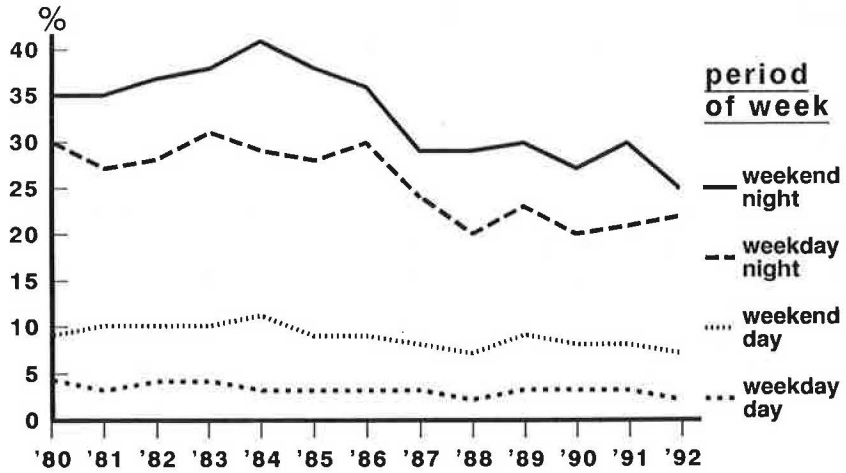

FIGURE 3 Percentage of car drivers in serious crashes with alcohol.

In Figures 4 and 5 this measure of alcohol involvement is presented for different age groups. During weekend nights the decline is much more pronounced for young drivers than for older age groups. For older drivers it is hard to decide if there was a decline at all.

The same information is also provided for pedal cyclists and pedestrians in Figures 6 and 7. There is no sign of a decrease in the percentage reported as drinking for these groups. A breakdown in age groups is not shown because of the low numbers per year.

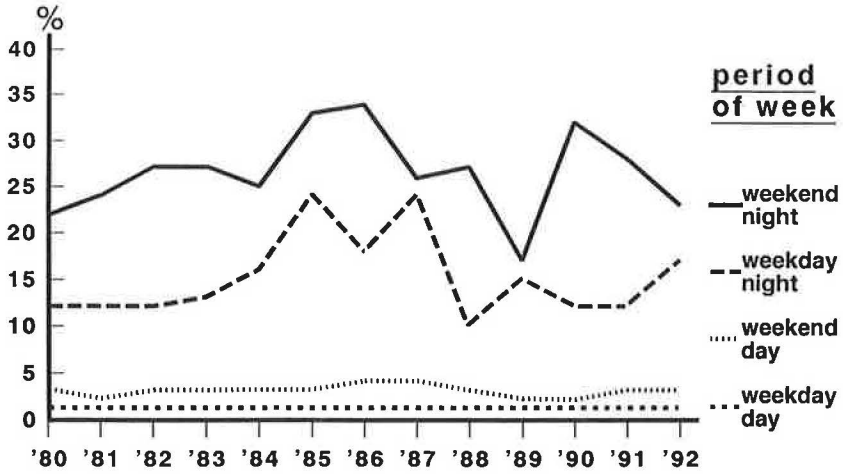

FIGURE 4 Percentage of cyclists in serious crashes with alcohol.

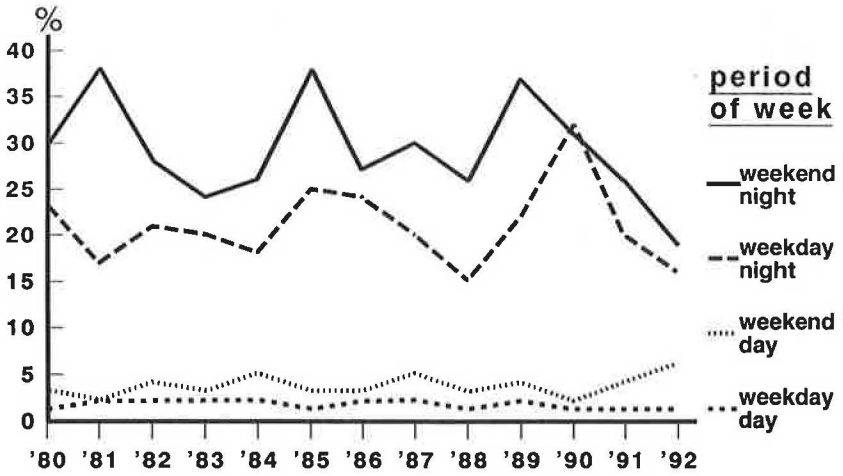

FIGURE 5 Percentage of pedestrians in serious crashes with alcohol.

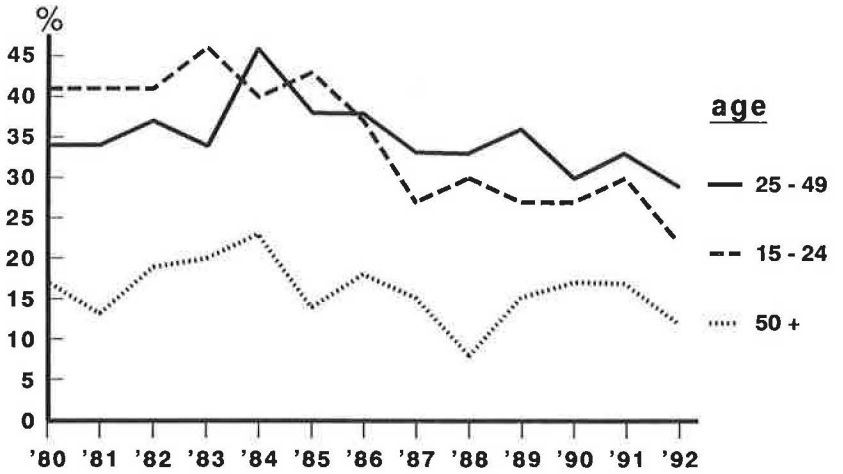

FIGURE 6 Percentage of car drivers in serious crashes with alcohol (weekend nights).

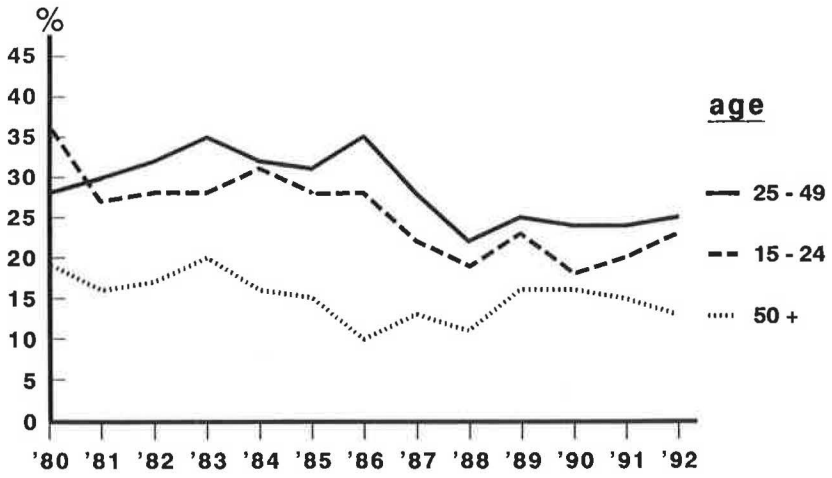

FIGURE 7 Percentage of car drivers in serious crashes with alcohol (weekday nights).

DISCUSSION

The decline in drinking and car driving started in the middle eighties. It has resulted in a decline in drinking (by car drivers involved in) serious crashes. Although the road side surveys are restricted to weekend nights, the accident statistics suggest a decline for all periods of the week. There is no sign of such a decline with pedal cyclists or pedestrians.

There are several points of confusion when comparing the results from different sources of information:

1. The road side surveys as shown in Figure 1 suggest a gradual decline, compared to an abrupt change in the percentage of car drivers in crashes with alcohol. It has to be remembered, however, that the exact time of at which the decline started cannot be determined from the road side surveys.
2. The surrogate measure (percentage of drivers in serious crashes at night) gives an indication of a decline for weekend nights only. The other measure (percentage of drivers in serious crashes with alcohol) shows a clear decline for weekends and weekdays. This difference may be explained by the lack of sensitivity of the surrogate measure.
3. According to the results of the road side surveys, the decline in drinking covers all age groups. However, the information from accident reports shows a more pronounced decline for drivers under 25 years during weekend nights. A likely explanation is given by the relation between age, drinking and risk of involvement in crashes. Drivers with a positive BAC have a higher crash risk than sober drivers. There is evidence that this relative risk is even higher for young drivers. This explains why the same change in drinking results in a greater change in crash involvement for young drivers.

With this more detailed analysis of the available information it is still difficult to explain what caused the decline in drinking and driving. The factors that may have contributed could be specific for drinking and driving or relate to drinking in general. Drinking in general has changed in the past, with a continuous rise until 1975. Since then, it levelled off. Figure 8 is based on sales figures. Population surveys suggest a decrease in the percentage of drinkers (in particular among women) and a decrease in the amount of alcohol for drinkers (in particular for men). The first of these surveys was held in 1986, to measure the effects of a series of intensive, nationwide campaigns against excessive drinking (WVC, 1992). This is not enough evidence to conclude that drinking in general started to change in 1986, let alone that this caused the decline in drinking and driving. At best, the change in drinking in general has been a favourable background for factors that are more specific for drinking and driving. Another reason to look for more specific factors is that drinking and driving declined for car drivers, but not for pedal cyclists and pedestrians.

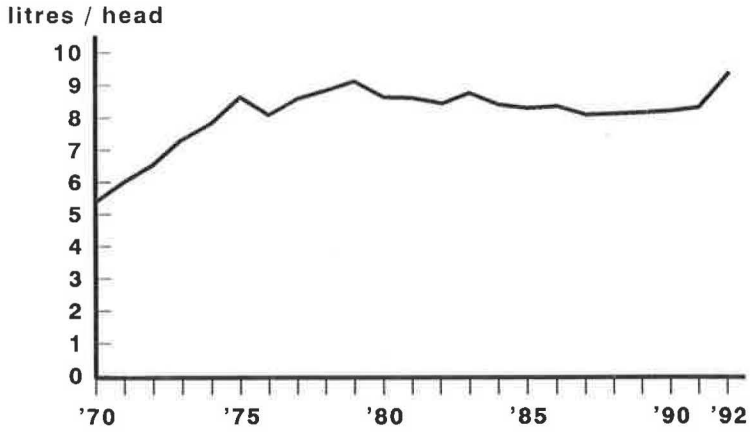

FIGURE 8 Alcohol consumption.

