RIDENDO DICERE VERUM

(Telling the truth with a smile)

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INTRODUCTION

Before concentrating on the subject of road safety, let us look at failures and production in a better understood system. From the behaviour of other systems, we may learn to model the developments in the traffic system related to road safety.

Figure 1 shows the annual number of breakages in a factory, where bottles are produced over the years 1950 to 1986.

We may wonder what caused the increase in breakages after 1956 and the marked decrease after 1970. It will be instructive to look at the production of bottles as well, since the number of broken or defect bottles may be related to the number of produced bottles.

As we see in Figure 2, the production has been growing nearly exponentialy up to 1969 and has levelled off to a small linear growth since.

It is interesting to see what the failure rate per unit of production is. The annual failure rate is shown in Figure 3. This figure shows us a remarkable, nearly smooth curve with an exponentialy decreasing rate of 5,6% annually.
A simplified way of describing this curve, is obtained by the 50% decline time of the rate which is achieved every 12 years. It seems that irrespective of changes in production methods and growth of production, the factory "learns" to produce its products more carefully.

A MODEL FOR ROAD SAFETY

What can be said about the traffic system and its failures?
Well what produces the traffic system ?
The main thing the system produces, are distances travelled, or the transport of goods and persons over certain amounts of kilometres. We will take the annual kilometres driven by motorized vehicles as the relevant volume of production of the traffic system.

Surely the failures of the traffic system are traffic accidents. We will look at the most severe accidents: the number of fatalities per year.
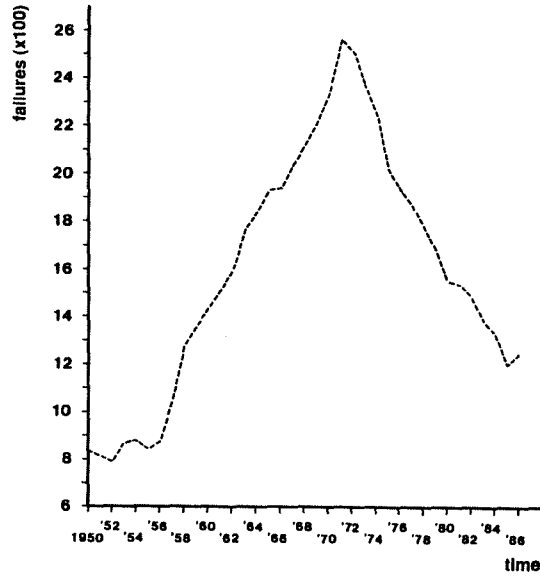
FIG. 1. NUMBER OF PRODUCT FAILURES OVER TIME

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FIG. 2. PRODUCTION OVER TIME

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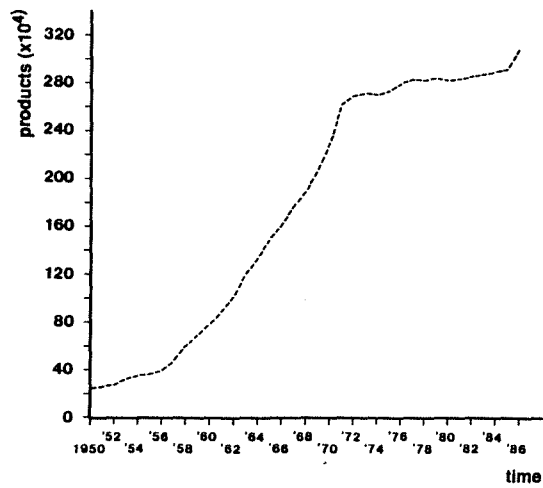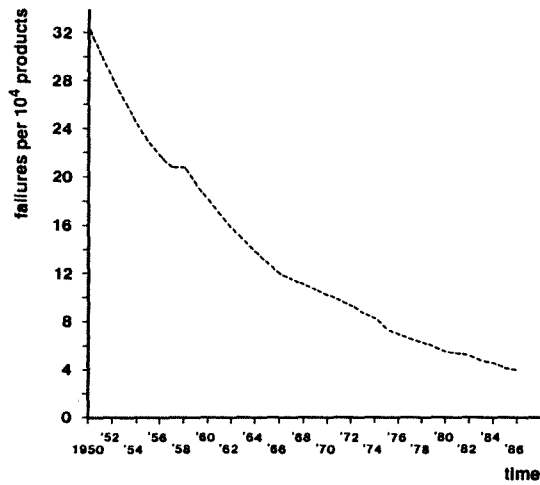## FIG. 3. FAILURE RATE OVER TIME

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Figures 4 and 5 show the figures for fatalities and kilometres over the
period 1953 - 1986 in the Federal Republic of Germany. The fatality curve
shows a rather irregular rise up to 1970 and an even larger drop there-
after.
The traffic volumes have been growing nearly linear, with some steeper
increase in the sixties and smaller increases in the seventies and eigh-
ties.

