

Enforcement and Rewarding Strategies and Effects



Enforcement and Rewarding: Strategies and Effects

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The Organisation for Economic Co-operation and Development has a Road Transport Research Programme which centres on road and road transport research, while taking into account the impacts of intermodal aspects on the road transport system as a whole. It is geared towards a techno-economic approach to solving key road transport issues identified by Member countries.

In 1974 an OECD report on 'Research on traffic law enforcement' was published in which an overview was given of the major elements in the traffic law enforcement system. It also contained a comprehensive review of research on the effects of enforcement of legislation on traffic offences, on traffic accidents and on both offences and accidents. No information was found on rewarding desired behaviour.

To reward desired behaviour and to punish undesired behaviour are two different ways to bring about changes in behaviour. While punishment has been used in various forms for many years, rewards are still rare, and it is to be decided for both ways, to which extent they are efficient and effective in the long term.

The symposium 'Enforcement and Rewarding: strategies and effects', which was held in Copenhagen, Denmark, had the aim to look for answers to questions such as:

- Is there a difference in effectiveness between incentives and rewarding?
- Are immediate rewards more effective than postponed ones?
- To what extent is the effectiveness affected by the amount and the likelihood of a reward?
- How does effectiveness of group rewards compare with rewards to individuals?

Similar questions were asked concerning police surveillance, punishment (immediate as well as postponed) and the threat of punishment.

A few years ago little was known about the effectiveness of using collective or group penalties for changing road user conduct. During the symposium examples of such measures were discussed and their merits were analyzed. Collective rewards are coming into use in the form of economic incentives offered by central governments to local governments who provide road safety improvements exceeding a set level. The symposium has discussed and compared the results of such systems.

In recent years combinations of information to road users and police surveillance have been tried as a means for changing behaviour. The total effect seems to be better than expected on the basis of the sum of the parts.

Rewards and incentives involve an economic risk and should only be applied if the marginal effectiveness is comparable with that of other still unexhausted venues to road safety improvement. Similar

surveillance and enforcement tend to be very expensive in terms of manpower. Any increase in these activities should therefore be examined with a close view to its efficiency compared with other road safety measures.

New information on the planning, operation and execution of rewarding and incentive system was given. There are interesting developments in the field of public information combined with surveillance and enforcement. An exchange of experiences and comparison of the results took place.

The participation of researchers as well as central government policy makers, local government representatives, police authorities and insurance companies resulted in the most timely setting for gathering and discussing existing experience.

Acknowledgements

First, and foremost, the editors owe a great debt to the authors whose efforts laid the groundwork of what has become an exciting symposium. Second, we are indebted to the members of the Scientific Committee and Organizing Committee; the quality of the symposium benefited from their critical comments, encouragements and help. Last, but by no means least, we thank Anita van der Vorst, who has handled, in exemplary fashion, a mass of details involving the preparation of these proceedings.

M. J. Koornstra
J. Christensen

HANS ENGEL

Minister of Justice of Denmark

Years of road safety actions taken by all the OECD and ECMT countries have reduced traffic risks. These reductions have been obtained even though road traffic has steadily increased during the last decades.

However, the number of traffic accidents and the number of persons killed and injured in traffic is still unacceptably high. Experience has shown that some of the so far applied road safety measures are quite effective, but also very expensive.

It is also common knowledge, that the economic situation does not allow an increase in the public expenses, no matter how recommendable the topic may be. For that reason it is essential to use the existing resources as effective as possible. New trends have to be defined to reach the overall target in reducing traffic risks.

In Denmark, quantitative targets have been set up in the Danish Road Safety Commission's recommendation of a road safety action plan.

According to the recommendations three action programmes have been set up to reach a 40-45 per cent reduction over 12 years of the number of persons killed and injured in traffic. Half of the measures recommended, aim at bringing about a better road user behaviour through instruction, information, control and other measures, suitable for affecting the road users.

Such measures are the most profitable, but unfortunately road safety actions cannot stick to these measures. It is also necessary to affect road user conduct through punishment and the threat of punishment. While punishment has been used in various forms for many years, rewarding is still very rare.

Little is known about the effectiveness of the sanctions used, and even less about rewarding measures. It is my hope, that the participants of this symposium will listen to and benefit of what will be said of the experiences of rewarding. In so far as it is practicable, I see great advantage in using rewarding measures towards the road users.

It is therefore with great pleasure that I welcome all the participants of this International Road Safety Symposium. I wish you all a fruitful discussion and a pleasant stay in Copenhagen.

B.E. HORN

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Good morning, I am delighted for the opportunity to participate in this international road safety symposium on Enforcement and Rewarding: strategies and effects. First I would like to commend both our hosts and the organizing committee for the excellent organization and preparation of this symposium. The active involvement by you the participants, will make the symposium successful.

The touch stone, and last resort, for our OECD nations' safety concepts - the containment of the frequency and severity of traffic accidents - is traffic law enforcement, whether popular or not, social and behavioral research have to cope with this issue and that is the reason why we consider this symposium to be of major significance. We, as the research community, have an obligation to assess and develop new strategies for traffic surveillance as a basis for accident prevention. Recently, the search for new integrated safety strategies has focused interest on the usefulness and effectiveness of rewarding approaches involving new ways of affecting individual and collective traffic behavior. That is the reason why we at the OECD have launched the present activity trying to combine discussions on both enforcement and awards. In order to ensure as far as possible follow-up of this symposium, we have coordinated this symposium with the European Conference of Ministers of Transport.

The OECD and the member nations have long recognized transport as a key element in economic progress with the International Road Research Documentation (IRRD) being established in 1965 and the Road Transport Research programme in 1967. The current programme is active in a number of areas. These include a look at:

Research perspectives where issues such as public and political priorities and the underlying reasons for changing research management structures are studied, advanced technologies and their future impact on transport is evaluated and means to improve the effectiveness of technology transfer and to increase the adoption of new technology are studied.

Infrastructure research where full scale pavement testing, geotextile applications, bridge management research and dynamic loading of pavements are all being addressed.

Road safety research where studies on the insurance system and its potential role in accident prevention, marketing of traffic safety information, the effects of

enforcement and rewarding on driver behaviour (you will be hearing a lot more about this over the next two days), and the effects of driver selection, training and licensing on the role of heavy freight vehicles in traffic accidents.

Road traffic management and control including such topics as communications systems to facilitate route guidance, truck routing and networks especially for overweight or oversized vehicles, and tunnel operation and safety.

Road transport analysis activities include the International Road Traffic and Accident Database (IRTAD) along with studies to guide and study the impacts of future developments in communications in road freight transport operations, transporting dangerous goods, and future road transport schemes for urban areas; and finally

Developing countries programmes aimed at adapting technology developed in the industrialised nations for use in the developing countries. These studies are primarily directed at maintenance management and traffic safety.

To conclude, let me quote the major conclusion of a study we undertook in 1974 on *Research on traffic law enforcement*:

'There is an air of uncertainty surrounding traffic law enforcement as a means of effecting the safe and efficient movement of traffic. This is due to the almost total lack of research into the effects of many components of the traffic enforcement system and their interactions. The police component has been researched to some extent and such evidence as is available is reviewed in the report. Almost no research or experimental work appears to have been carried out on the effective use of police in achieving the efficient movement of traffic. Scientific evidence to indicate the degree to which police enforcement and surveillance contributes to accident reduction is scarce. Most of the experimental work reviewed in the report appears to strongly suggest a positive road safety value in increased police enforcement. However it cannot be stated categorically that such is the case.'

I look forward to a stimulating and informative symposium which I hope will challenge these conclusions.

I would like to commend our hosts, the Danish Council of Road Safety Research and the Dutch Institute for Road Safety Research SWOV for having done an outstanding job of planning and organizing this symposium.

INCENTIVE PROGRAMS FOR PROMOTING SAFER DRIVING

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I will discuss incentive programs for promoting safer driving. I am an experimental psychologist who has spent most of his professional life studying learning and memory of college students as they work on artificial laboratory tasks; I have not done research on the psychology of driver safety, so you must be prepared to excuse a certain naivete in my remarks due to my unfamiliarity with the research on driver safety or current national programs to improve road safety. With those excuses given in advance, let me begin.

All of us are well aware that traffic accidents—and the injuries, fatalities, and damages they cause—are a major cost of our transportation system. Reducing those devastating costs requires a multidisciplinary effort: transportation engineers, automotive engineers, governmental agencies and police departments all contribute to making our highways safer. However, I will confine my remarks here to the behavioral science perspective.

I will focus on improving safe driving practices through programs aimed at individual drivers. One has only to examine the current laws and their failures to realize that the level of accident losses is about what our societies have resigned themselves to accept as the necessary cost of a fast, convenient transportation system that still allows its citizens to drive with relative freedom from aversive restraints. People love the freedom provided by their cars; they treat them as an extension of themselves. This attitude is reflected in a car advertisement currently playing on television in America. The ad opens with a long, slow shot of a Cadillac and a voice says, "Psychologists state that many men use performance cars as a symbol of their manhood. We'd like to point out (here the camera scans along the car) that Cadillac is significantly . . . longer . . . than the competition."

Because people's cars and driving often expresses their personal style, they resent any law that restrains their driving. This attitude must change, so that people view driving as a solemn obligation to protect the community rather than an opportunity to flaunt their individual machismo in reckless highway games.

Speeding: Variable Limit Systems

What driving practices contribute to vehicle accidents? The police consider speeding a major cause of auto accidents. Their popular slogan is "Speed kills." Despite their concern, there is no doubt that the present system for setting speed limits and enforcing their compliance is a colossal failure.

I expect Europe is similar to America where practically everybody drives faster than the speed limit most of the time, and enforcement is infrequent and sporadic. When looking at this massive failure, the first thing a behavioral scientist would ask is, "Who's setting the speed limit? Why do 90% of the people think it's perfectly safe to go faster? Are we all so stupid that we are taking unnecessary risks?"

I think a strong argument can be made that the speed limits on most highways are set too low and that we should consider more realistic, variable speed limits. In such a system, the speed limit on a given road would be set at a level that changed over time depending on the prevailing conditions of the highway, adverse weather and traffic congestion. I have heard that variable speed limits have been tried on some European highways with some success.

The notion of variable speed limits assumes that the middle 70% of drivers are rational in choosing a speed that balances their arrival time against the risk level they are willing to accept. Apparently drivers who go much faster, or much slower, than the average car are more likely to have an accident. Figure 1 shows this U-shaped relationship based on United States highway reports from 1982 (Warren, 1982). It shows the accident involvement rates per 100 million vehicle-miles driven depending on the vehicle's deviation from the average speed in miles per hour, the three curves representing data from freeways, smaller highways during daytime and during night driving. The fact that slow-moving vehicles have as high an accident rate as fast vehicles indicates that both a lower and an upper speed limit should be set. The graph suggests that accidents would be minimized if most people drove near the average speed at which traffic flows smoothly without bunching up. If everyone drove near that same speed, it would maximize distances between cars, reduce overtaking, lane changing, and rear-end collisions. A further recommendation is that the desired average speed would be that which most drivers would spontaneously adopt for given road conditions.

A variable system would post the recommended speed limit on electronic highway signs every few miles. These speed limits might be changed every half hour or so by a computer which took account of the traffic congestion and the weather. In addition, the signs could indicate lane closures due to work crews or accidents on the road ahead, suggested slowdowns due to traffic jams ahead, and alternate routings.

The U-shape of Figure 1 may be a consequence of the fact that accidents most likely involve a faster vehicle overtaking and hitting a slow vehicle. We could simulate travel of a collection of vehicles moving at different speeds, adding the assumption that whenever one vehicle overtook another their momentary accident rates were slightly elevated. I imagine that that assumption would suffice to produce the U-shape of Figure 1.

An immediate advantage of a higher average variable speed limit is that in one stroke the state would reduce the currently outrageous percentage of people driving at unlawful speeds, and perhaps make speeding a more substantial social evil than it is at present. My variable system would convey the message that it is variability of speeds among different drivers that kills since that causes the bunching up of cars in dense traffic. But even with variable speed limits, there will still be many speeders and reckless drivers. In America we have the saying: "The most dangerous part of a car is the nut that holds the steering wheel." What more can be done to reduce the reckless driving of the nuts?

Behavior Modification Techniques

Behavior modification techniques can be used to alter maladaptive habits like unsafe driving. These view the problem behavior in terms of its ABCs: the A stands for Antecedents or events that just precede the behavior, the B for the Behavior itself, and the C stands for the Consequences of the behavior—both the immediate consequences and the delayed ones. Consequences can be rewards or penalties and these can vary in their magnitude, timing, and type.

The set of techniques for modifying behaviors is large.

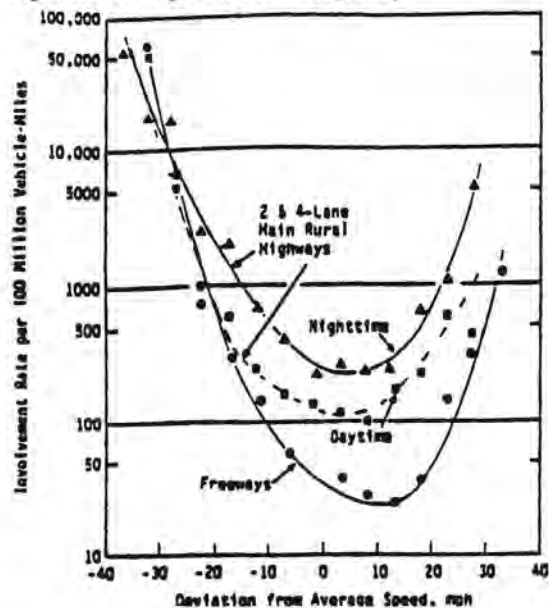
Scott Geller and Timothy Ludwig (paper in this volume) list 24 such techniques. I have compressed their list into three categories shown in Table 1: No explicit incentives, incentives for individuals, and incentives for groups of drivers. No incentives include the traditional methods favored by public agencies because they are inexpensive,

Table 1

Categories of Behavior Modification techniques
Adapted from Geller and Ludwig (this volume)
No Explicit Incentives
*State Norms; Model Behavior; Give Reasons
*Discuss; Persuade; Elicit Commitment
*Present Reminders; Activators
Individual Incentives
*Goal Set: by Agency; by Self; Competition
*Promised: Feedback; Reward; Penalty
*Received: Feedback; Reward; Penalty
Group Incentives
*Goal Set: by Agency; by Group; Competition
*Promised: Feedback; Reward; Penalty
*Received: Feedback; Reward; Penalty

Here one tries to alter some behavior, such as getting drivers to buckle up their safety belts, by passing a law which sets forth the norms, by giving lectures informing people of the new rule, and by demonstrating or modeling the desired behavior in television ads or movies. Publicity and announcements can be effective, especially when the

Figure 1. Accident rates depending on deviation of vehicle from average speed on the highway, for freeways and for rural highways during daytime and nighttime driving. From Warren (1982)



target behavior is easy to perform and its benefits are obvious. Publicity is far less effective when the behavior to be changed is inconvenient or a bother to carry out, or when it has its own sources of reinforcement such as speeding.

The second technique with no incentives engages the participants in discussion, trying to persuade them and get them to commit themselves to performing the desired behavior. We can also present cues which remind people of their commitment, and prompt them to carry out the behavior.

Unfortunately, people eventually habituate to reminders and tune them out. The hope is the reminders will train a strong habit that will persist because of its intrinsic reinforcement.

The second and third class of techniques in Table 1 use goals, incentives or disincentives, these have more certain, durable effects, and so are more often used. In these cases, the individual accepts a goal level of desirable behavior to work towards; his behavior is monitored and feedback is given about how closely his behavior approximates to the goal. The individual's goal may be set in three ways: by some agency, perhaps the company for which a truck driver works; by the individual deciding on his own goal, perhaps advancing it as he improves his behavior; or the goal may be set by competition within a group, such as to achieve more good driving points than other drivers in the group.

Different kinds of consequences for the behavior may be promised in advance (as incentives or threats) or delivered after the action. Sometimes the feedback for performance may only provide information about it rather than explicit rewards. For example, in research conducted in Nova Scotia and in Israel, Ron Van Houten and his collaborators (1985) significantly reduced accidents and the percentage of vehicles exceeding the speed limit along given roadways by simply posting beside the highway a large sign saying "Drivers not speeding last week was X (e.g., 40%). Best record so far is Y (e.g., 60%). This sign gives feedback about recent group compliance, sets a standard, and prompts the lawful drivers to reward themselves by noting how they are contributing to the group welfare.

Parameters of Reinforcement

Information feedback can be augmented by explicit positive rewards for achieving the goal or by penalties for falling short of the goal, for undesirable behaviors. Rewards can be such things as praise, money, tokens, points, or coupons that provide a chance to win a lottery.

Penalties can be fines, reprimands, license suspensions, demands for restitution, for community service, or for repeated practice of the correct behavior undoing the error.

For example, a person caught running through stop signs might be required to repeatedly practice braking to a full stop at stop signs.

Adaptation Level theory as well as Weber's Law tells us that the impact of a given monetary incentive or penalty should depend on how large a change it brings about in his or her wealth. This change is best calibrated as a percentage of the person's wealth or income level.

Penalties need not be monetary: in America one of the most effective penalties for reckless or drunk driving is suspension of the driver's license for three months or longer, because this causes enormous inconvenience for the driver and his family. Such suspensions would still be very aversive even if shortened to two or three weeks, so they could be applied for less serious driving offenses but used more often. The principle is that a moderate punishment delivered with high probability is far more effective than a severe punishment delivered with very low probability.

The impact of a reward or penalty also decreases with its delay after the behavior. That is, future consequences are discounted when viewed from the present time. This is why self-injurious behaviors like smoking, overeating, or drug abuse may persist: the immediate gratification more than offsets the long delayed bad consequences of the behavior. Reckless driving practices are a bit like overeating or drug addictions: each act may confer some immediate gratification, such as getting ahead of other drivers, but habitual use is likely to be eventually destructive. We can reduce the time discounting and bring forward the remote consequence by the use of language and imagery. Thus, we can rehearse the contingency between our action and its delayed outcome, as when we say "I'll be punished for this action next week" or later when we say "I'm being punished now for what I did last week."

One of the most important aspects of a reward or penalty is the probability that it occurs immediately after the critical behavior. The more reliable and consistent the outcome, the greater the impact of the incentive or disincentive contingency. This suggests that we should reward drivers in different instances of safe driving and penalize them for most instances of unsafe driving, and almost never permit the reverse to happen. Unfortunately, it is precisely in this area of monitoring the behavior of the hordes of individual drivers and applying contingencies that safety programs meet their greatest challenges. Later I will return to this topic of monitoring the driver's behavior.

To finish up the information in Table 1, the bottom part describes incentive programs for coherent social groups such as truck drivers of a delivery service, taxi drivers, university students in different dormitories or fraternities, and so on. The impact of group goals depends on how much each member accepts and works to attain the goal, and that effect is the degree

to which they identify with the group and can be influenced by its members.

While the slide lists the techniques separately, any given program to promote driver safety typically contains several such methods—lectures, reminders, incentives and penalties with both individual and group contingencies.

People wanting to change others typically bring to bear all the influences they can conveniently put together.

Different Approaches to Driver Behavior

The behavior of the individual driver can be analyzed according to several different approaches and at several different levels. One approach is that of human factors which views the driver as an information processor. This approach analyzes the sensory information the driver uses in judging highway hazards, the motor skills needed to brake and maneuver in dense traffic, and his decisions in assessing upcoming road hazards and the ability to cope with them. This approach links up well with that of highway engineering and design, with its concern for building safer highways; it also links up with the approach of automotive engineers who try to design vehicles that are easier to drive safely.

A human factors approach might point out how drivers are misled by several illusions of motion perception which cause them to believe that they're going slower than they are, that they can see better than they in fact can, and that they can stop quicker than they can (see Appendix A).

Such findings illustrate the general principle that most drivers are overconfident about their ability to cope with unexpected events such as a sudden flat tire, a pedestrian darting into the road, or a vehicle ahead suddenly stopping.

Because drivers have driven so many hours without encountering these rare events, they have nearly extinguished watching out for them. Moreover, overconfidence in their ability to cope is rarely tested except when an unexpected event happens, and by then an accident is likely.

We can recommend that driver training classes should more often warn student drivers and give them corrective feedback about these perceptual illusions and try to shake their overconfidence in their ability to cope with highway hazards.

Another approach, complementary to that of human factors, is to view the driver as a bundle of motivations.

This approach views a complex behavior like driving as a hierarchical plan with several levels of goals and actions.

At the top level in the hierarchy is the person's goal for taking a given trip, say, to drive into the city to attend a concert; at the next level the person chooses a route and an expected driving time, which determines when he leaves home and how fast he tends to drive; at the lower level of this plan hierarchy are moment by moment decisions about maneuvering in traffic, whether to overtake in given circumstances, and so on. Decisions made at the top level trickle down to affect the urgency of actions at lower levels. In particular, if the person hasn't allowed enough time, then he's more likely to speed and take greater risks.

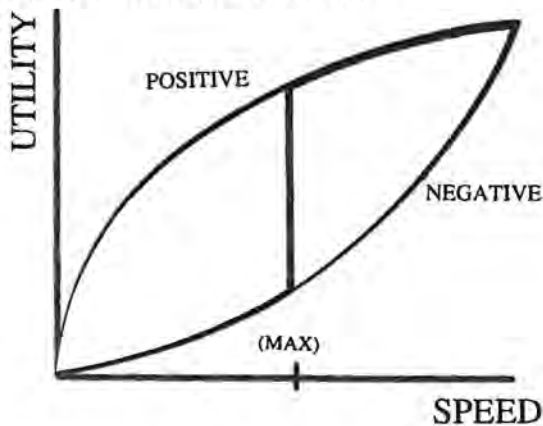
Drivers are influenced by many possible motives to reach one's destination quickly, to compete against other drivers, perhaps to show off one's driving skills, and so on.

But in the moment by moment decisions, the main

motive is to avoid accidents, injuries, and police citations. The driver's selection of a speed can be analyzed in terms of maximizing his utility, as shown in Figure 2. This plots two hypothetical curves, the top curve indicates the total positive utility of driving at different speeds, and the bottom curve indicates the total negative disutility or risk that the person associates with those speeds for given road conditions. The top curve reflects all positive factors leading to faster speeds, such as the value of getting to the destination, the thrill of beating other drivers, and most importantly the value of the time saved by getting to the destination sooner. The bottom curve reflects the combination of factors promoting caution, such as the person's momentary assessment of the accident probability based on conditions of the highway and his assessment of the probability of being caught by police were he to drive at a given speed.

The basic assumption of this model is that people will choose to drive at the speed that maximizes their net utility, the difference in positive minus negative utilities. The speed that maximizes the utility is indicated in Figure 2 as MAX and is an equilibrium

Figure 2. Hypothetical utility (positive) and disutility (negative) curves representing the value of driving at different speeds. The analysis requires a concave-downward positive curve and concave-upward negative curve, as provided by power functions with exponents less or greater than unity.



point because any further increase in speed beyond that produces a gain that is more than offset by an increase in risk. The model is similar to that of Gerald Wilde (1982) who assumes that people drive so as to produce a preferred level of risk.

The model implies that the equilibrium speed changes appropriately as we alter the positive incentives or the risks for fast driving. Figure 3 illustrates the case of increasing the value of getting to the destination quickly - for example, a man is rushing his pregnant wife to the hospital. This situation increases his value of getting there quickly, raises the upper curve, and shifts the maximum net utility to the right, to a higher speed. Figure 4 illustrates the case of increasing the risk of fast driving perhaps the road is slippery, visibility is poor, or police surveillance has increased. This raises the risk curve, so the equilibrium point shifts to the left, to slower speeds when there is more risk.

The equilibrium model can easily be applied to analyze what happens in new conditions such as imposing a speed limit that is strictly enforced. That generates a graph like that in Figure 5 which has a jump in the risk curve at the speed limit. If the rule is strictly enforced, then the optimal solution is to travel

Figure 3. By providing greater reward for reaching the destination quickly, the positive utility curve is raised, moving the maximum point of net utility to a higher speed.

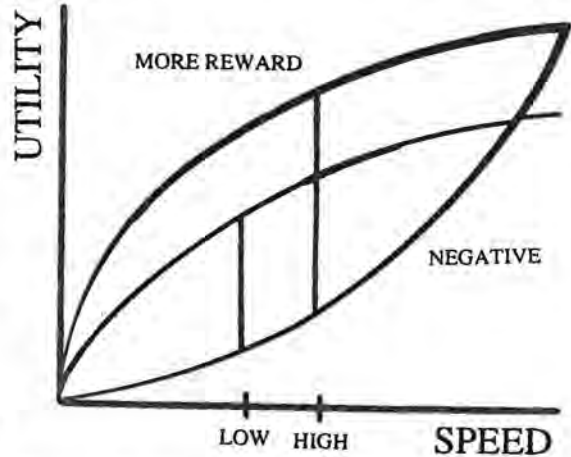


Figure 4. By increasing the perceived risk, the point of maximum net utility is moved to slower speeds.

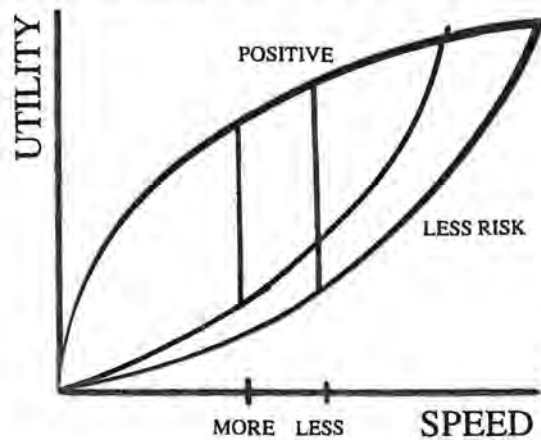
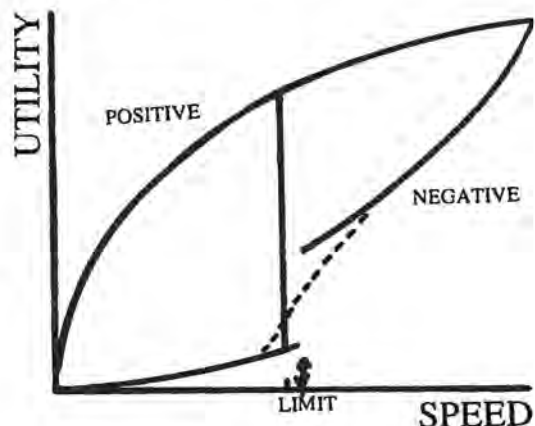


Figure 5. A speeding limit causes a jump in the risk curve. If the limit is more likely to be enforced at higher speeds, the dashed average risk curve is obtained.



at a speed just below the limit. If the limit is not strict but more likely to be enforced the more one exceeds it, then we get the expected risk function represented by the dashed line, and that has a somewhat higher equilibrium speed.

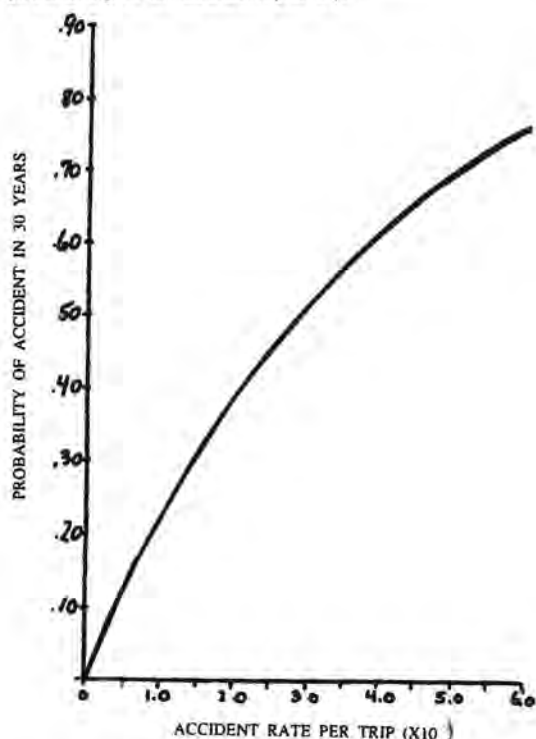
Modifying the Risk Curve

The risk curve reflects many factors, such as the person's fear of having an accident at different

speeds. We can elevate the risk curve by campaigns to frighten drivers, by publicizing and re-enacting on television many vivid examples where an unsafe action in a risky situation leads to a gruesome accident with much bloody maiming of the driver and his passengers. Other factors will lower the risk curve. For example, alcohol lowers people's fear of bad consequences. If the risk curve is lowered, then the maximal net utility will be moved to the right, towards higher speeds. So the drunk driver not only has poorer coordination and slower reactions, but he will also maximize his subjective utility by driving at a faster speed. And that is a lethal combination.

One way to increase the perceived risk is to get the driver to appreciate in more vivid terms the high probability that reckless speeding can lead to tragedy. The objective probability of being involved in a traffic accident is incredibly low, as is the probability that one will be caught and cited for speeding. An estimate I've seen (in Slovic, Fischhoff & Lichtenstein, 1978) is that the chance that an individual will be killed on any given auto trip is about 3 chances in a million, and that he will suffer a disabling injury is about 1 chance in a hundred thousand. Suppose that a person who drives safely lowers his chances of injury per trip by half to 1 in 200,000, whereas the reckless driver doubles his rate per trip, to 1 in 50,000. But these changes in probabilities are just too tiny for people to appreciate. However, these figures can be made far more impressive to drivers if they are scaled upwards to refer not to chances per trip but rather to chances of an injury or fatal accident over a 30-year lifetime of average driving, say, of 15 trips a week. This probability is shown in Figure 6 for different accident rates. In these terms, the chances of a disabling or fatal accident in a driver's lifetime is now almost one in two for the reckless driver, whereas safe-driving practices reduce that to around a one in 10 chance. Stated in this way, the reduction in risk is considerably more concrete and impressive (Slovic et al., 1978). A similar framing of benefits could be made to promote buckling up safety belts,

Figure 6. Probability of an injury accident in 30 years of driving at 15 trips per week related to the probability of an accident per trip.



which supposedly reduce the extent of injuries in accidents by over 50%.

Behavioral approaches also suggest that we examine common motives for speeding and see if we can reduce those factors. For example, we know that interrupting an ongoing plan to get somewhere is almost always frustrating. People react to backed up traffic jams with upset, irritation, and determination to speed up once they pass the traffic jam.

Is there any way to reduce that emotional reaction? One way is to teach drivers to reduce the time-pressure by leaving early and expecting some delays. An expected delay is not nearly so upsetting as an unexpected one, which is why rush hour commuters learn to expect delays and are considerably less frustrated by them.

A second method to reduce the aversiveness of an interruption is to plan for pleasant activities or jobs to do while waiting in a vehicle. While sitting in traffic jams, one can dictate letters, make telephone calls, listen to music or books on tape, plan daily errands or a vacation, and so on. Importantly, people can learn to use the interruption as an opportunity to carry out alternative plans. By reducing the frustration of the delay, the recklessness of the driver should be decreased after he's passed the traffic jam.

Monitoring Behavioral Compliance

Let me return now to the important topic of monitoring the driver's behavior. Effective behavior-change programs arrange some way to monitor the relevant behaviors and to give timely feedback. This monitoring component is precisely what we do not have for individual drivers. There is no Big Brother sitting beside each driver, giving him valuable points when he drives safely, and penalizing him whenever he commits some unsafe act. In place of such a monitor, researchers and agencies interested in studying driver behavior use derivative measures, such as accident rates and police citations for speeding or reckless driving.

For some purposes, such as setting auto insurance premiums or deciding whether to suspend someone's driving license, those kinds of derivative measures can be useful.