Publicity campaigns and police enforcement have been specific for drinking and driving. These publicity campaigns became more aggressive in 1984 and may have contributed to the decline in drinking and driving. However, the abrupt change in drivers in serious crashes with alcohol was some years later. Some improvements in police enforcement coincide more closely with the decline in drinking and driving. The most important improvements were:

- Gradual introduction of electronic screening equipment (to replace chemical test tubes) after 1984;
- Replacement of blood test by evidential breath test after 1987;
- Gradual transition from selective to random breath testing since 1985; and
- Change in enforcement strategy from large static teams to smaller, mobile ones since 1986.

Taking all the evidence together, it is likely that the decline in drinking and driving was caused by a combination of factors. In order of priority these are:

- Police enforcement;
- Publicity campaigns against drinking and driving;
- Publicity campaigns against drinking in general;
- Other factors, specific or general.

REFERENCES

Mathijssen, R. & Noordzij, P.C. (1993). The decline of DWI and of alcohol related accidents in the Netherlands, 1983-1991. In: Alcohol, drugs and traffic safety - T92. Verlag TÜV Rheinland, Cologne.

WVC (Ministerie van Welzijn, Volksgezondheid en Cultuur) (1992). Alcohol: toen en nu. Rijswijk.

DECLINE IN DRINKING AND DRIVING CRASHES, FATALITIES AND INJURIES IN THE UNITED STATES

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INTRODUCTION

Over the last decade, the number of deaths and injuries related to impaired driving has declined significantly in the United States as well as in other industrialized countries. For example, in 1982, 57 percent of all highway fatalities in the U.S. involved a driver with a measurable blood alcohol level. By 1992, this figure had decreased to less than 46 percent of fatalities. At the same time, the total number of traffic fatalities decreased from 43,945 in 1982 to 39,235 in 1992. An understanding of this significant social change can indicate how further decreases might be achieved. It can also serve as a model for understanding other social problems and how they might be ameliorated.

THE NATURE OF THE DECREASE

Total Fatalities and Alcohol-Related Fatalities

There are many different ways of measuring the incidence of impaired driving, each with inherent biases and inaccuracies. Most commonly used are a variety of measures of alcohol-related fatalities. The role of alcohol in fatal crashes is not reported consistently (especially when the driver is not killed in the crash), however, the U.S. National Highway Traffic Safety Administration has developed a method for estimating alcohol-involvement in all fatal crashes based on available information (Klein, 1986).

As indicated by Table 1, the total number of drivers involved in fatal crashes increased for the most part through the 1980s until 1989 when a steady decline began. By contrast, the proportion of drivers in fatal crashes with any measurable blood alcohol content (BAC) has declined fairly steadily throughout the period. While the number of fatalities resulting from crashes involving sober drivers has increased by over 15 percent, the number of fatalities from accidents involving drinking drivers has decreased by almost 30 percent. Figure 1 traces the trend over the last decade (using 1982 as the base year) for total fatalities resulting from crashes involving drivers at three BACs. Comparisons between the results of roadside surveys carried out in 1973 and 1986 indicated a 52 percent decrease in the percentage of drivers on the road with BACs of .10 percent and above (Lund and Wolf, 1991). Thus, decreases in alcohol-related fatalities seem to be consistent with apparent decreases in the incidence of alcohol-impaired driving. Unfortunately, more recent comparable roadside survey data are not available.

Pedestrian Fatalities

The proportion of fatally injured pedestrians who are impaired by alcohol has also decreased, though not to the same extent as that of drivers (See Figure 2). In 1982, 45 percent of fatally injured pedestrians over 16 years of age had BACs of .10 and above. In 1992, 38 percent were intoxicated. Thus, it would appear that whatever factors have contributed to the decrease in impaired driving deaths have also applied to some degree to pedestrians, although more strongly to drivers. It is worth noting that a significant proportion of fatally injured intoxicated pedestrians are killed by drivers who are themselves impaired by alcohol. Thus, reducing impaired driving also is likely to reduce the number of impaired pedestrian deaths.

Gender and Alcohol-Related Fatalities

Male involvement in fatalities per 100,000 drivers is three times that of females. Moreover, male drivers in fatal crashes are about twice as likely as females to be intoxicated (25 percent as compared to 13 percent). Female drivers have also shown a greater reduction in the proportion intoxicated (a reduction of 33 percent as compared to 24 percent for men) since 1982 (NHTSA, 1993). Female drivers' involvement in fatal crashes in general has increased. Analysis carried out by Popkin (1991), indicates that when crash involvement for young females is examined separately, alcohol-related deaths may actually be increasing.

TABLE 1 Drivers involved in fatal crashes by BAC: 1982-1992

YEAR	TOTAL	00	%	.01-.09	%	.10+	%	TOTAL ALCOHOL INVOLVED %
1982	56,029	34,250	61.1	4,987	8.9	16,793	30.0	38.9
1983	54,656	34,145	62.5	4,677	8.6	15,834	29.0	37.6
1984	57,512	36,831	64.0	4,952	8.6	15,729	27.3	35.9
1985	67,883	38,321	66.2	4,668	8.1	14,894	25.7	33.8
1986	60,225	39,633	65.8	5,140	8.5	15,560	25.8	34.3
1987	61,442	41,049	66.8	5,060	8.2	15,332	25.0	33.2
1988	62,253	41,813	67.2	4,957	8.0	15,483	24.9	32.9
1989	60,435	41,271	68.3	4,511	7.5	14,654	24.2	31.7
1990	58,893	39,978	67.9	4,378	7.4	14,537	24.7	32.1
1991	54,391	37,500	68.9	3,913	7.2	12,978	23.9	31.1
1992	51,881	37,047	71.4	3,476	6.7	11,358	21.9	28.6

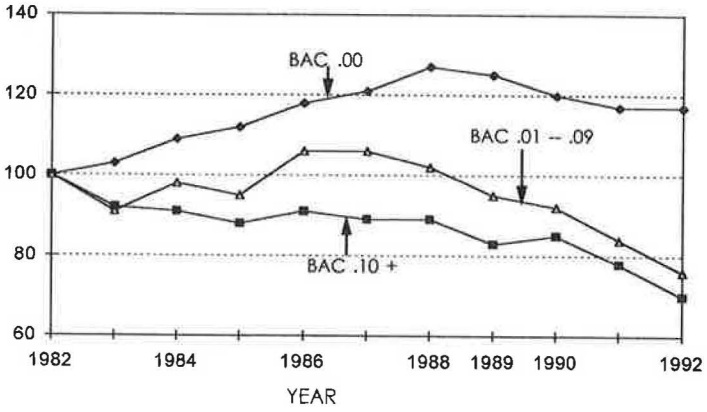

FIGURE 1 Trends in alcohol related fatalities.

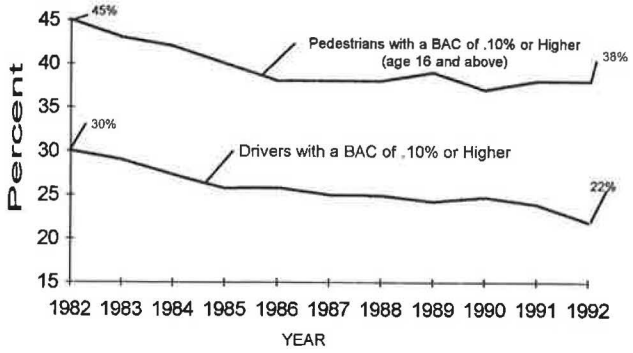

FIGURE 2 Drivers and pedestrians in fatal crashes with a BAC of .10% or higher.

Age and Alcohol-Related Fatalities

While drivers of all age groups showed a decrease in intoxication rates from 1982 to 1992, the largest decreases occurred in the youngest and oldest age groups. Drivers 65 and older showed a 39 percent decrease while drivers

16 to 20 years old showed a decrease of 44 percent (See Figure 3). Young drivers have decreased their involvement in total fatal crashes by 19 percent while older drivers have increased their involvement in total fatal crashes by 40 percent.

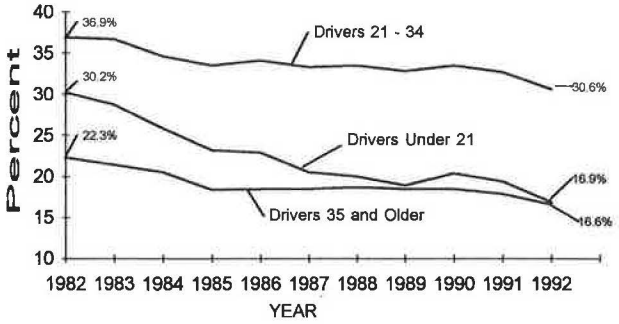

FIGURE 3 Drivers in fatal crashes with a BAC of .10% or higher by age.

POSSIBLE EXPLANATIONS

The difference between the trend for non-alcohol-related as compared to alcohol-related fatalities suggests that it is alcohol programs rather than highway or motor vehicle improvements that are responsible for the decrease in fatalities. Considerable caution must be exercised, however, in interpreting these trends. In 1992 the U.S. recorded its lowest level of accidental deaths from all causes since 1922 (National Safety Council, 1993). Traumatic injury fell from third to fourth in the list of major causes of death in the U.S. in this last year. It is clear that there is a nation-wide trend of reduced accident losses of which highway fatalities are only one part.

It will require careful analysis to tease out all the factors contributing to this national trend. Among the major factors requiring analysis are trends in alcohol consumption, miles driven, and economic conditions. These factors need consideration as part of the analysis of the impact of specific safety legislation and alcohol programs. Figure 4 presents trend information on the two key elements of the drinking-driving problem: alcohol consumption and the amount of driving. Between 1982 and 1992, the number of licensed drivers increased by 14 percent and the number of registered vehicles increased by 17 percent resulting in the steady increase in the number of vehicle miles driven show in Figure 4. This increase in driving exposure would be expected to increase the number of fatalities throughout the decade. As can be seen in Figure 1, however, while .00 BAC fatalities followed this trend through 1988, since that time there has been a drop in fatalities despite increasing vehicle miles. From 1988 to 1992, total fatalities decreased 17 percent while vehicle mileage increased 10 percent.