Now we may construct the fatality-rate curve, like the failure-rate curve
of the factory. From Figure 6, we see a somewhat irregular decay curve.
The best fitting log-linear curve is plotted through the observed rates.
This estimated curve shows an annual decrease of 6.2% or a 50% decline
every 10.8 years.

Although there are marked deviations (undershooting 1970 and overshooting
1958 for example, resulting in deviations of estimated fatalities of over
2000), the curve describes the general trend over more than 30 years
rather well (log-linear correlation -.986).

UNIVERSALITY OF THE MODEL

To show that this result is not unique for the Federal Republic of Ger-
many and may held over longer periods, we show in Figure 7 the same
picture for the fatality rate in the USA from 1933 to 1985.
Although the pattern is somewhat more irregular, again the best fitting
log-linear curve describes the trend over more than 50 years again rather
well form a macroscopic point of view (log-linear correlation -.977).

It can be seen that in the USA the annual decrease is less (3.3%) and
consequently the 50% decline time is nearly twice as long (20.7 years)
compared with the FRG. Although some caution for comparison of curves due
to measurement differences is necessary, it must be said that the fatali-
ty rate in the USA seems much lower (by a diminishing fraction) over the
whole period in contrast to the FRG.

To illustrate the universality of this exponential decrease in fatality
rate we show in Figure 8 the curve for Great Britain from 1949 to 1985.

FIG. 4. ROAD FATALITIES IN THE F.R. OF GERMANY, 1953 - 1986.
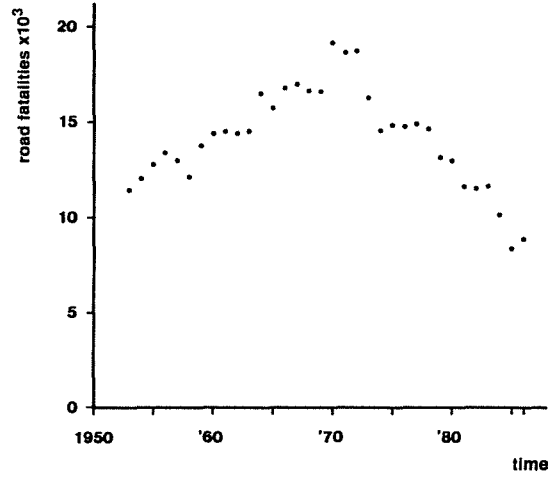

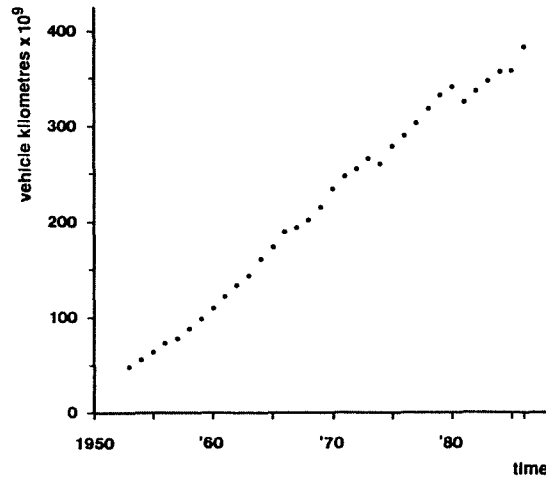## FIG. 5. VEHICLE KILOMETRES IN THE F.R. OF GERMANY, 1953 - 1986.

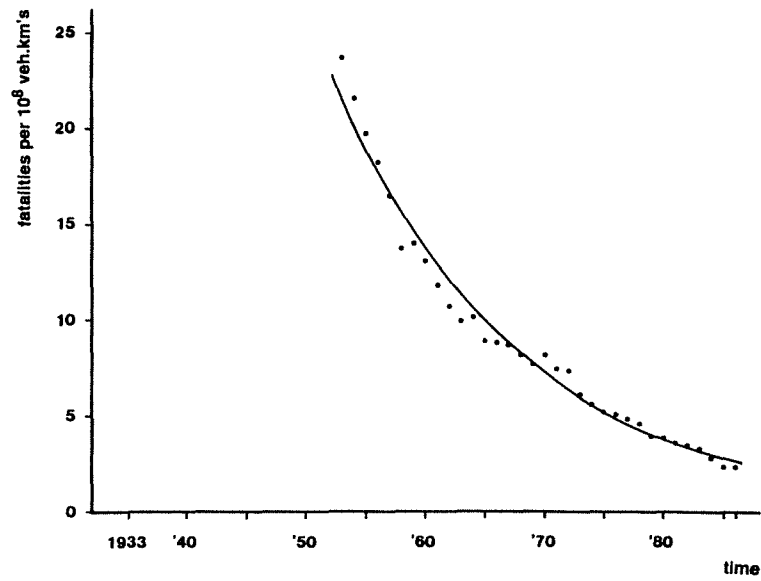## FIG. 6. FATALITY RATE IN THE F.R. OF GERMANY, 1953 - 1986.