Bonus-malus systems Insurance companies are interested in promoting safe driving because, up to a point, it increases their profits. They do this with bonus-malus incentive systems which reduce a driver's annual insurance premium for each year of accident free driving, or which raise his premium when he has an accident or is cited for a moving violation. Bonus malus systems are useful tools, but the ones familiar to me could be fine tuned for greater effect. One suggestion is to make the payoff for good driving far more salient and conspicuous, and give it more promptly. Most customers are hardly aware of the incentive, since the premium reduction is often buried in the midst of the new billing of the annual premium, so the subjective experience is the unpleasant one of receiving just another bill to pay. One has no sense of being rewarded for good driving. A preferable option would be for the insurance company to collect in advance a large annual premium, and then to mail back cash refunds every four months of accident free driving, making a big fanfare linking the cash refund with the customer's safe driving. Of course, that adds short-run administrative costs for the company, but it might be cost effective in the long run.

While the bonus malus system is a good incentive

system, it falls short in several respects. First, one would like other segments of society besides the insurance industry to become involved in solving this society-wide problem of devastation on our highways; second, many drivers in America, estimated at 25%, do not carry any insurance whatsoever even though it is required by law in most states—that fact alone suggests how lax is the enforcement of our traffic laws; a third problem is that the unsafe driving behavior targeted for change only very rarely leads to police citations or injury accidents. Thus, the data used by insurance companies in the bonus-malus system have only a weak relation to the unsafe driving maneuvers that need to be changed.

I want to emphasize that it is the absence of an appropriate monitoring system for individual drivers that presents the major obstacle to implementing more powerful behavior change programs. Even the most sophisticated incentive programs will be minimally effective unless we can first solve the monitoring problem. We will have to be able to observe when people are driving safely or unsafely and then quickly apply rewards or penalties contingent upon how they are behaving. Without reasonably direct observation, precise response-outcome contingencies cannot be arranged, and so incentive programs will invariably yield ineffectual results.

Engineering Monitoring Systems

Because monitoring the behavior of individual drivers is so important, I scanned the transportation literature for engineering solutions to the problem. I found a few hopeful techniques, and there are probably several more that I missed. One device for monitoring a car's speed is a tachograph recorder, which is a small clock-driven device which can record a vehicle's speed, distance traveled, idling time, quick jerky stops, and so on. Each function is recorded by an ink stylus moving over a paper chart. In an experiment by Larson and her associates (1980), tachographs were installed in 224 police cars during 1976-77 in the Nashville, Tennessee police department, so that the driving of each officer using the vehicle was fully recorded. At the end of each 8-hour shift, the officer turned in his driving chart to his sergeant supervisor who reviewed the chart daily, questioned the officer about any speeds above the speed limit, questioned unexplained periods of idling, small collisions, and so forth. The supervisor provided officers with praise for acceptable charts, criticism for taking unacceptable risks, if the infractions were serious and frequent enough, the supervisor could issue a departmental reprimand to the officer and could even suspend him from duty with loss of pay for several days. This type of intervention, with monitoring plus incentive feedback, greatly increased safe driving, lowered speeds, and reduced the accident rates for these drivers; personal injuries from auto accidents were cut by one half to two thirds in different divisions of the police department. The savings in lost work days and repair costs for vehicles more than paid for the costs of installing the tachographs. Moreover, after a brief period of initial resistance, the field officers accepted the tachograph monitoring as a helpful part of their job. Based on such results, one can recommend greater use of tachographs throughout the world in companies and agencies committed to lowering driving accidents of their employees on the job. For example, tachograph monitoring is an obvious method for long distance trucking companies to

check whether their drivers are taking the required number of rest stops to avoid the dangers of driving while tired or sleepy. Of course, the trucking company itself may not care to enforce safety rules on its drivers, since driving slower and taking rest stops lowers the hauling productivity and profit of the fleet of trucks. And so one would have to address that problem, too.

A second method for monitoring driver behavior is the electronically-activated camera used at intersections in Singapore and some cities of New Zealand. The camera photographs cars running through red lights at intersections, thus catching them redhanded (Chin, 1989).

The license number of the red-light violator is identified and the car's owner receives a citation in the mail along with a photograph, the time, and place of the offense. The system need not be turned on except for a few hours a day, so long as the public believe that it may be recording them at any time at any intersection. The impact of such recorders can be considerably enhanced by publicity about the numbers of cited offenders.

Automated Surveillance Systems

I would propose greater use of such surveillance or monitoring systems. The camera system is fine and could be set up over freeways on gantries to monitor speeding. But the camera requires personnel to read the license plates of the vehicles; better to automate the vehicle identification, too. Using my imagination, I can envision future cars and highways in which each vehicle would have on board a small microprocessor or computer for recording speeds, weather conditions, the incidence of sudden stops, bumps and collisions, and perhaps the use of safety belts. Each vehicle would also have a small radio transmitter continuously sending out the vehicle's registration number and its current speed. Every few miles some unobtrusive receiver boxes on gantries over each lane on the highway would record these identifying numbers and classify the speed as excessive or not for the given road conditions. If the person were driving under the speed limit, he could be rewarded with a feedback signal like a doorbell chime that sounded in his car, informing him that his name was being placed in a state-wide, weekly lottery with a chance to win a substantial sum of money. On the other hand, if the vehicle's speed were excessive, then any of several penalties might be imposed. One alternative would have the receiver send to a central computer the registration number, the time, place, and speed of the offending vehicle. That computer would then mail out a citation and notice of fine to the owner of the vehicle, giving all the relevant information. If the owner of the vehicle was not driving it at the time, it would nonetheless be his responsibility to identify the culprit and see that the fine was paid.

A problem with the mailed citation is that the punishment is delayed until the driver receives it in the mail. We could make the penalty more immediately contingent on the speeding by having the roadside receiver turn on a buzzer inside the vehicle informing the driver that he has been caught speeding and will soon receive a citation in the mail. As a more Draconian punishment, one could imagine that the buzzer also informs the speeder that within 60 seconds his motor will shut off and stay off for, say 15 minutes, so he should quickly pull over to the side of the road to wait out this delay. For a person in

a hurry to get someplace, being interrupted and having to endure a time-out or delay of 15 minutes would be a very frustrating, aversive, and effective punishment. It is also a punishment that is inexpensive, has no human agent to get angry at, does not clog the court system, and is a punishment that fits the crime because it undoes or reverses one inherent incentive for speeding, namely, to get somewhere sooner.

Let me carry my fantasy a step further. Suppose that we use the computer on board each vehicle like a tachograph which would record and accumulate over several months its total number of speeding episodes, collisions, red-light runnings, and so forth. This recorder would be safely locked away in a tamper-proof strongbox in the trunk only to be opened and inspected every six months when the owner took the vehicle into his insurance agent. At that time, the owner and agent would examine the accumulated record for that period. Depending on the driver's safe driving record, the agent would on the spot refund part of the last period's premium and calculate the new premium to be paid for the upcoming period. This fantasy is technologically feasible now, and might add, say, 2% to the price of a new car.

Turning to other means for enhancing safe driving, automotive engineers have suggested many useful innovations.

One device would be a built-in light-meter that automatically turns on the headlights of the vehicle when you turn on its motor if the natural lighting is too low for adequate visibility. Another useful device would inform the driver by a buzzer just how safe is the distance in following the vehicle ahead of him. The buzzer becomes louder the less safe the distance to the car ahead relative to the driver's current speed.

Speed-Controllers

Other useful devices are those that artificially control the maximum speed of a vehicle, such as motor governors which are required on buses and large trucks in America. Another speed-controller is the deaccelerator (Schulman, 1985). This device attaches to the accelerator pedal and provides very high resistance when a driver tries to depress the pedal beyond a pre-set speed limit. The resistance increases as the pedal is depressed to levels above the speed limit. However, in case of an emergency need to go faster, the driver can overcome the pedal resistance by pressing with great force, and thus speed up.

The system has been successfully field-tested in a fleet of university-owned vehicles driven by employees, and it works well. Apparently, the pedal resistance is sufficient to remind drivers of the speed limit, and the extra required to go faster is sufficient to deter them from speeding. The deaccelerator's disadvantages are that it is not yet tamper proof and it can be pre-set for only one speed on a given trip, so it does not adjust to the different speeds appropriate to different roads.

A more flexible device could be invented with available technology that could electronically control the vehicle at any of several preselected speeds. Perhaps it would be feasible to make an electronically controlled governor or deaccelerator that would be linked to and controlled by a computer on board the vehicle. A transmitter on gantries over the highway would send to each vehicle's receiver a radio signal specifying a speed limit appropriate to

present highway and driving conditions for the next few miles; and this speed limit would be electronically set onto the deaccelerator pedal. With this system, then, a driver would be deterred from going any faster than a variable speed limit, although with special effort he could over-ride the pedal resistance to accelerate to avoid accidents.

You might be surprised to see that although I am a behavioral scientist, these last proposals to improve driver safety call mainly for technological fixes from highway engineers and automotive engineers. I do so because, within our presently inadequate system for monitoring driver behavior, it is far easier to change highways and cars so as to monitor and constrain drivers than it is to change their behavior directly. Psychologists know a lot about how very sophisticated and complex schedules of reinforcement control the behavior of subjects in laboratory experiments.

However, modifying driver behavior does not require sophisticated reinforcement contingencies. In my opinion, it simply requires better implementation of very simple, familiar contingencies. But that requires far better systems for conveniently monitoring drivers' behaviors so that we can apply those simple contingencies. And that's why I have emphasized various engineering solutions as a first step in monitoring to improve drivers' behaviors.

Final Comments

Many other safety recommendations come to mind regarding new devices, new regulations, and constraints on car advertising (see Appendix B). But enough of my fantasies and proposals to reduce traffic accidents. I imagine each of us has his own set of proposals to improve future transportation systems. There is little doubt that if adopted the various proposals would drastically reduce the accident and injury rate on our highways. But I think we can be reasonably certain that few of our proposals will be adopted by the public and the politicians. In fact, any American politician who proposed stringent controls and monitors of the sort suggested here could be committing political suicide. Why would our safety proposals be so unpopular? Partly because of the costs, but largely because the public does not want us to control their behavior, even when those behaviors en masse are killing us off at an alarming rate. The public consists of a large number of car junkies or speed freaks; they are like drug addicts who oppose attempts to control access to the drugs that are destroying them. Some of our proposals for traffic controls conflict with the libertarian ideologies of Western societies conflict with the value placed on liberty, freedom from restraint, individualism, and personal expression. Our societies want us to solve the problem of high accident rates, but to do so within the constraints of a democratic, laissez-faire society which jealously guards all manner of individual freedoms. We are in a position similar to that of doctors who have been asked to stop some disease epidemic that is ravaging the population, but we are not allowed to inconvenience anyone by installing effective public health measures.

What one does in these circumstances is to try to develop inexpensive band-aids and convenient but mildly effective measures that will be acceptable to the public. I think those are honorable goals but difficult to achieve. I convey my best wishes for success to the participants as you begin this conference on promoting driver safety. You are embarked upon a worthy mission. I will end by wishing you a safe journey.

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Appendix A

Several perceptual illusions can contribute to unsafe driving. Leibowitz and Owens (1986) have noted one perceptual miscalibration that can lull drivers into a false sense of security by believing that they can see and react far better than they actually can. The human visual system consists of several components, two of which are important in driving: one important subsystem is that used in guiding ourselves as we move around—for example, aiming and steering a car between the white lines of a highway lane; the other is that involved in object recognition—for example, reading signs or identifying pedestrians along a highway. Guidance can be carried on reasonably well in semidarkness, whereas object recognition is seriously degraded by poor lighting. Safe driving requires both systems, but in particular it requires the ability to detect hazardous objects and road conditions. Because the driver can

steer his car alright in conditions of poor visibility, in twilight, rain, or fog, he can be fooled into believing that he can also identify road hazards equally well, and therefore be lulled into driving faster than warranted by the visibility. This may be why the accident rate per mile driven during night time is 3 to 4 times higher than in daylight. In darkness, a dark-clothed pedestrian or a stopped vehicle on the road ahead can be identified in low-beam headlights at a distance of about 100 to 120 feet. Since it takes a driver about 2.5 to 3 seconds to identify an unexpected road hazard and begin to brake his car, a driver going 40 miles per hour will go about 150 to 175 feet before he can come to a complete stop—by which time he's likely to have hit the pedestrian or rear-ended the stopped car. And 40 miles per hour is a relatively slow speed; at higher speeds, drivers increasingly over-drive their headlights, relying almost completely on everything getting out of their way.

Other distortions of the risk curve can be produced by various illusions of motion perception (Shinar, 1978). The perception of velocity depends on the rate of streaming of the optimal flow field in peripheral vision. The error of velocity estimation increases if there are very few features or landmarks along the road. Thus we are likely to misjudge our speed when we move along flat, gray, featureless roadways or drive in conditions of poor visibility, such as fog or night time on unlit roadways. Because people underestimate their speed, they tend to follow other cars much too closely, so they can't avoid a collision if the car ahead suddenly stops.

Another illusion of motion perception is that of velocity adaptation, whereby the subjective feeling of a given change in speed is greatly enhanced by its contrast to the speed to which the person has just adapted. Thus, a person who leaves a freeway by reducing his speed from 120 to 80 kilometers per hour will perceive that 80 kph as very slow. This illusion of slow motion can cause him to exit the freeway at a speed considerably above the safety margin.

These are perceptual illusions that can be overcome the first, by highway designs to include road features and embedded reflectors; the second, by extending exit ramps and using signs that gradually reduce the driver's speed as he exits.

Appendix B

Proposals to improve driver safety come easily to mind.

One recommendation would require periodic inspection of vehicles to see that they have working brakes, headlights, and safe tires. In America, this inspection could be done at the same time as the required smog check on the engine.

Another recommendation would require periodic testing of drivers, especially the very old and very young. Other recommendations would apply to drunk drivers; there should be more random sobriety testing on highways along with stronger measures to minimize repeatedly drunk drivers. The most effective penalty is immediate suspension of the driver's license. Another technique is to install a breathalyzer on the drunk driver's car so that the driver must pass a breathalyzer test for low blood alcohol in order to start the car. Another measure would be to prosecute the bars and saloons where the drunken drivers were drinking just before they went out on the road. Another recommendation would be for the state to

control advertising that sells cars by promoting non-safe attitudes towards cars and their uses, that glorify cars and their powerful engines as a means for self-enhancement, for expressing one's freedom from social restraints, for macho challenging of competitors to drag races. We could prohibit the showing of popular TV series and films that portray fast, reckless driving as a thrilling behavior to be admired and imitated.

In America this summer (1990) one of the more popular films is Days of Thunder about the thrill and glory of stock car racers. The handsome hero, played by Tom Cruise, drives recklessly on and off the track, is involved in multiple scrapes and crashes, yet manages to escape without serious injury, eventually winning big prizes, the pretty girl, and the public adoration of all the other macho males in the film. I would bet that, through modeling reckless driving as joyful and admirable, that film alone will indirectly cause more auto accidents this summer than have been prevented by a whole year's traffic-safety publicity campaigns conducted by the highway patrol.

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**Session 1: Modifying individual road
user behaviour**

**Séance 1: Changer le comportement
individuel de l'utilisateur de la
route**



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1. Introduction and Problem Definition

My paper sets out to provide an introduction and framework for the papers in this first theme of the symposium. In its short compass it is impossible to provide any comprehensive review of such a vast topic. I have therefore chosen to try to present some underlying models and theories which need to form the basis of any scientific or practical study of the topic. A subsidiary objective is to draw some conclusions from the use of enforcement and reward in industrial settings, which may be of value to stimulate thought about the similarity with, or difference from driving situations.

In the first instance it is vital to be clear about the subject areas with which we are, and are not concerned.

1.1. Definitions and Delimitations

Individual behaviour is influenced by factors both internal and external to an individual. The internal factors are the capacities, goals, beliefs and values of the individual; the external factors are the physical design and layout of the environment and the social/societal framework, rules and norms within which the activity takes place. The focus of this symposium is on a subset of these:

We are only concerned here with behaviour which deviates from what we have defined as ideal because road users *choose* to deviate from that ideal, not because they physically cannot, or do not know how to act in the ideal way, nor because they do not know they are deviating from it, nor because they are misled into unintentional deviation.

This leaves the influencing factors of internal goals and values and the external pay-offs which social groups and society manipulate (consciously or unconsciously) to modify individual behaviour. Theme 2 of the symposium concentrates on the norms and values. I shall therefore concentrate more on the external pay-offs. However, it is premature to begin that discussion before saying a little more about what we have left out of consideration and how those excluded factors can set the scene for, or make impossible the use of motivational factors.

A widely accepted hierarchy of safety measures in the spheres of occupational and product safety gives the first priority to the elimination of a danger source, followed by its isolation and only then the use of warning and instruction and finally motivation to promote safe use. Such a hierarchy aims to force system designers to consider and justify why any unsafe actions and choices cannot be excluded from

the activity at the design stage. Application of such a hierarchy to the design of cars would put the onus on car makers to produce convincing arguments that the incorporation of, for example speed governors to eliminate high speeds, or tamper-proof interlocks between seat-belt buckles and ignition, would NOT enhance safety. The fact that such design changes are not made to remove choice from the individual level also has a motivational element. This has to do with the rewards and possibilities for enforcement at other levels than the individual (e.g. would such measures bring popularity to politicians or opposition from the car manufacturers?).

Given that the option for removing choice from the individual is not possible, or is not chosen, the success of motivational interventions is predicated on a satisfactory level of knowledge and skill in the road user. No one can be encouraged to choose an action of which they are not sufficiently master. Studies in the field of health education and industrial safety have shown that information about how to behave safely produces more behaviour change in many situations than attempts to frighten or coerce people into action by stressing the negative aspects of the unsafe behaviour. Fear can even discourage people from trying to find out for themselves how to behave safely. We should not jump too readily to the conclusion that people know sufficient, and have sufficient possibilities in order to act in the way we want them too.

1.2. Choices about what?

Having placed the focus on the influencing of choice, it is relevant to look at the question of choice about what.

1.2.1. Punishing accidents and rewarding their absence

The simplest answer is to define the choice as: all behaviour which leads to accidents, environmental pollution, excessive energy use, or whatever we define as an undesirable outcome.

If we measure this behaviour in terms only of its results and apply our rewards and enforcement to them we do not need to concern ourselves with how the results are reached. We can leave that to the person whose behaviour is being influenced and who will get the reward or punishment only if they can solve that problem. In this way we should achieve self regulation.

If we consider the application of penalties, this approach may have merit in improving the regulation of pollution (e.g. from car exhausts) because the current penalties of pollution do not fall sufficiently on the polluter. Its full blooded application to improve accident rates is more questionable:

- the current penalties of injury and death for some accident victims are clearly not enough in themselves;
- culpable accident victims are already punished additionally in some cases with fines or imprisonment otherwise we would not be here and this is not sufficiently effective, otherwise this symposium would not be necessary.

It could be argued that such punishment should be increased in frequency and/or severity in order to make all accidents have serious consequences for the perpetrator. Such reasoning would lead logically to the abolition of all but third party insurance, since fully comprehensive insurance reduces the penalty of an accident for the person who was responsible. These are extreme suggestions which smack of the laissez faire principles of 19th Century capitalism. They are only acceptable if we really believe that the individual is fully in control of the chance of causing an accident and that no other party (car designer, road designer, traffic management) plays a part.

It is an issue for research and debate how far along the road towards this use of punishment for having accidents we should go. The bonus-malus systems of insurance companies and extensions proposed to them indicate some possible steps. It may be of relevance that such a system of punishing people for having accidents is rarely used in occupational safety. The company may be fined, or the directors may even be put in prison for failing to run a safe system; the individual's injury compensation may be reduced for contributory negligence; but individual disciplinary action for accident victims is rare.

What is done more frequently in industry is to pay attention to initial job selection or to move someone who has had one or several accidents to another job, if there is evidence that he is not fit for, or cannot be trusted to carry out the one on which he was injured. The sanction of removing the license to drive from those who have accidents is a similar possibility, which transfers them to public transport. The use of such a sanction raises the fundamental issue of the right to drive. Current attitudes in most developed countries seem to accept only a relatively small hurdle to initial acceptance as a driver. For example c. 90% of candidates finally pass the driving test in the Netherlands. This is coupled with a comparatively rare and usually temporary removal of licences for only a small number of offenses (e.g. drunken driving). It is a matter of speculation whether increased concern for reducing car usage for environmental and energy conservation reasons may bring about a marked change in this societal belief in the right to drive.

The use of incentive schemes based on accident free periods is a far more accepted part of industrial safety practice. Its value has not been very scientifically tested, since most reports are in the professional and trade rather than the scientific press. However, the reported effects are highly promising. This is the intervention level described by Janssen in this symposium.

1.2.2. Enforcement and reward based on behaviour.

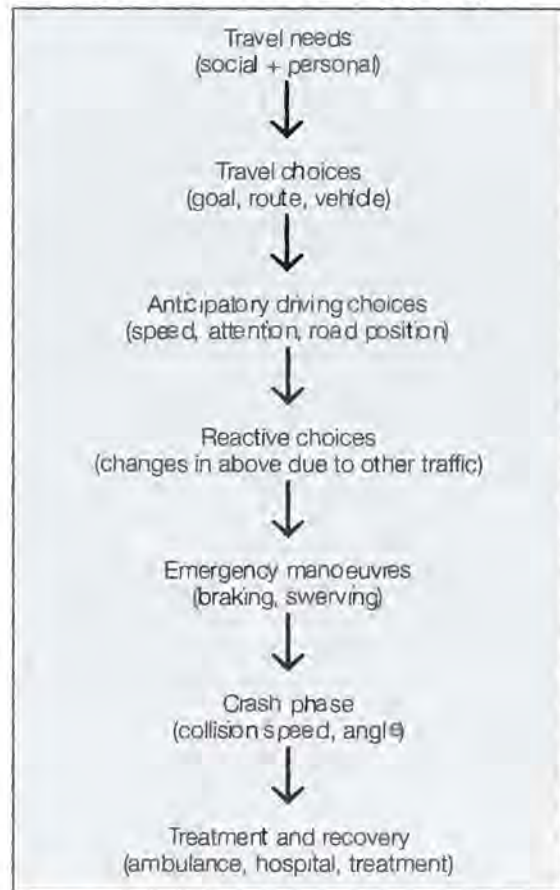
The use of enforcement or rewards based only on accidents rests on the assumption that the people concerned know what behaviour causes the accidents or will be able and willing to find it out (see also Fuller in this symposium). Usually we will want to use motivation applied to the behaviour relevant to preventing accidents. The majority of the papers in this symposium take this starting point. For this we must have a model of the decisions which it is relevant to influence. Asmussen's phase model provides a useful framework (see figure 1).

Decisions made at each step influence the behaviour we may be trying to control in order to break the sequence leading to accidents. For example the speed someone drives on a motorway is influenced

by many factors such as:

- Choice of car and its top speed
- Expected journey time given the chosen route in combination with start time.
- Concern for fuel costs & engine wear
- (Unexpected) hold-ups en route
- The intrinsic value of speed
- The feel & handling of the car
- Visibility
- Road design and layout
- Density and speed of other traffic
- Speed restrictions and presence of the police
- The reactions of passengers

Figure 1: Phase model of traffic behaviour (adapted from Asmussen & Kranenburg 1986)



These influence many different phases of the model. It is a matter of research which is the most effective phase to try to influence with motivation. With other safety-related behaviour the decisions we wish to influence may be more restricted. For example buckling of seat belts is usually a one off decision at the start of the driving phase; with drinking and driving the only effective intervention is to prevent people getting past the planning stage if they have drunk alcohol.

Again the question must be asked whether the road users themselves know what decisions in which phase influence the final behaviour choice (speed, seat belt use, drinking and driving, etc.) and hence can modify their behaviour if we change the rewards for that final choice. The more complex the pattern of influence, the more it may be necessary to apply the motivational influence to subsets of the choices leading to the final behaviour; for example by rewarding the purchase of cars with top speeds lower than the motorway limit and not just trying to motivate drivers of cars capable of 200km/h to drive at 100km/h.

1.3. Choice or learning

The success of motivation depends upon there being a choice to make. If behaviour is being controlled at the skill-based level, there is little or no choice involved at the moment that the behaviour is shown. Motivational elements can only influence the learning of such skills and not their implementation (Noordzij 1989). Only at the rule and knowledge-based levels can motivation have a direct influence. It is also important to remember that even quite large chunks of road user behaviour may be habits carried out at a skill-based level of control.

Taking the car to the pub on a Saturday night, driving off without buckling a seat belt and leaving too little time to drive to a meeting can all be habits which are more or less under automatic control. They have to be brought to a more conscious level before they can be first unlearned and then relearned more safely. The application of the motivational regime must take account of this dynamic if it is to have any lasting effect. This inertial element in behaviour has both positive and negative consequences for motivation. If enough motivation can be provided so that the person concerned feels it worthwhile to go through the unlearning and relearning phase, the reward or punishment can then be removed without risking an immediate reversal to the old unsafe behaviour.

Such a distinction between direct attempts to manipulate the desirability of a choice and indirect influence through the breaking of old, and the teaching of new habits is well known in the health education campaigns aimed at (problem) drinkers and smokers.

This discussion also emphasises that the rules which people use to govern their own behaviour are subject to constant change. People learn by testing the boundaries of the applicability of rules and seeing what the consequences are. In this way they refine skills and make them more appropriate to a range of different circumstances. They may thus erode rules which are designed for their long term safety, but which have little short term pay off. Motivational campaigns must address all these issues to be successful. They must not only initiate, but direct and sustain change.

2. Motivation and change

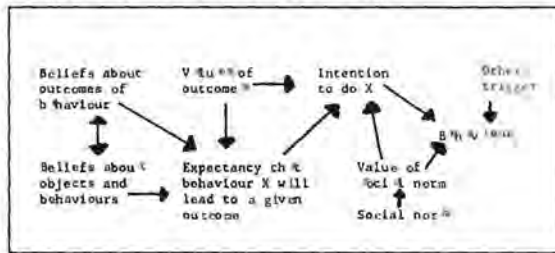
2.1. Theoretical framework

In order to understand the effectiveness of motivational campaigns we must have an underlying motivational theory from which predictions can be made and into which results can be fitted. Expectancy theory is a useful framework to choose because it provides a link between individual and social factors.

Using this framework it is possible to postulate some hypotheses about the mechanisms underlying some of the results reported in the behavioural change literature and in the papers in this conference. In particular it can be used to postulate stages through which motivational campaigns must push behaviour in order to achieve lasting change.

1. At the lowest level are influences of such factors as the presence of a police car on speed behaviour or the wearing of seat belts. These are largely temporary effects which fall under the heading of 'other triggers'. As soon as the trigger is removed, the behaviour reverts to the control of the individual and social norms.

Figure 2: Motivation, attitude & behaviour (adapted from Hale & Glendon 1987)



2. At a somewhat more permanent level are the influences acting on social norms and through them on behaviour. Media campaigns, police controls and signboards beside the road can make the existing social norm more salient for the road user and thereby enhance its effect in the short term and sometimes in the long term. The longer term effect is only likely to occur if the individual previously had a wrong impression of what the social norm is.

The importance of stating these norms clearly and feeding back information about how well people are conforming to them is shown by the results of industrial studies. These studies have been concerned typically with such behaviour as the wearing of protective clothing, use of machinery guards, good housekeeping. Observable behaviour relevant to a target are first defined and agreed with the group concerned; a system of sample observation of the defined criteria is set up and the results are fed back in graphical form to the group. This defines a group goal, makes progress towards it visible and hence generates and channels group motivation and conformity. Highly significant results have been achieved in some studies, even in the absence of any material reward for the progress (e.g. 70% reduction in accidents in a shipyard over 2 years). The direct applicability of such studies to traffic behaviour is, however, a matter of debate, because group pressures are much weaker than in a company, the only exception being perhaps professional drivers. Given the success of such techniques in industry, it is, however, worth considering how such feedback could be applied in traffic; for example by the use of new technology to detect undesired behaviour automatically (e.g. with speed detector loops) and indicate to the driver that it had been detected and recorded.

The majority of the papers in this symposium give attention to these issues of publicity of desired behaviour and acceptance of the norm among the target population.

3. A third level of effect is that achieved by changing the values of the outcomes. Changes may be temporary or permanent. e.g. an increased presence of police supervision is usually temporary, given the resource limitations of the police; changes in the price of petrol or the size of fines are more permanent (as long as they keep pace with inflation). The effect of temporary changes in reward or enforcement are only likely to last a limited time, typically 6 months to a year and may lead to a negative result even worse than the period before introduction, when removed. Only permanent changes in pay offs can be expected to have long term effects.

The influence of outcome values on behaviour is mediated by the expectation that the behaviour will lead to the outcome. This step caters for the effects

of beliefs about the chance of, for example, being caught and punished for traffic offences. Such beliefs are also influenced by media campaigns, e.g. about enforcement policy when a new law or speed limit is introduced. The large short term effect of such campaigns reflects partly the overshoot in the expectation that offences will be detected, which is often disproved by later experience. A subject of research is the optimum way of keeping expectation high with minimum resources, e.g. in the use of radar speed traps and cameras. The research literature on health education shows that people are inclined to underestimate significantly the chance of unwanted outcomes (Østvik & Elvik give as "Just Noticeable Difference" for police control a factor 3 increase). On the other hand the literature on gambling shows that there are significant overestimates of the chance of wanted outcomes. This suggests that, given the same objective chance of behaviour producing the outcome, rewards will be subjectively more effective than punishments.

An unwanted side effect of manipulating outcome values is that people will still try to maintain their other beliefs and behaviour as much as possible intact while still exploiting the new rewards or avoiding the new punishments. Such compensatory behaviour can be seen in the side effect of incentive schemes based on reported accidents, which tend to suppress the reporting of minor accidents (e.g. material damage or minor injury which can be self treated). Such an effect may make it appear that incentives are working better than they are.

4. The feedback loop between behaviour and the beliefs which are at the left of figure 2 indicates the long term effects of sustained attempts to influence behaviour. These can trickle through to more permanent changes in the individual attitudes and beliefs which are then more independent of the temporary motivational climate.

2.2. Individual and group differences

This discussion leads to a number of questions which can be posed of enforcement and reward campaigns. Given the different layers of factor discussed it is relevant to ask of any situation what the starting point of the individual and group values and expectations is. We may expect different results from a given intervention if a clear social norm for the desired behaviour has been established, than if no clear norm exists (i.e. the problem is not salient in the group, as is still the case with the effects of car driving on environmental pollution in many countries).

We may also expect that there will be individual differences in the sensitivity to particular sorts of motivational intervention. It will be relatively easy to convert those who are social conformists to new behaviour by changes in legislation and informational campaigns. Those who are basically convinced of the value of the desired behaviour, but inconsistent in following it because of forgetfulness or short term distractors, may be brought to greater conformity by raising the profile of the problem with reminders and warnings or by small changes in rewards or punishments. It is likely that there will always be a hard core of people who are resistant to such influences. In research on smoking such groups are known as "consonant smokers" because they are happy with their habit despite knowing its dangers and have no intention to try to give it up. Such groups have sometimes been shown to be less sensitive to social pressures and rules (Clark & Prolisko 1979). These 'hard core' groups do not

seem to have been the subject of such intensive research in traffic behaviour as in health education. The papers of Nilsson and Grant et al will take up this issue to some extent and the paper of Hagenzieker provides encouraging evidence that her intervention had a greater effect on a group often regarded as a hard core problem, namely young male drivers. There may be lessons to learn from the more intensive group and individual therapy applied to smokers or drinkers (perhaps even a Speeders Anonymous modelled on Alcoholics Anonymous or Weightwatchers).

Such differences in individual and group values will result in different techniques being necessary depending on the type of behaviour to be influenced, the degree to which the population already conforms to desired behaviour and the degree to which deviation is confined to a hard core of "consonant" rule breakers. Geller's paper makes a start on this classification of programmes and their effectiveness in different situations.

3. Change mechanisms and motivators

3.1. Rewards versus punishments

The outcomes to be influenced have been crudely grouped into rewards versus punishments (enforcement). There is no space in this contribution to explore the relative value of the different types of rewards and punishments (e.g. money, social pressure, challenge, legal sanctions). It is however important to try to distinguish the effects of positive incentives from those of punishment (see Hale & Glendon 1987, chapter 9 for a review).