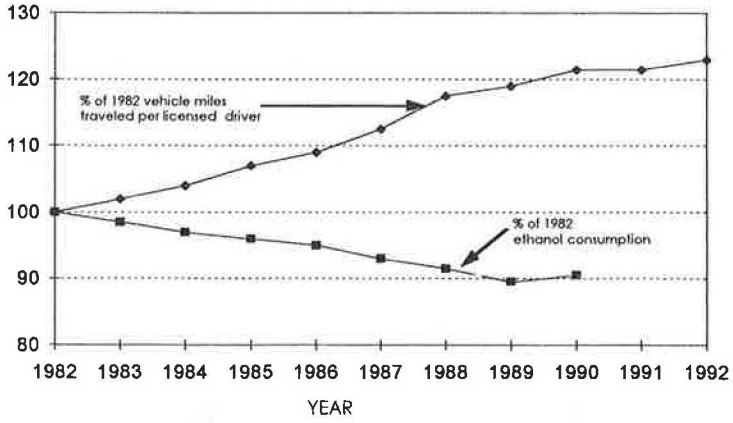

FIGURE 4 Trends in U.S. per capita ethanol consumption.

From 1982 to 1989, per capita alcohol consumption declined. In 1990, the last year for which figures are available, alcohol consumption increased. Despite this increase, the downward trend in alcohol-related fatalities was

accelerated between 1990 and 1992. It is possible that the longer term trend to reduced consumption played a role in the reduction in alcohol-related fatalities, but it can not explain the recent acceleration in this trend.

The nation's economy is generally believed to affect highway fatalities: Good economic conditions are associated with increased driving and drinking and therefore with increased alcohol-related fatalities. Through most of the decade, the economy (as indicated by the unemployment rate) was improving following the recession of 1982-83. This is consistent with the increases in vehicle mileage and fatalities. The slow-down in the economy from 1990 to 1992 may have contributed to the reduction in total fatalities from 1989 to 1992. It has been suggested that while per capita alcohol consumption may not be greatly affected by a recession, more people may drink at home rather than going out, thereby reducing impaired driving.

In general, neither the amount of change in drinking or in driving per se, nor the fluctuating economic conditions appear to account for the very large (30 percent) reduction observed in alcohol-related fatalities over the last decade. Safety improvements in vehicles and roadways have apparently reduced the risk per mile driven, as evidenced by a decline in the deaths per hundred million vehicle miles from 2.8 in 1982 to 1.8 in 1992. The greater decline, however, in alcohol-related fatalities cannot be explained on the basis of such improvements. One factor that may have provided a differential benefit for drinking drivers is safety belt use and passive restraints. Safety belt use by drivers involved in fatal crashes increased from 4 percent to 46 percent between 1982 and 1991. While the greatest part of this increase occurred from 1985 to 1990, before the recent rapid drop in alcohol related fatalities, it is possible that the proportionate rise for drinking drivers who have been shown to have lower belt use rates has been greater than for the non-drinkers who adopted the belt use habit earlier.

To what can decreases in alcohol-related fatalities be attributed? Clearly, as the problem of impaired driving is complex, the progress made is most likely the result of complex and interconnected factors in society. What proportion of change is attributable to any given factor is impossible to determine. Moreover, the various factors are not independent of each other. For example, changes in societal attitudes and changes in enforcement practices might both be named as possible factors in the decrease of drinking and driving. These factors interact and amplify each other.

Four types of factors that may have played a role in the reduction will be discussed below. First are deterrence strategies, primarily related to traffic safety policies and legislation. Second is the raising of the drinking age to 21. Both of these factors have had measurable effects on alcohol-related fatalities. The third factor is changes in alcohol consumption and the fourth is increased public awareness and activism. These last two factors are more difficult to relate directly to rates of impaired driving but they have logical connection to impaired driving.

Detection, Deterrence and Consequences

Most of the impaired driving countermeasures that have been used effectively in the past have involved enforcement of impaired driving laws and punishment of offenders. It is important to note that it is not catching and punishing offenders per se that has the greatest effect on impaired driving rates but rather the public perception of the likelihood of apprehension and punishment that leads to deterrence.

More Vigorous and Effective Enforcement has been cited as one factor in the decrease in impaired driving fatalities. The number of impaired driving arrests peaked in 1983 (Federal Bureau of Investigation, 1984-1989). The public perception of the likelihood of arrest, however, may continue to deter impaired drivers. Sobriety checkpoints are one effective method of increasing deterrence. A recent study by Ross (1992a) indicated that communities that used sobriety checkpoints experienced significant decreases in alcohol-related traffic crashes. Whether or not the use of sobriety checkpoints has increased enough in recent years to account for part of the overall reduction in impaired driving fatalities is not known. They are, however, indicative of the increase in vigor and conspicuousness of enforcement efforts in the 1980s.

Administrative license revocation (immediate loss of license following arrest) has been shown to be effective in discouraging the public from driving after drinking. In one study, carried out for the Insurance Institute for Highway Safety (Zador et al., 1988) the number of traffic crashes in states with administrative revocation laws were compared to those in states without such laws. The study concluded that these laws reduced fatal nighttime crashes (which are likely to involve alcohol) by about nine percent. These findings were supported by another study of 17 states with administrative revocation laws (Klein, 1989) which found an average reduction in fatal crashes of seven percent. In a recent study carried out for the AAA Foundation in Minnesota, New Mexico, and Delaware, administrative revocation was found to reduce both nighttime fatal crashes and the proportion of drivers involved in fatal crashes

with a significant amount of alcohol in their blood (Ross, 1991). Administrative license revocation has also been found to be effective in reducing recidivism among offenders (Stewart et al., 1989).

Thirty-three states (and the District of Columbia) now have administrative revocation. Most of these states imposed the penalty at least five years ago. It is likely that some of the decrease in impaired driving fatalities can be attributed to the increasing use of administrative revocation and the increased public awareness and attention to impaired driving that accompanied the legal change.

Reductions in the legal BAC limit have not been widely applied in the United States. Currently ten states have reduced the BAC limit from .10, which is standard in most states, to .08. This change occurred within the last year in most of these states. Evaluation of the effects of decreasing the legal limit to .08 in California found a 12 percent reduction in alcohol-related fatalities statewide. This change in the law occurred along with the implementation of administrative license revocation, thus it is not possible to disentangle the effects due to each of these changes -- both of which have been shown in other research to have a general deterrence effect (NHTSA, 1991). It is unlikely that these relatively recent changes have made a substantial contribution to decreases in alcohol-related fatalities, but they have potential to contribute to further decreases.

Increasing the drinking age to 21

The increase in the drinking age to 21 has repeatedly been shown to have reduced alcohol-related traffic fatalities as well as other alcohol-related injuries and health and social problems among young people. In the early 1980s, overwhelming evidence emerged that lowering the drinking age had resulted in a sharp increase in alcohol-related traffic fatalities among youth (Douglas, et al., 1974). Pressure was therefore applied to states by the Federal government through control of highway funds, and the drinking age was raised to 21 in all 50 states and the District of Columbia (Sweedler, 1991). The National Highway Traffic Safety Administration estimates that more than 13,000 lives have been saved since 1975 because of the increase in drinking age (NHTSA, 1993). In 1982, 30 percent of drivers under 21 years of age involved in fatal crashes had a BAC of .10 percent or higher. By 1992, that figure had dropped to 17 percent -- a 43 percent decrease. Certainly this policy change has contributed to some of the overall decrease in alcohol-related fatalities. Figure 3 compares decreases in the proportion of intoxicated drivers involved in fatal crashes among different age groups. The most precipitous decline has been in the 16 to 20 year age group.

Thirteen states have recognized that young drivers are particularly vulnerable to impairment at low BACs and that drinking under the age of 21 is illegal. Thus, they have established lower BAC limits for young drivers -- usually .02 percent. Evaluations of these laws indicate that they have significantly reduced alcohol-related traffic deaths in the affected age groups. Hingson found a 42 percent decrease in fatalities for teenagers in states with the lower limits while fatalities in comparison states declined 29 percent (Hingson, 1992). Campaigns to promote public awareness were found to be important in maximizing the effectiveness of the laws. In Maryland, a change in the law coupled with a vigorous public awareness campaign resulted in a 50 percent decrease in alcohol-related fatalities among the affected age group (Blomberg, 1992). At this point, these laws may not be widely enough applied to have influenced fatality rates nationwide, however, their potential to contribute to further reductions is clear.

Levels of Alcohol Consumption

Overall alcohol consumption is only a rough indicator of consumption patterns among drivers. For example, it would be possible for overall consumption to remain the same and for no one to drive while impaired, as long as the patterns of consumption were altered appropriately. Research has indicated, however, that reductions in overall levels of consumption do result in decreases in a variety of alcohol-related problems (Moore and Gerstein, 1981). As discussed above, the per capita consumption of alcoholic beverages has decreased somewhat in the last decade. Surveys carried out for the National institute on Drug Abuse also indicate that adults report using alcohol less frequently (NIDA, 1990). The reasons for these change are probably complex and their impact on impaired driving unknown. The increased emphasis in recent years on health and fitness may play a role both in the way people drink and in their likelihood of drinking and driving. Demographic shifts, economic conditions and changes in lifestyle could all contribute to decreased consumption. Concerns about impaired driving could even be a factor in that decrease.

Increased Public Awareness and Activism

The most obvious social change that occurred in the 1980s that would appear to have led to decreases in alcohol-related traffic fatalities was the unprecedented increase in activism and the resulting increase in public awareness and change in public attitudes. It is impossible to directly evaluate the contribution of these changes to the decrease in fatalities, however, the apparent social and legal changes were dramatic. Victims' groups focused attention on the human costs of impaired driving and worked to change public attitudes so that impaired driving was viewed as unacceptable criminal behavior. The number of citizen activist groups addressing impaired driving -- primarily Mothers Against Drunk Driving (MADD) and Remove Intoxicated Drivers (RID) chapters -- grew rapidly in the 1980s. Along with the increase in citizen activism came increases in media attention to the issue of impaired driving and rapid proliferation of legislation regarding impaired driving. This legislation resulted in increased vigor of enforcement and prosecution as well as more severe penalties (Evans, 1991).