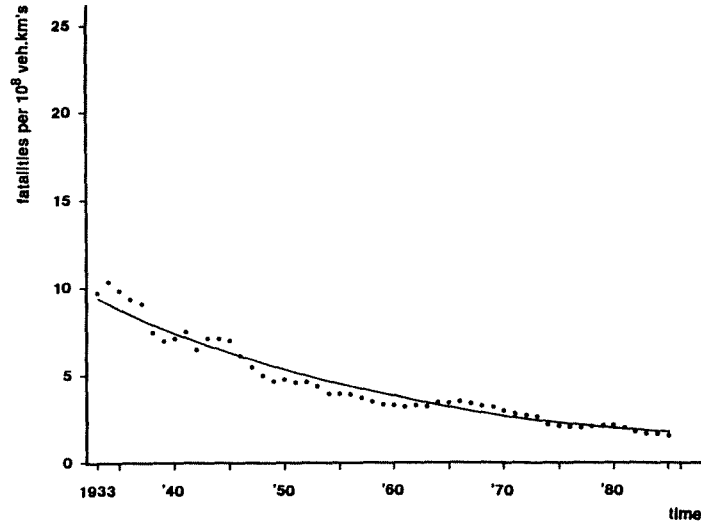FIG. 7. FATALITY RATE IN THE U.S. OF AMERICA, 1933 - 1985.

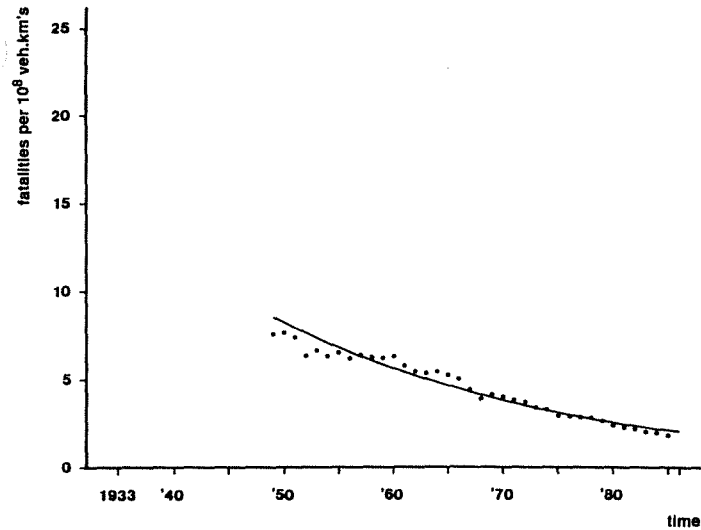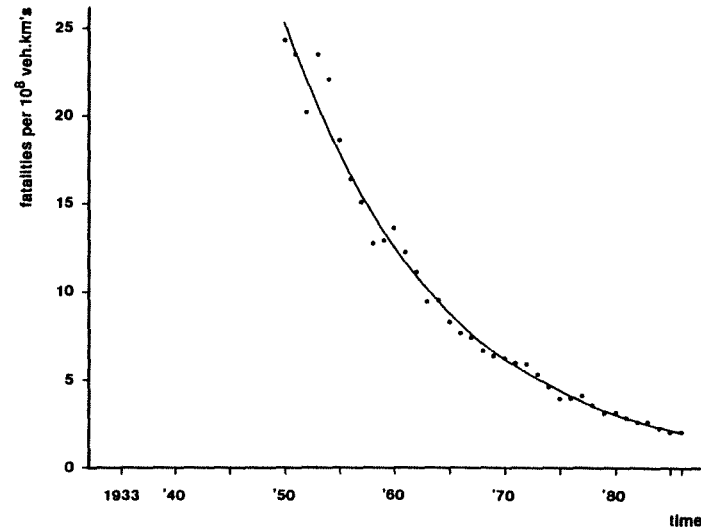FIG. 8. FATALITY RATE IN GREAT BRITAIN, 1949 - 1985.

FIG. 9. FATALITY RATE IN THE NETHERLANDS, 1950 - 1986.