Incentives provide a positive challenge to learning. From industrial studies they appear to be particularly good at inducing initial change in behaviour by making it worthwhile to consider breaking habits.

Punishments/threats/fear. These tend to work best to keep the already converted in line. Their influence on those not converted is to encourage rationalisation rather than change, resentment of those meeting out the punishment, and attempts to evade getting caught, rather than to change the behaviour. Their effectiveness relies on a high chance of detection and a fast response to the offence. In industrial settings negative feedback to individuals can be carried out easily by supervisors and the effect of social disapproval can be high, making relatively mild punishment quite effective. In traffic situations such a "middle management" layer is absent. Other practices may also limit the social effects of punishment: such as administrative handling of fines through the post rather than the social pressure of the police confronting the offender; the practice, in the Netherlands at least, of referring to offenders in the press by their initials and not their name also limits the social effects of punishments.

3.2. Successful incentive schemes

The lessons of industrial incentive schemes can be summarised as follows:

- specific and detailed targets must be set, preferably in consultation with the participants and should be explained clearly to the target group.
- these should preferably include not only individual but group targets in order to harness social motivation.
- the pay off contingencies should be as simple as possible and should be made clear, i.e. what behaviour leads to reward or punishment. They

should be seen as equitable by the participants.

- the target group should have (or be given) the necessary knowledge and skill to exploit the contingencies, and should believe that their attainment is dependent on their own behaviour.
- there should be rapid and clear feedback about progress towards the goals and rewards or punishments should not be delayed.
- the pay-offs should be meaningful to the participants.
- rewards should be progressive; one failure should not lead to all subsequent rewards being unattainable, but continued success should be more highly rewarded as it nears the target (on the assumption that more effort is needed to make improvements as the asymptote is approached).
- the whole scheme should be launched and run with a high profile to arouse interest and make the target behaviour salient.

Petersen (1978) tries to encapsulate the important issues in this area in a series of six questions which will determine the response to incentives:

1. Will my efforts bring results, or will factors beyond my control play a large part in outcomes?
2. Will the safety goal be rewarded?
3. Even if the safety goal is rewarded, will alternative goals be rewarded more?
4. Will other people be rewarded for my efforts?
5. Are the performance measures valid?
6. Would I achieve better results in another area?

4. Conclusions

This broad review of the modification of individual behaviour has put forward a number of models and frameworks to try to structure the discussion in this symposium:

1. A safety science model which warns that the manipulation of motivation is an intervention which comes low in the hierarchy of preferred safety measures. Only where measures to make undesired behaviour impossible are technically or politically (for the time being) not feasible and where design and training as preventive measures are reaching the limit of their usefulness should we move to the issue of motivation. If we do turn to motivation, we should not expect too much, and certainly not in the short term from temporary campaigns.

2. Models of the phases of decision making which lead to road user behaviour and the levels of automatic or conscious control of that behaviour. These indicate the scope and complexity of intervention in choice, but also the need to consider not only the execution of behaviour, but also the learning of routines. The importance of the knowledge of cause-effect contingencies, and the need to know how to behave safely were stressed. The choice of where to apply the incentives (to accidents as outcomes, to behaviour such as speeding or to the antecedent choices) depends on the degree to which the desired behaviour is known and available to the target group.

3. Theories of motivation and change, which indicate the factors which can be manipulated to produce short and long term behaviour change. Expectancy theory was preferred as a framework because it stresses the interaction of behavioural triggers, social factors, outcome values and beliefs and expectancies over cause and effect. Motivational campaigns must analyse how all these factors currently interact for the behaviour which is their

chosen target. Only then can they choose the techniques which are likely to be most effective both in the production of short term change and in maintaining that change over the longer term without the occurrence of reactance.

A link can be made to the themes of the rest of the conference in the importance given to the need for changes in social and individual values if behaviour is to be changed on a more permanent basis. The question of the conflict between the principles of comprehensive insurance and the necessary incentive not to have accidents was also raised. This issue has a long history in many countries in the discussions around no-fault compensation, bonus-malus systems and punitive premiums for high risk groups. The answer given at any one time to that question of trade-off between the two conflicting objectives of safety and compensation will define to a great extent the room for manoeuvre in applying individual rewards and punishments.

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REDUCING DRINKING-DRIVING BY INDIVIDUALS THROUGH ENFORCEMENT

6

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Many western societies have created the conditions for a drinking-driving problem by presenting incentives and inducements for drinking, while providing only private automobiles for transportation. The problem having been recognized, these same societies are now attempting to reduce it with disincentives and punishments embodied in the criminal law. The mechanism relied on is deterrence, which purports to reduce prohibited behavior by threatening that behavior with punishment. Although, at least in short run, the criminal law is unable to affect the underlying causes of drinking-driving (or other social problem, for that matter), to the extent that deterrence expectations are valid it can play an important part in controlling the problem.

This paper proceeds from an acceptance of a role for criminal law in controlling drinking-driving. It reports evidence from the evaluation literature concerning the impact of law on crashes and other measures of alcohol-impaired driving. Certain criminal and quasi criminal policies appear to be effective in reducing drinking-driving. These are in general not the ones with the most severe penalties, but rather those that appear to deliver moderate penalties in a swift and sure way. Among the most important are massive screening of motorists, as in random breath testing, and administrative application of driver license penalties, as with 'per se' and implied consent statutes. However, though they may possess deterrent effectiveness and be evaluated as cost-effective, not all of their real costs are included in traditional calculations. With suitable attention to avoiding all implicated costs, such policies may be recommended as internationally available techniques for use in the attempt to control the international problem of alcohol-impaired driving.

DETERRENCE-BASED POLICY

The criminal justice approach to social engineering is based on expectations embodied in the deterrence proposition. This proposition holds that legal threats will successfully deter behavior to the extent that they are perceived as swift, certain, and severe. Although intuitively appealing, the proposition has not been well confirmed, at least in its simple form, in empirical studies of the criminal law (Zimring and Hawkins, 1973; Ross and LaFree, 1986). I have on several occasions reviewed the international literature evaluating deterrent policies for drinking driving (Ross, 1981, 1982, 1985). In this paper I will note some important recent additions to the literature and evaluate their meaning for the

general subject of this conference, enforcement and rewarding.

Severity

Recent years have seen an abandonment of the most severe drinking-driving penalties, internationally. This has been seen most clearly in Scandinavia, where the retreat from long standard prison sentences has taken place on the background of increasing concern for enforcement, i.e., where reduced severity of penalties has been compensated by attempts to increase their certainty of application. Despite considerable concern on the part of temperance advocates, the reduced penalties do not appear to have negatively influenced the extent of drinking-driving in the northern countries. Rather, favorable trends existing over several years appear to have continued without change through the legal forms (Ross, et al., 1984). Evaluations of the complex changes of the last few years have yet to be done. Scandinavians do not appear to have become more tolerant of drinking-driving, but the rigidity and ferocity of earlier laws have been mitigated, and the results should be instructive.

Conversely, in North America, the severity of legal punishments has been increased in numerous independent jurisdictions. Currently, all states mandate jail or community service (forced labor) for second-offender drinking drivers, and some mandate jail even on the first offense. Evaluations of first offender 24 hour jail policies in Tennessee (Jones et al., 1987) and Arizona (Ross et al., 1990) found no measurable effect, either on the recidivism of the offenders or, through general deterrence, on the driving public. No evidence of deterrence was found for a local policy of 15 days in jail for first offenders in an Ohio city (Ross and Voas, 1989), although the theoretically requisite general perception of the severe penalty was indeed documented. Two studies of a Minneapolis judicial policy of 48 hours' jail for first offenders did claim a deterrent effect, but the one (Falkowski, 1984) based this claim on changes in crash statistics that occurred only after a two month gap following implementation of the policy, and the other (Cleary and Rodgers, 1986) noted the possible influence of numerous simultaneous changes in the handling of drinking drivers.

New evidence from other countries further supports skepticism concerning the deterrent effect of jail as compared with other sanctions for drinking-driving. In an Australian study, Homel (1988) found no impact of jail sentences of different length on subsequent recidivism. In Canada, Vingilis (1990) found that, for repeat offenders, longer jail sentences were associated with greater recidivism, an effect she speculates may be due to negative selection of candidates for jail.

Evidence from a correlational analysis of U.S. state data (Zador et al., 1988) does lend some support to

the claim of deterrent effectiveness for it. Although a similar designed study came to the opposite conclusion (Joksch, 1988), the prior one appears to have been better controlled, and it cannot be disregarded. However, the apparent effect was small (a 6-per cent drop in late-night fatal crashes) and the controls were of necessity incomplete.

To summarize, the balance of scientific evaluations of both increases and reductions in severity of legal sanctions for drinking drivers gives little reason to hope for important deterrent consequences from severe sanctions. The counterintuitive finding may possibly be explained by the fact that actual chances of apprehension for drinking drivers are very low throughout most of the world, and that these may be perceived by the target population as negligible. Indeed, one may speak metaphorically of there being a "death penalty" for drunk drivers, although with a probability of only about one in a half-million kilometers of impaired driving (in the U.S.), the magnitude of the alcohol related crash death rate testifying to the inability of this ultimate penalty to eliminate the problem. It should furthermore be noted that severe penalties for drinking driving have consistently been shown to lead to slowness and uncertainty of any punishment at all, compromising other aspects of the deterrent threat (National Institute of Justice, 1984).

Certainty

More promise appears in studies of drinking-driving countermeasures that focus on increasing the certainty of apprehension and punishment. Classical examples from Britain include the Road Safety Act of 1967 (Ross, 1973), which authorized police to breath test all drivers involved in accidents or traffic law violations, and the Cheshire Blitz (Ross, 1977), which by increasing enforcement recaptured the initial deterrent effect of the Road Safety Act. The effect of the Blitz disappeared when that enforcement campaign was ended as a result of political pressure, and the effect of the Road Safety Act disappeared over time, very likely as the public learned that actual chances of being stopped and tested had been vastly overestimated.

Recently there has appeared evidence of an apparently permanent increment in deterrence of drinking driving in the context of extensive and well-publicized enforcement policies in Australia. In the state of New South Wales and also in the state of Tasmania, police set up roadblocks and were entitled to stop any passing driver and demand an alcohol breath test at their discretion. Application of this technique has resulted in a million or more breath tests annually in New South Wales, with a driver population of only three million (Hemel, 1988). The ratio of tests to drivers is even higher in Tasmania, though the outcome there has not been comparably studied. It has been belatedly realized that similarly intensive police activity in other countries such as Finland may share responsibility for favorable developments in drinking driving (Ross, 1989).

The certainty of punishment for drinking drivers, once they are apprehended, can be greatly increased by substituting Scandinavian-type or "per se" drinking-driving laws for classical prohibitions referring to such subjective judgments as being under the influence of alcohol, or being intoxicated. Reviewed adoptions of this legislation in Canada,

Holland, France, and other jurisdictions in my earlier book. In general, deterrent results appeared to have been obtained, but the changes were temporary. Such laws are now general in the American states, and a cross-sectional national analysis (Zador et al., 1988) credits them with a 9 percent reduction in nighttime fatalities. The key to this apparent effectiveness may lie in the ability of Scandinavian-type laws to affect the perceived certainty of punishment. The previously noted continued suppression of drinking-driving in Finland, despite an enormous reduction in the severity of penalties, may be in part due to the adoption of a "per se" legal format in that country (Ross et al., 1984).

Swiftness

Swiftness of punishment for impaired drivers was not a feature of the legal interventions of a decade ago, except insofar as simplification of prosecution (as in adoption of "per se" laws) may have indirectly contributed. In any event, it was by and large impossible to isolate interventions that were mainly concerned with increasing the swiftness, rather than certainty and severity, of punishment. The advent of administrative license revocation procedures in the United States now provides an evaluation base for concluding that increasing the swiftness of punishment may produce deterrence. American administrative revocation procedures entitle police to take the licenses of drivers failing an evidentiary roadside breath test, or refusing to cooperate in the process (cooperation being mandated by so-called implied consent provisions of driver license laws). The testing devices are of the quality that would permit their admission in a criminal proceeding, and failing the test is equated with exceeding the blood-alcohol concentration tolerated in the criminal law, generally 0.10 percent in the United States. Driving privileges are retained for a short time in order to permit administrative appeals of the police action, but the loss of license does not have to await the outcome of a slow and uncertain criminal action. In numerous states, adoption of administrative revocation laws has been followed by reduced nighttime crash fatalities (Nichols and Ross, 1990). More formal evaluations have found evidence for both general and special deterrence (Stewart et al., 1989; Ross, 1987; Zador et al., 1989; and Klein, 1989) as a consequence of instituting administrative license revocation. The promise of these procedures for yielding deterrent results has rendered them a cornerstone of current attempts to establish national policy for deterring drinking driving in the United States. I am currently engaged in an evaluation of administrative license revocation in three states, funded by the AAA Foundation for Traffic Safety, which is showing that these laws can be applied in a way that serves to maintain fairness to both drivers and the traffic authorities.

THE COSTS OF DETERRENT POLICY

This paper is based on acceptance of deterrent policy as part of the political arsenal for the reduction or control of drinking-driving. As with many weapons, there are dangers in its use, which I would like to note as a caution for those considering further steps on the deterrent road for managing drinking driving.

First, the experience of punishment must be counted among social costs in determining whether a policy's benefits exceed its costs. The suffering of the punished violator is often overlooked in these calculations although he, too, "is of Mankind". This

concern has arisen most often in policy discussion when considering possible job consequences of strict and lengthy license actions in regions totally dependent on private automotive transportation. Although these fears often seem to be exaggerated (Nichols and Ross, 1990), they are sometimes realized, and some inconvenience and hardship may be expected for the offender and his family to the extent that the license restrictions are actually effective in preventing a person from driving. This has implications for the desirable length and absoluteness of license restrictions, which have not yet been adequately evaluated in the research literature.

More generally, reliance on threats of pain to secure responsible civic behavior might seem a questionable tactic for ethical governments, if other effective tactics are available as alternatives. In the context of the topic of this conference, can we not say in general that rewards are superior to punishments as the basis of the relationship between citizens and their governments? To quote Homel, at the close of his book reviewing the success of the deterrent approach in reducing drinking driving in New South Wales, "The costs in a democratic society of a system of enforcement and a style of publicity which rely increasingly on the creation of feelings of terror in the driving public should not be underemphasized" (1988: 271).

Second, the costs of engaging in various apprehension, conviction and punishment functions must be included. Law is not free; it does not jump off the statute books and affect behavior automatically. A credible threat requires machinery to back it up, and this requires resources, which must ordinarily be maintained over time. To lie to the public about the certainty and swiftness of a threatened punishment is not only unethical, but discrepancies are likely to be discovered and to result in attenuation of the perceived threat.

Third, deterrent policies may serve as red herrings to divert attention from alternatives based on more fundamental understandings of the origin of social problems. The roles of the institutions of recreation and transportation in inducing and inciting problematic behaviour like drinking-driving may be overlooked, and the agents of such institutions may be encouraged to continue in the status quo without accepting responsibility for its negative consequences. In the United States we treat alcohol as by and large an unexceptional commodity that fits into the market economy much like soap or sugar. Although improper use of any commodity is to be regretted, we fail to see unusual dangers in alcoholic beverages. We are told in the commercials that "beer belongs," and we see few sites or occasions where this should not be true, especially when we are off duty. Alcoholic beverages are relatively freely advertised and distributed, and they are promoted with all the skill of capitalist marketing. Even more incontestably do we assume the inevitability of the private automobile as the provider of transportation for every function, including that of recreation, and we sometimes glorify the assumption of risk in its use. An exclusive focus of deterrent measures detracts from considering whether programs for reducing the consumption of alcohol and of automotive transportation might not produce larger and more immediate reductions in drinking driving.

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FACTEURS DÉTERMINANT L'OBSERVATION DES RÈGLES DE LA CIRCULATION ROUTIÈRE

7

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La densité croissante de la circulation routière conduit de plus en plus à l'obligation de réguler le trafic par des prescriptions et signaux. Les usagers de la route ne se soumettent pas toujours de bon cœur aux contraintes qui en découlent. On observe même des comportements ayant un effet de boumerang. Lorsque les mesures juridiques sont trop nombreuses, les êtres humains ne s'y conforment plus, mais déjouent les intentions du législateur. Ce phénomène s'observe aussi dans la circulation routière et est sans doute en rapport avec le besoin de liberté. La population suisse, par exemple, a réfuté, vers la fin des années 70, l'obligation de boucler la ceinture introduite en 1976, et elle a obtenu son abrogation temporaire. Vu sous l'angle psychologique, il se pose la question de savoir dans quelle mesure l'observation des prescriptions est influencée par des facteurs tels que la réactance, les contrôles et la contrainte.

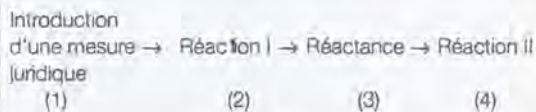
Comportement des conducteurs et réactance

Le comportement du conducteur est essentiellement déterminé par les trois éléments

- situation
- dispositions (faculté/capacité/aptitude à conduire)
- assimilation

qui sont en interaction: la situation stimule l'acte de conduite. L'assimilation est commandée par les dispositions innées. L'attitude du conducteur joue un rôle primordial dans ce contexte, bien que des facteurs tels que les émotions et les capacités intellectuelles interviennent également (cf. Huguenin 1988 a & b).

Si le législateur intervient dans le sens d'une optimisation du système global en introduisant ou modifiant des prescriptions, il s'attend à ce que se produise un changement de comportement. Toutefois, l'usager de la route réagit souvent par ce que l'on appelle 'réactance', définie comme 'la tendance à recouvrer toute liberté ressentie comme menacée ou perdue' (Bauer, 1987, cf. Brehm, 1966, Grabitz-Gniech, 1975). La théorie de la réactance tente d'expliquer les paramètres "expérience de la liberté" et "restriction de la liberté", ainsi que les réactions aux restrictions de la liberté d'action. La réactance à la situation suivante est en premier lieu commandée par des mécanismes affectifs.



Facteurs déterminant l'observation des prescriptions

Basé sur ces réflexions un premier modèle théorique fut établi en qualité de base hypothétique contenant les facteurs principaux connus, déterminant l'observation des prescriptions (O). Les variables indépendantes, déterminant O, étaient les suivantes:

- R = réactance
- A = approbation d'une règle/norme
- I = information
- C = intensité des contrôles
- P = peine antipécuniaire

On part du principe que les diverses variables s'influencent mutuellement et intensifient/réatténuent l'effet de la réactance.

L'observation des règles de la circulation (O) est insérée comme variable dépendante dans un modèle fonctionnel. L'approche a été formulée de manière très générale. L'accent a été mis sur la représentation des variables dans un système psychologique. La mise en rapport des paramètres (multiplication, addition, rapport linéaire ou curvilinéaire) fait l'objet d'analyses. Les équations et explications n'ont que la valeur d'hypothèses.

$$O = f(R, A, I, C, P)$$

Les notions ont été définies sous l'angle de la subjectivité, donc comme étant la représentation cognitive de l'état de fait en question.

La réactance (R) est "la tendance à recouvrer toute liberté ressentie comme menacée ou perdue" (Bauer, 1987, cf. Brehm, 1966; Grabitz-Gniech, 1975). L'individu essaie de garder ou d'agrandir sa liberté d'action.

L'approbation d'une règle/norme (A) est définie comme une attitude positive par rapport une ou plusieurs règle(s)/norme(s), mesurant le niveau de compréhension de l'usager de la route au sujet du sens des règles/normes. La variable est déterminée comme suit:

$$A = f(sc, cf, cp, vs)$$

- sc = sens civique
- cf = conformité
- cp = compétence personnelle
- vs = valeur de la sécurité

Le fait d'approuver une prescription comme condition première de son observation, dépend de l'attitude individuelle envers les prescriptions (sens

civique sc), de la volonté de se soumettre à des règles (conformité cf), de l'appréciation de la propre capacité de conduire (compétence personnelle cp) et de la valeur accordée à la sécurité (vs). Alors que des valeurs élevées pour sc, cf, vs augmentent la valeur de A, celle-ci s'abaisse en fonction de cp. La valeur de A ne sera jamais égale à zéro, eu égard au fait que O doit être supérieur à zéro.

L'information (I) est définie comme la connaissance des prescriptions et des corrélations entre celles-ci et les accidents. La variable est déterminée comme suit:

$$I = f(cc, sa, fa, ex)$$

- cc = connaissance des prescriptions
- sa = suites des accidents vécues
- fa = fréquence des accidents
- ex = exposition (au risque)

La variable I dépend de la connaissance des prescriptions et de la capacité d'apprécier les risques personnels en rapport avec la prescription ou les prescriptions en général. En fait partie l'assimilation mentale des suites (sa) et de la fréquence d'accidents (fa) et l'exposition au risque personnelle (ex). Plus ces sous-variables sont élevées, plus grand sera I. Etait postulé que la valeur de I ne sera jamais égale à zéro dans l'équation principale, A étant alors également zéro, ce qui voudrait dire que O ne pourra être supérieur à zéro. A est donc considéré comme lié multiplicativement à I.

L'intensité du contrôle (C) peut être définie comme la connaissance de la fréquence des contrôles inévitables. Cette variable peut être comprise comme opposée à la réactance.

La peine anticipée (P) est une variable psychologique; le terme implique l'anticipation de sanctions appliquées à titre de punitions inévitables dans le cas où un contrôle intervient en même temps qu'une infraction. La valeur de P est déterminée par la sanction.

Méthodes d'analyse

Pour mesurer les variables, l'étude est basée sur une enquête représentative auprès de 1000 personnes. Plus de 50 questions/items furent présentés aux probands. L'analyse a le niveau d'étude pilote afin de pouvoir formuler des hypothèses plus précises et mieux localiser les variables interdépendantes. Le schéma et les instruments ont été les suivants.

Exemples de questions pour

- O1: Images / Questions
- O2: Je refuse parfois la priorité une voiture prioritaire. / Cela m'est déjà arrivé souvent de passer à un feu rouge.
- R: Un tracteur roule à 30 km/h dans un village et vous ne pouvez pas le dépasser pendant environ 100 mètres. Dans quelle mesure vous sentez-vous gêné par cela? / Dans quelle mesure vous sentez-vous limité par les nouvelles prescriptions du code de la route?
- A: Je trouve que l'actuel code de la route est bon. / Je comprends bien que d'autres automobilistes ne se tiennent pas au code de la route.
- I: Dans quelle mesure, au juste, êtes vous informé sur le code de la route?
- C: A combien estimez vous la probabilité d'être observé par la police
 - quand vous roulez sur l'autoroute?
 - quand vous aimeriez contrevenir aux règles sur une route cantonale?
 - quand vous aimeriez contrevenir aux règles dans une grande ville?

Résultats

Dans l'équation
 $O = f(R, A, I, C, P)$

O a été considéré comme variable dépendante et les autres comme variables indépendantes. Les résultats sont basés sur les opinions recueillies de vive voix en ce qui concerne le propre comportement ou sur des indications concernant les connaissances des candidats. L'analyse des variables avait pour but de faire ressortir les interdépendances, les pléonasmes verbaux et d'examiner l'équation de base afin de la

	O	R	A	I	C	P
O	-	n	p	o	o/n	?
R		-	n	o	p	?
A			-	o	o	?
I				-	o	?
C					-	?

- p = corrélation positive
- n = corrélation négative
- o = pas de rapport

Variables	Méthodes	Subs
O	enquête O1 enquête O2 enquête O3	questions au sujet du comportement dans des situations restrictives questions au sujet du comportement par rapport aux prescriptions nombre de punitions
R	questionnaire	aspects émotionnels de R; coefficient de fiabilité = .71
A	échelle	opinions sur les prescriptions et comportements dans la circulation routière (attitudes); coefficient de fiabilité = .70
I	test enquête	5 questions sur les connaissances de prescriptions appréciation subjective de I
C	échelle	appréciation de la probabilité des contrôles; coefficient de fiabilité = .65
P	enquête P1 enquête P2 enquête P3	peines escomptées (anticipation des conséquences) nombre/gravité des punitions du proband nombre des accidents avec suites du proband

modifier. Voici, sous forme de résultats préliminaires, les rapports entre les variables principales:

- Rapport entre O et R:

Plus les conducteurs réagissent à des situations particulières (O1) telles que: être dépassés, être harcelés par des appels de phare, en observant ou enfreignant les règles, plus/moins la restriction, définie comme reactance (attitude envers la limitation de la vitesse sur l'autoroute, envers la ceinture de sécurité), est ressentie comme telle. La même chose vaut en ce qui concerne les opinions sur l'observation des règles (O2) et le nombre de punitions (O3) (niveau de signification statistique $p = .02$).

- Rapport entre O et A:

Plus les conducteurs réagissent aux restrictions dues à la situation particulière (O1), telles que: être dépassés, être harcelés par des appels de phare, en observant ou enfreignant les prescriptions, mieux/moins ils approuvent les règles (vitesses maximales, port de la ceinture). Le même principe vaut en ce qui concerne les déclarations sur l'observation des règles (O2) et le nombre de punitions (O3) ($p = .001$).

- Rapport entre O et I:

L'ampleur des informations (I) des probands au sujet des prescriptions questionnées ne peut être mise en rapport avec les indicateurs de l'observation des règles O1 à O3.

- Rapport entre O et C:

L'intensité des contrôles perçus (C) n'est pas en rapport avec les indicateurs de l'observation des règles O1 et O2. En ce qui concerne O3 (nombre de punitions), on relève une corrélation négative. Les personnes affirmant que les contrôles sont nombreux ne sont pas plus disposées à observer les règles que celles disant qu'il y a peu de contrôles. Ceux qui ont encouru un nombre élevé de sanctions affirment cependant que les contrôles sont notablement moins fréquents que ceux qui ont encouru un nombre limité de sanctions ($p = .001$).

- Rapport entre O et P:

La contrainte exercée par les sanctions n'a pas pu être étudiée en détail. On ne peut donc donner de précisions en ce qui concerne la relation entre P et les autres variables.

On constate en outre des relations entre les variables indépendantes.

- Rapport entre I et les autres variables indépendantes: on n'a pas pu relever de corrélations significatives.

- Rapport entre R et A ainsi que C:

Une forte reactance (R) est liée à une faible approbation des règles (A) et à l'opinion que les contrôles sont fréquents (C). La compétence, mise en rapport avec A dans le modèle ne peut être reliée à R.

- Rapport entre A et C:

Il n'y a pas de rapport significatif entre l'affirmation que les contrôles sont fréquents et une attitude négative envers les prescriptions (A négative). Ceux qui affirment que les contrôles sont fréquents refusent, comme on pouvait s'y attendre, l'autorité exercée par la police.

Les relations entre P et R, A ainsi que C n'ont pas

été analysées pour les raisons susmentionnées.

Les concepts A et I ont été validés à l'aide des relations entre les variables secondaires et principales collectées dans différents temps. Il s'est avéré qu'une relation significative existe entre A, analysé indépendamment des variables secondaires correspondantes, et le sens civique (sc), la conformité (cf) et la valeur accordée à la sécurité (vs), mais pas entre A et la compétence personnelle (cp). La variable "information" (I) ayant peu de rapport avec les autres, on peut dire tout au plus qu'il y a rapport entre la connaissance des prescriptions (cc) et I. La relation interne des variables secondaires est en somme plutôt faible.

L'analyse factorielle des variables indépendantes a révélé trois facteurs principaux:

I: Facteur Réactance vs. Approbation (fiabilité .62); composantes: R, A, cf, vs; part de la variance expliquée: 28,6 %

II: Facteur Information et Compétence (fiabilité .58), composantes: I, cc, cp; part de la variance expliquée: 13,0 %

III: Facteur Accidents et Contrôle (fiabilité .51); composantes: fa, C, vs; part de la variance expliquée: 10,6 %

L'analyse de variance mettant en relation ces trois facteurs à la variable observation des règles démontre les rapports suivants:

- Facteur I:

Le refus des prescriptions est accompagné d'attitudes et de comportements qui sont à l'encontre des règles de la circulation et de la sécurité.

- Facteur II:

Le refus des prescriptions est accompagné d'une bonne connaissance des règles de la circulation et d'une estimation élevée de la compétence personnelle.

- Facteur III:

Le refus des prescriptions est en léger rapport avec les contrôles et la valeur sécurité. Les personnes se sentant contrôlées et ayant une valeur de la sécurité élevée transgressent plus rarement les prescriptions que les autres. En ce qui concerne les accidents, il existe uniquement un rapport avec le facteur II. Le taux d'accidents est en relation avec la compétence personnelle estimée et la connaissance des règles de la circulation.

Discussion - conclusions

On peut dire en conclusion que les résultats suggèrent une réduction de la complexité de la formule principale. En outre, il faut revoir la structure des variables hiérarchisées. L'étude pilote mène à de nouvelles hypothèses, plus exactes et mieux fondées. Les variables principales psychologiques déterminant l'observation des prescriptions semblent être

- Réactance

- Approbation des règles

- Compétence personnelle

- Valeur de la sécurité

- Conformité

qu'il faut regrouper au niveau opérationnel en tenant mieux compte de l'influence de la variable "peine anticipée".

Il faut croire que la connaissance des prescriptions au niveau analysé ne joue guère de rôle pour

l'observation des règles. Par contre, la réactance et l'approbation des règles ont sans doute une influence primordiale sur l'observation. Si cette déduction préliminaire, qui sera analysée dans un deuxième temps, est correcte, il faut en pratique veiller à introduire de nouvelles prescriptions en minimisant l'aspect de la liberté restreinte et en valorisant la sécurité au niveau des attitudes.

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Annexe

Corrélations entre les variables O/R/A/C/I et les variables secondaires

	R	A	cp	cf	sc	vs	C	I	cc	sa	fa	ex
O1	-.50	.41	.02	.25	-.01	.21	.00	.06	.02	.17	-.07	-.31
O2	-.42	.40	.00	.28	.26	.22	-.01	.00	.01	.22	-.23	-.33
O'	.30	-.23	-.04	.32	.07	-.05	-.21	.00	-.01	.14	.31	.30
R	-	-.49	-.04	-.35	.20	-.25	.32	-.03	.02	-.14	.17	.29
A	-	-	.05	-.28	.19	.26	-.20	-.01	.02	.12	-.19	.23
cp	-	-	-	-.03	.01	.00	.16	.03	.30	-.17	-.16	-.33
cf	-	-	-	-	.28	-.32	.22	-.04	-.04	.13	.14	.31
sc	-	-	-	-	-	-.21	.19	-.03	.04	-.13	.11	.12
vs	-	-	-	-	-	-	-.12	.00	-.05	.26	-.12	-.24
C	-	-	-	-	-	-	-	.04	.08	.19	-.12	-.00
I	-	-	-	-	-	-	-	.10	-	.03	-.15	-.26
cc	-	-	-	-	-	-	-	-	-	-.14	-.13	-.18
sa	-	-	-	-	-	-	-	-	-	-	-.18	-.20
fa	-	-	-	-	-	-	-	-	-	-	-	-.30

THE MODIFICATION OF INDIVIDUAL ROAD USER BEHAVIOUR

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Talking about the use of sticks and carrots to modify driver behaviour seems to imply that the average driver is an ass. Though this view is in stark contrast with drivers' own estimations of themselves (Naatanen and Summala 1976, Svenson 1981, Job 1990) and is a view resented by those who resist behavioural interventions as being paternalistic and manipulative (Hale and Glendon 1987), it is clearly not alien to many authorities, including the police (see Figure 1).

I shall comment more fully later on the global stick and carrot approach which tries to get drivers to drive more safely. But some problems associated with such an approach are that it often fails to specify what the required behaviour is of the driver (what is safe driving?) and makes it difficult to specify precisely what changes in behaviour have occurred once a safer accident record has been achieved. Rather than employ this somewhat telescopic view of driver behaviour, I wish to present here more of a microscopic examination to show that accidents may arise out of driver ignorance and delusion (which may indeed be ass-like qualities) but may also arise because drivers become entrapped by previous experience and the attraction of rewarding outcomes which compete with safety. I also hope to show how a more microscopic behavioural analysis can throw some explanatory light on why global interventions which are directed at safe outcomes may be successful.