FACTORS THAT CAN CONTRIBUTE TO FURTHER REDUCTIONS IN FATALITIES

The reductions in alcohol-related traffic fatalities that have been achieved in the last decade have prevented great suffering and have demonstrated the power of social and policy change to address social problems. The problem of impaired driving is still immense and many thousands of Americans die or are seriously injured in traffic crashes in which alcohol plays a part. If further progress is to be made, the effective strategies described above must be applied even more vigorously. Additional efforts must be made in other areas that have received less attention. These include changes in the social environment regarding alcohol and changes in the transportation environment.

Changes in the Social Environment Regarding Alcohol

Changes in the ways in which alcohol is used can reduce alcohol-related traffic injuries. Of course, alcohol is also involved in many thousands of other types of intentional and unintentional injuries as well as other health and social problems. Society controls the way that alcohol is promoted and sold, and to a large extent, the way it is consumed. Recently, ways of improving this control have received increased attention. Alcohol advertising and promotion, in particular, have been the target of criticism. While changes in the social environment with regard to marketing of alcohol have promise, they have not been well researched regarding their potential for saving lives. Other environmental changes have been demonstrated to have the potential to decrease alcohol-related problems. These include pricing and availability, especially availability to youth. To a lesser extent, there is evidence that improving the way alcohol is served can decrease drinking to intoxication in commercial establishments.

Pricing of alcoholic beverages has been shown to influence consumption and consequent alcohol-related problems, including alcohol-related injuries. This effect is particularly strong for young drinkers. The most efficient means of increasing the price of alcohol is taxation. Saffer and Grossman (1987) found that increases in taxes on beer reduced motor vehicle fatality rates for youth ages 15 to 24. They estimated that if the Federal excise tax on beer had been indexed to inflation since 1951, there would have been a 15 percent decrease in the number of 18- to 20-year-olds killed in traffic crashes. If the alcohol content in beer had been taxed at the same rate as the alcohol in distilled spirits, the number of fatalities in this age group would have been reduced by 21 percent. If these two strategies were combined, a 54 percent reduction in fatalities could be achieved. These estimates may be optimistic. However, even if they are wrong by a factor of two or three, significant reductions in morbidity and mortality could be realized through increased alcohol taxation. The alcoholic beverage industry has strongly opposed significant tax increases. In California, despite the success of a 25-cent-per-pack tax on cigarettes in reducing smoking and providing funds for prevention (University of California, 1991), a massive publicity campaign by the alcohol industry led to the defeat of a referendum to impose a nickel-per-drink tax on alcoholic beverages.

Availability of alcohol has also been shown to affect consumption and consequent problems. Availability can be controlled in part by the density of sales outlets. There is considerable evidence that restrictions on outlet growth can result in reductions in alcohol consumption and problems in the general population. Early studies suggesting that outlet densities were related to consumption levels (Colon et al., 1987) have been supported by recent econometric studies measuring the extent to which formal laws are related to density reduction (Gruenewald et al., 1991a) and the degree to which these density reductions are related to consumption rates (Gruenewald et al., 1991b). Outlet

densities have also been directly related to reductions in a variety of alcohol problems including traffic crashes (Rush et al., 1986; Glicksman and Rush, 1986). These studies suggest not only that reductions in outlet densities may result in reductions in alcohol use and problems, but that the effects of reducing outlet densities may be more pronounced than a comparable proportionate increase in beverage taxes (Gruenewald et al., 1991b).

Responsible beverage service has received attention in recent years as a way of preventing impaired driving. Between one-third and one-half of all drivers killed in traffic crashes are served in a bar or restaurant prior to their fatal crashes. In addition, 90 percent of drivers fatally injured in alcohol related crashes have a blood alcohol content of .12 percent. This level indicates that the drivers were served at least one drink *after* they were already legally intoxicated (McKnight, 1991). These figures emphasize the importance of educating servers and owners to adopt service policies that would decrease the probability of impaired customers driving away from their establishments. Economic incentives for owners to adopt training programs include liability protection, meeting legal requirements, and insurance cost benefits.

Since server training programs began in the mid-1980s, several studies have indicated some effectiveness (e.g., Russ and Geller, 1987). Effectiveness was found to be greatest when combined with increased enforcement and threat of punishment (McKnight, 1991).

Availability of alcohol to people under 21 continues to be a problem. Surveys of high school seniors indicate that 89.5 percent of seniors have drunk alcohol at least once, and 32.2 percent have drunk five or more drinks in the last two weeks -- more than enough to seriously impair their driving ability (Johnston et al., 1991). A recent report by the Office of Inspector General of the Department of Health and Human Services (1991) points out the poor design of much drinking age legislation and the lack of serious enforcement of the laws. More well-designed laws and more vigorous enforcement can further reduce the number of young people involved in impaired driving crashes as well as reduce other negative effects of alcohol consumption.

Changes in the Transportation Environment

The characteristics of the transportation environment can affect the degree to which overindulgence in alcohol results in traffic crashes (Ross, 1992b). Americans depend on private automobiles, making us more likely to drive after drinking. Approaches have been tried based on providing alternative means of transportation. Efforts have also been made to improve the safety of roads so that crashes are avoided or minimized. The safety of the vehicle itself is critical once a crash has already occurred.

Alternative Transportation programs include the provision of "safe rides" through volunteers or taxi service or the use of designated drivers, either in formal programs or informal arrangements among drinking companions. A major drawback to these programs is that they may be seen to encourage or condone drinking to excess. No research evidence is yet available about the traffic safety impact of these programs and they have been criticized because their promotion by the beverage industry and others deflects attention from proven effective strategies (De Jong and Wallack, in press).

Further Improvements in roadway and vehicle safety are another way of decreasing alcohol-related traffic injuries. Unsafe driving will always occur and in many cases it will involve alcohol. Thus, reducing the hazards on roadways and improving the crashworthiness of vehicles can make a life-or-death difference when prevention and deterrence efforts have failed.

Mandatory seat belt use laws have been shown to decrease traffic fatalities by between five and 15 percent (Lund et al., 1987; Skinner and Hoxie,, 1988). This percentage is lower than might be hoped because the vehicle occupants who are most likely to be involved in crashes, including impaired drivers, are least likely to wear safety belts (Williams and Lund, 1988). Because of the low safety belt use rate by those drivers most likely to crash, the importance of passive restraints, in particular, air bags, is even greater. The Insurance Institute for Highway Safety reported in 1991 that driver deaths in frontal crashes were 28 percent lower in air bag-equipped cars and moderate to severe injury was 25 to 29 percent lower. Even when drivers were wearing seat belts, fatalities were reduced 15 percent by the air bags (IIHS, 1991).

IMPLICATIONS FOR OTHER SOCIAL PROBLEMS

Some lessons about the reduction of other social problems can be learned from our experience in impaired driving. First, it is important to acknowledge that social problems, including impaired driving, are complex and influenced by

many inter-related factors. Interpretation of changes will be difficult and simple causal attributions will be impossible. Factors that lead to change interact in complicated ways and may amplify each other or cancel each other. Despite this complexity, our experience with impaired driving as a social issue appears to have some discernable patterns. First is the role of citizen activism. In the case of impaired driving, victims groups appear to have been the precipitating factor in the increased attention and concern focussed on impaired driving. Government began to play a role in changing laws and providing resources and incentives after the consciousness of society as a whole has been raised and there was a public demand for change. This pattern may be analogous to what is occurring in social attitudes towards smoking. The Surgeon General's report may have brought about initial attention to smoking as a health and social issue. It was citizen demands, however, for smoke-free environments and individual concerns about personal health that appear to have led to changes in attitudes and behavior. Government regulation and participation has lagged behind citizen concerns.

On the whole, it appears that a partnership of citizens and government was effective in reducing impaired driving. Citizen outrage and concern led to changes in policies and laws, which together led to changes in attitudes and behavior in the general public.

The progress we have witnessed in impaired driving in the last decade is not necessarily permanent, however. If public concern shifts to other issues, if laws and policies are weakened or are unenforced, we may see progress eroded. The celebration of successes should not be the occasion for complacency. Rather, the evidence of the effectiveness of our efforts should motivate us to continue them with renewed energy and purpose.

REFERENCES

Blomberg, R. "Lower BAC Limits For Youth: Evaluation of the Maryland 0.02 Law." NHTSA, USDOT, 1992.

Colon, I., Cutter, H. S. G., and Jones, W. C. Prediction of alcoholism from alcohol availability, alcohol consumption and demographic data. *Journal of Studies on Alcohol*, 43, 1199-1213, 1987.

DeJong, W. and Wallack, L. The role of designated driver programs in the prevention of alcohol-impaired driving: a critical reassessment. *Health Education Quarterly*, 1992.

Douglas, R., Filkens, L., and Clark, F. *The Effect of Lower Legal Drinking Ages on Youth Crash Involvement*, NHTSA, Report No. SR 1 AL 74 1, 1974.

Evans, L. *Traffic Safety and the Driver,* Van Nostrand Reinhold, 1991.

Federal Bureau of Investigation, U.S. Department of Justice, *Uniform Crime Reports for the United States.* Washington, D.C., U.S. Government Printing Office, 1984-1989.

Gliksman, L. and Rush, B. R. Alcohol availability, alcohol consumption and alcohol related damage: II. The role of sociodemographic factors. *Journal of Studies on Alcohol*, 47, 11-18, 1986.

Gruenewald, P., Madden, P., and Janes, K. *Alcohol Availability and the Formal Power and Resources of State Alcohol Beverage Control Agencies*. Berkeley, CA: Prevention Research Center, Pacific Institute for Research and Evaluation, 1991a.

Gruenewald, P. J., Ponicki, W., and Holder, H. D. *The Dynamic Relationship of Outlet Density to Alcohol Consumption: A Time Series Cross-Sectional Analysis*. Berkeley, CA: Prevention Research Center, Pacific Institute for Research and Evaluation, 1991b.

Hingson, R. Effects of lower BAC levels on teenage crash involvement, Paper presented at the 71st Annual Meeting of the Transportation Research Board, 1992.

Insurance Institute for Highway Safety, *Status Report*, Vol. 26, No. 10, 1991 .

Johnston, L., O'Malley, P., and Bachman, J. *Drug Use Among American High School Seniors, College Students and Young Adults*, 1975-1990, U.S. Department of Health and Human Services, Rockville, Maryland, 1991.

Klein, T. Changes in Alcohol-Involved Fatal Crashes Associated with Tougher State Alcohol Legislation, National Highway Traffic Safety Administration, July, 1989.

Klein, T. A Method of Estimating Posterior BAC Distributions for Persons Involved in Fatal Traffic Accidents, Sigmastat, Report to NHTSA, 1986.