Again for Great Britain the curve fits the trend rather well (log-linear correlation -.980). It shows an annual decrease of 3.8% per year and a 50% decline every 17.7 years.
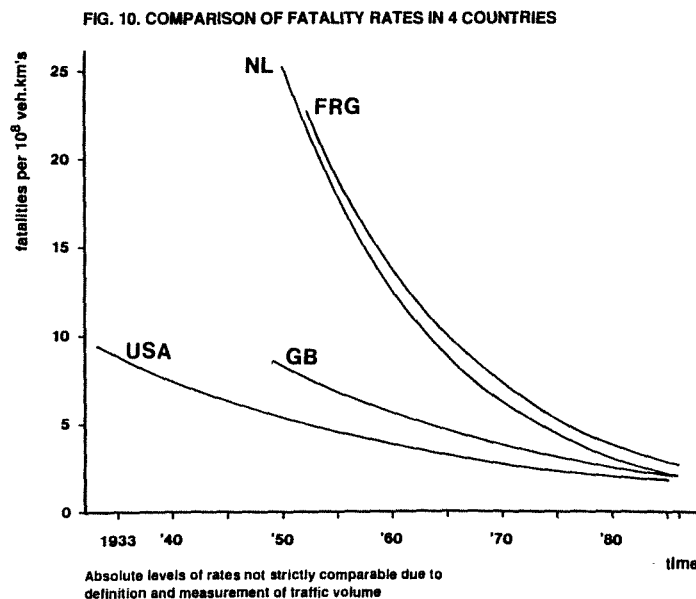
The comparison of level and slope of the curve is even more problematic because of the fact that the British counts of traffic volume include bicycle kilometres, not included in the Federal Republic of Germany or the USA. Shortly after the war these bicycle kilometres formed about 30%. The lower level and less steep slope compared to the FRG will at least partially be explained by that difference in traffic volume.

As a last example the fatality-rate curve for The Netherlands is shown in Figure 9.

This curve shows an annual decrease of 6.7% and a 50% decline every 9.9 years. This curve seems to fit the observations best compared to the other curves shown (log-linear correlation -.993)

In Figure 10 these estimated fatality-rate curves of the four mentioned countries are displayed.

Over the considered periods the rank order of the four countries remains the same and generally we also see a diminishing proportion of differences. The comparison is ambigious, because differences in definitions and methods of measurements of traffic volumes (within one country these differences are corrected by backward adjustments).

FIG. 10. COMPARISON OF FATALITY RATES IN 4 COUNTRIES

Absolute levels of rates not strictly comparable due to definition and measurement of traffic volume

From the different shapes of curves we may conjecture that the decrease
is a general, but not identical community learning process in industrial-
ized countries.
Apart from the generality it seems as if actions and circumstances in
each country can be reponsible for the curve differences.

COMMUNITY LEARNING PROCESS

With respect to discussions by Adams (1987) and Minter (1987), we take a
different line of thought. We do not assume that only cumulative
experience, irrespective of actions taken, is the only explanatory fac-
tor. We rather assume that each society "learns" to cope in a more or
less effective way with the threat of fatalities. This community learning
may depend on exogenous influences and measures taken related to the
traffic system.

In Tabel 1 and illustrated in Figure 11 we show the influence of develop-
ping influences and measures since 1970 in the Federal Republic of
Germany, based on the work of Brühning et al. (1986).

The first column of Tabel 1 describes the effect as an increase in fatal-
ities for particular changes in the period 1970-1984 in the Federal
Republic of Germany for the hypothetical case that these changes not had
taken place. If nothing had changed (all changes absent) the number of
fatalities would have been equal to the fatalities in 1970, which would
have meant an increase of 88% in the number of fatalities for 1984.
Brühning et al. analysed the available data with respect to the effect of
absence of one single change under the condition that everything else
changes as it has changed. Their analyses take great care in not confoun-
ding these changes with other related changes, such as changes in propor-
tional distribution of traffic volume on the safer motor freeways and
higher percentages of seat-belt wearing on these roads. They succeeded in
isolating four single factors of changes in a convincing way.
They showed that the number of fatalities would have been 30% higher than
actual, if the increase in seat-belt wearing had not taken place. The
absence of the change in distribution towards a relatively higher traffic
volume on motor freeways, due to their enlargement and improvements,
would have accounted for 11% more fatalities.

TABLE 1. ESTIMATED EFFECTS DURING 1970-1984 IN THE FEDERAL REPUBLIC OF GERMANY

Nr.	Cause(s)	Without effect on 1984 %	Without effect on fatality-rate curve		
			reduction 1970-1984 %	annual change %	50% decline time in years
0	None	0	-59	6,2	10,8
1	All	+88	0	0	∞
2	Seat belt	+30	-47	4,4	15,3
3	Motorway	+11	-54	5,5	12,3
4	First aid	+10	-55	5,6	12,1
5	2+3+4	+59	-35	3,1	22,4
6	All excl. 5	+18	-37	3,2	21,0
7	Population	-10	-63	6,9	9,7
8	All excl. 6+7	+31	-43	4,0	17,1
9	Traffic volume	-35	Effects eliminated from curves		
10	All excl. 8+9	+103	(Effect represented by equal fatalities curve '70)		