A behavioural analysis of driver behaviour requires at the very least a specification of the relationship between responses and their consequences and of the antecedent conditions under which the relationship occurs. Put more concretely what this means is that a behavioural analysis is concerned with what people do, what happens as a consequence and the conditions under which particular act-consequence relations occur. With this perspective, even a cursory examination of what drivers do reveals that, in the main, they continuously take action to avoid punishing (i.e. undesirable) consequences. Drivers adjust speed and the direction of their vehicles to avoid collision with things in front of them and to avoid leaving the roadway unintentionally. That driver behaviour is under the direct and continuous control of its potential punishing consequences is indisputable - a fact exploited by engineers in designing for particular roadway speeds (Ross 1984) and characterised by Brenac (1990) as the 'infrastructural policeman'.

However, despite the aversive nature of these consequences, drivers all too frequently encounter them, yielding the enormous toll of casualties which in the US and Europe alone has been described as

equivalent to a medium-sized war continuing all of the time. In exploring why this should occur, a behavioural analysis offers both an explanatory framework and points to those variables which need to be manipulated if driver behaviour is to be modified and the road accident toll reduced.

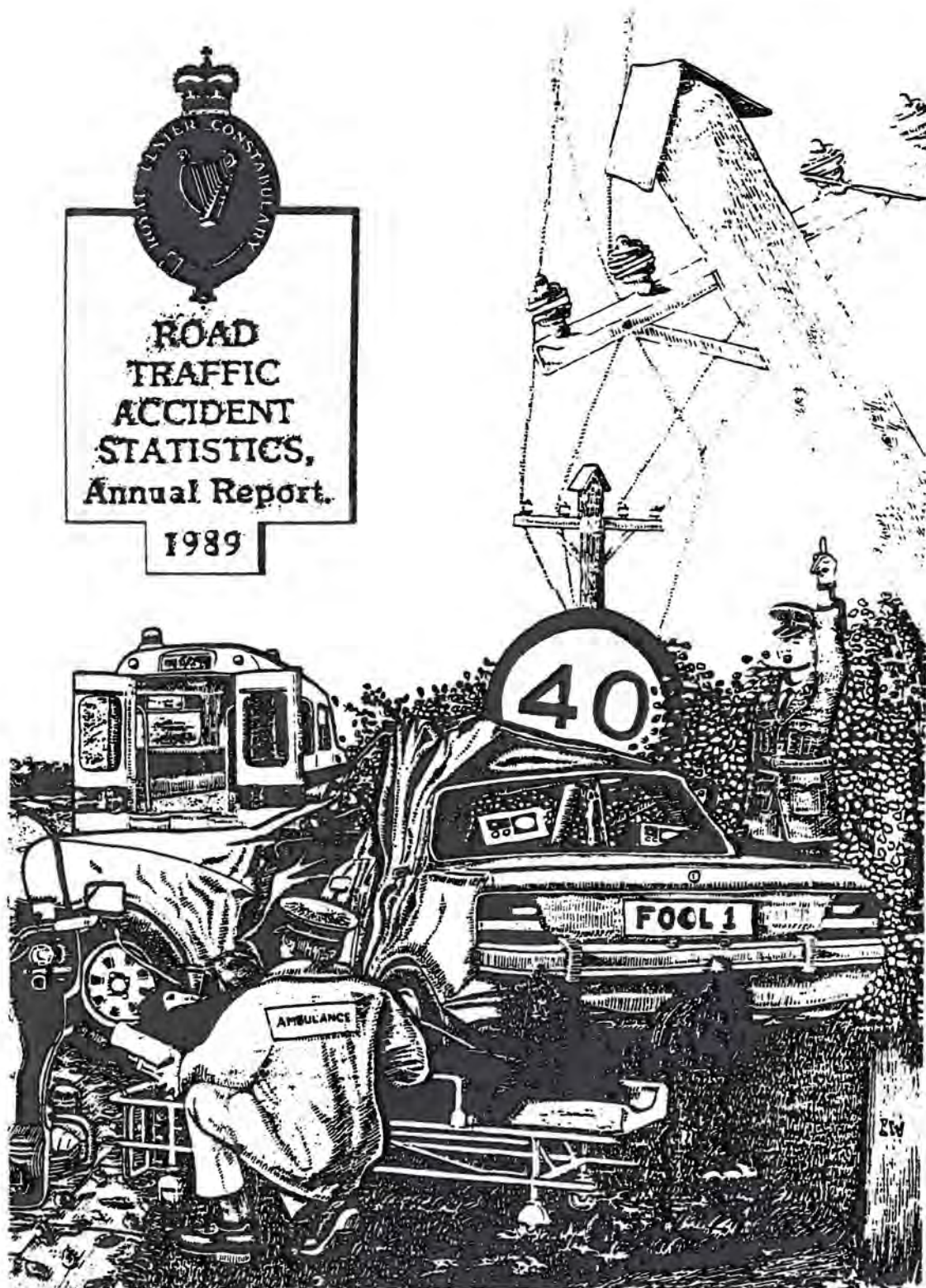
Learning safe driving

Before any person can safely negotiate a section of roadway, she or he needs to have learned antecedent-behaviour-consequences relationships. A large proportion of these are simple and obvious, such as when to make steering adjustments to follow the roadway or drive around obstructions and when to stop to avoid collision with objects. Others however are more complex and subtle and far less predictable, such as the selection of the highest speed with which a corner can be negotiated under various road surface conditions without losing control of the vehicle. The learning problem in this example, and in general, is that for each set of conditions, the driver has to learn the response-consequence contingency or relationship.

These contingencies do not all have to be learned through direct experience however; they can be represented symbolically by the individual road user and transmitted from one person to another verbally in the form of rules (Skinner 1988). Such rules cannot of course deal with every contingency that the driver might experience, even if he could learn and use them. Of necessity therefore verbal rules are typically expressed as generalisations. For example, to cope with the impossible task of specifying the maximum safe speed for every section of every roadway under every possible condition, one general rule which might be established is that wet, icy, greasy or snow covered surfaces generally tolerate slower speeds. Fine tuning of such a rule and its application on particular roads, arises only out of more direct experience of the contingencies (that is the relationship between what the driver does and its consequences) in a trial and error fashion. Sometimes the error takes the form of an accident. Thus it is not surprising that it is the novice driver, who has had least experience of direct contingencies, who is significantly over represented in road accident statistics (see Summala 1987 and Fuller 1988 for more extensive discussions of this problem).

Contingencies can also be expressed symbolically in the form of sequences of visual images and internalised by the viewer as a private visual narrative. Compared with verbal representations, however, which typically deal with classes of events, images are more concrete and describe discrete instances. The implications of this difference for cognitive processing, and for the effectiveness and efficiency of application to real experienced situations, is an important issue for instruction, training and media safety presentations for which experimental evaluation is notably lacking (see Hale and Glendon 1987 p 238).

Figure 1. Cover from Road Traffic Accident Statistics Annual Report 1989. Belfast. Royal Ulster Constabulary.



The learning of contingencies is, of course, not helped by the fact that many of them are unreliable. It may lead to aversive consequences to drive fast around a blind corner, if, for example, there is a hidden obstruction on the far side. But then again it may not. Thus from the perspective of behaviour theory, in many driving situations drivers must be continuously exposed to alternating periods of reinforcement and extinction of the same behaviour.

Taking risks

Lack of certainty of contingent relationships between antecedents, response and consequences not only makes learning considerably more difficult but also provides the opportunity for drivers to gamble on potentially aversive consequences (to particular responses) not occurring.

But why should they want to do this? The simple fact of the matter is that the avoidance response, which would deliver the driver from potentially aversive consequences, often carries with it a penalty. This penalty may occur in relation to behaviour preparatory to engaging in safe driving as well as to specific responses during the driving task itself.

In the first instance, preparatory to driving, the avoidance of alcohol consumption or the fastening of a safety belt may involve too much of a penalty for some drivers to maintain such behaviours in the face of uncertain risk. Biecheler-Fretel and Moget-Monseur (1990) have provided recent evidence of the consequences of this in a questionnaire study of 1,002 French motorists. They found that users' refusal to accept such safety oriented behaviour was the best predictor of dangerous driving and consequent accident involvement. Whether this refusal is in part or indeed wholly motivated by the utility or reward value of non-compliant behaviour in general is a moot point. Nevertheless there seems to be a general relationship between risky behaviour and non-compliance (for example with safety laws - see discussion by Geller et al. 1990).

Regarding specific avoidance responses during driving and excluding for the moment adjustments of direction, a reduction of speed is almost certainly the hazard avoidance response most frequently required. Unfortunately however, speed is intrinsically rewarding. People like to go fast. Furthermore speed is inseparable from its inverse relationship with time: higher speeds save more time. And the saving of time seems to be a pervasive value in contemporary western society. These two reasons must underlie the all too common observation that many safety interventions are consumed by greater mobility, reflecting a desire to save time which even motivates some pedestrians at light controlled junctions (Jørgensen 1988).

But the point I wish to emphasise here is that the potential hazard avoidance response of reducing speed carries with it the corresponding cost of a loss of time. Where time has such an economic value, travellers are essentially being rewarded on a piece-work system, earning more time the faster they go - a system typically associated with greater risk taking (McKelvey et al. 1973, Fuller 1989) and with more severe and more frequent accidents (Hale and Glendon 1987). Because safety has a price, if contingencies are uncertain, the driver may gamble on not paying that price. It should be mentioned however that this risk taking may be adaptive in a community over the longer term, if the net gains

from saved time are considered to outweigh the net costs (accidents and other costs). Accidents in the last analysis therefore may be a regrettable but nevertheless unavoidable consequence of more productive economic (and social) activity.

Thus far I have argued that driver behaviour is under the control of its consequences; that drivers need to learn the conditions under which particular response-consequence contingencies occur; that this learning requires direct experience and is difficult because contingencies are frequently uncertain, being neither reliable nor consistent; and that responses that would enable avoidance of potentially aversive consequences often carry with them a cost. The uncertainty of contingencies then enables drivers to gamble on not paying this price of safety.

Behavioural traps

Couching unsafe driving behaviour in learning theory terms enables us to identify a number of behavioural traps lurking to ensnare the unwary motorist and which throw some light on the aetiology of road accidents. We might call these behavioural traps the consequences trap, the contingency trap and the conditioning trap. The distinction between these different traps may have important implications for the kinds of behavioural intervention which can be effective.

The consequences trap. In the consequences trap the driver executes unsafe behaviour because that behaviour has rewarding consequences such as:

- (a) value of time saved,
- (b) experience of thrill,
- (c) demonstration of skill or courage,
- (d) avoids expenditure of effort (e.g. Bradshaw et al. 1981).

How can we prevent drivers falling into this kind of trap? Where risk behaviour is extrinsically rewarding, such as a condition where drivers save valuable time by gambling on not slowing down, interventions might operate to counteract the reward with punishment, such as the imposition of penalties for driving at speeds faster than warranted by the prevailing conditions, or to reward incompatible (i.e. safe) behaviour.

Note however that with these procedures, if after a period the intervention is withdrawn, we should not be surprised to find the original undesirable behaviour returning, because presumably it will still be under the control of its original rewarding consequences.

Another procedure might be to decrease the utility of the reward to the individual (in this example saved time) by developing a sort of "manyana motive", more pertinently represented in the old adage "Better late than never". A related procedure might be to demonstrate the extent to which drivers typically overestimate the time actually saved by driving at high speeds over about 60 km/hr (Svenson 1978). As Hale and Glendon (1987) have urged, this error needs to be demonstrated "as graphically as possible" (p. 286). Finally attention might be paid to systematically reducing the instances of approach-avoidance conflict, for example where drivers run amber or red lights to avoid further delays in their progress (Jason et al. 1985).

Where the reward of risk behaviour is intrinsic to the behaviour itself, however, such as the exhilaration experienced from high speed, the problem may be

more difficult. Again the behaviour might be modified by decreasing the utility of the reward, rewarding incompatible behaviour or counteracting it with punishment. However the last strategy may founder where the possibility of punishing consequences actually contributes to the rewarding effect of the risky behaviour.

The contingency trap. In the contingency trap the driver executes unsafe behaviour because he does not know the contingencies operating at a particular moment in time. This may be because:

- (a) they have not been learned,
- (b) antecedent events which predict upcoming hazards (and therefore should trigger avoidance responses) have not been detected or recognised.

Dealing with the contingency trap requires similar interventions to those demanded by the conditioning trap and so that will be described next.

The conditioning trap. This arises where the driver has learned (been conditioned into) unsafe behaviour because:

- (a) safe behaviour has extinguished, for example where a hazardous outcome has a low probability,
- (b) responses learned in a safe domain have overgeneralised to an unsafe domain,

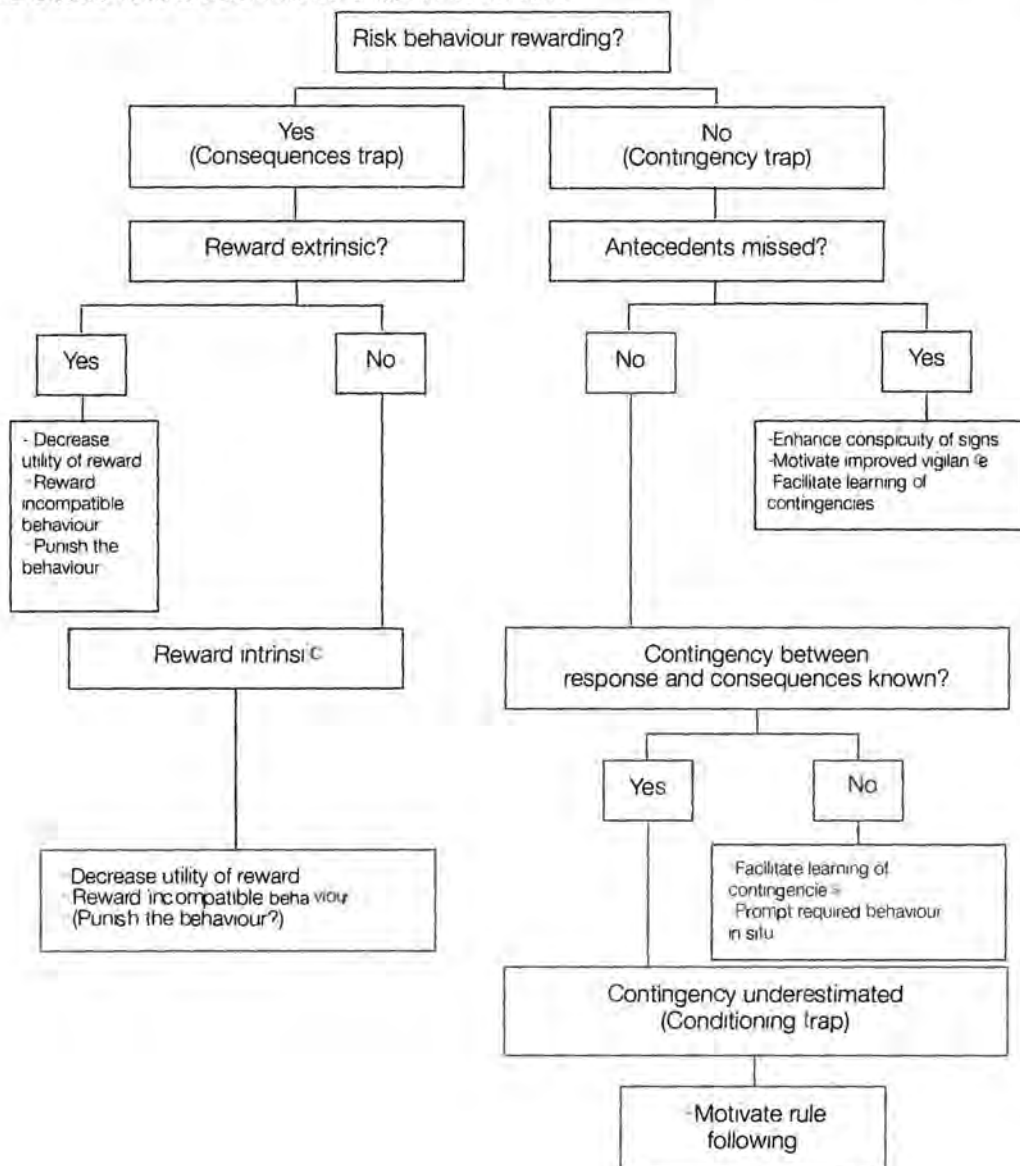
(c) he has become desensitised to objectively hazardous events (see Job 1990).

To avoid both the contingency and conditioning traps we need to consider ways of:

- (a) facilitating the learning of contingencies with analysis of personal safety 'incidents' (Lewin 1982), techniques of rule learning (e.g. public information campaigns using behaviour directed messages (Rooijers 1988); rule based skill training (Fisk and Gallini 1989)), modelling (see comments by Geller 1988, Evans 1989) and safe practice (see Fuller 1988),
- (b) reducing reliance on the learning requirement by providing direct prompts *in situ* (e.g. Van Houten et al. 1985, Van Houten and Van Houten 1987, Rooijers 1988, Rogers et al. 1988),
- (c) enhancing the conspicuity and reliability of antecedent events, such as warning signs (Van Houten 1988, Suarez de Balcazar et al. 1988),
- (d) motivating improved vigilance (Holland 1958, Wood 1988),
- (e) motivating rule following to help maintain hazard avoidance behaviour in the face of feedback that it is not always necessary (e.g. Cope et al. 1988).

A summary of these suggestions is presented in Figure 2 in the form of a simple decision tree for

Figure 2. Decision tree to determine behavioural interventions



determining the appropriateness of particular behavioural interventions.

A verbal statement of rules is a particularly useful means of representing and communicating learned contingencies, thereby enabling us to avoid continuously reinventing the wheel, and incidentally to also avoid getting run over by it. Rules have a further use in situations where natural contingencies are not very effective at maintaining the desired behaviour. In such situations Skinner (1988) recommends not only the use of rules (e.g. do not drive at such a speed that you cannot stop within the visible safe distance ahead) but also their enforcement. Enforcement here involves the introduction of consequences additional to those which may occur naturally, such as the imposition of a financial penalty. In our driving example this might be applied for taking a blind corner at a dangerously high speed even if the behaviour did not retrospectively present a hazard in the punished instance. However given current technical and resource limitations for monitoring driver behaviour at this level, more tractable examples might include enforcement programmes relating to drinking and driving and seat-belt use (see for example Malenfant and Van Houten 1988).

The application of penalties for rule-breaking seems to be an important principle because the evidence suggests that where rule following is not supported by the natural contingencies, the control of behaviour may become transferred from the rule(s) to those natural contingencies (Galizio 1979). Thus where a deterred behaviour is founded on unrealistic perceptions of getting caught (such as driving under the influence of alcohol), we may expect the behaviour to return once the real probability has been discovered (Epperlein 1987). It should be added here that rule following can also be motivated by the introduction of rewards (e.g. Geller et al. 1982, Kalsher et al. 1989).

Global interventions

A number of attempts have been made to modify driver behaviour without specifying the required responses but rather the required consequences. Such procedures include rewarding drivers for accident-free (or reduced) records and punishing culpable accident occurrences.

Reward for accident reduction. Although there is room for better controlled studies (Friedland et al. 1987), under a variety of conditions the global reward of safe driving behaviour has been shown to work (Wilde and Murdoch 1982, Wilde 1985, Wilde 1988). Through the provision of financial incentives, with and without social incentives such as the maintenance of peer approval, significant improvements in driver accident records have been reported. Though attractive because they are non-punitive and allow the individual some sense of autonomy as to how he might drive more safely, such procedures suffer from a number of weaknesses, not the least of which is that the required behaviour of the target road user is not specified for any given driving situation. In their review of 'better driving' incentive programmes, Harano and Hubert (1974) suggest that programme effectiveness is in part determined by the availability of the desired behaviour in the driver's repertoire.

What is specified as a requirement in global safety incentive programmes is not a behaviour but a consequence – a safe outcome. This creates

problems for the driver who does not know how to behave to achieve this consequence, it also creates problems for the researcher who will find it even more difficult to determine the mechanisms via which any observed improvements are mediated. In turn this hinders the development of more efficient and effective safety interventions. However the theoretical analysis of driver behaviour outlined above would lead to the hypotheses that global reward strategies for safe behavioural outcomes, in the absence of other concurrent interventions, operate through either or both of the following mechanisms:

- (a) enhancement of vigilance behaviour and the corresponding level of detection of antecedent events. Enhanced vigilance in turn exposes the driver more effectively to the contingencies of the traffic environment and it is these contingencies which ultimately select the stimuli to which the driver reacts (see Skinner 1988 p183),
- (b) provision of a counterweight to the rewards of unsafe behaviour, essentially by rewarding behaviour which is incompatible with it (e.g. rule following, driving more slowly) – what Wilde (1988) refers to as stimulating the desire for safety.

Punishment for unsafe behaviour. There are a number of factors which can affect the degree of punishment experienced for unsafe behaviour when an accident occurs and which can similarly affect the deterrent effect of the threat of the aversive stimuli associated with accident involvement. These factors pertain in the main to the driver's physical, social and financial worlds. Devices such as seat belts, toughened and splinter proof windscreens, air bags and collapsible steering columns, rigid side panels, energy absorbing vehicle sections, crash barriers, collapsible light standards and the removal of unnecessary roadside 'furniture', these and other engineering interventions are all designed to lessen the severity of the punishing consequences of a collision, should one occur. In other words they are all designed to ameliorate the consequences of unsafe driving behaviour. As such, from a behavioural point of view, they may have an unintended and detrimental effect on the motivation of safe behaviour, the phenomenon known as risk compensation. This is not to argue that such devices can have no effect in the long run on the overall accident toll per unit travel time or per capita in a jurisdiction, the rather radical version of the compensation hypothesis known as risk homeostasis (see for example Wilde 1982). We have already seen that inadequate contingency learning and inadequate discrimination of antecedent conditions can lead drivers unwittingly into accident consequences. Passive safety devices must contribute to greater protection in these circumstances. But if a driver is balancing the pros and cons of undertaking a risky manoeuvre (albeit at a preconscious level), the softening of the impact of aversive consequences can hardly weigh in favour of the less risky options. Thus for example the many imaginative behavioural interventions which have been shown to increase levels of seat belt wearing (see review by Geller et al. 1987), may on occasion have a counterproductive effect on the motivation of safe driving (Adams 1985).

The social punishment for unsafe driving behaviour seems virtually non-existent, as does systematic observation of the phenomenon. If anything, social reinforcers seem to be applied contingent on risk taking (Job 1990). Passengers appear to be reluctant to comment adversely on the unsafe driving behaviour of their own drivers. Motorists involved in accidents are typically given sympathy, comfort and

support. Nevertheless, one suspects there has been a shift in attitudes and behaviour against intoxicated drivers involved in accidents (e.g. MADD). If this kind of change can be realised, then similar campaigns might be considered in relation to other kinds of culpable driver.

The financial punishment for unsafe driving behaviour can also be mollified by the nature of insurance cover. As indicated by Friedland et al. (1987), the civil liability system has increasingly become more one of compensation rather than of deterrence (p9). The insurance concept originally assumed that accidents happened as part of some divine plan rather than were caused by some human agent and because accidents were ordained from above it made sense for road users to share amongst themselves the burden of divine retribution. Nowadays however, some level of responsibility may be attributed to the driver who may then be penalised in the form of increased insurance costs. However there is no question that there is generally considerable room for a more sensitive use of this form of penalty: for much more discrimination in premium charges between those who cause accidents and those who do not. Friedland et al. (1987), in their review of the impact of civil liability-insurance schemes on accident rates, conclude that the most important contribution may be in excluding high risk drivers from the traffic system or at least postponing their entry. For such a system to work however, they stress that premium differentials must accurately reflect the accident costs associated with particular categories of activities and drivers (see pp70-71).

A case could also be made for the removal of first party or comprehensive cover altogether so that unsafe behaviour is punished financially even if it does not involve a third party. Furthermore consideration might be given to the pricing structure of insurance for first time drivers who typically pay high costs because of their age category membership rather than because of their individual risk taking behaviour. Indeed the management of this group's insurance characterises a fundamental weakness in the insurance system from a behavioural engineering point of view: individuals are penalised financially because of their category membership, whether it be age, location, owner of vehicle type or whatever, rather than because of their individual risk behaviour. Finally in this area it should be noted that the avoidance of (or escape from) a punishing event, such as high cost insurance, is rewarding (technically negatively reinforcing) and this points to the potential of insurance premium reductions as incentives for safety (see discussion by Wilde 1988 at p487).

What this kind of development of the application of behavioural principles needs is a change of insurance philosophy. As evidence of this need, Wilde (1988) concludes that "no published reports exist on experiments examining the safety consequences of insurance fee manipulation conducted by private insurers" (id. p507). What is also needed is a better method of assigning culpability in accident situations. The introduction of in car 'black-box' recorders, which reliably record information such as the drivers speed over the last 20 sec. may make a significant contribution in this area (Fuller 1990).

Active punishment of unsafe driving to have any deterrence effect requires both detection and the enforcement of penalties, or at least a raised perception of the likelihood of apprehension (Epperlein 1987, Åberg 1988). For example drivers

are most likely to conform to a speed restriction if they can both see a police vehicle and it is in a position to intercept them (Shinar and McKnight 1985) even though the effect may be short-lived (see Mäkinen 1988). Such interventions are however extremely expensive and their cost effectiveness is open to question, particularly in terms of actually achieving enhanced safety rather than greater compliance with regulations. The evidence suggests also that criminal sanctions and civil proceedings typically have limited effects on driver behaviour. There are many possible reasons for this, but one may well be that in many jurisdictions deaths arising from careless driving or driving while intoxicated are regarded as incidental events and not punished as the responsibility of the agent of death, the vehicle driver. What the law needs to do in such cases is distinguish between motivated risk taking, for which the driver is culpable, and non motivated risk taking which can arise through the various behavioural processes described earlier. A major problem in the past has again been the determination of culpability. Perhaps what we need to wait for in this area is the development of automatic monitoring systems such as the 'black box' concept mentioned earlier and also more sophisticated monitoring and penalty systems, the type of machine intelligence currently being developed in the *Autopolis* component of the EC Drive programme (Harper 1990).

For the present however it seems that legal measures which exclude certain classes of high risk drivers from the highway effectively reduce fatality and accident rates (see Friedman et al. 1987 pp 112-116). Such measures comprise raising the legal drinking age and the legal driving age, imposing night-time curfews on young drivers, penalising high-risk drivers with higher insurance premiums and imposing license suspensions on deviant drivers.

In this section we have considered the perhaps surprising notion that the punishing consequences of accident involvement are not aversive enough to deter unsafe driving under certain conditions. The physical, social and financial consequences of accidents can be ameliorated in many ways. The implication here is not necessarily that it would be better for every driver to drive without compensatory insurance cover or a seat belt or, as suggested elsewhere, with a sharp steel spike extending to within 2 cm of his or her forehead. Protection is necessary for the novice driver who has not had the opportunity to learn contingencies, it is necessary for situations where there are no antecedent events to signal impending hazards, it is necessary for the victims of others' unsafe acts and it is also necessary for those occasional wrathful interventions from on high. However there is room for exploration of more discriminating insurance systems and there is room for more effective and efficient detection and penalisation of motivated dangerous behaviour before it results in an accident.

It has also been pointed out that although strategies of rewarding safe outcomes appear to lead to improvements in road safety, we don't really know through what changes in behaviour such improvements come about. The identification of the mechanisms which mediate such improvements will almost certainly lead to the development of more effective and more efficient interventions. Thus far we have little more than a theoretical framework from which hypotheses may be derived about what is happening.

It is argued that drivers become unsafe because they are entrapped by their previous experience or lack of it and entrapped also by motives which directly or indirectly mediate unsafe behaviour. A behavioural analysis, focussing on antecedent-behaviour-consequence relationships, indicates that effective interventions must pay attention to ways of facilitating the learning of those contingencies; to the enhancement of hazard antecedents; the clear specification of required behaviour and the systematic application of rewards and punishments where appropriate (see also the taxonomy of behaviour change strategies described by Geller et al. 1990).

It is to be hoped that more attention will be paid in the future to the promotion of research designed to test these hypotheses. With regard to remediation of the traffic accident problem, as reviewed by Perkins (1989) and indicated in this paper, a behavioural analysis has been used in only a small number of applications. Nevertheless the results obtained so far indicate that further application is likely to be productive.

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A BEHAVIOR CHANGE TAXONOMY FOR IMPROVING ROAD SAFETY

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For more than two decades behavioral scientists have applied behavior analysis to a number of community issues (e.g., safety belt promotion, recycling, litter control, energy conservation); and as a result, an arsenal of behavior change techniques are available for solving community-based problems. There has been little attempt, however, to categorize these techniques in terms of relative effectiveness; and thus, the community change agent is faced with the formidable task of choosing an intervention program from an incomplete and disorganized list of potential behavior modification procedures. This paper offers a framework for conceptualizing the social validity and large-scale significance of behavior change strategies, and for predicting the relative impact of particular intervention programs. Two theoretical models are offered: (a) a multiple intervention level (MIL) hierarchy to categorize behavior change approaches and evaluate the cost-effectiveness of successive interventions for large-scale behavior change, and (b) an intervention impact model to guide the development of more effective community interventions. A year-long study of strategies to increase the safe driving of pizza deliverers is presented to evaluate the applicability and utility of our models.

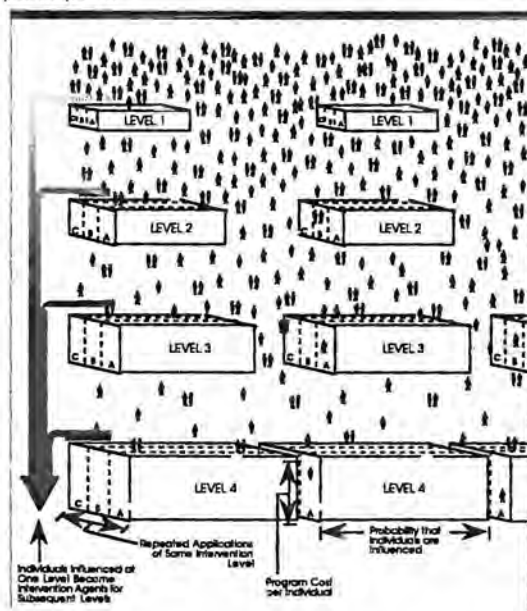
A MULTIPLE INTERVENTION LEVEL HIERARCHY

The MIL hierarchy depicted in Figure 1 is characterized by dividing interventions into multiple tiers or levels, each defined by its ability to influence the targeted population. At the top of the hierarchy (i.e., Level 1), the interventions are least intrusive and target the maximum number of people for the least cost per person. At this level, an intervention is designed to have maximum large scale appeal, while allowing only minimal contact between individuals and intervention agents.

Those showing the desired target behavior at a particular intervention level may continue to benefit from repeated exposure to similar intervention programs, but we assume that those individuals uninfluenced by the first exposure to a particular intervention level will 'fall through the cracks' and be uninfluenced by repeated exposure to intervention programs at the same level. These individuals require a more influential (higher level) intervention program.

The MIL model in Figure 1 indicates that individuals who are influenced by a particular level of the intervention hierarchy may become intervention agents for the next level of intervention effectiveness

Figure 1. A multiple intervention level hierarchy differentiating repeated interventions at the same effectiveness level from interventions that are progressively more influential at changing behavior. The height and width of each intervention level increases progressively from levels 1 to 4 in order to denote successively increasing amounts of intervention effectiveness and cost per program participant.



(cf. Katz & Lazarsfeld, 1955). Thus, after individuals have adopted a particular target behavior, it is not cost effective to include these persons among the targets of another program to motivate the occurrence of that behavior. Instead, these persons need to be enrolled as agents for more effective intervention programs. In other words, "preaching to the choir" is not as beneficial as enlisting the "choir" to preach to others.