Lund, A., Zador, P., and Pollner, J. Motor vehicle occupant fatalities in four states with seat belt use laws. In *Restraint Technologies: Front Seat Occupant Protection*. Warendale, Penn, Society of Automotive Engineers, 1987.

McKnight, J. Enforcement and Server Intervention. Paper presented at the Impaired Driving Initiative Expert Panel Meeting, Office for Substance Abuse Prevention, U.S. Department of Health and Human Services, Arlington, Virginia, 1991

Moore, M. and Gerstein, D. (eds.), *Alcohol and Public Policy: Beyond the Shadow of Prohibition*. Washington, D.C.: National Academy Press, 1981.

NHTSA, Traffic Safety Facts 1992. USDOT, 1993.

NHTSA, *Fatal Accident Reporting System 1989: A Decade of Progress*. USDOT, 1991.

NHTSA, Examine the effects of a legal change of the blood alcohol concentration level in California from 0.10% to 0.08%, DOT HS 807 777, 1991.

National Institute on Drug Abuse, *National Household Survey on Drug Use*. Rockville, MD, U.S. Department of Health and Human Services, 1990.

National Safety Council, *President's Quarterly*, Itasca, Il, 1993.

Office of Inspector General, DHHS. *Youth and Alcohol: Laws and Enforcement -- Is the 21-Year-Old Drinking Age a Myth?* 1991.

Popkin, C.L., Drinking and driving by young females, *Accident Analysis and Prevention*, 23:1, 37-44, 1991.

Ross, H. Effectiveness of sobriety checkpoints as an impaired driving deterrent. Paper presented at the 71st Annual Meeting of the Transportation Research Board, 1992a.

Ross, H. *Confronting Drunk Driving: Social Policy for Saving Lives*, Yale University Press, New Haven, 1992b.

Ross H. Administrative License Revocation for Drunk Drivers: Options and Choices in Three States, AAA Foundation for Traffic Safety, Washington, D.C., 1991.

Rush, D., Glicksman, L., and Brook, R. Alcohol availability, alcohol consumption and alcohol related damage. I. The distribution of consumption model. *Journal of Studies on Alcohol*, 47, 1-10, 1986.

Russ, N., and Geller, E. Training bar personnel to prevent drunken driving: A field evaluation, American Journal of Public Health 77:952-954, 1987.

Saffer, H., and Grossman, M. Beer taxes, the legal drinking age, and youth motor vehicle fatalities. *Journal of Legal Studies* 16:351-374. 1987.

Skinner, D., and Hoxie, P. Effects of Seatbelt Laws on Highway Fatalities: Update -- April 1988. Technical Report, Washington, DC, NHTSA, 1988.

Stewart, K., Gruenewald, P., and Roth, T., An Evaluation of Administrative Per Se Laws, Pacific Institute for Research and Evaluation, 1989.

Sweedler, B. Strategies to reduce youth drinking and driving, *Alcohol, Health and Research World*, Vol. 14, No. 1, 1990.

University of California, San Diego, *Tobacco Use in California 1990*, California Department of Health Services, 1991.

Williams, A., and Lund, A. Mandatory seat-belt use laws and occupant crash protection in the United States. In J. Graham, ed., *Preventing Automobile Injury: New Findings from Evaluation Research*. Dover, Mass, Auburn House, 1988.

Zador, P., Lund, A., Fields, M., and Weinberg, K., Fatal crash involvement and laws against alcohol-impaired driving, *Journal of Public Health Policy* 10: 467-485, 1989.

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DECLINE IN DRINKING AND DRIVING IN SWEDEN

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INTRODUCTION

I am very impressed with all the previous presentations, dealing with the decline in alcohol crashes. I wish that I could present similar declines as everyone else has done. Unfortunately, I can only do so in some respects. Fatalities in Sweden have come down from 1,100 in 1975 to 759 in 1992. Today, it would seem that we have almost reached our goals. Unfortunately, this is most likely due to the recession in the economy, leading to fewer new young drivers and fewer miles, etc.

Sweden has a very high level of road safety in an international comparison. We are at the very top but still not satisfied, of course. The government has set the road safety goals for the year 2000 - the number of fatalities and injuries on the road should decrease by 20% in comparison with the 1988 level. This is a very tough task when you are already very good and have applied most of the readily available and acceptable measures. The same thing applies to alcohol related crashes, Sweden has been very successful over the years. This is recognized by almost everyone but I do not know anyone who knows exactly how successful - not even I and this is a problem when you are asked to describe the situation to an international audience.

ALCOHOL LEVELS IN ROADBLOCKS AND ACCIDENTS

The only close to real figure as to how frequently drunken driving occurs on our roads dates back to 1975, when there was a random study done all over Sweden. It was found that 0.12 % of the drivers were above the legal limit, which at the time was .05 %. This means that slightly more than one driver out of a thousand was legally drunk.

It has been impossible to get police cooperation to carry out a random roadside survey again. These operations are very costly, especially when you know that you will have to stop 1,000 cars to find one drunken driver.

I could, of course, present the official statistics about drinking and driving here and now, but I choose not to because of the poor quality of the official statistics. The official figures indicate that approximately. 9% of the drivers who are fatally injured are positive for alcohol. We know that this figure grossly underestimates the problem. For the years 1989-92, the proportion of fatally injured car drivers, who were positive for alcohol, was as high as 29%. This is why I choose not to present the official statistics. It is even worst with the injury accidents, because in these accidents the statistics are based on police suspicion and when possible measurements by the police on site. But often the police never see the involved parties because they have already been taken to hospital. Sometimes the ambulance people or the doctors at the hospital report to the police that they suspect that a driver has been drinking but usually they do not. Some years ago, a study found that as little as approximately 50% of the real drunk driving cases involved in injury accidents were known to the police. Over the years there have been changes in the reporting system as well. The process of reporting the use of police resources and the emphasis on drunk driving has varied over time and therefore the figures presented by the police are notoriously unreliable. The statistics therefore reflects not only the real problem but also variations in enforcement. I suspect that the situation might not be altogether different in other countries.

Actually, not even the fatality figures describe the situation 100% accurately. Some drivers survived the accident for a few hours and since the blood or other fluid sampling is made during the autopsy, alcohol metabolism could have reduced their BAC's. They may even have been given blood transfusions. This, of course, means that not even the figure of 29% positive for alcohol is true - it may be somewhat higher.

But to continue with the fatalities - since all victims are autopsied and a central laboratory makes all the analyses we can get results from more than 90% of all victims. Our findings also show that 51% of the drivers in fatal single vehicle accidents were positive for alcohol. As for the sex of the driver, we can draw the same conclusion as everyone else. It is a male problem - 31% of the male drivers and 13% of the female drivers were positive. If we look at age, we find that the greatest proportion of alcohol positive drivers is found between 20 and 24 years of age.

The distribution of BAC's indicates that these drivers have been drinking a lot. A few are found at .01% but the majority is found above .15%. The median BAC is .17%. This means that they have been drinking very often and great amounts and many have also been driving under the influence before. This can be seen from the fact that

a much greater proportion of the drivers who had been drinking than among those who were sober, had lost their licenses before. Thus, we are dealing with a hard core group here. This has consequences for the selection of measures to curb drunk driving. Knowing that we are dealing with the hard core means that we cannot expect a great impact from lowering a low legal BAC limit to a very, very low limit. Therefore, the fact that we cannot see an increase in the number of drivers found positive although the police has stepped up their drunk driving enforcement quite considerably, is very encouraging.

Now, let us look back at what has happened during the last four years with the proportion of drivers who were alcohol positive in fatal accidents. 31% in 1989, 29.7% in 1990 and 29.9% in 1991 have come down to 23.9% in 1992. We do hope that we are seeing a break in the trend. In 1990, the legal limit was lowered from .05 to .02 %. During 1989 the year that preceded the change, 31% were positive and when 1991 and 92 are combined we find 27% to be positive.

We can also note a slight decline in the mean BrAC in roadblocks. From early 1991 until August of 1993 the mean BrAC has gone from .1 to .09%

In roadblocks, the police seldomly find more that approximately .04 percent of the drivers above the legal limit, even if they are stopping drivers on Friday night. But we also have extreme cases, e.g. in a ski resort where, a couple of years ago, 10% of the drivers were above the legal limit. However, through systematic enforcement, knowing where and when to hit, and by being very visible and also by announcing their activities, the incidence of drunk driving in these areas has been pushed down to .3%. A rather impressive improvement.

We have also studied the attitudes towards issues concerning drunk driving, for a number of years. As an example, we have asked about their views on a zero legal limit. In 1989, there was a lot of discussion about the issue in the media. This is reflected in that people were rather in favor of a zero limit. Then nothing happened for a couple of years. Now again this year we see the acceptance of a zero limit rising.

CONCLUSIONS

We are, of course, not satisfied when we find a 24% alcohol involvement in our fatalities. Therefore, we must find a means of doing something about it. Alcohol, drugs and road safety has been designated as one of eight areas which will be given priority until the 2000. We will try very hard to get better. we may not have lowered our figures on alcohol involvement in road accidents the way other countries have. I think one of the reasons for this may be what Herb Simpson mentioned earlier, namely the low starting point - the lower the figures, the harder to lower them further. Maybe, our ultimate measure will have to be the introduction of a additive to alcohol which will paralyze the right foot.

ALCOHOL AND DRIVING IN FRANCE: WHY WE HAVE SEEN CHANGES AND WHAT IS NEXT?

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INTRODUCTION

This material, while not presented at the conference, is an update of two papers presented at the International Conference on Alcohol, Drugs and Traffic Safety, T-92, in Cologne, Germany in October, 1992. The papers review the drinking and driving situation in France. They are:

1. Drinking and driving in France during the years 1983-91: changes in legal framework and analysis in road users' behavior (M. B. Biecheler, C. Filou); and
2. Drinking and driving law enforcement in a wine-producing country: a multi-criteria process from 1960 to 1990 (M. Ch. Jayet)

These studies present different types of changes in the drinking and driving issue in the early 1990s (behavior, risk, repression, habits and economy) after two decades of steadily reinforced legal policy (legal BAC limit, random testing and the use of breath alcohol testing, more severe punishment).