Based on Brühning et al. , 1986

FIG. 11. ESTIMATED EFFECT CURVES 1970 - 1984 FOR FATALITY RATE IN FRG.
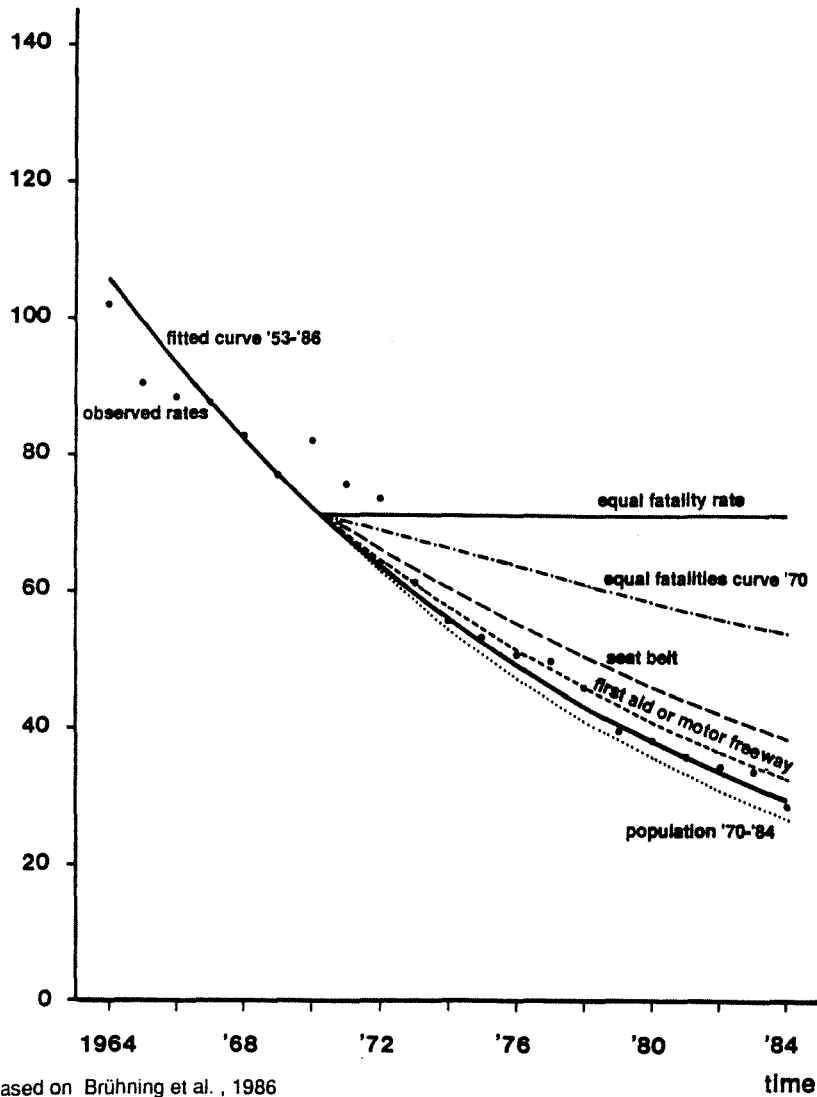
Based on Brühning et al. , 1986

It must be noted that the growth of traffic volume itself was not in-
volved in this assumption, only the proportional distribution over road
types is hypothetically restored for 1984 as in 1970 in order to estimate
this effect. The improvement of medical care, first-aid and warning sys-
tems is accounted for an effect of about 10% increase in 1984, if that
system had been unaltered since 1970.

It was estimated by Brühning et al. that the combined effect of the
absence of these three causes since 1970 is a 59% increase in 1984. (One
notices that these effects must not be added, but multiplied: that is
1.30 x 1.11 x 1.10 = 1.59).

From the fact that the actual fatalities in 1970 were 88% higher than in
1986, it can be deducted that absence of all other changes accounted for
an increase of 18% fatalities in 1984 (Again one notice the multiplica-
tive rate: 1.59 x 1.18 = 1.88).
This is not the same as saying that all other safety measures only had an
impact of 18% in 1984. This statement would only be correct if only
safety measures had changed the relevant scene. Brühning et al. show for
example that, if the change in composition and volume of the population
between 1970 and 1984 had remained unchanged, the fatalities in 1984
would have been 10% less. If we correct for this relevant exogenous
change, we would have attributed an effect of 31% to the other safety
measures (computation: 0.90 x 1.31 = 1.18).

Continuing this line of thought, we may correct for one major factor of
increase in accidents which is not yet accounted for: the growth of
traffic volume.

If everything changes between 1970 to 1984, except traffic volume, then
the achieved fatality rates of 1984 would have to be multiplied by 35%
less traffic volume and hence hypothetically reduced the number of
fatalities in 1984 by 35%.