AN INTERVENTION IMPACT MODEL

Behavior Change Techniques

Table 1 on the next page gives brief definitions of 24 different approaches to change behavior, distilled from a review of the behavioral community psychology literature, especially publications in the *Journal of Applied Behavior Analysis* (cf. Greene et al., 1987). Eighteen behavior change techniques occur before the target behavior and are considered antecedent procedures (from the antecedent-behavior-consequence model of applied behavior analysis, cf. Geller, Winnett, & Everrett, 1982). Each technique represents an attempt to persuade individuals or groups to emit a desired response.

Feedback, reward, and penalty consequences can be given to an individual or to a group, and therefore Table 1 defines six different consequence procedures. Rewards include pleasing items or events as well as opportunities to escape or avoid unpleasant situations, whereas a penalty can be the

Table 1: Definitions of 24 Techniques to Motivate Behavior Change

1.	Lecture: Unidirectional oral communication by an agent concerning the rationale for specific behavior change.
2.	Demonstration: Modeling the desired behavior for target subject(s).
3.	Policy: A written document communicating the standards, norms, or rules for desired behavior in a given context.
4.	Commitment: A written or oral pledge to emit a desired behavior.
5.	Discussion/Consensus: Bidirectional oral communication between agents of an intervention program and target subjects.
6.	Intervention Agent: The subject(s) participate in promoting the desired behavior to other individuals.
7.	Written Activator: A written communication that attempts to prompt desired behavior.
8.	Oral Activator: An oral communication that attempts to prompt desired behavior.
9.	Assigned Individual Goal: An intervention agent mandates the level of behavior change the subject should accomplish by a certain time.
10.	Individual Goal: The subject decides the level of desired behavior (i.e., the goal) that should be accomplished by a specific time.
11.	Individual Competition: An intervention promotes competition between individuals to accomplish the desired behavior first (or best).
12.	Individual Incentive: An announcement to an individual in written or oral form of the availability of a response-contingent reward.
13.	Individual Disincentive: An announcement to an individual specifying the possibility of receiving a penalty contingent upon a particular undesired behavior.
14.	Individual Feedback: Presentation of either oral or written information concerning an individual's desired or undesired behavior.
15.	Individual Reward: Presentation of a pleasant item to an individual, or the withdrawal of an unpleasant item from an individual for emitting a desired behavior.
16.	Individual Penalty: Presentation of an unpleasant item to an individual, or the withdrawal of a pleasant item from an individual following undesired behavior.
17.	Assigned Group Goal: An intervention agent mandates the level of desired behavior a group should accomplish by a certain time.
18.	Group Goal: Group members decide for themselves a level of group behavior they should accomplish by a certain time.
19.	Group Competition: An intervention promotes competition between specific groups to accomplish the desired behavior first (or best).
20.	Group Incentive: An announcement specifying the availability of a group reward contingent upon the occurrence of desired group behavior.
21.	Group Disincentive: An announcement specifying the possibility of receiving a group penalty contingent upon the occurrence of undesired group behavior.
22.	Group Feedback: Presentation of either oral or written information concerning a group's desired or undesired behavior.
23.	Group Reward: Presentation of a pleasant item to a group, or the withdrawal of an unpleasant item from a group or team following desired group behavior.
24.	Group Penalty: Presentation of an unpleasant item to a group, or the withdrawal of a pleasant item from a group or team following undesired group behavior.

presentation of an unpleasant event (e.g., a jail term or requirement to do community service) or the removal of a pleasant item or privilege (e.g., money or a driver's license).

Intervention Impact

We hypothesize that five factors determine the effectiveness of an intervention program, as measured by the proportion of a target population showing desired behavior change over the short and long term. Based on our literature review, we theorize that the immediate impact of an intervention is a direct function of: 1) amount of participant involvement; 2) degree of social support; 3) amount of specific response information transmitted by the intervention, facilitated by increasing the salience of the information presentation and the proximity between the behavioral request and opportunities to emit the desired response (cf. Geller et al. 1982); 4) degree of extrinsic control determined by reward or penalty contingencies, and 5) the target individual's perception of self-efficacy or intrinsic control regarding the behavior change techniques (cf. Bandura, 1989; Deci & Ryan, 1987).

Table 2 depicts our initial taxonomy of behavior change techniques for evaluating intervention impact and for guiding the development of more effective

community interventions. To derive the factor scores for each behavior change technique, we defined each technique according to relevant community-based applications (see Table 1), and then judged whether the procedures of each technique included aspects of the five evaluation factors. A simple all-or-none (a priori) scoring system was applied by assigning a "1" if the following questions per factor were answered affirmatively:

1. Involvement - Does the behavior change technique set the occasion for overt participant action relevant to the target behavior?
2. Social Support - Does the behavior change procedure include opportunities for continual support from program participants or others (e.g., family, friends, work groups)?
3. Response Information - Does the behavior change procedure offer new and specific information relevant to the behavior(s) targeted?
4. Extrinsic Control - Does the behavior change procedure manipulate a response consequence (i.e., a reward or penalty) in order to influence a target behavior?
5. Intrinsic Control - Does the technique offer an opportunity for personal choice or control? We only used this factor when totaling the points for the "Long Term Effects" column. The literature on psychological reactance and intrinsic motivation (e.g.,

Brehm, 1966; Deci, 1975) persuaded us to assign a score of "-1" to procedures which offer rewards or threaten penalties.

A particular intervention program usually consists of a number of behavior change components, and would therefore receive a composite score by adding the relevant numbers from Table 2. At the bottom of Table 2, we summarize the various components and results of three different intervention programs designed to increase the safety belt use of the same pizza deliverers. This represents the first systematic test of our MIL model and behavior change taxonomy.

TESTING THE BEHAVIOR CHANGE TAXONOMY

Subjects and Setting

The pizza deliverers (n = 57, mean age = 24.5, age

range = 13-42, mean education = 3 years of college) for a pizza store in a semi-rural community in southwest Virginia were observed driving their delivery vehicles. All vehicles were equipped with a manual shoulder belt. At the time of the study, Virginia had a safety belt use law, based on secondary enforcement with a \$25.00 fine for convicted violators.

Observation Procedures and Data Collection

During peak business hours (i.e., 5:00-3:00 pm), the use of safety belts and turn signals by the drivers of the delivery vehicles was unobtrusively recorded from an automobile parked at a strategic position overlooking the parking area of the pizza store. A large "TRAFFIC COUNT" sign (similar to those used intermittently in the area by the Virginia Department of Motor Vehicles) was placed in front of the

Table 2. A Taxonomy of Behavior Change Techniques for Predicting Intervention Impact

Behavior Change Techniques	Involvement	Social Support	Response Information	Extrinsic Control	Immediate Effects	Intrinsic Control	Long Term Effects
1. Lecture	0	0	1	0	1	0	1
2. Demonstration	0	1	1	0	2	0	2
3. Policy	0	0	1	1	2	-1	1
4. Commitment	1	0	1	0	2	0	2
5. Discussion / Consensus	1	1	1	0	3	0	3
6. Intervention Agent	1	1	1	0	3	0	3
7. Written Activator	0	0	1	0	1	0	1
8. Oral Activator	0	1	1	0	2	0	2
9. Assigned Individual Goal	0	0	1	1	2	-1	1
10. Individual Goal	1	0	1	0	2	0	2
11. Individual Competition	1	0	1	1	3	-1	2
12. Individual Incentive	1	0	1	1	3	-1	2
13. Individual Disincentive	1	0	1	1	3	-1	2
14. Individual Feedback	0	0	1	1	2	-1	1
15. Individual Reward	0	0	1	1	2	-1	1
16. Individual Penalty	0	0	1	1	2	-1	1
17. Assigned Group Goal	0	0	1	1	2	-1	1
18. Group Goal	1	1	1	0	3	0	3
19. Group Competition	1	1	1	1	4	-1	3
20. Group Incentive	1	1	1	1	4	-1	3
21. Group Disincentive	1	1	1	1	4	-1	3
22. Group Feedback	0	1	1	1	3	-1	2
23. Group Reward	0	1	1	1	3	-1	2
24. Group Penalty	0	1	1	1	3	-1	2

	Baseline Belt Use	EFFECTIVENESS SCORES	Intervention Belt Use	Follow-Up Belt Use
Awareness Program	4,5,7,8 41% (n=23)	2 2 4 0	8 61%	8 58%
Community Program	4,6,7,8 58% (n=23)	2 2 4 0	8 78%	8 48%
Driver Safety Program	1,2,3,5,7,8 48% (n=5)	1 3 6 1	11 34%	10

observation vehicle. Approximately 1/3 of the observations were recorded independently by two research assistants, thus enabling assessment of interobserver reliability. After recording belt use and turn signal use, the observer(s) recorded the time of the observation, the license plate number of the vehicle observed, the gender of the subject, and whether the driver was departing or returning from a delivery. In every case the pizza deliverer was the driver and the only vehicle occupant.

Intervention Strategies and Impact

A simple time series paradigm was employed to evaluate the effects of three intervention programs, each including four or more behavior change techniques from Table 1. First, an awareness program was implemented after 9 weeks of baseline observation. It included: 1) a discussion/consensus meeting among employers regarding the value of safety belts and the need to boost the corporate image through visible safety belt use (3 points for both immediate and long-term effects), 2) buckle-up pledge cards to obtain an individual's written commitment to use vehicle safety belts (2 points for immediate and long term effects), and 3) written (store signs) and oral (buckle-up reminders from store personnel) activators (3 points for both immediate and long-term effects). This program received a composite score of "8" for both immediate and long-term impact (see bottom of Table 2), and resulted in a mean increase in safety belt use of 20 percentage points (i.e., a 49% increase over baseline). Safety belt use dropped only slightly during 10 weeks of follow-up observations (initiated 2 1/2 weeks after the intervention program), and such response maintenance (unusual for intervention research to increase safety belt use, as reviewed by Geller, 1988, 1989) was predicted by our scoring system.

After the follow up observations, a second intervention program was implemented at this pizza store for 4 weeks. Specifically, a community safety-belt program was sponsored by the store, and included: 1) the pizza deliverers becoming intervention agents by giving their customers buckle-up pledge cards when delivering pizzas (3 points for immediate and long-term effects); 2) written activators, including a sign in the store announcing the contingency that patrons receive \$1.00 US off the price of their pizzas when they ask the dispatcher to remind their deliverer to buckle up, and a message printed on the deliverer's receipt if the patron had made the order with a "buckle up" reminder for the driver (1 point for immediate and long-term effects); 3) oral activators (or "buckle up" reminders) as deliverers left the store to deliver pizzas (2 points for immediate and long term effects), and 4) buckle up promise cards for the pizza deliverers to sign and hang in their vehicles (2 points for immediate and long term effects). This community safety belt program received considerable media attention from local radio and newspapers, which could be considered additional oral and written activators for the deliverers to use their safety belts. The composite score for this intervention was "8", the same as the prior awareness program, and this intervention increased the same drivers' belt use another 20 percentage points.

After a non observation period of 7 weeks, baseline observations were taken for 4 weeks, followed by another 7 week break and a third intervention program. This was a special safe delivery program customized for the particular pizza company with which the store is affiliated. The program applied innovative and state of the art educational

procedures (i.e., lectures, demonstrations, group discussions, oral and written activators) within a 3-hour video program and a concomitant workbook. The program specified the company's safe driving rules, which include safety belt use (i.e., policy). All employees had to pass the 20 item test accompanying the program before delivering pizzas. The composite intervention score from our taxonomy (Table 2) is "11", and this is consistent with observing the highest (84%) mean safety belt use following this intervention. This data, however, only included 5 pizza deliverers from the previous programs, and these drivers' safety belt use had dropped to 48% during the 5 month period between this education intervention and the prior community program.

RESULTS

During this year-long study, 4210 total vehicle observations were made. Inter-observer agreement for both safety belt and turn signal observations averaged above 90%, never dropping below 75% for any observation session. Twenty three drivers were observed from the initial baseline through the end of the community program. Of these, 9 were observed into the third baseline and 5 were observed after receiving the safe delivery program. Another 5 drivers were only observed immediately before, during, and after the community program.

Figure 2 shows the mean use of safety belts and turn signals by the pizza deliverers for each experimental phase. The percentage means for a phase were determined by calculating the means for drivers when they were observed at least three times during an observation session. Drivers who didn't provide percentages for at least three sessions per phase were not included in the phase means. The average number of vehicle observations per phase was 702, ranging from 275 to 967. Noteworthy findings shown in Figure 2 are: 1) Higher levels of safety belt use were reached with the community program than the awareness program; 2) Drivers who received the awareness program were not more influenced by the community program than drivers who had not received the prior awareness program; 3) After the community program, the safety belt use of both groups of drivers dropped markedly; 4) The safe delivery program had prominent effects on the 5 drivers who remained from the original target group.

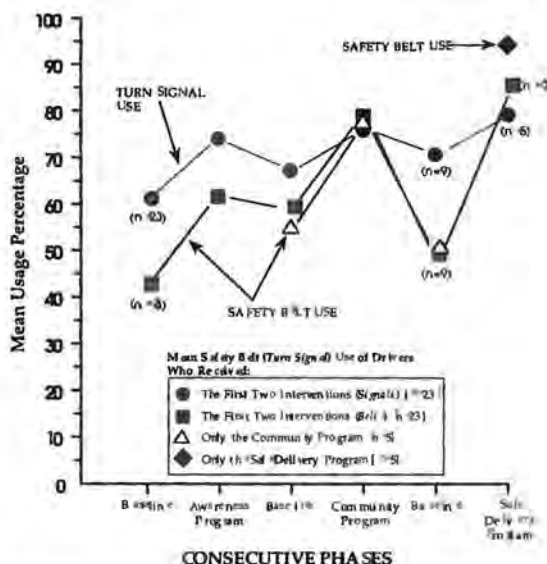


Figure 2: The mean use of Safety Belts and Turn Signals by pizza deliverers for each experimental phase.

(mean belt use = 84%) and on 27 new employees who had not experienced the previous intervention programs (mean belt use = 94%); and 5) The drivers' use of turn signals increased concomitantly with the increases in safety belt use following the awareness and community intervention programs. Turn signal use did not increase following the safe delivery program, and this is difficult to explain since this intervention program (and not the others) addressed specifically the consistent use of turn signals.

DISCUSSION

Clearly this research represents only a first approximation toward developing a reliable and valid taxonomy of behavior change techniques from which to choose a particular intervention program for improving road safety. Our scoring system for evaluating intervention impact is preliminary, and our initial attempt to test the system raises more questions than it answers. Whereas the awareness and community programs received equivalent impact scores and indeed increased mean safety belt use by the same number of percentage points (i.e., 20), the pre-intervention baselines were different for these two tests and it's possible that the community program would have increased safety belt use 40 percentage points if it had been the first intervention program. The finding that drivers who had not received the awareness program were influenced to the same extent by the community program, suggests the absence of an additive effect of the two consecutive programs. It must be considered, however, that the baseline belt use of "new" drivers (i.e., who had not received the awareness program) matched the post-intervention baseline of drivers who had received the awareness program. Is this a demonstration of beneficial peer influence? Perhaps the remarkable effects of the third intervention (i.e., the safe delivery program) was also partially influenced by a contextual (social/environmental) change resulting from the prior exposure of some drivers to the other interventions.

Although our MIL hierarchy predicts that an individual who is uninfluenced by an intervention at a particular effectiveness level will not be subsequently influenced by repetitions of other interventions with the same effectiveness score, it does not address the issue of individuals who are only temporally influenced by an intervention program. For example, all drivers contributing to the data in Figure 2 were influenced to some degree by the awareness program, and thus could be influenced again by the implementation of another intervention program with the same effectiveness score. Would we expect the same increase in safety belt use if the same awareness program were repeated rather than implementing the community program, which was a different program but received the same effectiveness score? The intuitive answer of "no" implies another weakness of our initial attempt to develop a behavior change taxonomy for improving road safety.

This paper suggests a variety of directions for future research. Empirical evidence is needed to verify the classifications of the behavior change techniques according to the five impact factors, and to develop a more sensitive scoring system than the all-or-none scheme used in Table 2. Moreover, intervention research is needed to develop a plan for operationally scoring the involvement, social support, response information, and intrinsic versus extrinsic control of a particular behavior change technique. Such research might also indicate a need to develop a weighting system to account for differential influence of the five

impact factors, and to add other impact factors to the scoring system. The benefits from such investigation would be numerous, including the refinement and enhancement of behavior change theory and methodology with regard to its applicability for increasing safe driving practices.

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SPEED LIMITS, ENFORCEMENT AND OTHER FACTORS INFLUENCING SPEED

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This paper deals with four subjects

- Speed limits and speed enforcement systems.
- Factors of importance for the acceptance of the speed limit system and the speed enforcement system.
- Factors which influence the speed choice.
- The benefit of harmonizing speeds.

SPEED LIMITS AND SPEED ENFORCEMENT SYSTEMS

In Figure 1, the different parts of a speed enforcement system is presented. Without any doubt the probability of detection and action when driving too fast is the core of the system. But there is always an interaction between the level of this probability, the drivers acceptance and the fine and penalty system.

As this symposium takes into account rewarding systems this is also included as a part of the enforcement system, even if it is difficult to realize how such a system will influence the probability of detection and action if driving too fast.

Which speed can be considered too fast? Faster than the speed limit? 10 km/h faster than the speed limit? The tolerance level differs between different countries and even inside a country. This depends to some extent on the methods used; the more accurate the method the lower the tolerance level.

Even if the methods are accurate, there is still a forgiving interval, which has been decided by the police or demanded by the court system.

The driver can control his speed behaviour against the speedometer, which by vehicle regulations has to show a higher speed than the real speed. This inaccuracy causes safety problems as it differs between different car models. Speedometers which show 5-10 km/h more than the real speed are not uncommon.

All surveillance methods are aimed at extracting unwanted or non-accepted behaviours. This strategy seems natural and efficient. But the effectiveness is dependent on the frequency of erroneous behaviours. As many surveillance methods are familiar to the driver or can be observed, drivers under risk of being detected often respect speed regulation at the time of the surveillance.

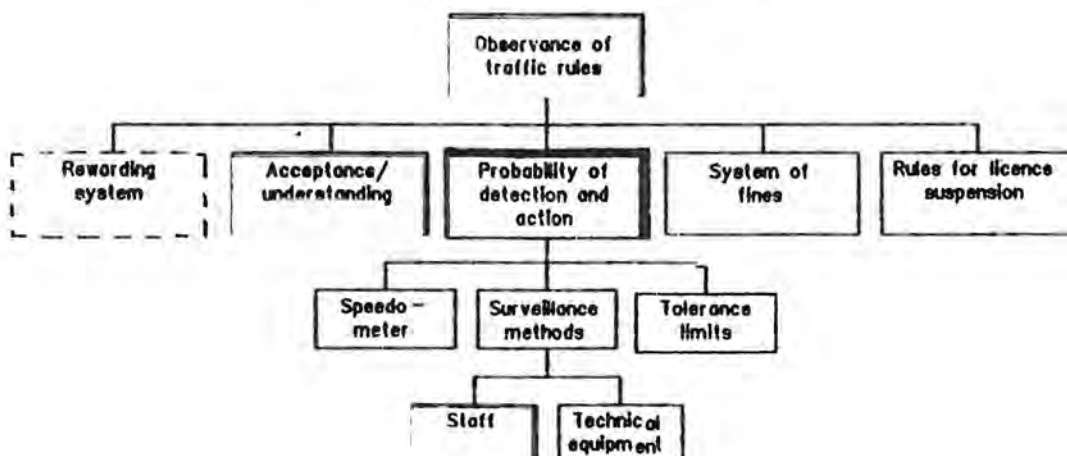
This is positive if the probability of being detected is high, but negative if it is low. In the last case the awareness and/or the importance of the fines have a very limited effect and the effect on speeds is also limited. For a normal driver in Sweden (average annual mileage and average speed behaviour) the probability of being detected for speed violation is on average once in 30-40 years driving.

One important punishment then is the suspension of the driving licence. In the case of low probability of detection a great proportion of the speed violations results in suspensions of the driving licence (30 km/h over the speed limit in rural areas and 20 km/h over the speed limit in urban areas in Sweden).

In order to increase the probability of detection and action it is important that some surveillance methods

Figure 1. Different parts of a speed enforcement system.

Speed Enforcement System



are hidden. This means that the drivers' prediction of being detected become uncertain. The larger the uncertainty the greater prediction of the probability of being detected and penalized.

The "hidden methods" are also possible to use as a rewarding part of the surveillance, but only if the method can not be predicted by the driver. It is also important that the action from the police refers to a general positive behaviour, not to the situation observed or registered, as evidences have no value in the process of rewarding. If a rewarding system points out the observed good behaviour and refers it to time and place the effect probably will be limited.

The experience from Sweden during the eighties is that the probability of detection and action at speed violations is too low and has been decreasing. One of the factors behind this is the very old equipment, which has not been replaced in time, and the personal resources, which have been reduced in spite of the increase of traffic. Personal problems have resulted in fewer radar checks but an increasing use of police-pilots in normal cars. On the other hand, the proportion of speed surveillances in recent years has increased from on average 20% to 35% of the working time in the traffic units of the police organisation. The intention is to reach 50% in 1990.

The latter is a consequence of the increasing number of killed and injured car occupants. VTI has together with the Police Board performed four different research projects concerning speed enforcement.

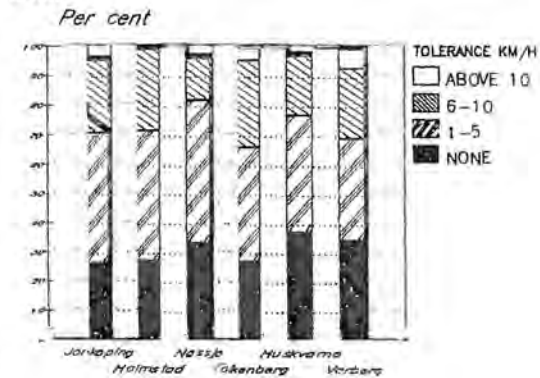
- Advertising in local papers and with signs (SPEED ENFORCEMENT) around cities at the time of speed enforcement activities in the city.
 - Increasing short term effect during the first part of the experiment due to a combination of radar checks and the interest shown from massmedia. No long-term effect on speeds.
- Simultaneous investigations of a speed campaign, increased frequency of radar checks at certain spots, increased fines and reduced tolerance in two cities. Before and after studies with control cities.
 - Only the reduced tolerance limit (-5 km/h compared to the before period) seems to have reduced the speeds and the effect was long term.
- An increased number of radar checks (more than 10 times compared with the year before) in some areas of two cities. Control areas and a control city.
 - Extremely high short term effect on speeds even in the surrounding areas, but limited long term effects on speeds. Mass-media played an important role in the beginning.
- Experiments with automatic speed enforcement. Statistical experiment during 1990 and 1991.
 - No results yet (started April 1990).

The most important experience from these investigations is that the duration must be longer than one year and that the police organisation must be permanently changed to fit the experiment. It is possible to change the routines for a short period but afterwards police activities are often reduced in comparison with the normal level. The limited number of accidents for short periods also makes it more or less impossible to evaluate safety effects. As far as the speed situation is concerned these local trials have a bit to gain in the beginning as long as local papers and other mass media hold a "positive" interest (a

couple of weeks). After that public may be of the opinion that the police organisation has more essential things to do. Then it is easy for mass media to find individual policemen who are critical to their own work and the experiment, and the situation is soon back to "normal".

From the above it is important to stress that lowering the tolerance level seems from many aspects to be a relevant way to reduce the speeds. The message is simple to transform to the drivers regularly and the methods used and the organisation of the police can remain, at the same time as the probability of detecting speed violations increases. About 70% of Swedish drivers are of the opinion that the tolerance level ought to be maximum 5 km/h over the speed limit. This however put demands on a more flexible and progressive fine system - both lower and higher fines compared with today.

Figure 2. Results from roadside interviews of drivers in six cities on the question "which tolerance level ought to be used at speed enforcement in urban areas?"



FACTORS OF IMPORTANCE FOR THE ACCEPTANCE OF THE SPEED LIMIT SYSTEM AND THE SPEED ENFORCEMENT SYSTEM

All speed limit systems are related to the road standard and/or the complexity of traffic.

The drivers' behaviour, described with the speed behaviour, is that the lower the speed limit, the more drivers exceed the speed limit. If we for a moment imagine that the speed limits were removed, we will find that the greatest effect on speeds will occur at the lower speed limits. This fact is often forgotten and drivers driving faster than the speed limit are regarded as a law moral problem.

The problem is to a much greater extent a technical problem of the car, which easily can be driven at much higher speeds, and a human problem from the fact that drivers in general underestimate their speed at low speeds and overestimate their speed at high speeds, if not looking at the speedometer. This problem can be solved with technical aids.

Almost all speed limits are defined as maximum speed limits due to the speed enforcement system. It is not possible to enforce recommended speeds. The choice of a speed limit system in different countries depends both on subjective and objective factors. Safety is the main reason but the environmental problems and energy saving factor are also important. Lobby groups from motorist organisations are directly or indirectly supported by the car and transport industry to introduce subjective opinions in

order to reduce the importance of the above factors at the expense of other factors.

When a speed limit is decided it is informally understood that this is the highest accepted speed at good conditions. But together with the tolerance level the accepted speed is higher and the speed limit will more or less be regarded as a minimum speed. The information that we often ought to drive slower than the speed limit is to some extent rejected every time we observe the speed limit sign.

The rigid use of the same speed limit for all conditions and the restricted use of different speed limits also influence the speed enforcement strategy. If the police is of the opinion that a road has too low a speed limit, the ambition to use speed enforcement is very low. On the other hand, if the limit is considered too high, the ambition to use speed enforcement increases. The latter results in short-term speed effects. The solution is to lower the speed limit which have a long-term effect on speeds and safety in that case. Of course it must be possible to discuss an increase of the speed limit in the first case.

The above problems ought to be solved with speed limits differentiated in time due to light, road surface and traffic conditions and at the same time more differentiated speed limits.

FACTORS WHICH INFLUENCE THE DRIVERS CHOICE OF SPEEDS

An investigation in Sweden done by VTI on behalf of the National Society of Road Safety where a random sample of drivers were asked about their normal speed level on a road with the speed limit of 90 km/h showed that 38% drove up to a maximum speed of 90 km/h, 46% drove with a speed between 90 and 100 km/h and 15% above 100 km/h. These results corresponds to empirical speed measurements.

In order to find out the factors behind the choice of speed level and the relative importance of these

factors between the three groups of drivers the following factors were presented as a background to the question 'Why not driving faster?':

- ACCEPTANCE of the speed limit
- RISK of accidents
- PRINCIPLE to obey traffic rules
- POLICE surveillance
- DANGER
- OVERTAKING difficulties
- FUEL consumption
- EMISSION increase
- STRAIN
- STRESS
- CONFORMITY REASONS
- NOISE

The factors above are in order of importance of the average driver. The order is about the same for all three groups of drivers but the magnitudes are less the higher the speed level. The magnitudes of the different factors are presented in Figure 3 for the three driver groups and were given on a scale from 0 to 5 by the drivers.

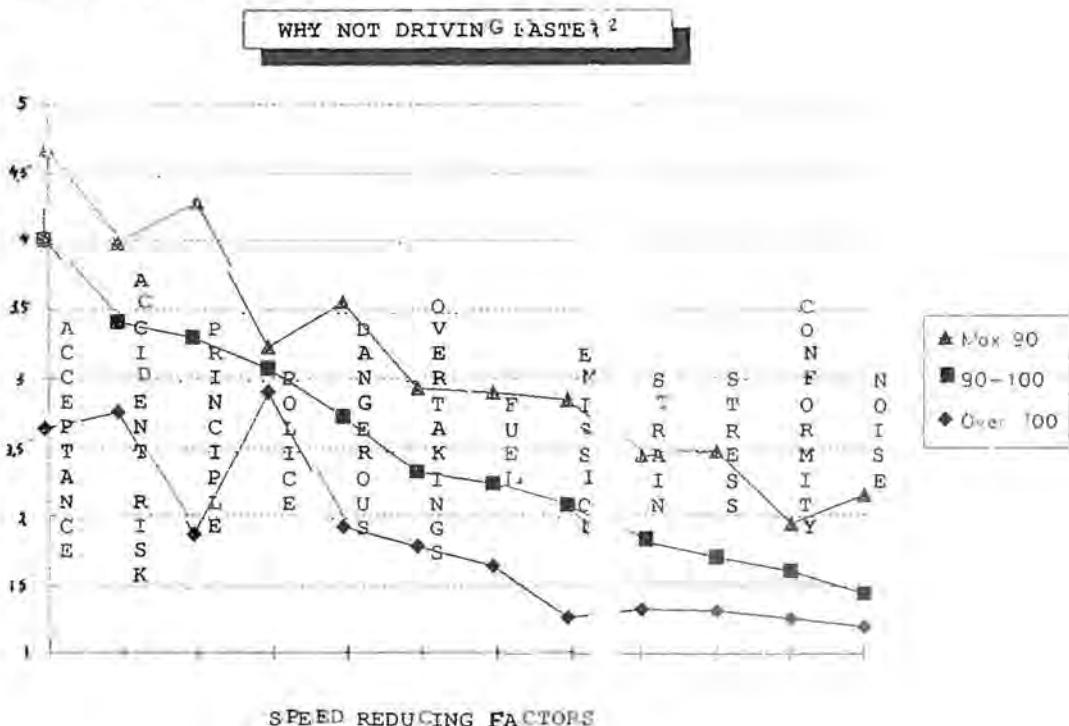
However, one of the factors seems to be of the same value for the three groups and that is POLICE ENFORCEMENT.

Given the opposite question "Why not driving slower?" the drivers were presented the following factors. On the next page the factors are given in order of magnitudes for the three groups of drivers.

Not to impede traffic seems to be of the same importance for all three groups. The factor which differs mostly between three groups is the dullness factor. In Figure 4 the magnitudes of the factors are presented.

For the low speed drivers, it is obvious that the speed limit itself increases their speeds in combination with the factor not to impede traffic.

Figure 3. The magnitude of speed reducing factors



Group I 90 km/h	Group II 90-100 km/h	Group III above 100 km/h
IMPEDE on traffic	IMPEDE	DULLNESS
RISK of accidents	DULLNESS	IMPEDE
PRINCIPLE	TIME	TIME
CONFORMITY of traffic	CONFORMITY	STRESS
DULLNESS	RISK	CONFORMITY
TIME loss	PRINCIPLE	PRINCIPLE
STRESS	STRESS	RISK

An interpretation of this is that if the traffic density increases, speeds increase - the race track situation. The time loss factor seems to be of limited importance and differs very little between the groups.

In another investigation road, vehicle and journey factors have been analysed by a combination of roadside interviews and speed measurements on main roads with the speed limit of 90 km/h. The interview data and speed data collected, which included the registration numbers of the cars observed, have been supplemented with data from the vehicle register, driving licence register and 1980 national census kept by Statistics Sweden.

The cars were divided into two groups, privately owned cars and cars owned by companies. Cars with and without trailers and private cars owned by men and women were analysed. The results from these analyses show that:

- No statistically significant speed effect due to the sex.
- A significant speed difference between privately owned cars and company owned cars. The last group had a 6.4 km/h higher speed on average.
- A significant speed difference between cars with and without trailers, 16.9 km/h lower speed for caravans and 14.0 km/h lower speed for other trailers. The speed limit for these vehicle combinations is 70 km/h.

For cars owned by men, the following speed effects were achieved:

- Purpose of the journey. Different purposes give a

maximum difference in speed of 5 km/h.

- Covered and remaining distances. Different combinations of covered and remaining distances give a maximum difference of 11 km/h.
- Model and age of the vehicle. Different combinations of model and age of the vehicle give a maximum difference of 9 km/h.
- Age of the owner and the driving licence. Different combinations give a maximum difference of 8 km/h.
- Paved width of the road. Speed increases by 0.4 km/h per meter paved width (Speed limit 90 km/h).

For the cars owned by companies the speeds at the end of a long journey are a great deal higher than those in the beginning of a journey.