THE NATIONAL CHANGES

Drinking and driving in France during the years 1983-91: changes in legal framework and analysis in road users' behavior

1. Specific changes in drinking and driving behavior: stability of % over the legal limit and decline of legal and illegal alcohol use among young drivers (<25 years).
2. Overall decline of injury accidents without any specific decrease of well-known alcohol-related accident categories (single vehicle, night, week-end, young drivers).
3. No specific effect of drinking and driving law enforcement on the decrease of injury accidents.

Drinking and driving law enforcement in a wine-producing country: a multi-criteria process from 1960 to 1990

1. Economic and cultural weight of the wine production stake on the modes of developing drinking and driving legal policy enforcement (1970-90).
2. Heavy increase of the implementation of drinking and driving repression (detection, convictions, type of sentence) by the middle of the eighties (1986-90).
3. Trends of repression and fatal accident evolution are not parallel (increased rise of punishment scores and low decline of fatal accident numbers by 1986-90).
4. Steady decline of alcohol consumption in national population and specific changes in drinking habits (type of beverage, consumption time and amount) linked to the deep mutations having affected generally French life-styles from 1970 to 1990 (urban living, tertiary activities, women at work, aesthetic and dietetic standards).

The trends and changes observed in both studies indicate an on-going phenomenon of diversified social evolution which produces an overall regulating effect on drinking and driving, especially among young population. This evolution is the matter of a long term social process involving a multiplicity of active sectors (political, social, economic) as much as a legal control of drinking and driving growing tighter and tighter.

WHAT IS NEXT ?

No direct statistical relation could be clearly set out between behavior, risk and legal control on the basis of the criteria independently examined to study drinking and driving. However, the changes observed outline an underlying

complex *system* of preventive working process. Moreover, some environmental *criteria* (travel modes, drinking modes) and some specific sociodemographic *categories* (age, sex and occupation) are particularly brought out by the social changes. (the young generation (< 25 yrs) shifts to less alcohol consumption and less drinking and driving while working and maturity time-life combined with urban life for male (25-40 yrs) go with more circumstantial alcohol consumption (invitation, restaurant) and drinking and driving). Thus, future monitoring of drinking and driving situation implies to take into account the previous results carried out.

Systems approach, new criteria and in-depth categories give research directions to put forward the knowledge about drinking and driving preventive work and assessment. That assumes an in-depth modelling purpose based on a systems approach. Insofar as the alcohol related accident patterns are well-known (single vehicle, night, week-end, young drivers), and the travel and alcohol intake patterns actually well-known too, this set of patterns introduce an approach of interactive relationships between risk, mobility and alcohol habits. It would consist of developing a transversal analysis by the means of an investigation of each area based on common descriptive categories. Besides, some other rule violations such as speed as well as other licit drugs could positively be associated with this approach, knowing that reducing road traffic risk is not only a matter of reducing alcohol influence.

With reference to the conjunction of alcohol economy impact and to the availability of long series of official data, a more macro-approach would consist of developing an analysis about relationships between economic alcohol values (prices, types and amounts of household and restaurant expenses), social alcohol uses (types and modes) and alcohol road traffic emergencies (mobility and accident).

The following are summaries of the two papers presented at T-92:

"Drinking and driving in France during the years 1983 to 1991: changes in legal framework and analysis of road users behavior"

In the first part of the paper we describe the evolution of the regulatory action in France in the alcohol field since 1983 which is the year which institutes the single legal level in blood 0.8 g/l to define an indictable offence and furthermore as an equivalent the legal level in breath of 0.40 mg/l.

In the second part we show through different quantitative criteria (number of tests and % drivers over the legal limit observed from random tests, motoring offenses, non fatal and fatal injuries), the overall trends in the road traffic offence control system .

We then analyze on the basis of INRETS surveys (1985 and 1991) the evolution of the driver's behavior in the general population and in specific subgroups, mainly age groups (>25 years, 25-39 years, 40-55 years, older than 55 years).

As a final part, we examine the injury accident trends between 1983 and 1991, in contrasting accident series using criteria most frequently linked to the presence of alcohol in an accident (sex, age, night and number of vehicles involved). This overall set of data lead us to the following main conclusions:

1. The increased number of checks since 1988 has helped to maintain stable the general level of illegal alcohol use on roads in France (2% in rural areas);
2. The levels of alcohol use in traffic appear to be falling among young drivers; and
3. The decreasing trends for categories of accidents known to be associated with alcohol are of the same order than those observed for other categories of accidents. Thus, there is no specific overall effect of drinking and driving law enforcement in the decrease of the number of injury accidents.

"Drinking and driving law enforcement in a wine-producing country, a multi-criteria process from 1960 to 1990"

In the wine-producing countries (France, Italy, Spain, Greece, etc..), legal prevention of the drinking-and-driving risk has to work within a complex set of competitive socioeconomic and political stakes exclusively supported by the alcohol produce. In so far as a comprehensive view of the evaluation problem is required, it is necessary to look at the efficiency and effectiveness issues with reference to a range of socioeconomic interferences (economic alcohol benefits, social status or life-style and alcohol consumption, alcohol risk awareness).

The evolution of per se law enforcement in France is examined over the past two decades with reference to economic data about wine and alcohol production (agriculture, labor market, industry), resources (taxes, trade market, stock-exchange) and consumption. From the preventive point of view, long term social processes are observed working in a positive converging manner.

The phenomenon of increasing punishment of the late 80's as well as a lowering of accident rates came out jointly of steady socio-economic transformations observed in the area of wine production and consumption (life-style mutations, production and market redeployment). Growing justice commitment and law enforcement progress are as closely connected with observed self-governing mutations altering the trench alcohol socio-economy as determined by the advances of the detection technology (breathhalyzer) and the improvement of the punishment process.

This approach shows that positive law enforcement evolution and specific alcohol related socioeconomic changes go hand in hand which confirms the need to widen the classical efficiency and effectiveness analysis by involving socioeconomic criteria in the process of law performance evaluation.

Conclusions and Commentaries

The particularism of the wine-producing countries introduces more easily the question of the multi-criteria process of drinking-driving law implementation. The historical French situation of wine production puts into light the deep relationship between the preventive process and a national background made of economic stakes and cultural habits. Nevertheless, the question is not of minor importance when the national context deals with beer and liquor manufacturing, the range of social and economic stakes interfering with legal process does not vary: production, distribution, consumption markets, drinking habits and cultural status of alcoholic drink are still of equal importance.

The national trends observed in France over the last 20 years show that the steady progress of drinking-driving detection and repression is not only a matter of technical improvement of the drinking-driving legal system. The growing justice and police commitment of the late eighties is factually linked to a growth of the social commitment going hand in hand with self-governing changes in the French society. Therefore, if the improvement of detection and punishment techniques (legal evidence + prosecution procedures) contribute to the performance of drinking and - driving law enforcement, the deep transformation observed in the social and economic background of drinking-driving regulation (wine production and distribution market, life-style and drinking habits) has made possible the intensification of the repression during the late eigthies. The main issue of the relationship between improved law enforcement and road safety improvement remains to be demonstrated and needs future time-series studies, knowing that law implementation is a long social term process.

The modelling purpose actually constitutes the more fitting technic for assessing complex sociological background of the working law process thus defined (economic, cultural, legal context). The attempt of modelling begins with the functionnalist multi-criteria rationalization of the law process that we began (integration of economic and socio-cultural criteria among more usual criteria of law working assessment). The next phase belongs to the development or the application of appropriate modelling techniques. Furthermore, the considered model allows more discriminating national and cross-national studies because the law enforcement variations are reported to a larger set of relevant criteria themselves recording more national features of law improvement process.

For copies of these two papers, see the proceedings of T-92, the 12th International Conference on Alcohol, Drugs and Traffic Safety, Cologne, Germany, September 28-October 2, 1992, edited by Utzelmann, Berghaus and Kroj, Verlag TÜV Rheinland, Cologne, 1993.

GENERAL DISCUSSION

This is an edited transcription of the general discussion that took place following the formal presentations. The discussion was moderated by Barry Sweedler.

Hans Klette (Sweden): It has been obvious that there would be a decline in drinking and driving in most countries because of the good programs dedicated to that purpose through the criminal justice system, alcohol policy, and transportation policy. But, of course, it takes time, as Kathy Stewart said, to increase awareness to such a level that the programs start to work. It takes a decade, or several decades, to create morality in this area.

Thus, there have been declines in the 1980s, and many other socially responsible people could be influenced: the social drinkers, socially responsible drivers, and so on. But there is the problem, as Herb Simpson has mentioned, of the hard-core drinking driver. The current programs could continue for a while in Canada and the United States, perhaps longer in Australia. However, the problem remains, as it does in Sweden and other Scandinavian countries: what do you do about the hard-core drinking drivers, those with the high BACs?

I do not think that the criminal justice system, alcohol policy, or transportation policy will affect these drivers. I think that only technology will work. We have to depend on smart cars, interlocks, and alcolocks in all cars on the production line. We should install interlocks in the future. For now, we should use interlocks and other technology. Members of this hard core group have to satisfy their basic needs, and they cannot do it without alcohol at the moment. So, if we cannot provide them with alternatives to alcohol, we will have to use technology.

Roelf Wittink (The Netherlands): In general, the explanations for the decline in drinking and driving are interesting. Looking at the situation in The Netherlands, nonalcoholic beer now has a market share of 7 percent. That is not so high, but if we look at the commercials about beer in the past few years, half were about nonalcoholic beer, because of the strong competition. The growing popularity of this beer has perhaps contributed to the different social climate.

There are more examples to show how the social climate has changed. Most of the presentations here have emphasized enforcement, threatening people, sanctions, and so forth, and I think those are very important. But maybe the effectiveness of enforcement can be multiplied when there are also policies for alternatives to drinking and alternatives to drinking and driving, and a good social climate for both.

Another example in The Netherlands, although not on a massive scale, is the disco bus. People who go into a disco can take a bus at 2:00 a.m. so they do not have to drive after they have been drinking. There are similar programs in restaurants. I heard the examples from the United States, and I think we have some of the same kinds of programs. In some villages, there are now restaurants that display a special sign saying that they also have nonalcoholic drinks, and they promote this service; they want also to be part of a group. Restaurants are saying that they are good hosts for their guests.

There are also some spot announcements on television about alcohol and drinking and driving; we have the traditional messages about the harmful consequences of drinking and driving, but we also have spots that only demonstrate how nice it can be not to drink alcohol and that show very clearly that you can have a very lovely evening without it.

Sweedler: Who sponsors those nonalcohol commercials? Is it the state?