Correcting the influence of growth of traffic volume also, would result
in an effect of 103% on the fatalities in 1984 for all other changes than
change in traffic volume, population, seat-belt wearing, first-aid
system, and use of motor freeways (computation: 0.65 x 0.90 x 2.03 =
1.18). If only other safety measures are relevant, then we could conclude

that the rest of the safety measures contributed to road safety approxi-
mately twice (103%) as much as the three mentioned measures together
(59%). [Total comparison: (0.65 x 0.90) x (1.30 x 1.11 x 1.10) x (2.03) =
1.88; which means (exogenous factors) x (mentioned measures) x (all other
measures) = 88%].

This way of demonstrating the effect of safety measures demands a rather
complex reasoning. The task to do so is much more simplified if we trans-
late these results in effects on the fatality-rate curve.
That is shown numerically in the other columns of Tabel 1 and graphically
in Figure 11.
The single effect of absence of changes are displayed as hypothetical
curves from 1970.
By drawing the decreasing curve of fatality rates corresponding to equal
numbers of fatalities as in 1970, one clearly sees our point that the
effect of other safety measures should not be measured by the unexplained
past up to that curve for equal fatalities, but up to the equal fatali-
ty-rate level.

This illustrates the hypothesis that that the community will invent new
safety measures, if the fatality rate does not decrease in the same way
as in the period before. It also illustrates how difficult it is to
demonstrate the effect of a single safety measure in a period of limited
time. Even a measure of 10% decrease in 14 years could easily be con-
founded by other changes and statistical fluctuations, because it only
produces in the case of the Federal Republic of Germany a change in
annual decline percentage from 5.6% to 6.2% in fatality rate. On the long
run, however, such changes are very noticeable as can be seen from the
differences in 50% decline time of Tabel 1 and in Figure 11.

1986 IN HISTORICAL PERSPECTIVE

On the occasion of this symposium we will pay attention to the effect of
the European Road Safety Year 1986.

In Tabel 2 the results for the Federal Republic of Germany and The
Netherlands are given. What can we learn from such results? The answer
is the reason for the title of this paper and that answer is "Nothing!".

TABLE 2. CHANGES IN 1986 RELATED TO 1984 AND 1985

Country	Fed. Rep. Germany			The Netherlands		
Year	1984	1985	1986	1984	1985	1986
Road Deaths	10199	8400	8948	1615	1438	1529
Vehicle kilometres x10^9	358,3	358,9	384,4	69,25	68,68	71,73
Death Rate observed (per 10^8 km)	2,85	2,34	2,33	2,33	2,09	2,13
Death Rate estimated (per 10^8 km)	2,95	2,77	2,59	2,33	2,18	2,03
Estimated Road Deaths	10570	9941	9956	1616	1494	1455

The first reaction might be a concern about the increase in fatalities in 1986. That is always in place, but are these figures reason for new troubles and worries?

Comparing these figures in relation to the macroscopic model just discussed, we also note:

- a large growth in traffic volume in 1986;
- a marked drop in fatality rate for 1985 compared to 1984 and to the predicted value;
- a nearly identical fatality rate in 1986 as in 1985;
- predicted fatality rates that are higher than (FRG) or approximate (The Netherlands) the observed values.

The conclusion is that development for The Netherlands is in line with predictions and fluctuations around them, while for the Federal Republic of Germany the predictions are higher then the observed data since 1984 and probably so because of the change in seat-belt wearing after the law in 1984.

If there is a lesson to learn, then it is that no easy campaign or general motivational appeal will influence road safety any more.

The time that one could aim at broad safety campaigns is behind us. We
should go on the way we were effective in the past and that is: doing
research, applying research findings, applying them in a coördinated and
integrated way. It will not be the place here to elaborate on what is
meant by these general statements. Not only is it possible to mention
numerous technical and behavioural research results which are not applied
or particularly applied in the realm of road design, vehicle design,
traffic control and education; it is also evident that new research will
guide us to new safety improvements. The implementation of safety measu-
res and the contra-productive actions of different agencies form a fore-
most problem, in which co-ordination, concerted action and fine tuning
are the key words to produce the maximum attainable safety results.

EFFECTIVITY OF POLICE ENFORCEMENT

In selecting some research findings to illustrate these general state-
ments, it seems appropriate to realize that this symposium is held at a
leading police academy and organized by chief police officers.
The topic selected therefore is the effectiveness of enforcement prac-
tices and how on the basis of research findings these practices can be
modified in order to be more effective.

We will show results of research in the field of enforcement with respect
to seat-belt wearing, speed limits, and last but not least driving under
influence of alcohol. On the basis of the results in The Netherlands, we
will be able to formulate a general applicable scheme of effective enfor-
cement strategies. As such it will be a nice illustration of the meaning
of the general statements just given for the field of enforcement and
road safety.