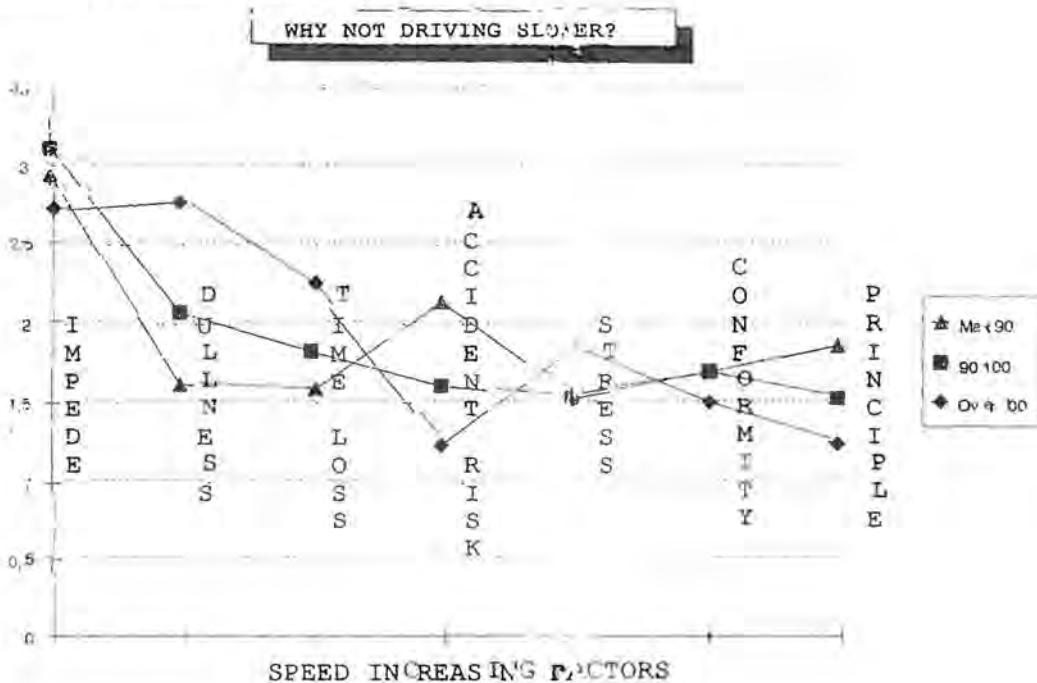
BENEFITS OF HARMONIZED SPEEDS

From the result presented above, it is obvious that the speed distribution on a given road is a result of different speed choices among the drivers, different types of vehicles, but also inaccurate speedometers. The effects of these three factors have been analysed by using the VTI traffic simulation model. The study refers to a two-lane road, where the carriageway has a width of 9 m and the total length is 12 km. The speed limit was 90 km/h and the traffic flow 750 vehicles/h in both directions. 12% of the vehicles were lorries and buses.

Three different simulation studies were performed.

1. Passenger cars were clustered into five speed levels 80, 90, 100, 110, 120 km/h and busses into 0

Figure 4. The magnitude of speed increasing factors



three levels: 80, 90, 100 km/h. The proportions of each speed level were chosen in order to obtain the same journey speed and standard deviation in speed as empirical data showed.

These situations were simulated both with accurate speedometers and with today's inaccurate speedometers.

The main result was that the average journey speed increased with 6 km/h and the number of overtakings was reduced by 22% with accurate speedometers.

II. Passenger cars were clustered into three speed levels: 90, 100, 110 km/h and lorries into four levels: 80, 85, 90, and 95 km/h.

With today's speedometers the average journey speed increased with 3 km/h and the number of overtakings was reduced by 15%. With accurate speedometers the journey speed increased with 6 km/h and the number of overtakings decreased by 44%.

III. The lorries were taken away and only three speed levels: 90, 100 and 110 km/h were used.

The average journey speed increased with 8 km/h and the number of overtakings was reduced by 67% with accurate speedometers in this case. Most interesting was that the constraint time of a journey (time behind a vehicle at lower speed) was reduced by about 50%.

Of course the trivial case of only one speed level and accurate speedometers is the most effective. The results show that accurate speedometers and more restricted speed choices can result in a more effective traffic and probably also a safer traffic.

How to combine technical solutions, enforcement and rewarding systems is an urgent question as more effective and safer road traffic for the society has previously not been regarded as a satisfactory reward to many individual road users.

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SELECTIVE ENFORCEMENT OF SPEEDING BEHAVIOUR IN BUILT-UP AREAS

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It is well known that speeding by motorists is a major factor in traffic accident causation (e.g. OECD, 1982). Hence, speed control is one of the main strategies to improve traffic safety. In order to regulate driving speed most countries have implemented speed limits by law for different road types. It is one of the tasks of the police to enforce these limits.

Speed registrations on the Dutch roads show that the limits are exceeded by a large part of the motorists. According to Riedel, Rothengatter, and de Bruin (1988), the relative low obedience to speed limits is partly due to the limited police manpower and partly to the enforcement strategy traditionally used. Most of the time the enforcement strategy consists of general surveillances, attending offences against divergent traffic laws.

In a study on improvement of enforcement strategies for speed control, Riedel et al. (1988) conclude that selective enforcement in combination with publicity is the most effective strategy to reduce driving speed. Selective enforcement implies that the enforcement activities are temporarily limited to only one specific traffic behaviour, in this case speeding. The Riedel et al. study was concentrated on roads outside built-up areas with a speed limit of 80 km/h. Selective enforcement in built-up areas has not been investigated extensively. As the roads in built-up areas differ in many respects from the 80 km roads outside the built-up areas, a number of experiments have been carried out in order to determine whether the results found in the earlier studies also apply to built-up areas.

Roughly two types of roads can be distinguished in urban areas: residential streets and arterial roads. In many countries infrastructural countermeasures have increasingly been applied for speed management in residential streets, such as humps and 30 km/h zones (Danish Road Directorate, 1990). The main function of arterial roads is a quick and efficient but safe traffic stream. Therefore, infrastructural countermeasures would not be appropriate for these roads. Consequently, the studies on selective enforcement in built-up areas have been concentrated on reducing driving speed on arterial roads by non-infrastructural countermeasures.

Because of the generally limited police manpower, an important condition for the studies was that no or only minimal extra manpower had to be used as compared to the normal enforcement activities. The difference should be in the allocation of the resources.

The experiments presented in this paper have been conducted in 1989 and 1990 in the city of Rotterdam. These experiments are part of a larger research project concerning strategies for speed control, which eventually will lead to a handbook on this topic for local and provincial authorities and police officers. The project is co-ordinated and financed by the Dutch Ministry of Transport.

METHOD

In the city of Rotterdam four arterial roads were selected. Among the selection criteria used were:

- a speed limit of 50 km/h;
- presence of (potential) dangerous sites (complex intersections, narrowing of lanes or regular slow traffic);
- representativity for this type of roads in other cities.

Three experiments have been carried out. Within these experiments the same research design has been used, consisting of five consecutive phases (see table 1). Firstly, the driving speed of private car drivers was pretested during two weeks, by induction loops in the road surface. During the next week selective enforcement of speeding was conducted by the local police force. The enforcement strategy consisted of unobtrusive speed checks by radar in combination with obtrusively holding up offenders and was applied during four hours per day, three days per week. In all three experimental studies the same enforcement strategy was used. Other strategies used in the Riedel et al. study (1988) were not appropriate for application in built-up areas.

Table 1. Research design selective enforcement experiments

week 1-2	Pretest
week 3	Selective Enforcement
week 4-5	Publicity
week 6-7	Selective Enforcement Plus Publicity
week 8-11	Posttest

In the third phase of the study only publicity activities were carried out. These activities were different for the three studies. The fourth phase consisted of both publicity and selective enforcement of speeding. That is to say, the fourth phase consisted of the combination of the treatment during the second and the third period. During all the experimental treatments, the driving speed of motorists was continuously registered, except for the weekends, in the same manner as during the pretest. After the interventions the speed registrations were prolonged for two to four weeks.

This design should enable us to assess the effects of selective enforcement and publicity both separately and in combination.

Experiment 1

The first experiment was carried out on one of the main roads entering the city of Rotterdam. The road

has four lanes (two lanes in and two lanes out). Shortly beyond the sign of entering the built-up area there is a very busy intersection regulated by traffic lights. Coming from the motorway car drivers usually approach this intersection at very high speeds.

The publicity activities at this location consisted of warning signs by the roadside. Also a banner was hanged above the road, communicating the necessity of reducing the driving speed because of entrance of the built-up area.

Experiment 2.

The second experiment was conducted on two arterial roads with quite different characteristics. One road had four lanes and a separate cycle track. The road is characterized by a complex intersection at one end and a substantial road narrowing at the other. The second road was a two lane road without a separate cycle track. The objective of this experiment was to study the effects of the same enforcement and publicity activities on the driving speeds on two different types of road.

The publicity activities at these locations consisted of warning signs by the roadside, as in the first experiment. In addition, a local mass media campaign was carried out for public information, using local newspapers and local television and radio broadcasting.

Separately, both before and after the treatments, a questionnaire survey was carried out among independent samples of car drivers who actually used these roads. These surveys aimed at measuring the opinions about the treatments and to study possible changes in attitudes and beliefs towards speeding in consequence of the treatments. For both surveys 800 questionnaires were mailed.

Experiment 3.

The last experiment was conducted on the fourth location. This four lane road is characterized by several pedestrian crossings and lane narrowings.

Again, warning signs were placed by the roadside. In addition, feedback concerning speed information to the road users has been applied. During the publicity period, the percentage of drivers who were not exceeding the limit (plus a certain margin) was indicated on signs by the roadside. This percentage was adjusted once a week. The strategy of collective feedback was successfully applied in former studies on driving speed reducing countermeasures (Riddel et al., 1988, Van Houten & Nau, 1983) and is based on the assumed motivation among drivers to comply with (the majority of) other motorists. In addition, feedback information of this sort implies that the driving speed has been registered, which might be considered as a form of surveillance.

RESULTS

Experiment 1.

Table 2 shows the average driving speed across each experimental period. The averages are based on daily measurements from 7:00 to 19:00 hours. Recall that the speed limit at the spot of measurement was 50 km/h, whereas the mean speed was about 30 km/h higher.

As expected, the largest speed reduction was found when the enforcement was combined with publicity

by the road. During this period the mean driving speed was about 6 km/h lower than during the pretest. During the posttest this effect was reduced to 2.4 km/h.

Table 2 also shows the results of the statistical analyses. The average driving speed across the different treatment conditions and across the posttest period is tested to the pretest level. The analyses are based on the mean driving speed per day of registration. This reduces the number of degrees of freedom considerably. If the analyses were based on the raw data (driving speeds of thousands of cars), even a speed difference between two conditions of less than 0.5 km/h would be significant, but obviously not really relevant.

As can be concluded from the table, both publicity only and publicity plus enforcement led to a significant reduction of the driving speed. Police enforcement only did not. Although the speed during the posttest showed a clear return towards pretest level, when compared to the former treatment conditions, the difference between this period and the pretest still turned out to be significant.

Table 2. Mean speeds (km/h) during different treatment conditions

	m	sd		
1. Pretest	83.7	1.7		
2. Enforcement	83.1	1.1		
3. Publicity	79.8	1.4		
4. Enforcement + publicity	77.9	0.8		
5. Posttest	81.3	0.7		
Effects:			df	p
Overall	F=32.97	39.4		<.001
2 vs. 1	t=0.89	39		n.s.
3 vs. 1	t=6.92	39		<.001
4 vs. 1	t=10.31	39		<.001
5 vs. 1	t=4.29	39		<.001

Figure 1. Percentages of motorists exceeding 80 km/h, experiment 1

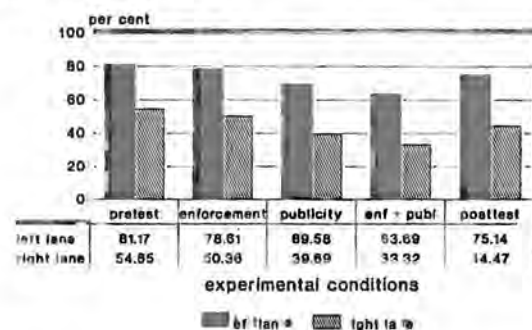


Figure 1 shows the percentages of motorists driving over 80 km/h. The speed level was chosen because of the overall high driving speed at this location. During the pretest more than 80 per cent of the drivers on the left lane exceeded 80 km/h. On the right lane 55 per cent drove at higher speeds. During the most effective experimental treatment these percentages were 64 and 33 respectively.

Experiment 2.

Table 3 shows the average driving speed across the different treatment conditions in the second

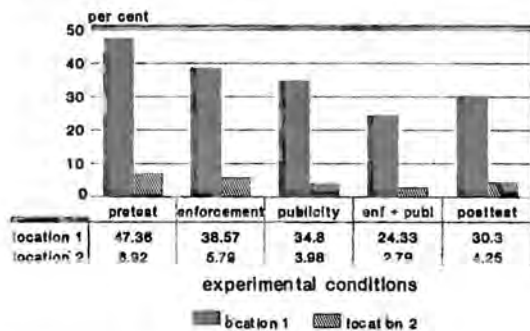
experiment. Location 1 is the four lane road with a separate cycle track and location 2 is the two lane road without a separate cycle track. The speed difference at these two locations is considerable: about 15 km/h.

Table 3. Mean speeds (km/h) during different treatment conditions at two experimental locations

	Location 1		Location 2	
	m	sd	m	sd
1. Pretest	69.9	1.0	55.7	.9
2. Enforcement	67.1	1.4	54.9	1.0
3. Publicity	66.4	1.3	53.5	1.2
4. Enforcement + publicity	62.4	2.1	51.6	.9
5. Posttest	64.8	.9	53.4	.6
Effects:	df	p	df	p
Overall	F=38.17	40,4 <.001	F=20.23	35,4 <.001
2 vs. 1	t=-3.67	40 <.01	t=1.33	35 n.s.
3 vs. 1	t=-5.51	40 <.001	t=4.37	35 <.001
4 vs. 1	t=-11.90	40 <.001	t=8.03	35 <.001
5 vs. 1	t=-8.08	40 <.001	t=4.46	35 <.001

Again the combined treatment condition consisting of enforcement plus publicity led to the largest speed reduction at both experimental locations. And again police enforcement only, led to the smallest reduction. As the proportion of motorists exceeding the speed limit is much larger at location 1, it is not surprising that the magnitude of the speed reduction was highest at this location. This can also be observed in Figure 2. The percentage of motorists exceeding 70 km/h diminished from 47 during the pretest to 24 during police enforcement combined with publicity. At location 2 these percentages were 7 and 3 respectively.

Figure 2. Percentages of motorists exceeding 70 km/h, experiment 2



Like the registered speed, the results of the questionnaire surveys showed large differences between the two locations. Location 1 was seen by the respondents as more safe ($F(780,1)=299.57, p<.001$), the reported speed at this road was higher ($F(807,1)=31.31, p<.001$), and both the attitude and the subjective norm towards speeding were more positive ($F(693,1)=55.59, p<.001$ and $F(671,1)=9.95, p<.001$ respectively).

After the treatments both locations were judged as being less safe ($F(780,1)=6.12, p<.05$). Also police enforcement of speeding was valued more positively ($F(773,1)=18.55, p<.001$) and both the attitude and

the subjective norm towards speeding were less positive than before the treatments ($F(693,1)=4.05, p<.05$ and $F(671,1)=6.88, p<.01$ respectively). The reported driving speed was not affected. In addition, no significant interaction effects between location and treatments were found.

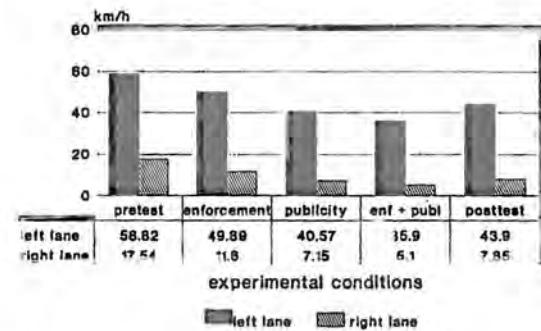
Table 4. Mean speeds (km/h) during different treatment conditions at two experimental locations

	m	sd
1. Pretest	64.1	.5
2. Enforcement	60.8	1.0
3. Publicity	59.4	1.8
4. Enforcement + publicity	57.9	1.5
5. Posttest	60.6	1.0
Effects:	df	p
Overall	F=32.85	42,4 <.001
2 vs. 1	t=4.50	42 <.001
3 vs. 1	t=8.15	42 <.001
4 vs. 1	t=11.0	42 <.001
5 vs. 1	t=6.71	42 <.001

Experiment 3.

Table 4 shows the average driving speed across each experimental period of the third study. In Figure 3 the percentages of motorists driving over 70 km/h during this study can be found.

Figure 3. Percentages of motorists exceeding 70 km/h, experiment 3



As can be concluded from table 4, police enforcement and public information, both separate and combined, resulted into a significant reduction of the driving speed. Again, during the combined period the largest reduction was found. Compared to the pretest level, the mean driving speed was about 6 km/h lower and the percentage of motorists exceeding 70 km/h was dropped from 24% to 10%. During this period, the mean driving speed was even significantly lower than during the enforcement only and the publicity only period ($t=3.81, p<.001$ and $t=2.56, p<.05$ respectively). The smallest reduction of the driving speed was found during the enforcement only period. Compared to the pretest level, the mean driving speed was about 3.5 km/h lower and the percentage of motorists exceeding 70 km/h reduced to 18%.

During the posttest period the driving speed showed a slow but persistent increment. Compared to the pretest level, however, the mean driving speed in this period turned out to be still considerably lower.

DISCUSSION

From the results of the three experiments on speed management in urban areas several relevant conclusions can be drawn. In the first place, it is always the combination of selective enforcement of speeding behaviour and publicity that leads to the largest speed reduction. In addition, in all three experiments publicity only appears to be more effective than enforcement only. This does not necessarily mean that publicity only is more effective per se. One of the advantages of publicity over enforcement is, however, that this kind of countermeasures can be applied in principle 24 hours a day, in a relatively cheap way, whereas enforcement for practical reasons can only be carried out during a rather limited period, and is rather expensive as well.

Apart from this, the observed results could be due to a sequence-effect. The effectiveness of publicity only could partly be resulted from the preceding enforcement period. That is to say, when the sequence of the treatments would be reversed, the publicity effect might be smaller and the enforcement effect might be larger. Unfortunately however, for practical reasons, the sequence was not varied.

In the most effective experimental conditions a speed reduction of 5-7 km/h was found. The question arises whether this reduction benefits traffic safety. It probably does. Recall that during the enforcement plus publicity phase the percentage of motorists driving at high speeds was considerably lower. During the posttest this effect was still sizable. As the relationship between speed and accident rate seems to be strong and positive (OECD, 1982), a decrement of excessive high speeds leads to fewer and less severe accidents. As Salusjärvi (1982) has pointed out, even a small reduction of the mean driving speed can have a considerable positive effect on traffic safety.

In their study on selective enforcement of speeding behaviour on highways outside built up areas, Riedel et al (1988) also found the combined treatment to be most effective. In contrast to the results of the present study, however, mere enforcement led to a relevant speed reduction too. This discrepancy can probably be attributed to the divergent traffic situations. In the more complex situations (in cities) it may be more difficult to attract the attention of the road users by local and temporary enforcement only.

Although during the enforcement only phase in all three experiments the reduction of the driving speed was small to moderate at best, we think that the enforcement strategy played an important role. By applying radar checks in combination with obtrusively holding up offenders on a particular road, the police is more visibly and emphatically present on the road than with the usually applied surveillance strategy. Moreover, the strategy used in our experiments incorporates both an important repressive function and an important preventive function.

On the basis of the three experiments it is difficult to conclude which of the applied publicity activities is most effective. Because of the considerable differences among the selected roads, the results of the studies are difficult to compare. In the second study, for instance, the same treatment was applied on two different road types. The resulting speed reduction on the four-lane road turned out to be almost twice as large as the observed reduction on the other road.

These different effects probably depend on the initial speed levels.

In general we believe that public information by the road side is an important condition to influence driving speed. The target group can be reached at that particular location where the behavioural adjustment is required. Collective feedback of speed information, as applied in the third study, has, at least theoretically, some additional value over regular roadway signs. Because of changing percentages on a regular basis, the attention of the car drivers might be more attracted. In addition, collective feedback motivates the drivers to conform to others and probably leads to an implicit notion of surveillance. Last but not least, feedback may serve as a reinforcement to drivers who already adjusted their driving speed.

The extensive local publicity campaign held in the second experiment, using newspapers, radio, and television, did not show any additional effect compared to the warning signs in the first experiment, at least with respect to the actual driving speed. It is possible that the use of the mass media did contribute to the observed change of the attitude towards speeding. However, because no surveys were held in the first experiment, we can only speculate about this.

A change of opinion of motorists about speeding was found for both locations in the second experiment. We hypothesized that the effect would be considerably smaller for that location where the speed limit is least accepted. In other words, we expected to find significant interaction effects between location and treatment. However, the survey data are not in accordance with this hypothesis. The question remains how long the observed change lasts or lasted.

With respect to the observed speed reduction a similar question has to be answered: How long will the effect sustain? The data showed a reduced but still significant speed effect during the posttest. Sooner or later, however, the effect disappears, in particular when no following activities are carried out. Within the same overall research project a study is in progress to determine the rate at which this type of enforcement and publicity activities should be repeated in order to maintain a speed reduction as long as possible.

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THE EFFECTS OF SPEED ENFORCEMENT ON INDIVIDUAL ROAD USER BEHAVIOUR AND ACCIDENTS

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INTRODUCTION

It is well documented that increased speed increases accident risk. Speed limits are introduced in order to reduce the number of accidents, and to limit other drawbacks connected with driving at a high speed, such as noise and air pollution. The effects of speed limits on the number of accidents have been documented in a large number of studies, most recently in the United States when 38 states raised the speed limit on rural Interstate roads from 55 to 65 mph (NHTSA-report, 1989).

Speed limits are, however, not always respected by road users. On the contrary, exceeding the speed limit is very common, and is probably the most widespread violation in traffic today.

Police enforcement of driving speed have as its chief purpose to reduce accidents by ensuring greater respect for speed limits, especially in places and at times when high speed may lead to a particularly high accident risk.

A certain mobility will be decided by a certain speed limit. Total compliance to speed limits is, however, more or less impossible to achieve. Society therefore has to decide on what level of mobility, enforcement and compliance it will have in relation to how many accidents society will accept. A certain level of mobility will always have some level of accidents.

In order to reduce the accident rate, speed enforcement must convince drivers that they run a certain risk of being caught when exceeding the speed limit. This again leads to fewer speeding violations and the decrease in violations leads to fewer accidents.

In this paper the effects are mostly expressed as changes in violation rate. The estimated changes in violation rate is based on the percentage of violations before and after introduction of enforcement programs. Thus if 30 percent violated the speed limit before and 15 percent after, this counts as a 50 percent reduction of violation rate. When we use the expression violation rate this means the actual violations according to the measured speeds, not the violators apprehended. It is also important to note that we talk about *changes* in violation rate, not the different absolute levels of violation.

THE RATIO BETWEEN ACTUAL AND SUBJECTIVE RISK OF APPREHENSION

Surveys carried out in the Scandinavian countries (Lund, Brodersen & Jørgensen, 1977, Endresen

1978; Åberg, 1983; Salusjärvi & Mäkinen, 1988) show that the subjective risk of apprehension is correlated with the actual risk of being detected. The variations in subjective risk are, however, slighter than the variations in actual risk of detection. A study of 11 police districts, in which the objective risk of apprehension varied by a factor of 5-10 (depending on the method of calculation), found that the percentage of car drivers who declared that the risk of detection was "very great" or "great" only varied from 47% to 71% (Endresen, 1978). A Swedish survey found that the subjective risk of apprehension on roads where the actual risk of detection was increased 5 times only increased 15 - 20% (Åberg, 1983). A Finnish survey indicated that increasing the actual risk of apprehension three times led to the subjective risk of apprehension only increasing by a factor of 1.4-1.9 (Salusjärvi & Mäkinen, 1988).

In an experiment performed in the Netherlands, public information was used to give the impression of an increased actual risk of detection, without any actual change. This did not lead to any notable reduction in speed. Information can, however, strengthen the impression of an increased risk of detection if the actual risk of detection is increased (Rothengatter, 1988).

In other words, road users are unable to perceive small differences in the actual risk of detection, or be fooled into believing that the risk of detection has increased when this is not the case. According to what is documented, the actual risk of apprehension has to be increased by a factor of at least three before road users begin to notice the difference. The importance of the absolute levels is discussed later in this paper.

GENERAL EFFECT OF POLICE ENFORCEMENT

Even though the actual risk of detection is often very slight, the certainty that one can be checked by the police does influence driving behaviour. This became evident when the Finnish police went on strike for two weeks in 1976. It quickly became common knowledge that there were no traffic enforcement in operation. A survey of the change in road user behaviour during the strike (Summala, Näätänen & Roine, 1980) found that the number of serious speeding offences increased by 50-100%. The effect on the accident rate could not be measured, because no accidents were recorded during the strike.

EFFECTS OF INCREASED POLICE ENFORCEMENT ON SELECTED ROADS

A number of surveys show the effects of increased speed enforcement on selected roads. Only a few surveys have measured the effects on both subjective risk of apprehension, the number of speeding offences and number of accidents.

In England in 1964/65, speed checks on six roads with a speed limit of 30 mph (48 km/h) were

increased by a factor of 6-8. Average speed was reduced by about 1-5%. The percentage of speeding offenders was reduced from 40% to 26%, a relative decrease of about 35%. Accidents on the roads where the number of checks had been increased decreased by 25% compared to other similar roads in the same area, and by 28% compared to the general accident trend in England during the same period (Munden, 1966).

In the summer of 1965, speed enforcement on E-roads 3 and 18 in Sweden was increased three times. The enforcement was directed against all types of traffic violations, not only speeding offences. The effect of employing more frequent enforcement was measured with a before-and-after survey, in which speed and accident trends in the summer of 1965 on European roads 3 and 18 were compared with corresponding trends on European road 4. The percentage of speeding offences on European roads 3 and 18 went down from about 29% to 27%. On E-road 4, which was used as control, the proportion of speeding offences increased from about 45% to 48% in the same period. Average speed remained practically unchanged. The accident trend was more favourable on E-roads 3 and 18 than on E-road 4. The number of accidents reported by the police went down by 37%, the number of accidents registered by the Central Bureau of Statistics went down by 24%, and the number of car rescue and salvage jobs registered by a car rescue and salvage firm went down by 21%. A special point was made of registering the number of car rescues and salvages, as it was assumed that increased checks might lead to the police being informed about more accidents, which would mean that the true effects could not be measured. The results do not indicate that the increased enforcement led to increased accident reporting by the police (Ekström, Kritz & Strömgren, 1966).

In two experiments in Denmark in 1970/71 and 1975, invisible enforcement on selected road sections was increased, first by a factor of 2.8 and later by a factor of 5.5. The first experiment found no change in behaviour or the number of accidents (Lund & Jørgensen, 1974). The second experiment found that the increase provided measurable results with reference to both subjective risk of detection and speed. Average speed was reduced by 1-5%. The percentage of drivers found to exceed the speed limit by 10 km/h or more was reduced by 15-40% (Lund, Brodersen & Jørgensen, 1977). The effect on the accident rate was not investigated.

In 1979, speed checks were intensified on about 10% of the entire network of national highways in Sweden. These checks were carried out with uniformed police cars. A survey of the long-term effect of the enforcement showed that increase of enforcement led to an increased subjective risk of detection, fewer speeding offences, and fewer accidents (Engdahl & Nilsson, 1983; Åberg, 1983). The following approximate relation was found between the change in enforcement intensity and the change in the number of accidents (see Table 1). In six counties in the state of Texas in US, the

number of visible speed checks was greatly increased (probably by a factor of 4-8) in 1979/80 in order to secure greater respect for the national speed limit of 55 miles per hour, which was introduced in the USA in 1974. A before-and-after study found that the increase led to an approximately 2.4% reduction in average speed, a reduction in the percentage of speeding offences from 67% to 57%, and reductions of approx. 18% in the number of fatal accidents, 14% in the number of accidents involving personal injury, and 6% in the number of accidents involving material damage, compared with the general accident trend in Texas. The figures must be interpreted with caution, however, as the six counties had an abnormally large number of accidents before the experiment (Roop & Brackett, 1980).

In another experiment conducted in Texas, enforcement strategies were tried out to give road users the impression of massive enforcement, without any corresponding increase in the extent of enforcement. This experiment led to an about 5% decrease in average speed, and fewer speeding offences. Accidents involving personal injury were reduced by approx. 11% compared with other sections of road where enforcement was not intensified (Brackett & Beecher, 1980).

In 1984, speed checks in the municipality of Vanda in Finland were increased about three times. A before-and-after study found that the average speed was reduced by 1-5%. The percentage of speeding offences was reduced by 20-40%, and the subjective risk of detection increased by 40-90%. The number of police-reported accidents, regardless of the degree of damage, increased by 11% in relation to the total trend in Southern Finland during the same period. The increase was most marked with respect to accidents involving personal injury. The fact that accidents increased was unexpected, and may appear difficult to explain in light of the effect the enforcement had on the speed level. Possible explanations may be a simultaneous growth in traffic volume in Vanda of 9% and an increased degree of accident reporting because of the increased presence of police (Salusjärvi & Mäkinen, 1988).

Summary

The studies reviewed above indicate that increasing enforcement intensity on a given road by less than three times the previous level has little or no demonstrable effect on subjective risk of detection, the number of speeding offences, or the number of accidents. Increasing enforcement on a given road by three to five times increases the subjective risk of detection, reduces the numbers of offenders, and may reduce the number of accidents by about 10-20%. Increasing enforcement on a given road by more than five times increases the subjective risk of detection, reduces the percentage of offenders, and may reduce the number of accidents by up to 20-30%.

HALO-EFFECT OF ENFORCEMENT

A stationary police check usually has a local effect only. The extent of the effect in time and space varies, but is usually very small. A Finnish survey

Table 1. Change in enforcement intensity and change in accidents

Up to 50% reduction of enforcement:	+ 11% reported accidents
Normal level:	No change
Approx. 100-300% increase of enforcement:	-11% reported accidents
Approx. 300-500% increase of enforcement:	-12% reported accidents
Approx. 500-800% increase of enforcement:	-19% reported accidents

(Syvänen, 1976) demonstrated the "space"-effect on the speed level of a clearly visible, parked police car up to 1.9 km away from the car.

In an American study, a stationary police car was moved around from place to place, giving the impression of a massive concentration of checks. The moves took place randomly, so as to prevent road users from detecting any pattern in them. The purpose of parking the car in so many different places was to make the checks effective over a longer section of road. The effect on the speed level could be observed up to 20 km from the car (Brackett & Edwards, 1977).

A Canadian survey found that the effect on the speed level of a parked police car was halved for each 0.9 km the passing cars distanced themselves from the police car. The effects of one single control lasted for three days. Repeated enforcement were effective for up to 6 days. Repeat enforcement do not appear to have a greater effect on daily road users than on drivers merely passing through (Hauer, Ahlin & Bowser, 1982). In Sweden the after-effects of repeat enforcement have been demonstrated up to 14 days after the conclusion of the enforcement (Åberg, 1980).

A Norwegian survey established the effect of a stationary radar speed check up to 2.5 km from the actual checkpoint (Østvik, 1989) for the duration of the check period. No effect seemed to persist after the enforcement period.

EFFECTS OF VARIOUS TECHNIQUES

A distinction is made between visible (uniformed police vehicle) and concealed enforcement. The purpose of concealed enforcement is to increase the uncertainty as to when and where road users may be subjected to enforcement. The intention is also to prevent road users from simply adapting to the speed limit wherever they can see there is a check in progress.

Concealed enforcement allows unsuspecting road users to be apprehended, and thus has a certain individual preventive effect on serious violations of the law. The general preventive effect is, however, very slight (Shinar & McKnight, 1985). Only uniformed police patrol car enforcement and visible enforcement appear to curb speed in general.