Wittink: Yes. In fact, with money from the state, the organization that has been working in the Netherlands for many years on this problem has developed both threatening spots and alternative spots. At our institute (SWOV), one of my colleagues is developing a school program, because young people often discuss alcohol and what one is to do with it. The social pressure to drink alcohol is very great.

We have made some in-depth studies, and I think it is very important that we have more in-depth studies to look at opinions of people, but not only opinions—we need also to find out what the barriers are to refraining from alcohol. What are the social bonds? What in fact are the motivations to drink or not to drink alcohol, and to drink and drive or not to drink and drive? I think that is what we have missed in the last few years. We did not do motivational research, and now we want to know the explanation for the decline. Enforcement is, I think, a very important contribution, but again, its effect could be multiplied if there are also alternatives, in fact, a kind of a social marketing approach.

Herb Simpson (Canada): First, I would like to comment on what Hans Klette said a few moments ago and then make an appeal for what I think is something we really need to look at. I could not agree more with Hans's comment that many countries are tracking down a similar line, slowly but surely eroding the problem, to be left with the very significant problem of the hard-core. Since a lot of the more contemporary discussion of this problem was elicited by our report, *The Hard Core Drinking Driver*, I want to put in a plug, but not for the hard-core.

The plug is for the fact that, although we are investigating the issue of the hard core drinking driver as thoroughly as possible, we should not lose sight of the fact that there are other drinking drivers who are at risk. We cannot lose the momentum that we have achieved in terms of changing the social attitudes of a group of people who constantly need to be reminded. So I think we should continue our measures on all fronts. The hard core is important, but I do not want to lose sight of the fact that the other group of drinking drivers needs constant attention as well.

The appeal that I want to make is one that Hans Laurell hit directly, namely, concerns about official and unoffical statistics, good numbers and bad numbers. I keep asking what the percentage is that you have computed. Tell me what the denominator is, so that I can know whether we are talking about the same thing, or whether you are talking about the same thing over time. I believe that since we are now in a forum of international comparisons, the time has come to try and develop certain standards and certain consistencies, or explanations, with respect to the methods we use, the data that we gather, and how we report them so that we can understand each other.

In the International Council on Alcohol, Drugs, and Traffic Safety, we have established two working groups. It is my intention as president to establish a third working group that would parallel what S. Davide Ferrara did with respect to drugs and driving: get people together to establish methodological practices and standards with respect to the epidemiology of drugs and driving, experimental procedures, and so forth. So if anyone is interested, a call will go out in the *ICADTS Reporter* in the not-too-distant future for those interested in participating in that working group, and I hope that we have lots of volunteers.

Sweedler: I think that is something long overdue, and it is so sorely needed. We all talk about declines, but it is virtually impossible to compare one country to the next because everybody is keeping their own statistics in their own ways. If we could have some guidelines, a handbook, or a methodology so that we could all start using the same method, I think that would make what we talk about, as far as countermeasures are concerned, much more meaningful.

Ekkehard Brühning (Germany): My statement is directed toward the hard-core group that has been mentioned several times. Of course, a driver who drives with a high BAC level forms part of a hard-core group, but I think we can widen the view a little bit. Driving with a high BAC level is somewhat a lack of socially adaptive behavior. There are other areas in which there is such a lack. In a recent German study on motorway crashes, it became evident that, on the one hand, the wearing of safety belts on motorways constantly showed levels of more than 95 percent. However, within the group of fatally injured drivers, the percentage of nonbelted drivers was high by about 30 percent. Fatally injured drivers were overrepresented in not wearing belts, in drunken driving, in having a record in the central license system, and in other factors.

All these types of unsocially adaptive behavior characterize the hard-core group. I would like to know if there are experiences from other countries, with reliable data concerning driving while intoxicated and unbelted.

Sweedler: I am sure that there are: Bob Voas, can you respond to Dr. Brühning before we move on to other subjects?

Bob Voas (USA): Well, specifically on belt use versus BAC, we have data from roadside surveys showing that if you stop drivers at random to measure their BAC and observe their belt-wearing, those with positive alcohol involvement will have lower belt-wearing rates. We have also observed this correlation in our data on fatalities. Of course, drivers are more likely to die if they are not wearing a belt, so you cannot compare the fatally injured directly with those you observe on the roadway, because not wearing the belt contributes to the death.

It is better to look at the those who are driving and get both the BAC measure and data on whether they are wearing belts. Where that has been done in the United States, we have direct evidence that those who have positive BACs are less likely to be wearing their belts.

Sweedler: Yes, I think this is a trend that we see in most countries.

Voas: In fact, we have seen a rather precipitous drop in the last couple of years in our alcohol-related death rate, and it is just possible that our very strong campaign at the moment to increase belt-wearing is producing a differential effect with drinking drivers. That is, the closer you get to 100 percent belt use, the more likely it is that you are beginning to include more of the drinking drivers. When you have belt-wearing rates, as we have, down around 40 and 50 percent, most of those are low-risk drivers and nondrinking drivers. But as you increase the percentage, the relative increase among drinking drivers is probably greater than the relative increase among the drivers who have not been drinking.

I would like to second the call for a study on how we can compare statistics but to urge that, in addition to the specific statistics on crash rates and drinking and driving, we also get some agreement on related statistics that we know need to be studied, such as how well we express alcohol consumption, how well we express the number of vehicle miles traveled, and how well we express unemployment or other economic factors.

Hans Laurell (Sweden): I just wanted to add to Dr. Brühning's discussion of nonsocial behaviors. We are doing a nationwide study right now that covers 5 years. We find that those who are involved in accidents with suspicion of alcohol involvement have a far more extensive criminal background than those who are sober. There is a very wide perspective of antisocial behavior.

Wolf Nickel (Germany): I have two points. Maybe one or the other would give us the opportunity to have some more sunshine in our data and take some of the clouds away, because we are still discussing, I think, what the reasons are for the remarkable declines we have observed in different countries. Now, I heard very little about the differences between declines in first offenders and second offenders or multiple offenders. As some of you know, we have been dealing with the hard core. I do not like the expression much, because the group is not a group as such, and therefore I would rather use a better phrase.

There has been a remarkable decline in recidivism from the late 1980s to the present as a consequence of administrative licensing procedures developed in the last few years and a new set of criteria for assessment introduced in 1987-1988. These developments have greatly improved the differentiation between, and diagnostics and assessment between, alcoholics on the one hand (I could differentiate the group into more subgroups, but I will make it short, and just say alcoholics) and heavy-drinking drivers on the other hand offering the latter the possibility of short-, medium-, and long-term rehabilitation procedures, which contributes to the decline in recidivism, as we have proved several times. As a first step, not relicensing heavy-drinking drivers offers a good motivation for individual abstinence, and relicensing those who have gone through short-, medium-, or long-term rehabilitation successfully gives them back their mobility and allows them to take part in traffic again with a very low relapse rate. I would not want to make more comments on the group you mentioned. It is not only the heavy drinkers that we should focus on. I think the decline we have seen is very much linked to all the different measures that have been instituted in the last 10 or 15 years. I think Hans Klette is right in saying that the consequences of such measures do not show up 1, 2, 3, 4, or 5 years after the measures have been undertaken, but they take time. We have seen this in the installation of the German administrative license program. It took 5 years to determine the first consequences.

Sweedler: Very good. I think that certainly the program that you discussed is one of your main reasons for being here. Tomorrow, one of the working groups that Dr. Simpson has mentioned will be meeting on this whole program of regranting of licenses. Johan de Gier, chairman of the group, has called a meeting for 1:00. I think that Herb would probably welcome volunteers among colleagues who would be willing to serve on that working group to try to come up with what seems to be the best program, maybe even come up with internationally recommended guidelines or standards on regranting of licenses. That is a subject that has not really gotten much attention on our side of the Atlantic yet. It is much more prevalent in the U.K., in Germany, and to some extent in the Netherlands and Sweden. We all need to learn about regranting of licenses, so that will be a big discussion item for the next few years.

Dr. Klette, I think you would like to have time to respond to some of the people who commented on your remarks.

Klette: I agree with you, Herb, we should not forget the other group. Surely every new generation must be told. But I was interested to hear your remarks about technology, because in Sweden, for example, many people drive without their license; 40 percent or so of the drunk drivers drive without a license. The detection rates get so low, and they continue to drive. So the system does not work too well. Technology would help quite a lot in different areas. Do you call them "passive restraint systems?"

Sweedler: Airbags.

Klette: Airbags as well as safety belts. And of course, you could make the car unable to function if the driver is impaired using technology. If we are willing to use technology in these areas, I think it relates very much to the basic values in our society. In Sweden even if it is worse now, we still stress a bit of solidarity. But, we would not mind using this technology to help us, and other people who cannot do without it, to have effective social control in this area. I would like very much to hear what you think about technology in different countries of the world.

Sweedler: As another commercial, the TRB committee that I chair, which is part of the National Academy of Sciences, will be having a special workshop next summer to discuss a program for the "hard-core driver" or the "problem drinking driver." This area certainly needs to be focused upon, and we will try to get the best experts—keep it to a small group—and try to actually come up with some recommended practices. What should such a program look like? What should it include? Certainly the technology, the legal aspects, and the educational and the rehabilitation components must be included.

The hard-core drinker-driver is something we talk about a lot, and we hear about, but if we could come up with recommended guidelines, they could go a long way to helping deal with that problem. Bob, you might want to comment on Hans's question about the technology.

Voas: Yes, if I may, since Hans raised it. He mentions 40 percent. I presume it is the DUIs in Sweden who drive unlicensed. The figure in the United States is similar. In the State of Washington, one-half to two-thirds of drivers who have lost their licenses as the result of a drinking-driving offense do not have their license reinstated when they are eligible. In fact, after 4 and 5 years, we find that fully 60 percent of the individuals who lost their licenses 4 and 5 years ago are still unlicensed. So we are creating an outlaw group.

Now, the interesting thing is that the outlaw group has fewer accidents than those who are reinstated. On the other hand, they are probably uninsured. So it is a very interesting problem, and it relates exactly to what is going to be discussed here tomorrow afternoon in that one of the procedures used by states like New Jersey and California is to attempt to have relicensing dependent on an assessment and perhaps a treatment or education program.