In The Netherlands mandatory seat-belt wearing was implemented in 1975
for those who are driving in cars not older than 1971, since thereafter
cars had to be equiped with belts. Probably because of the gradualy
introduction of the obligation, the percentage of wearing belts had not
the effect of the later obligation in the Federal Republic of Germany or
Great Britain, where more then 90% are wearing seat belts now. In The
Netherlands this percentage was 50-70% depending on the type of road.
This percentage has not grown despite nationwide information campaigns.

Police enforcement is on a low level and in itself does not show any influence.

In Figure 12 the result is shown of the combined effect of police control and a regional and local campaign presented in a co-ordinated and concerted action by local police, local and regional authorities, and private agencies in the region.
Originally it was planned to invest 12% more capacity for police enforcement, but after the campaign it turned out that hardly any extra police capacity was used. The campaign lasted from August to November 1984 in the province of Friesland. As control area the comparable region of West Friesland, almost totally separated from Friesland by water (IJsselmeer), was chosen.
As can be seen the combined effect of this regional action was an increase in, seat-belt wearing of above 25% and had a long lasting effect of nearly 20%.
In July 1984 a nationwide campaign also started. It had no effect on the control area, while the police enforcement in Friesland in its end effect was hardly changed. The difference can only be attributed to the local and regional intensity of the campaign and the publicity on the enforcement of police in the area, which in effect only took place on a marginal level. Similar results of the combined effect of enforcement and information campaigns have been obtained by Jonah et al. (1982).

As a second example, part of some results of the research on driver behaviour and speed limits going on at the Traffic Research Centre (VSC) of the Groningen University in co-operation with the Institute for Road Safety Research SWOV, is presented.
It can be seen from Figure 13 that general information on speed limits, even in a locally oriented campaign, only has a momentary effect on reducing speed, while the combination of information and police enforcement has a lasting effect on the reduction of speeding.
The research also investigated the effects of personal mailing on violations, matrix displays of percentages driving above the speed limit, mobile police control, obtrusive and unobtrusive stationary police control in all possible combinations with and without information campaigns. A summary of the results of this long-term research programme is given by Rothengatter (1987). He concludes that normal police enforcement practices are ineffective in order to influence speed behaviour and could be

FIG. 12. SEAT BELT USAGE RATES IN FRIESLAND AND CONTROL
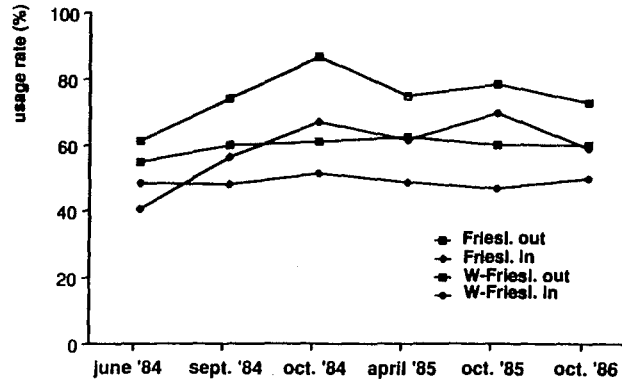REGION INSIDE AND OUTSIDE BUILT UP AREAS
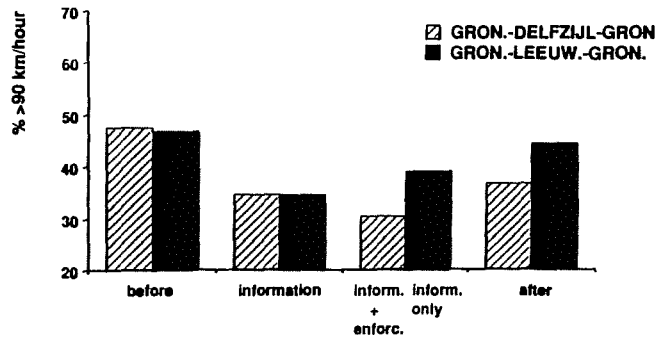