The police always insert a safety margin in speed checks, among other things so as to allow for inaccuracies in speed measurement and to be sure that the evidence for speeding offences will stand up in court. This safety margin means that the actual speed limit employed in police speed checks may be approximately 10% higher than the limit given by road signs. In Sweden, an experiment was carried out using a reduced limit of tolerance in speed checks in the towns of Halmstad and Jönköping (Andersson, 1989). The reduction amounted to between 3 and 5 km/h. A before-and-after survey, in which the Swedish towns of Nässjö, Huskvarna, Falkenberg and Varberg formed the control group, showed that the lowering of the level of tolerance led to a decrease in the number of motorists who drove at speeds above the official limit. The frequency of the police checks was not changed, only the speed level at which the police reacted.

We have found no documentation other than what is here presented (which is surprisingly little), on

comparative studies of different police strategies.

AUTOMATIC POLICE ENFORCEMENT

Several studies over the last few years have demonstrated that automatic police surveillance have good effects on compliance in traffic. In Germany a study found that the introduction of 100 km/h speed limit on a part of a motorway reduced average speed up to 30 km/h. When automatic surveillance was introduced average speed was reduced even 20 km/h more (Lamm & Klöckner, 1984). We have calculated the reduction of accidents on the surveilled road section to be 91%, while the reduction of accidents on all German motorways was 56% in the same period. It is, however, important to bear in mind that this is a combination of two countermeasures, namely introduction of speed limit and automatic enforcement. In Singapore it was demonstrated that red-light offences were reduced by 40% when red light cameras were introduced (Chin, 1989). In Victoria, Australia such cameras led to up to 32% reduction in accidents (South et al, 1988).

An ongoing study of automatic speed enforcement in Norway have found that the average speed on a 80 km/h road was reduced up to 10 km/h. Such effects have been found two years after the introduction of the countermeasure even if the cameras were active for only about 12 hours a week. The percentage of offences were reduced from 43% to 14% at one point, from 35% to 7% at another point, which is calculated to a relative reduction of up to 69% when taken into account the speed on our control road. On a 50 km/h road with much local traffic the reduction of speed only seems to be found at the camera with only a small halo-effects. Our study seems to indicate that the change of speed choice persist even with inactive periods by the camera of up to two months.

"TASK FORCE" - A NORWEGIAN STUDY

A recent Norwegian study seems to indicate that long term effects also can be obtained by use of manual police enforcement. The results from the study are not yet completely analysed and therefore not published. However, the project will evaluate the effects of a group of police officers formed as a "Task force" with the objective of reducing the mean speed on a certain section of road. The group was free to choose any countermeasure available for manual police surveillance. Decreased average speeds seems to have been found 2 months after the group had stopped their enforcement program. A special effect of the program was that the productivity of the police officers increased considerably, due to the fact that the group felt responsible for obtaining effects. The details of the study are not yet available, but will be published early next year.

DISCUSSION AND IMPLICATION FOR FUTURE RESEARCH

In general it is difficult to compare the different studies presented in this paper. Most of the studies do not fully outline the details of the method used to evaluate the effects. We do, however, suppose that the measuring of speed is reliable and that the studies have control of the most dominant variables that can affect the speed of vehicles, such as the time of the day, weather etc.

It is also important to be aware of the fact that the different studies operate with different absolute levels of enforcement. An increase from no enforcement at

all to a little more than nothing could be counted as for example a 50 times increase. The results from the presented studies might therefore be difficult to compare.

From the results of the research presented we will draw the conclusion that the certainty that the police are checking driving speed influences the normal behaviour of road users. The likelihood of being apprehended for exceeding the speed limit is however very low, and must be increased considerably if greater respect for speed limits is to be achieved. The studies do, however, not indicate that there will be very long term effects of speed enforcement. The possibility can not be ruled out that an enforcement program has long term effects and thus reduces the accidents to an acceptable level, the police and/or the superior political authorities will reduce enforcement because of the cost/benefit ratio, which again will lead to increased speed. Such an hypothesis could be studied empirically.

It is also a possibility that automatic systems to a greater extent than manual enforcement will tolerate the "total-compliance-situation", which means that the enforcement will still be cost-effective. This is still a question to be answered.

Much research has been conducted on speed enforcement. There are nevertheless areas where knowledge is limited.

There is little knowledge about the effects of automatic devices in speed enforcement. Some ongoing studies do, however, address this problem. There is as far as these authors know no information on what strategies should be used when performing automatic surveillance. Research must also be conducted to find other areas of using automatic equipment. In the future we can foresee a massive use of automatic policing systems. The social acceptance of the use of such system should be addressed in order to direct the innovation of such systems in the right direction. Long term effects of automatic enforcement is not yet studied. It is a clear possibility that drivers will take the same calculated risk of being apprehended as we know from manual enforcement if automatic systems only are operated from time to time.

We know a lot about what techniques should be used in non-automatic speed enforcement. There is, however, little knowledge on what strategies that should be used in ordinary police enforcement other than the level of enforcement on specific techniques. When it comes to the use of combination of police enforcement and public campaigns we know something about the effects. But how is it possible to increase the productivity of the police officers and how should their productivity be maximized? With limited man power resources it will be essential to know how to utilize the man power. And in what fields of enforcement should police enforcement be directed to maximally reduce accidents?

These questions should be addressed by future research.

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AUTOMATIC POLICING AND INFORMATION SYSTEMS

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Introduction

The efficiency and safety of the road transportation system depend to a considerable extent on the road users' compliance to traffic rules and regulations. Unfortunately, in most countries road users tend to violate these rules and regulations on a rather massive scale, which results in unnecessary congestion, fuel consumption and accident occurrence. Due to the lack of necessary empirical data, this effect has never been quantified on an aggregate level, but examples drawn from isolated studies provide a clear indication that the accumulated effects must be tremendous.

One of the most extensively studied violations is non-compliance to speed limits. Depending on situation, type of road, country and level of police enforcement, between 20 and 80% of the drivers exceed the indicated limits. It has been estimated that an estimated 30-50% reduction in traffic casualty accidents could be achieved if speed limits could be realistically enforced. A similar picture emerges from studies investigating seat belt use, compliance to traffic signals, violation of priority rules, drinking-driving, and compliance to the regulations for professional drivers with respect to driving, working and resting hours and with respect to maximum vehicle load. Until recently, the focus of the studies has been mainly on the effects of non-compliance on accident occurrence, but there is increasing concern about the effects in terms of energy consumption and congestion. The effects of speeding on energy consumption have been demonstrated both experimentally and in field studies, as for example in the recent change in speed limits on motorways in the Netherlands. It has also been calculated that speed, and in particular speed distributions, affect road capacity, and thus the occurrence of congestion. A second example is found in situations which require traffic flows to merge, where road capacity is influenced by the willingness of individual motorists to adapt speed and weave with the merging traffic flow. Finally, parking behaviour in cities can also be used as an example for road user behaviour that directly has an effect on congestion.

The willingness of road users to comply to traffic rules and regulation is also of great concern in the introduction of road transport informatics. Many systems that are in development, in particular navigation, traffic control and parking systems, assume that the road user will voluntarily comply with the instruction and indications presented to him. Given the high levels of non-compliance at this moment, it is very doubtful whether motorists are willing to comply, even if it may seem to be to their

own advantage to do so. At present, there is no reason to assume that road users will react in a rational and coherent manner to RTI innovations. Another issue, that will aggravate the situation is that many RTI innovations will be mostly beneficial to the road traffic system per se, and not necessarily to the individual road users. In those cases, experience from social psychological studies and experience related to safety issues (collective risk, but individual safety) warrants the hypothesis that road users will not comply to newly introduced RTI systems unless they are either demonstrably deriving personal benefit, or are forced to comply by means of external manipulation.

Enforcement plays a crucial role in the efficient and safe usage of the road transport system and its role is more likely to increase rather than diminish with the introduction of RTI innovations. Unfortunately, at present the police forces are unable to maintain necessary levels of enforcement. There are a number of factors that contribute to this situation.

- (a) The intensity of motorised traffic has increased rapidly in the last decade, without similar increases in police force manpower.
- (b) In the assignment of the available manpower traffic surveillance has to compete with other societal issues – increase in violence, criminality, environmental problems – that also demand the attention of police forces
- (c) The enforcement strategies and techniques that are used are not particularly efficient and are mostly based on common sense notions rather than empirical evidence.
- (d) Public opinion and politics are not generally in favour of intensive surveillance and enforcement.
- (e) Legal requirements and procedures often seriously jeopardize efficient traffic law enforcement.

Automatic policing information systems can contribute to the effectiveness of the efforts of police law enforcement in several ways. Firstly, automatic detection systems can increase the probability of detection of violations being committed without requiring substantial increases in police manpower. In theory, the detection probability can be equalled to one. Secondly, automatic information systems can increase the amount and relevance of information or feedback provided to the road user, and thus can result in a decrease in the likelihood of an offence being committed. Thirdly automatic systems can increase the 'fairness' and objectivity of enforcement. The assessment of the question whether an offence is being committed will not depend on the subjective judgement of the police officer. Moreover, automatic systems are in many cases able to produce definite proof of the offence being committed. The increase in 'fairness' and objectivity will not only simplify court procedures, or even make these superfluous, they are also likely to increase public acceptance of traffic law enforcement. In fact, automatic policing is in the end conceptually not very different from automatic debiting and road pricing.

Only very few experimental and rudimentary attempts

at automating police enforcement have been made. Most of these concern stand-alone detection systems monitoring speed or red light compliance combined with photographic registration equipment and/or feedback signposting. For this reason it has been necessary to develop a conceptual framework exploring all theoretical possibilities of automatic policing information systems.

Functional aspects

Enforcement can be considered as a step-wise process. The first step is legislation. Most countries have a set of laws that specify the requirements road users have to fulfil. In some countries this can be a set of rather general rules, such as the highway code; in some others traffic law deals with very specific behaviour required in specified situations. The degree of specificity of traffic law has large consequences for the possibilities of automation. The step of appropriate legislation is therefore crucial. The second step involves police surveillance to ensure that the general conduct on the road is in accordance with the legislation. Where discrepancies are found the police can take a number of alternative actions depending on the severity of the violations. They may stop and warn the driver without formal registration, stop and fine him, or may apply some on-the-spot sanctions varying from a compulsory one hour delay to confiscation of the vehicle or detention. Depending on the provisions made in law they may also register the action and the licence plate without attempting to stop the driver. The third step in the enforcement process involves the legal action that will result from police registration of an offence. Again, a wide variety of actions may ensue. In some countries offences such as parking and speeding are dealt with on an administrative level using a system of fixed penalties. Other countries use demerit point systems in those cases. More serious offences will result in a court case, often preceded by an offer of the prosecutor to settle out of court. If the offence results in a court case, a wide variety of appeal procedures are open to both the offender and the prosecutor. As these court cases are very often extremely time consuming both for the prosecutor office and the police officers involved, the prosecutor may in some cases decide to file the case, in particular when it proves difficult to produce hard evidence. Such considerations, in their turn, also affect the police officer's decision to issue a warning only.

The description of the law enforcement process demonstrates that enforcement is much more than police surveillance alone, and that the effectiveness of law enforcement is dependent on many other factors than police surveillance alone. For this reason, all steps of the law enforcement process have to be taken into consideration when developing automatic policing information systems.

Police surveillance is generally thought to have two main functions: deterrence and detection. The deterrent function is based on the assumption that road user behaviour will be affected by the awareness of the road user that his behaviour is monitored and that violations may result in a fine or conviction. At present, it is not fully clear how this mechanism works, as it has been repeatedly demonstrated that the mere presence of police does not necessarily influence road user behaviour. On the other hand it has also been demonstrated that certain measures (such as posted feedback) can affect road user behaviour without police

enforcement being present. Implied threat and subjective probability of detection have been put forward as explanatory mechanisms for these findings, but these have as yet not been sufficiently substantiated.

The detection function is based on the assumption that road users will alter their behaviour if violations can result in receiving a fine or other more drastic punishments such as driver licence withdrawal or imprisonment. Again, empirical evidence is not fully unambiguous, which is probably due to the fact that in operational circumstances police enforcement, and consequently detection, does not reach a sufficiently high level to have an impact on road user behaviour. The objective probability of detection remains below the threshold necessary for influencing the subjective probability of detection. If the subjective probability of detection is raised, for example through publicity campaigns, changes in road user behaviour may be achieved with relatively low levels of objective detection probability.

On the basis of the evidence so far, it is reasonable to assume that automatic policing information systems have to assist police enforcement both in its deterrence and in its detection function. In other words, simple detection and registration systems as such are not sufficient. The systems will also have to act as a deterrent by providing information to the driver about the fact that he is committing a violation and that this will result in a fine or similar punishment.

In addition to the above functions, automatic policing information systems may also assist in the further steps in the enforcement process. Firstly, automated systems may be used to procure hard evidence. Semi-automated systems are already used for this purpose in many countries. This may involve radar speed registration, photographic registration of traffic light violations, licence plate registration for road tax purposes, and electronic breathalyzers used for the unambiguous registration of drinking-driving offences. Secondly, in-car electronic devices are used when a driver is stopped by the police to retrieve information about his record, for example, concerning his previous offences. Thirdly, office automation coupled to existing data bases, such as the driving licence and licence plate registrations, is increasingly used for the administrative processing of offences. In principle, licence plate number and type of offence provide sufficient information to process all administrative offences and out of court settlements. If such systems, which are already operative in some countries, are coupled to automatic detection and registration systems, it will be possible to process the majority of offences without any burden to the manpower of either the police force or the prosecutor's office.

In summary, the possibilities of automatic policing information systems can be divided into three categories: on-site registration and information systems; in-car information systems, and registration processing systems.

On-site registration and information systems

Most semi-automated policing systems that are used at present are on-site registration or information systems. These systems can fulfil the following functions:

- (a) on-site detection of an offence being committed
- (b) on-site registration of an offence
- (c) providing information to the driver about the fact

that (i) he is committing an offence and (ii) that this offence has been registered
(d) feeding the recorded information into an automated offence processing system.

On-site detection of an offence being committed

Detection of offences is at present limited to particular speeding and traffic light violations based on induction-loop systems. The induction loop system can also be used for a variety of other offences, as for example in lane-keeping in motorways. In considering the potential of induction-loop systems it should be realised that it is to be expected that these systems will be installed in a wide variety of applications for the purpose of other RTI system (in particular, traffic control) and these systems will be increasingly supplied with 'intelligence', which, in principle, makes it feasible to use such systems for the detection of offences such as violation of priority rules.

On-site registration of an offence

Registration of offences at present takes place through photographic means. This has the disadvantage that licence plates have to be read by human operators. Automatic licence identification can be achieved in two ways. The first involves replacing the photographic camera with a video-camera which produces an image that can be processed automatically. It seems realistic to assume that this approach can be operational in the near future. The alternative would be the use of electronic licence plate identification. In that case, the electronic licence plate would transmit a code that can be used by on-site registration systems to identify the vehicle. This requires that an electronic licence plate becomes mandatory for all vehicles and that on-site registration is equipped with a system that can receive the licence plate code specific for the vehicle committing an offence.

Providing on-site information to the driver

One of the major reasons why the present traffic law enforcement system does not work is that the delay between committing an offence and, if this is recorded at all, receiving feedback is much too long. Immediacy has been pinpointed in both laboratory and field experiments as a crucial factor in behavioural change. In present day law enforcement it can take several months before the driver receive a notification of the fact that he has been recorded for committing an offence. Even if, and this is by no means always the case, it will lead eventually to some sort of punishment, the delay between the offence and the punishment will be so long that it is unreasonable to assume that any form of learning will result. For this reason, the provision of feedback to the driver is an important aspect of automatic policing information systems. The simplest way to achieve this is by placing message signs at the locations where recording is taking place. However, this can only be applied when the progression of the vehicle over time can be logically inferred, as is for example the case in motorway driving. Even then, it will be difficult to ensure that the feedback is given to the offending driver and not to other non-offending drivers. In many other situations, such as at intersections, the course of the driver cannot be ascertained. A final consideration is that on-site message signs cannot be installed in a density that would be desirable from a policing point of view. Reliance on a system with low density feedback

would simply mean that drivers will adapt their behaviour in a site-specific manner instead of adapting their behaviour strategically. Just how many site-specific feedback message signs are required to achieve a generalisation of behavioural adaptation is unknown, but this probably requires such a massive effort that it is unlikely to be viable. One of the main disadvantages of this approach is that the mere presence of a alerting device would act as discriminative stimulus, that is to say, would be used by the driver as an indication that he is at present in an area where violations are registered.

Consequently, he would infer that this is not the case when no message signs are present, response generalisation is for that reason not likely to occur. The above disadvantages are not relevant in the case that specific behavioural adaptations are required. An example of such an application would be in situations requiring temporary or site-specific behaviour, for example, during road works. In this case the objective is to ensure that road users adapt their behaviour to the specific circumstances and hence generalisation is not an issue. In some aspects the situation is the same for variable message signs, where road users are only required to adapt their behaviour when the variable message sign is in function. In that case, it would very well be feasible to link the variable message sign system to a detection system that registers car drivers ignoring the specific message. Since it is likely, that variable message signs are only in function when this required in critical safety or traffic flow situations, this type of application of automatic policing systems is likely to be cost-effective.

In-car information systems

An alternative way of providing feedback information to the driver would involve transferring the message to the in-vehicle information system. This would require all vehicles to be equipped with a receiver that can process the information transmitted by the on-site registration system. In principle, a simple device being able to translate the transmitted code into a verbal or visual warning message would be sufficient. In principle such a device could operate on stand alone basis or could be integrated in general driver support systems, provided such systems would give sufficient priority to the feedback message to be displayed. The advantage of this approach is that it gives the driver no visible cues when his behaviour is being monitored, and for this reason, response generalisation is more likely to take place than in systems using on-site feedback. In simple operant conditioning terms, the road user would adapt his behaviour in such a way that negative feedback, indicating an offence being registered, would be avoided. Avoidance conditioning based on conditioned stimulus (in this case the feedback) has proved to be a very powerful tool in suppressing undesirable behaviour (in this case infringement of traffic law) in a wide variety of situations, provided that the feedback is given contingent upon the behaviour, and a sufficient high ratio of behaviour-feedback can be reached. In the above providing feedback is equal to providing a (conditioned) negative reinforcement, because it only occurs after the offence has taken place and consequently will lead to some sort of legal action. In principle, the same principle can also be used for providing antecedent information. In that case, the road user would be informed that he is committing an offence, or about to commit an offence, and that this offence will be registered if he persists in his behaviour. In operant conditioning terms, the

information will act as a discriminative stimulus rather than feedback, because the road user is given the possibility to adapt his behaviour such that he will avoid being registered as having committed an offence. Such a system would be very similar to driver support systems that provide drivers information on manoeuvring aspects of the driving task. A message generated by an automatic policing system instructing the driver to slow down because he is about to exceed the legal limit would be very similar in nature to a message generated by a driver support system instructing the driver to slow down because he is approaching a curve. In both cases the message contain behavioural instructions that will help him avoid situations that might result negative consequences. The only difference is that in the first case the negative consequence concerns possible legal action and in the second case it concerns increased risk of an accident. As antecedent information implies an instruction to the driver, it is essentially dissimilar to feedback information. It can be regarded as a part of the task domain of the driver, while feedback is in fact informing the driver about the outcome (or consequence) of his task performance. For this reason, providing antecedent information cannot be regarded as separate from providing other types of information that assist the driver in adequate task performance and it should therefore be integrated in other driver support systems that the driver may have at his disposal. In fact, it can be argued that if traffic law would be sufficiently specific, antecedent information from automatic policing systems is all the driver needs for adequate task performance.

Providing antecedent information poses additional requirements to automatic policing systems because it necessitates at least two consecutive measurements. In the case of speeding for example, one measurement would be needed to provide the driver with antecedent information (that he is exceeding or about to exceed the speed limit) and another measurement to check whether he has adapted his behaviour (i.e. reduced his speed), and if that is not the case, to register his speed, and possibly, to provide him with the feedback that his offence has been registered. Consequently, antecedent information systems would require much more sophisticated registration systems than simple offence recording or feedback systems.

An alternative way of providing in car information to the driver would be based on directly assessing vehicle parameters or a combination of vehicle and on-site registration. An alerting device based on vehicle parameters alone is feasible for those behaviours that are illegal irrespective of the situation in which they are displayed. Examples of such behaviours are: exceeding the absolute maximum speed limit (assuming that speed limits will be harmonized in Europe), making a 90° turn without signalling, driving during dark without lights and exceeding the maximum driving hours allowed for commercial drivers. However, many behaviours are only illegal in certain circumstances. In those cases, it will be necessary to provide the in car device with information about the environment and the legal constraints that are in operation in that environment. For example, if the in car system would receive information from on-site beacons wherever the speed limit is altered, the in car system would be able to provide the driver a warning whenever he is exceeding the speed limit that is operation in the situation he is driving in, i.e. 30 km/h in residential areas, 50 km/h in built-up areas and so on.

In-car registration of violations

Two systems can be thought of. The first system would entail an active component that transmit relevant information (e.g. licence registration and type of offence) to on-site registration beacons for further processing. The second system would basically involve the electronic equivalent of a tachograph. However, unlike a tachograph such a system could be used for the registration of many different types of violations. Storage of the registered violations could be an integral part of the vehicle and in that case retrieval could take place during periodic vehicle inspection. Alternatively, if smart card systems would be developed to replace convention licences, the violation history could be stored on such smart cards and checked during licence renewal or tax payments. It would in theory even be feasible to develop an electronic demerit point system, which would render the smart card useless if the collected demerit points exceed a preset maximum.

Automated offence Processing Systems

A major problem in law enforcement is the processing of recorded offences. Both for recording and processing purposes it is essential that automatic registration is implemented, whether by video image analysis or by electronic car identification, and that automatic registration is admissible in legal procedures. In many countries this would require substantial adaptation of law and this is essential for traffic law enforcement to proceed in an efficient manner. If prosecution on the basis of electronic evidence alone is permissible, large number of offences could be processed without requiring any increase in manpower. At present, some countries already use automatic systems that retrieve the driver's identification and address from databases containing the information of all licence plate holders and determine the fine on the basis of preset criteria. Even though appeal, and hence costly court procedures are still possible, in practice only a very small proportion of offenders decide to refuse the possibility to settle out of court, and hence the system offers substantial benefits to the court system.

The realisation of a fully automated processing systems for on-site registration systems requires the following components to be implemented:

(a) electronic registration of the offence and the identification of the offender (b) transmission of the information from the registration site to a central processing system (c) retrieval of information from licence plate registration data base and (d) product check and dispatch of the documents required. In some European countries (c) and (d) are already partly or fully automated. A major problem to be addressed in automatic offence processing is the transmission of the on-site information to a central processing unit. Both line transmission and radio transmission can be considered. However, even though, because of the low density of information, relatively simple systems can be used, the cost of high density networks is likely to be prohibitive. Alternatively, semi-automated systems can be considered that require manual retrieval of the information stored on-site.

In-vehicle information can be transmitted to on-site beacons whenever two-way communication is required, for example, at sites for automatic toll collection. Alternatively, the information can be retrieved during vehicle inspection or revalidation of smart card driver's

Conclusions

At present non-compliance to traffic laws and regulations already is severely impeding the safety and efficiency of the road traffic system. It is likely that the functioning of many of the RTI systems under development (e.g. traffic control and route guidance systems) will be highly sensitive to non-compliance. In theory, many possibilities for automatic enforcement exist, but the feasibility of such systems is at present unclear. Cost, fraud and public and political resistance will severely limit the possibilities of implementing such systems. For this reason the different components of the systems (on site versus in-vehicle and detection, feedback, registration and processing) have to be considered quite separately.

THE EFFECTS OF ENFORCEMENT AND REWARDS ON SAFETY-BELT USE: A FIELD STUDY IN THE NETHERLANDS

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INTRODUCTION

When drivers are grouped by age and sex, it turns out that young male drivers aged between 18 and 25 use their safety belt less often than other driver groups in the Netherlands. Average usage rate for this group of drivers was 55-60% in 1987, and about 65% in 1988. For this reason, it was decided to conduct a nationwide campaign to promote safety belt use by military personnel during October and November 1988. The campaign was aimed at young male drivers aged between 18 and 25; this group can easily be reached in a military setting, because drafted (male) personnel is around this age. The campaign was organized by the Dutch Ministry of Defense in co-operation with the Dutch Ministry of Transport.

From previous studies, it is known that a campaign consisting of a combination of enforcement and publicity can increase safety belt usage substantially; increases of 15-25 percentage points are not rare with baselines around 50-60% (see e.g., Jonah & Grant, 1985; Williams, Lund, Preusser & Blomberg, 1987; Gundy, 1988; Grant, 1989). The increased rates can also remain high for a relatively long time, even up to two years after withdrawal.

Other studies, in which incentive programs were used to stimulate safety belt use, show impressive results as well (see e.g., Elman & Killebrew, 1978; Cope, Smith & Grossnickle, 1986; Geller, 1984 for an overview). In general, in all these studies usage rates doubled due to incentive programs, regardless of baseline level or type of program (but with very low initial baselines).

Enforcement programs were always carried out in countries or states with mandatory belt use, most incentive programs in countries or states without this kind of legislation. Thus, the question arises whether incentive programs could also be effective in raising usage when safety belt use is mandatory, and therefore under conditions of already relatively high baselines. In addition, comparisons between different types of incentive programs are equally rare (see Geller, Rudd, Kalsher, Streff & Lehman, 1987 for an overview). Furthermore, a direct comparison of the relative efficiency of enforcement and incentive programs has been carried out only once under conditions of mandatory usage of safety belts (see Kalsher, Geller, Clarke & Lehman, 1989). The present study attempts to address the above mentioned comparisons directly. In order to evaluate the effects of the present campaign, a field study was conducted in which the amount of enforcement, the type of publicity, and incentive strategies were varied. Special treatments were implemented on twelve experimental military bases. The first month was

used to announce the campaign. For those bases allocated to incentive treatments, special brochures were manufactured in which 'the rules of the game' were outlined. Personnel at those bases allocated to enforcement treatments received brochures which contained information about penalties for not buckling up. During the second month of the campaign, drivers were actually 'punished' (either warned or actually fined) or 'rewarded', dependent upon treatment type.

Moreover, the type of publicity was varied. On some locations, publicity consisted of leaflets and posters announcing the campaign. On some bases, extra publicity was used. For instance, especially for the purpose of this campaign a movie was made, and special (30 second) video-spots were created.

METHOD

Experimental conditions.

A total of twelve different military bases in the Netherlands were allocated to ten experimental conditions. Treatments were varied as follows. Three levels of enforcement were chosen: minimal, moderate, and intensive. During the last four weeks of the campaign, a maximum of 40 periods of about two hours of surveillance were possible (i.e., 4 weeks x 5 weekdays x departure/arrival hours). Minimal enforcement was set at 2 of these 40 periods; moderate was 8, and intensive was 16 of these periods. Level of enforcement was factorially combined with type of publicity, which resulted in 6 experimental conditions, distributed over 8 military bases.

Four additional bases served as experimental groups to investigate the effects of incentive programs. On these four 'incentive-bases', no enforcement was implemented. On two of those bases, a contest was held during the campaign; a prize of Dfl. 5,000 could be won by the personnel of the camp site that showed the highest usage rate at the end of the campaign (group dependent incentives). On two other bases, during the second month of the campaign, lottery tickets were distributed to those drivers (and front seat passengers) who used their safety belt. Incentive rates were varied as follows: on one base one prize was drawn every week, on the other four prizes were drawn every week (individual incentives). Prizes to be won were money, coupons, photocameras, walk-mans, and CD players. Since the experimental field study could only take place when implemented into a nationwide campaign at all military bases in the Netherlands during the same period, it was not possible to create a control group. Hence, only comparisons of effects relative to each other could be determined.

Table 1 shows an overview of the complete design: the twelve different bases and the treatments.

Procedure.

Safety belt use by drivers in their personal automobiles was observed at the twelve bases. Safety belt observations occurred at the entrance/exit gates. Observations took place on weekdays, roughly between 06:30 and 08:30 in the

Table 1. The experimental design. The rows represent the experimental conditions. The first column shows the activities during the first month of the campaign, the second the activities during the second month, the third shows the 12 different bases allocated to the conditions (+ abbreviation), and the last column shows the estimated size of the populations at the different bases.

	October 1988	November 1988	bases 1-12 (abbr.)	estim. size
1	publicity	minimal enforcement	MIN	1800
2	extra publicity	minimal enforcement	MIN+EP	2200
3	publicity	moderate enforcement	MOD(A)	1500
			MOD(B)	850
4	extra publicity	moderate enforcement	MOD+EP(A)	400
			MOD+EP(B)	1400
5	publicity	intensive enforcement	INT	3500
6	extra publicity	intensive enforcement	INT+EP	1850
7	extra publicity	group dependent incentive program	GROUP(A)	600
8	extra publicity	group dependent incentive program	GROUP(B)	600
9	extra publicity	individual incentives/ 1 prize each week	IND 1	1000
10	extra publicity	individual incentives/ 4 prizes each week	IND 4	800

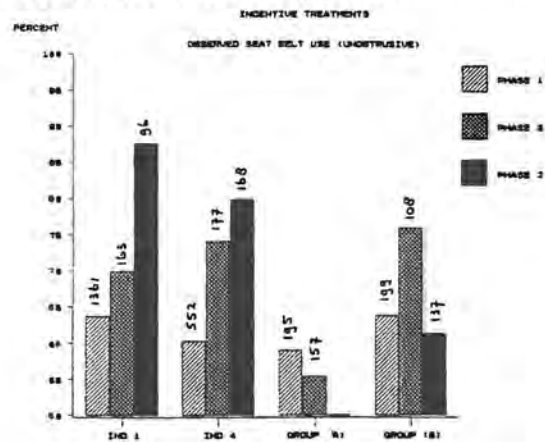
morning for entering vehicles, and between 15.00 and 17.00 in the afternoon for departing vehicles. Unobtrusive observations occurred on unannounced occasions during all three experimental phases (baseline, at the end of the campaign, and three months after withdrawal). A trained observer stood near the gate and recorded the belt use of all passing drivers. This method did not allow us to distinguish between different age groups. Therefore, another observation method was used: besides recording belt usage, the observers asked the drivers to mention their age. This method was called the 'obtrusive' method, because it was obvious that 'something was happening' near the entrance/exit gates, it was, however, not announced that safety belt use was being observed.

RESULTS

Observations.

A total of 17,072 unobtrusive observations were made, and a total of 21,671 obtrusive observations. It was concluded elsewhere (see for a discussion Hagenzieker, 1990) that as absolute figures the results of the unobtrusive observations were the most valid, while the obtrusive observations could be used for indicating relative effects, e.g., for different age groups. In the following sections, therefore, the results obtained with the unobtrusive observation method will be reported. Only when comparisons in effects between different groups of drivers are made, the results obtained with the obtrusive observation method shall be used. Figure 1 depicts the percentages of drivers using a safety belt per experimental incentive condition for each experimental phase; figure 2 depicts these results for the experimental enforcement conditions. Average observed safety belt use (over all 12 bases) was 65.4% during experimental phase 1 (baseline observations), 72.9% during experimental phase 2 (directly after the end of the campaign), and 76.1% during experimental phase 3 (three months after withdrawal), a final increase of 11 percentage points (see also Hagenzieker, in press). No effect was found for either entering versus departing traffic or for observation days for any experimental phase.

Figure 1. Percentages of drivers using a safety belt per incentive condition for each experimental phase (1 = baseline; 2 = directly after the campaign; 3 = during follow-up). The numbers associated with the various bars indicate sample sizes.