However, obviously that only works if people seek to be relicensed, and 60 percent do not. So your hard-core group does not come into the system under this kind of a procedure. They do not reapply. They continue to drive while suspended. We need to find ways in which we make sure they get into our system of rehabilitation. Now, I think this is where the technology comes in. The United States has probably had more experimental application of the so-called interlock system. It has not been entirely successful, in part because we have attempted to institute it through our courts and our courts fail to have the bureaucracy, or the administrative capability, to manage the system. So the indication is that if you can get the unit on the vehicle of the offender, while it is actually on the vehicle, the crash involvement or the recidivism involvement will go down. But, in fact, the bureaucracy, or the administration, fails to get it on the vehicle much of the time. In California, judges required them on the vehicles of offenders who did not have vehicles and they came off the vehicles too soon. One of the major requirements of the alcohol interlock system, we found, is that it must be inspected at least every 60 days, perhaps every 30 days, and that it have a recording system so that every attempt to start the car is recorded. Through study of the recording system you can determine the individuals who are being successful, in one way or another, in driving despite the device. However, that information frequently does not go back to an individual who can take action, and this happened in the California study. Problems would be detected, but when the probation officer was contacted, nothing was done. So the individual was allowed to continue to use the vehicle and the interlock, even though it was clear that he or she was finding ways to get around the control.

So a problem with that technology, at the moment, is that you cannot just place it on the car and forget it. You have to have the administrative capability to manage it, and this is an expense. There is increasing interest in the United States in having the motor vehicle departments administer these devices.

Another area of interest is electronic methods of preventing the driving of a vehicle by an unlicensed driver. We are beginning to have the driver's license in credit card form, in which there is a magnetic strip that might describe or define the driver, and there might be methods to use a vehicle's internal electronics to prevent driving by those who had had their license withdrawn. But those systems lie, I think, a little bit in the future.

Laurell: Well, I will just comment on what you are saying, because my organization is putting $2 million into the development of a smart card system for drivers' licenses that will make it impossible for a driver who has had his or her license revoked to drive. This system also has a side effect: it makes it very difficult to steal a car. The system could be used in many different ways. The way this one is designed makes it possible for the police to stop a car that has been stolen. For example, when you report a stolen car to the police, they can send out a signal that wipes out the ignition on that car or a warning, "Within two minutes, this car is going to stop." It would make it virtually impossible for a driver without a license to drive. But our problem is to introduce this in Sweden without considering its acceptance in the European community. We cannot introduce something that will be compulsory just within our country.

Andrew Clayton (U.K.): Three unrelated comments. First, in those various correlations, looking at all these graphs showing declines during the 1980s the one thing we forgot is that the decline started with the arrival of Maggie Thatcher as our Prime Minister, and then we went wrong when she left us. Just bear that in mind as a possible explanation.

The second point relates to driving while disqualified; I find this issue difficult in the moral sense of whether people should be allowed to continue to do this. Perhaps one reason why they do it is that, certainly, in the U.K. they are not going to get any insurance, or any worthwhile insurance, and I suspect that is true in many other countries. Insurance companies look very unfavorably on somebody who has been convicted of DWI. Now, I hesitate to use that as an argument for saying that insurance companies ought to be less severe on DWI offenders, but if we want people to drive legally, what do we do?

The third point I want to make is, again, from a U.K. perspective: please do not forget the pedestrian. Very roughly, about half of our fatalities with blood alcohol counts above .08 are pedestrians, and although Hans talks about technology for the driver, I do not think there is any for the pedestrian. It is a much more difficult problem. We have made very little mention of education. We have got to do more in that field starting at a much earlier age. We cannot rely just on technology and enforcement.

Sweedler: Another commercial: The other working group that Dr. Simpson mentioned is the pedestrian problem involving alcohol. That group is chaired by Kathy Stewart and is scheduled to meet tomorrow morning. That working group will also be coming up with recommended practices and programs to reduce the pedestrian alcohol problem, with the target of having a recommended program, and a session at T-95, in Adelaide. These are certainly important issues that Dr. Simpson and ICADTS have recognized, and they are moving to address them.

Julian Everest (U.K.): In relation to Bob's comment about the 40 percent of people who "were thought to be driving while not having recovered, or sought to recover, their license," I wonder if indeed they are trying to drive. We are, at the moment, looking at recidivism rates among high-risk offenders, people who have lost their licenses. Clearly, we can get some information on people who reappear in the statistics, but the statistics that we are dealing with are notoriously unreliable. They do not even take account of populations who are dead, or who have immigrated. Undoubtedly, underlying this, presumably, are one or two who have actually reached the conclusion that perhaps they do not want to drive. They want to go on drinking. But how do you reach this group? How do you tactfully, to get a reliable reply, reach this population, and say, "By the way, you have lost your license. Tough luck. Are you now boozing, or not drinking?"

So conceivably it is not 40 percent; perhaps, it is lower than your statistics imply. Perhaps 10 percent are dead. Perhaps another 10 percent have decided they do not want to drive. And perhaps the figure is 20 percent. I welcome ideas as to how we break down these residual populations. It is not easy.

Matthijs Koornstra (The Netherlands): I would like to address the question of the decline from 1980 to 1990, without having a good explanation for it. This maybe a little bit astray from the general practical work in this field, but I wonder, from a more theoretical, psychological point of view, whether there could ever be a possible explanation.

We should look at the history of information available and the reaction of the driver and feedback on his or her behavior. A driver's behavior is actually based on a stored form of reference, developed from former experiences that shape a template. That template is built up by positive bits of information, and on the basis of that theory, before the 1980s, all the information we got about alcohol and driving was of a mixed nature, in the sense that, you are a good tough guy in your peer group if you drink and drive. There is in The Netherlands a television spot about a love affair that goes astray because of drinking by one party or the other. It has nothing to do with drinking and driving. You get bits of information from your friends; now you get information from the police also. I think the accumulation of this information beginning in the 1980s started shifting the frame of reference, and the same behavior that was approved suddenly becames deviant.

Why is it that alcohol and driving are declining at the moment? Why do we not see the same trend concerning speed behavior? Why isn't it a general safety effect, or something like that? The answer is that the motor car industry, the films, and every bit of information about speed is mostly positive. Only some strange guys working in road safety say it should be lowered. I think it would help to explain why the younger people, who have a shorter history of information building from the past, are more influenced by the bits of information. If it is an integration with past information, and you already have 30 years of information, then the last 10 years is only a bit. When you are beginning to hear about alcohol from the age of 12, the fourth time you do not even like it.

When you are 18 and you are learning to drive, you have a 6-year start to contemplate what your reference is. If you get 10 years of information, or contrary information, it will do a lot for your comparison of what you think is deviant. So younger people should be more influenced than older ones. It fits in the theory of information integration by Anderson.

Two books were published in 1980 and 1981 on how people have their references for just themselves, what they can do or cannot do. Information integration theory is a good area for the explanation we have seen here.

Jarmo Pikkarainen (Finland): I am very confused, listening to all this, and I'd like to cite examples. We are discussing those drunken drivers who have been arrested by the police in their normal police work. Then we have those drunken drivers who are arrested in the roadside studies, which are two completely different groups. If we take those who are arrested in normal police work, the records show that, for instance, of those arrested in Helsinki in 1991, 80 percent were recidivists. And the same applies for the whole country.

From the police records, in 1 1/2 years, 125 people died, and only 1 in traffic. Fatalities were usually violent deaths involving drugs, suicides, homicides, and so on. So the prognosis is very bad. On the other hand, look at those drivers who usually are not arrested at all but by accident are found in the roadside study. We have followed a group for 15 years now, a group of about 200 persons. One-third of these people have been recidivists, and 15 percent had some arrests earlier. But there were 100 people who only had one drunken driving arrest or had been sentenced for drinking and driving. That means that 50 percent had only one occasion in their life, which gives a bit more optimistic picture about the real situation on the roads.

I would like to underline that, when we are discussing alcohol fatalities—or, let us say, alcohol-positive fatalities—that is only one side of the picture. We know that of fatalities in Finland involving the hard core, people who have fatty livers and other signs of excessive drinking, one-half were alcohol negative at the time when the accident happened. So it might be that an alcoholic is also very dangerous when sober.

Kees Heijster (The Netherlands): Just one small comment on what Matthijs Koornstra just said. I agree with his view on the history of what happened in The Netherlands in the last 20 years, and I like his theory but the only thing I cannot explain is why, in Holland in the last 2 years, 13- and 14-year-olds studied are smoking more and started smoking more than 10 years ago. Because if your theory applies, then smoking should have gone down in that age group.

Sweedler: Let me summarize. I think that is pretty clear that we have had what I characterized in the beginning as dramatic reductions, especially in the decade of the 1980s and into the early 1990s. We started looking at the reasons, which are somewhat different in each country, but I was able to gather from the presentations and the papers—and

it seems to be spread across various countries—that there has been increased enforcement, increased public education, improved legislation, and improved health consciousness. Some of the improvements I mentioned at the beginning of this session, such as better enforcement, public education, and legislation in some countries, came from a raising of awareness on the part of victims, which allowed the climate to be right for these other improvements to be made. The improvements led to changes in public perception and attitudes, which led to the reduction in drinking and driving.

We have also heard about improved vehicles. Vehicles are safer than they were. Roadways are safer. There is greater use of safety equipment such as seat belts and airbags. We heard about how the economy in the various countries could have affected the reduction. We have heard about other factors, such as alternative transportation. We have discussed a few here. But it is obvious that all of these factors have played a role to some extent—in some countries, more of an extent—but I think in all of the countries whose representatives presented papers here today, all of these factors that we have discussed came into play to some degree.

I think we have learned a lot today by sharing information, and we are at the point now, as Dr. Simpson said, when we have to keep the pressure on, we have to keep moving. It is not that we have solved the whole problem and are left only with the hard core. We certainly have the hard core to work on, but it is the other aspects of the drinking and driving problem that also should not be forgotten. We discussed where we should go from here to continue to reduce the problem of drinking and driving. We discussed the role of technology and regranting of licenses and the problem of unlicensed drivers. The need for improved and standardized data was also discussed. We should consider our discussions here as a status report on the road to accomplishing the goals we all share. What we learned today will help us all in attaining those goals. Thank you all for participating.

Simpson: I hope that you will again invite all of us after we have had another couple of years to think about this issue. You might consider convening a panel discussion with many of the same speakers at T-95, in which we can have a chance to reflect on what we have heard from other people, and perhaps with a little more sophisticated operation on our data, provide an update.

And then, I think on behalf of everybody here, I would like to thank you, for organizing this particular session, because I think it has been very valuable for all of us, and also for chairing it. Thank you very much.