FIG.13. MEAN PERCENTAGES SPEED OVER 90 KM/HOUR

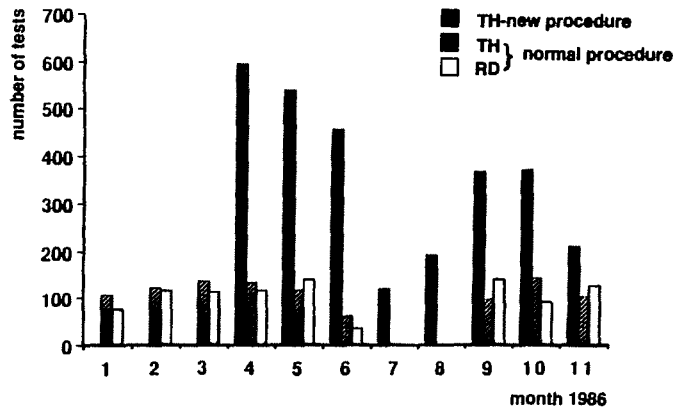FIG.14. TOTAL NUMBER OF TESTS IN THE HAGUE AND ROTTERDAM

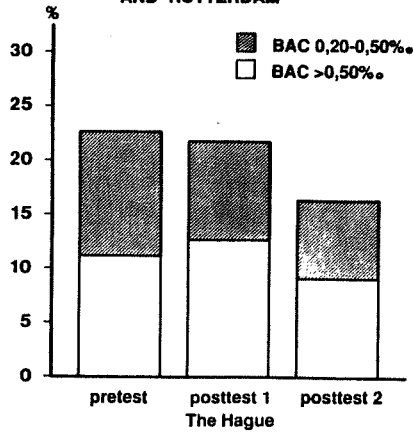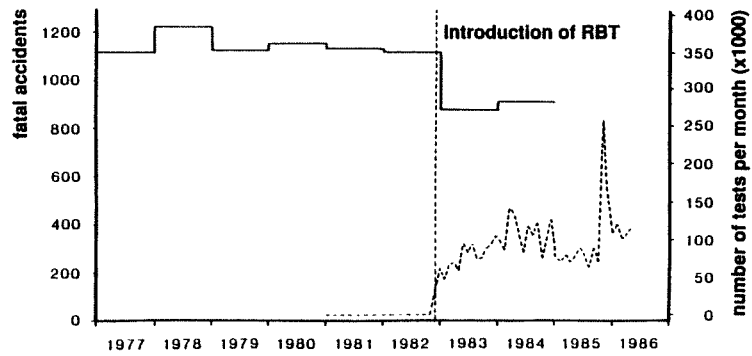FIG. 15. THE BAC DISTRIBUTION IN THE HAGUE
AND ROTTERDAM

FIG. 16. FATAL TRAFFIC ACCIDENTS AND NUMBER OF TESTS

left out all together without any negative effects. Without increasing the police-enforcement capacity over the year, however, police enforcement organized and managed in a different way will have long lasting effects.

In order to achieve that police enforcement must:
- be concentrated in particular areas and periods
- rise above a certain minimum level
- be obtrusive and stationary
- be combined with sustaining activities, such as information and automatic unobtrusive control (radar)
- be repetitive on places in a area and irregular in time, but frequent at the start.

After the behaviour is changed, only marginal freqencies of intermittent police enforcement on a certain minimal level on these place are necessary in order to keep the changed behaviour on the attained level.

The police capacity than can be directed to other areas with the same scheme.

The last example that shows the possibility for a more effective police enforcement is taken from the topic of drinking and driving.

In Figure 14 we display the number of alcohol controls that were performed in The Hague and in Rotterdam in 1986. In The Hague an extra team was equiped with new breathalizers instead of the classical procedure and was instructed to test every driver whether he was suspected or not.

The efficiency of that extra team was about 60% higher. The result also shows that in 25% of the cases the selection by suspicion was incorrect (25% < 0,5 o/oo BAC), but even worse that about 33% of the non-suspected drivers incorrectly were not selected (33% > 0,5 o/oo BAC).

The higher intensity of police enforcement in The Hague after April 1986 resulted in approximately an enforcement level of 2% of driver-license holders in The Hague per year, the level of enforcement before was about 0,5%.

In Figure 15 we show the effect of drinking and driving obtained in The Hague.

It can be seen that there was a decrease in drivers above the displayed BAC levels. If the new way of control with complete and random breath testing scheme would have been used by the usually applied police capa-

city, the level of control would have been about 1,5% per driver-license holder per year. That this level of enforcement is not enough to abandon the habit of drinking and driving can be seen from the posttest in The Hague.

The level needed to accomplish that may be illustrated by the results of New South Wales. The introduction of the random breath tests there after 1982 resulted in a control of 33% of all license holders per year.
In Victoria similar results were obtained by a million breath tests per year or about 1 hour police enforcement per week on 3750 inhabitants, which is nearly 10 times higher than the capacity used in The Hague. The effect of that level of enforcement on fatal accidents is shown in Figure 16.
It means that fatal accidents are reduced by 20% at such a high level of police enforcement on driving and drinking. This is not unexpected since more than 20% (workdays) or even 40% (weekends) of the fatalities under drivers were above the level of 0,5 o/oo BAC. These percentages are not unrealistic for The Netherlands or parts of the Federal Republic of Germany. It may therefore be concluded that besides more capacity for enforcement on drinking and driving, the efficiency of the random breath testing is needed in order to bring the level of police enforcement to the necessary level.

To conclude: Fatality rates can and will be reduced by actions of the community. One of the actors in that process is the police, who can effectively change the behaviour of drivers.
They can do so not only by more capacity for enforcement, but foremost by adopting new strategies for enforcement.

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