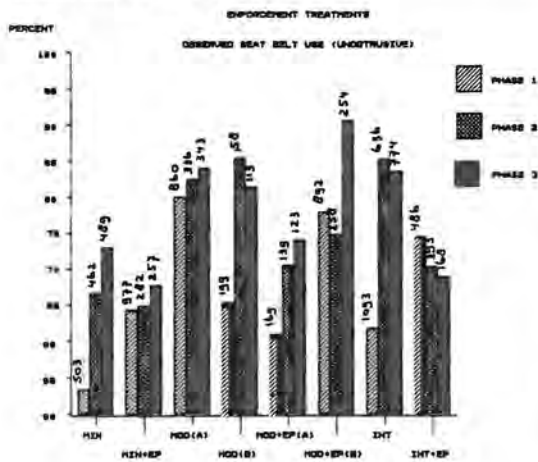
As becomes readily apparent from figures 1 and 2, effects in percentages belt use are not systematically related to the original treatment conditions; even most baselines at the twelve different sites differed. This complicates the interpretation of the results. Nevertheless, it is attempted to describe the results obtained in relation to the original experimental conditions.

Incentive treatments.

Group dependent incentives (GROUP).

Directly after the end of the campaign an extra series of observations was implemented to establish the "winner" of the group competition. At that time, the observed usage rate at GROUP(A) was 55.4%, and at GROUP(B) 63.3%. Thus, compared to baseline, no increases were found whatsoever. Yet it was decided to "award" the competition prize to GROUP(B), since at that site the absolute usage rate was the highest. One week later, a series of observations were again carried out. It appeared that within a week time safety belt use at GROUP(B) increased very significantly, compared to baseline, to 75.9% (experimental phase 2). During experimental

Figure 2. Percentages of drivers using a safety belt per enforcement condition for each experimental phase (1 = baseline; 2 = directly after campaign; 3 = follow-up). The numbers associated with the various bars indicate sample sizes.



phase 3, belt rates had dropped to baseline level at site GROUP(B). Unfortunately, no observations were possible at site GROUP(A) during experimental phase 3.

Individual incentives (IND 1 and IND 4).

Safety belt use in both experimental conditions IND 1 (1 prize drawing each week) and IND 4 (4 prizes each week) kept increasing throughout all experimental phases. In condition IND 1 a final increase of almost 24 percentage points was observed, from 63.7% at baseline to 69.9% in experimental phase 2, and up to 87.5% in experimental phase 3. In condition IND 4 a final increase of almost 20 percentage points was observed, from 60.3% at baseline to 74.0% during experimental phase 2, to 79.8% in experimental phase 3 (see also figure 1). Therefore, both individual incentive strategies were effective.

Enforcement treatments.

Experimental conditions MIN (minimal enforcement) were expected to show the least effect on safety belt use. However, base MIN turned out to show a continuous increase over all experimental phases (almost 20 percentage points, from 53.3% to 73.0%), whereas MIN+EP (with extra publicity) showed no effect at all. Experimental conditions INT (intensive enforcement) were expected to be the most effective in increasing belt use. INT indeed showed an impressive increase of 23 percentage points (from 61.8% to 85.2%), which was maintained for three months after withdrawal. However, condition INT+EP showed no effect whatsoever. The moderate enforcement conditions (MOD) yielded inconsistent results as well (see figure 2).

Actual effort of the police.

The actual effort of the military police varied from base to base: a minimum of 16 hours of surveillance was reported, a maximum of 72 hours, and the number of registered fines varied from 4 to 100 (see Table 2). Treatment allocations were not reflected in actual reported hours and number of fines. However, the variable 'number of fines per hour' had a Pearson correlation of .80 ($p < .05$) with observed absolute increases in belt use. Thus, the more police 'effort', the higher the observed increase in belt use.

Extra publicity (EP).

Within the enforcement conditions the type of publicity was varied. It was expected that extra

Table 2. Number of hours spent on surveillance and number of registered fines during the campaign for the enforcement treatment bases.

treatment type	# hours	# fines
MIN	16	20
MIN+EP	26	4
MOD(A)	72	5
MOD(B)	32	15
MOD+EP(A)	?	?
MOD+EP(B)	32	2
INT	60	100
INT+EP	24	6

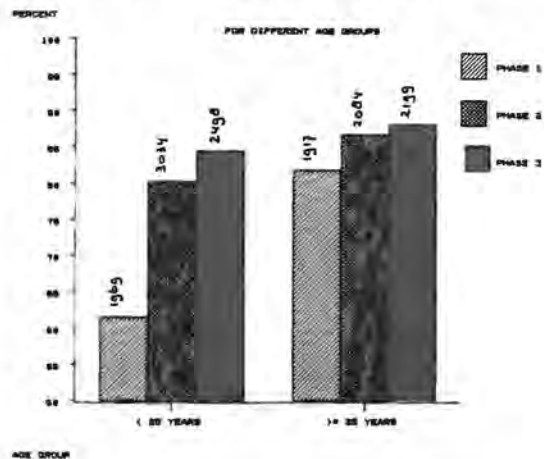
* No data available

publicity would lead to higher increases than only 'normal' publicity. No effect at all of extra publicity was found.

Age groups.

During the obtrusive observations, drivers' ages were recorded. Figure 3 shows the observed belt use for two age groups (< 25 years of age, and > 25 years of age) for each experimental phase. Since no substantial differences between sites were found concerning age- and personnel-group-trends, the results averaged over all twelve sites are depicted.

Figure 3. Observed belt use for drivers aged between 18 and 24 versus 25 years of age or older per experimental phase (1 = baseline; 2 = directly after campaign; 3 = follow up). The numbers associated with the various bars indicate sample sizes.



The observed increases in belt use throughout the entire period of study were almost entirely due to a dramatic increase of 23.1 percentage points in belt use by drivers under 25 years of age (from 61.4% to 84.5%). Drivers of 25 years or older showed an increase of - although significant- only 5.2 percentage points. It should be noted, however, that their baseline level was already much higher (an increase from 83.7% to 88.9%).

CONCLUSIONS

The present study shows that incentive programs are capable of enhancing safety belt usage substantially with already relatively high baseline levels. These results are consistent with previous findings obtained with relatively low baselines (Geller et al., 1987). This holds especially for the individual incentive programs IND 1 (1 prize a week) and IND 4 (4 prizes a week),

which showed a medium-long term increase in the order of 20 percentage points. Since the differences in effects between the two conditions are rather small, and statistically not significant, it can not be concluded yet which strategy is more effective. Until now they both seem to be equally effective. The group dependent incentive treatment showed no conclusive results. Safety belt usage increased at the "winning" site after receiving the prize. Usage rates had dropped to baseline level three months after withdrawal, so in this case only a short term effect was found.

Unfortunately no systematic effects of enforcement level conditions (as originally planned) upon belt use were found. However, when the actual effort of the police (in terms of 'number of fines per hour') was related to the observed increases in belt use, the nonsystematic effects were not so nonsystematic after all. This leads one to the conclusion that enforcement indeed enhances safety belt use substantially, if this enforcement is actually carried out. However, the question remains what the optimal, i.e. in this case the minimal, enforcement level should be to obtain substantial increases in belt usage.

No different effects in observed belt use were found when publicity and extra publicity treatments are compared. The results from a written survey among the personnel involved in the study (see Hagenzieker, 1990) revealed that only 40% of the respondents reported to have noticed an increase in publicity during the campaign. The results from this questionnaire showed also that respondents from the 'EP' treatment conditions did not report to have noticed these extras more often than respondents from the other conditions. It can therefore be concluded that the awareness of the campaign was rather disappointing. In addition, when consulting the military police who had to distribute the publicity materials, they reported to have had not enough material to hand out. Therefore, it can tentatively be concluded that extra publicity might have worked if the personnel indeed had been confronted with it.

The effects found were almost entirely due to a dramatic increase of 23 percentage points for young drivers in the age of 18-24 years. Since the campaign was especially aimed at this group of drivers, this result is quite satisfying. Drivers 25 years of age and older only showed an increase of around 6 percentage points on average, but since their baseline level was already rather high (around 80%) this is not really surprising.

In a recent study, Kalsher et al. (1989) investigated the relative impacts of incentive and enforcement programs on two US naval bases. Their study is comparable to the present one in many respects. Similar to Kalsher et al.'s findings, in the present study the average impacts of enforcement and incentive treatments were about the same, and also of the same size as Kalsher et al. report. Moreover, the baseline levels were more or less comparable, lying in the range of 50-60% in both studies. It is tempting to conclude that the present study and Kalsher et al.'s study demonstrated similar results, even though it would be probably misleading to do so (because on some bases no effect at all was observed, and treatments were not always applied as planned). In addition, similar questions remain from both studies. Further research is needed to assess the relative impact of incentive programs and enforcement, and (medium) long term effects should also be further investigated.

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INCREASING THE USE OF SEAT BELTS THROUGH SELECTIVE TRAFFIC ENFORCEMENT PROGRAMMES

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INTRODUCTION

Seat belt use has increased dramatically in countries which have adopted mandatory seat belt use laws (Jonah & Lawson, 1986; Hedlund, 1986). For example, in the United Kingdom belt use increased from 37% to 93%, and in New South Wales (Australia) belt use increased from 19% to 76% after the introduction of a seat belt law.

In Canada, with all provinces mandating seat belt use 76% (Transport Canada, 1990) of drivers wear their seat belts, an increase from 36.4% in 1980 when only four provinces required the use of seat belts (Transport Canada, 1990). The effect of having a law requiring seat belt use is demonstrated by the example of the province of Nova Scotia where belt use increased from 20% to 81% following the introduction of their seat belt wearing law. In another example, seat belt use in the province of Alberta increased from 28% to 74%, after the introduction of mandatory seat belt use law, but belt use dropped to 45% two years later when the law was declared invalid by a lower court (Transport Canada, 1990). However, in Canada, the introduction of a seat belt wearing law has not, by itself, maintained high levels of seat belt use. Provinces which had seat belt wearing rates between 70% and 80% shortly after they introduced seat belt wearing laws in the mid 1970's had wearing rates of below 50% five years later (Transport Canada, 1990).

Increased enforcement of seat belt wearing laws through special programs has been shown to be effective in increasing seat belt use where a law exists (B.C. Research, 1983; Dusault, 1987, 1990; Grant, 1989; Jonah, Dawson, & Smith 1982; Jonah & Grant 1985; Lamb, 1982). These programs, called Selective Traffic Enforcement Programs (STEPS), combine increased and high visibility police enforcement of the seat belt wearing law for a preset period of time with publicity about the increased enforcement and the effectiveness of seat belts. Feedback to the community about the number of police charges laid, and the changes in the seat belt wearing rate are provided during and after the program has been completed. STEPs have been shown to increase seat belt use within specific regions as well as across entire provinces.

It has been suggested that as the seat belt wearing rate increases, greater effort is required to obtain additional gains in the use rate. However, an alternative is to maintain the same effort, but direct the effort at those who are least likely to wear seat belts. To do this it is necessary to determine if current programs are equally effective with all groups of vehicle occupants, and determine which groups of vehicle occupants are most resistant to wearing seat belts.

The remainder of the paper is divided into five sections. The first of these presents an outline of what a STEP is, and how it is conducted. To illustrate the effectiveness of STEPs two examples are presented in the second section. One program, conducted in a large metropolitan area (Ottawa - Carleton) illustrates the effectiveness of STEPs over a 10 year period. The other program, conducted in the province of Quebec, demonstrates that STEPs can be implemented on a large scale; this program also used incentives to increase belt use. The third section describes some of the costs and benefits associated with STEPs. The fourth section discusses the evidence that certain groups of vehicle occupants are less likely to wear seat belts, and presents the argument that future programs should be directed at these groups. The final section discusses the issues associated with programs designed to encourage behaviour change through increased enforcement.

GENERAL DESCRIPTION

Selective Traffic Enforcement Programs can be viewed as having three major components: education, enforcement, and evaluation. The philosophy behind the programs is that it is more effective to tell people you are about to increase the level of enforcement, provide them with the information they need to make the decision to conform, and then to enforce the law with greater than normal vigour. It is hypothesized that this approach is less likely to result in a backlash against the enforcement activity because everyone is informed about the consequences of not wearing a seat belt.

Education

The educational part of the STEP is generally provided through the use of either paid or free publicity. Free publicity is generated through the use of press conferences to announce the program, and through the provision of written materials describing the importance of wearing seat belts, how they work, and why they work. The generation of ongoing publicity throughout the program is important in order to maintain contact with the target population. One way to do this is to provide the news media with information on the level of police enforcement and the effectiveness of the program for increasing seat belt use.

The other method of obtaining publicity is through the use of paid advertising. With paid advertising specific messages can be delivered to target groups.

However, paid advertising can be very expensive. To reduce the costs of advertising the government of Quebec solicited sponsors for their major seat belt program (Dussault, 1990). Money raised from the sponsor paid for supplements inserted in all newspapers in the provinces. In addition, advertisements were placed on television and radio. In British Columbia an agreement with broadcasters resulted in the contribution of \$3 million in advertising for a program. Although expensive, it would appear that for major programs, directed at large groups of people, there is a need for paid advertising to ensure sufficient intensity to reach the target population.

Enforcement

The enforcement of the seat belt wearing law is critical for the success of a STEP program. For the enforcement phase to be successful it must be more intensive than normal and it must be perceived as more intense than normal. The most effective way to achieve this is to ensure that when enforcement activities are conducted they are highly visible. Roadside checkpoints are both highly visible and very efficient because a large number of vehicles can be checked in a relatively short time, and those not checked are clearly aware that the police are enforcing the law. The publicity surrounding the program ensures that road users are aware of the purpose of the checks. Although the high visibility checks may allow some vehicle occupants to buckle their seat belts just prior to being checked the goal of the enforcement is not to issue as many citations as possible, but to ensure that people are aware that the law is being enforced and to encourage the use of seat belts.

An important aspect of the enforcement component of a STEP is the need for strong support from the police who must conduct the enforcement activities. The police come face to face with the public and they need to be assured that what they are doing is important in the promotion of safe driving and is perceived to be important by the general public. Frequently, the police perceive the enforcement of a seat belt law as a nuisance charge and therefore are reluctant participants in a STEP; this can be overcome by ensuring that the police are aware of the relative importance of seat belts in saving lives.

In the Quebec program efforts were made to reach all 12,000 police officers in the province (Dussault, 1990). This was accomplished by having program representatives meet face to face with representatives from 270 police units (municipal police forces and provincial police forces). At these meetings representatives were provided with an 11 minute video tape which was to be shown to all police officers in the province. An information booklet was also provided to ensure that all police officers were aware of the program goals.

Evaluation

Evaluation of a STEP is necessary for a number of reasons. Most importantly, the evaluation is needed to determine whether or not the program was successful in increasing the level of seat belt use. Equally important, is the need to provide feedback about the program to the community and to the police. If the police are aware that their activities have been successful then they are more likely to participate in future programs. The available data indicate that single STEPs generally do not maintain wearing rates (the Quebec STEP is an exception because its effect has been maintained for two years), and therefore program organizers need information to be able to solicit support for future programs. Providing feedback to the community about the success of the program is likely to increase support. In addition, during the program, information on the increasing level of belt use indicates that the program is being taken seriously, and that there is an increased probability of being stopped if you are not wearing a seat belt.

PROGRAM EXAMPLES

Ottawa-Carleton Program

The Regional Municipality of Ottawa-Carleton, with approximately 600,000 residents, consists of 6 cities including the capital of Canada, Ottawa, as well as, rural areas. The first major STEP was conducted in 1979 (Jonah, Dawson & Smith, 1982) and the most recent was completed in 1987 (Grant, 1989). During the eight year period seat belt use increased from 58% to 87%.

The STEPs followed a standard pattern. A committee of police forces and other interested groups initiated the program. A press conference was held to announce the program, followed shortly by increased enforcement of the seat belt wearing law. During the program the number of police charges laid, and the seat belt wearing rate were provided to the media. There was no purchased advertising for the programs but there was support through general news coverage in newspapers, radio, and television to ensure information about the program and about seat belts reach the public.

The overall results of the program are presented in Table 1. The first STEP produced an increase in seat belt use from 58.3% to 76.5% (Jonah, Dawson & Smith, 1982). The second program included three separate STEPS conducted over one year. These STEPS varied in length from 4 weeks to 4 days. Each individual STEP increased seat belt use, and the overall program resulted in an increase in belt use from 66% to 84% (Jonah & Grant, 1985). The third major STEP was conducted in 1987, and lasted one month; seat belt use increased from 79% to 87% (Grant, 1989). Seat belt use in a control community

Table 1 Percentage of seat belt use by location (STEP and Control City) across three evaluations: Ottawa Carleton STEP

	1979 STEP		1981/82 STEP		1987 STEP		
	Pre	Post	Pre	Post	Pre	Post	Post 1 month
STEP city (n)	58.3 (2769)	76.5 (3385)	66.0 (3187)	83.6 (3660)	79.4 (2398)	87.7 (3182)	86.9 (3173)
Control city (n)	54.3 (2392)	51.3 (2624)	43.8 (1293)	44.1 (2055)	57.5 (2326)	58.4 (2286)	54.5 (2285)

where no STEPs were conducted showed little change in seat belt use during the same period.

The effectiveness of the STEP for different subgroups of vehicle occupants was also evaluated (Grant, 1989). It was concluded that the STEP did produce increases in belt use for most groups although the level of belt use by the different occupant groups varied: males lower than females, passengers lower than drivers, and younger lower than older occupants. Belt use was found to be lower in the evening, but the STEP also had a positive effect on for both daytime and evening occupants. However, the only groups not influenced by the STEP were males or females observed to be leaving drinking establishments.

Quebec Program

The 1987 Quebec STEP (Dussault, 1990) required the coordination of over 12000 police officers in provincial and municipal police forces. As described earlier extensive efforts were made to ensure that all police personnel were aware of the importance of the program and the importance of seat belt use. The program was introduced to residents of the province by a series of press conferences and it was preceded and followed by public information announcements on radio and television, with additional information presented on billboards and in newspapers. The cost of public information program was estimated at just under one million dollars.

During the program the police issued over 1,467 citations each day for not wearing seat belts, 3.4 times the number issued per day prior to the program. In addition, as an incentive to encourage belt use, promotional vouchers which could be exchanged for free items (average value of \$1.18) were distributed by police at seat belt check points during the final week. The vouchers had a tear-off portion which could be used to enter a draw for larger prizes (8 prizes with an average value of \$3,000 each). The police distributed 226,830 of the vouchers.

Table 2 presents the changes in seat belt wearing rates as a result of the program. Prior to the program belt use was approximately 67% and increased to 86% during the program. It was measured at 85% one week after the program ended and remained high, at 82% 12 months after the end of the program.

Other Programs

A major program conducted in the province of British Columbia in 1983 resulted in seat belt use increasing from 58% to 73%. The program required the coordination of a large number of different police departments and community groups. One of the

unique activities in this program was to encourage community groups to organize local activities promoting seat belt use during the program (B.C. Research). More recently, British Columbia has conducted a major impaired driving enforcement program and coupled it with seat belt promotion. The program resulted in seat belt use increasing from 80% to 85%. The program used extensive media advertising which was provided by the Broadcasters Association.

The province of Saskatchewan, with a relatively small population, has completed 2 years of a five year seat belt promotion program using the STEP model. The program has produced a seat belt wearing rate of 88%, an increase of 16 percentage points. The program relied on \$500,000 in advertising and intensified enforcement which produced as many charges in two weeks as are normally issued in 6 months.

COSTS AND BENEFITS

Assigning economic values to costs and benefits of a STEP is specious task. The two major costs of a STEP are for police enforcement and advertising. Police enforcement is usually a "lost opportunity" cost, not an incremental cost. That is, in most programs the additional police enforcement is not purchased or added to ongoing activities. Rather, the additional police enforcement is obtained by shifting resources away from other activities so greater effort can be concentrated on a single enforcement action such as seat belt wearing laws. Therefore, there need not be a net increase in the cost of police services during a STEP. High priority police activities are generally not affected by STEPs. Income generated by fines levied during a STEP may or may not represent a net increase depending on what activities are forgone in order to conduct the STEP.

The other major expense associated with a STEP is for advertising. In smaller STEPs no money needs to be spent on advertising, rather, the news media is relied on to deliver the required information to the public. In programs where extensive advertising is used, such as occurred in the British Columbia and Quebec STEPs, sponsors were secured to reduce the direct cost to government of the STEP. Lawson (personal communication) has estimated that if seat belt use in Canada were raised from the current level of 75% to 90% there would be a saving of 2,600 lives and 70,000 injuries over five years. The minimum money value of these savings would be approximately \$900 million. STEPs in British Columbia, Quebec, and Saskatchewan have produced increases in seat belt use of this magnitude, and therefore such increases are feasible.

Table 2 Seat belt wearing rates before, during and after the 1987 Quebec STEP

Data Source	12 months	6 months	During STEP	Post STEP		
	pre-STEP	pre-STEP		1 week	6 months	12 months
Transport Canada	67.7%		85.8%		81.8%	81.6
Quebec (urban areas)		66.8%		79.2%	77.1%	
Quebec (expressways)		79.8%		84.7%	87.1%	

The Quebec program produced an initial increase in belt use from 68% to 86%, and this has remained at 82% for the two years following the program. If the seat belt use level is maintained for five years Quebec could see a saving of at least \$250 million (Quebec has 28% of the Canadian population). The cost of the program can be estimated very roughly as follows. Advertising costs were approximately \$1 million. The police issued 22,814 more tickets during the program than they would normally have. If we take an estimated cost of \$100 per ticket issued we could estimate the enforcement component cost at \$2.3 million. Thus the total cost of the program was approximately \$3.3 million. The potential economic benefit of the program could be 76 times its cost.

PROBLEM GROUPS

Some groups of drivers seem to be more resistant to the effects of STEPS. It was noted earlier that drivers observed to be leaving drinking establishments were less likely to start wearing a seat belt after an enforcement program (Grant, 1989; Malenfant & Van Houten, 1986). It has also been shown that those who drive while impaired are less likely to wear seat belts than those who do not drive when impaired (Transport Canada, unpublished roadside survey data; Wilson, 1989).

Wilson (1989), using a self report questionnaire, conducted a survey of three samples of drivers: those who had been convicted of impaired driving, those who had been involved in three or more reportable accidents or had accumulated 9 or more demerit points, and a random sample of drivers. Differences between nonusers and inconsistent seat belt users and those who always wore seat belts were evident and Wilson concluded that these represented a pattern of problem behaviours. Nonusers of seat belts were higher sensation seekers, consumed more alcohol, tended toward a pattern of alcohol addiction, experienced more personal problems and accumulated more traffic violations. These differences were evident in each of the subsamples of drivers. Wilson concluded that the problem behaviour pattern exhibited by the drivers least likely to wear seat belts may make them resistant to programs designed to change their behaviour.

Directing a STEP at specific groups of drivers and vehicle occupants requires more planning than has generally been the case in the past. Police will need to be more aware of how to identify members of the problem groups using variables such as location and time of day. In addition, it will be necessary to ensure that the identified groups are aware that there will be increased police enforcement.

DISCUSSION

The use of a STEP program, such as that described here, represents a gentle form of law enforcement. A form which provides for learning and for the opportunity to change behaviour. The data presented demonstrate that the desired behaviour changes do occur, that the changes persist, although at a reduced level, and that the program can be repeated to produce additional increases in the level of belt use.

Unfortunately, the one program which included an incentive or reward component did not separate the effects of that component from that of enforcement. The rewarding did produce positive attitudes toward the program. An opinion survey conducted as part of

the evaluation indicated that 72% of the population viewed the reward system as positive (Dussault, 1990). Respondents were also asked if they thought offering rewards was generally better than using tickets to get people to comply with the law. Sixty-one percent felt that it was better to issue tickets, that is, they thought that penalties were better.

There is evidence that some vehicle occupants may represent a group of problem drivers and that these groups are resistant to the effects of STEPs. It is likely that special enforcement activities will be needed to affect the behaviour of these people.

However positive the results of STEPs are it would be inappropriate to consider them as the only method for encouraging and increasing seat belt use. Any strategy to change behaviour which relies on only one type of program is unlikely to have a sustained effect. People may be willing to accept intensive police interventions as long as they perceive a problem to be serious for themselves. They may not be as willing to accept such intervention when they perceive the problem to be less central to their safety. Programs such as public education and employer based seat belt programs (Geller et al., 1990; Grant, 1990) are alternatives that should be used either by themselves or in combination with STEPs. Additional research is needed to provide other alternatives so program managers can select from an array of programs in order to select the one which will be most effective with the target group.

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CORPORATE INCENTIVE PROGRAMMES: AN APPLICATION OF UTILITY THEORIES

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1. INTRODUCTION

Many reports exist by now on the successes of incentive programmes in reducing accident rates of corporate fleets at favourable cost-benefit ratios to the incentive provider (see Wilde & Murdoch, 1982, and Wilde, 1988, for reviews). Invariably, however, these are anecdotal reports which lack a firm theoretical structure and which, therefore, cannot assist the incentive provider in making the critical choices when putting together his own incentive programme.

What I intend to do in this paper is to briefly present one approach in the line of classical utility theory that presents at least some tentative and testable guidelines to make these choices, to be followed by an equally brief presentation of results from tests in a laboratory situation.

2. SAFETY AS AN ELEMENT OF TRIP ECONOMY FOR THE INDIVIDUAL DRIVER

The non-trivial problem for a driver undertaking a trip from a utility point of view is how to minimize total trip cost, that is: expected accident costs plus the costs of time loss, by the choice of some particular way of behaving (e.g. Cownie & Calderwood, 1966; Peltzman, 1975; O'Neill, 1977; Orr, 1982; Wilde, 1982; Blomquist, 1986; Janssen & Tenkink, 1988). We consider speed as the prominent variable that is under direct driver control and that is most closely related to risk.

Let U_T be the (dis)utility per hour (or "opportunity loss") of travelling without accidents, and let U_A be the (dis)utility of having an accident. Without loss in generality the utility per hour being at the destination can be set at zero. Suppose furthermore the accident rate per unit of distance is p so that on a trip of length L , the number of accidents expected to occur will be $L \cdot p$.

The driver will choose the value of speed v which maximizes -makes the least negative- the sum

$$U_L = U_T \frac{L}{v} + L \cdot p \cdot U_A \quad (1)$$

Of the terms in this sum the first represents the opportunity time loss expected by the driver by undertaking a trip lasting L/v hours. The second term is the expected accident loss or risk, for the trip. In order to derive an expression for optimal v a relationship must be assumed to exist between vehicle speed and risk. A plausible assumption is that it has the form

$$p \cdot U_A = \gamma v^c \quad (2)$$

Nilsson (1984) has argued extensively for a relation of this form, where c is in the range of 5 to 7 depending upon what type of accident (property damage only; personal injury; lethal) is considered.

Substitution of (2) into (1) and differentiating leads to the result that v_{opt} , the speed which minimizes trip costs U_L , will be the following:

$$v_{opt} = \left[\frac{U_T}{\gamma c} \right]^{1/(c+1)} \quad (3)$$

If we now look at the level risk implicated by this process of speed choice it turns out that accident risk (probability \times severity) per hour at speed v_{opt} is given by

$$R_T = p \cdot U_A \cdot v_{opt} = \frac{U_T}{c} \quad (4)$$

where the remarkable thing is that the coefficient γ of the speed-risk function (2) has disappeared. Thus accident risk per unit of time will remain constant irrespective of changes in this coefficient. Or, put differently, there will be a level of risk per unit of time aspired by the driver which will not be changed by measures affecting either accident probability p or severity U_A . A new optimal speed will be chosen which nullifies these potentially beneficial effects and there will then be even more instances of what has been termed "risk compensation".

Incentive effects, because of their bringing around a shift in the balance of trip costs and, therefore, leading to effective changes in risk level can be incorporated in the relevant mode expressions. The exact form this takes will depend on the particular contingency that has been specified by the incentive provider as making the driver eligible for earning the incentive.

3. EXPECTED EFFECTS OF DIFFERENT FORMS OF INCENTIVE PROGRAMMING

The following factors have been identified as theoretically relevant for the functioning of incentive programmes (Hagenzieker, 1988; Wilde, 1988):

1. the extent of the required accident-free performance (whether in time or in kilometres)
2. whether the contingency is of an all-or-nothing type or whether the incentive is proportional to the actual reduction in accident rates achieved
3. whether there is a group or an individual contingency
4. whether the incentive is extended straight away after the desired contingency has been met or whether it is extended in an indirect form, notably as a ticket in a lottery that with a certain probability may win an even larger incentive.

3.1 Extent of the required accident-free performance

On common sense grounds one would expect the effect of an incentive to be larger for longer

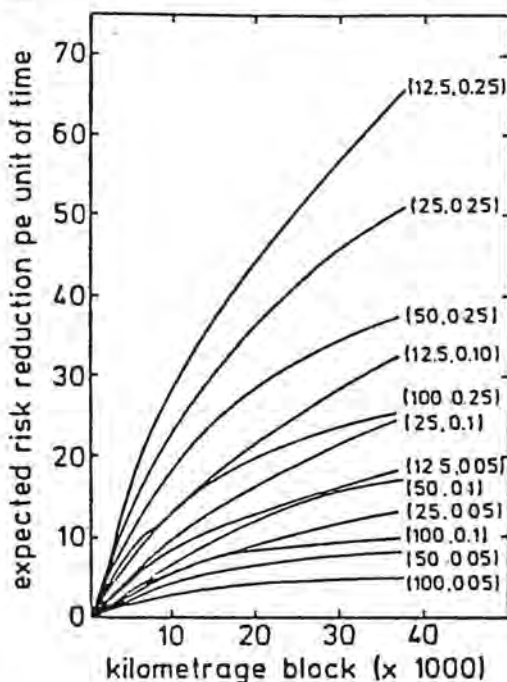
contingency periods. An incentive, expressing it as a fixed pecuniary award per kilometre, had best be specified in contingency periods that are as long as feasible. When we write this down in the form of an all-or-nothing contingency (you only get the incentive if you have had no accident at all) the expected cost function (1) changes into the following:

$$U_L = U_T \cdot \frac{L}{v} \cdot [-pr(0) \cdot L \cdot i + [pr(1) + 2pr(2) + 3pr(3) + \dots] \cdot U_A] \quad (5)$$

where i = incentive per unit of distance
 $pr(0), pr(1), pr(2), \dots$ = Poisson probabilities of having 0, 1, 2, ... accidents in the contingency period at speed v

The task for the driver again becomes to select the optimal speed v_{opt} which minimizes U_L . Fig. 1 shows a family of theoretical curves for expected risk reductions per unit time, for different parameter values, according to (5). These are then theoretical predictions to be tested in appropriate research.

Figure 1 Family of theoretical risk reduction curves for different combinations of hourly time loss values U_T (= 1.25, 25, 50 and 100) and of unit incentive per kilometre i (= .05, .10 and .25). U_T and i are in same units.

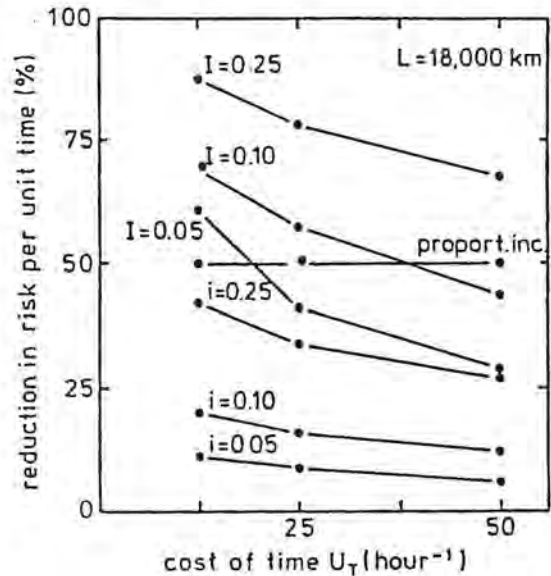


3.2 All-or-nothing or proportional schemes

Making the reward proportional to the achieved reduction in accident risk is a scheme that can be applied when group performance is the target. A proportional scheme is attractive for two reasons. First, the reward is 'just' exactly because it is proportional to performance. Second, the potential cost to the incentive provider can be fixed to a maximum.

There are two forms of proportional rewarding. One is to apportion the exact savings in accident costs themselves among the relevant population. In the other a maximum amount is set for the group which is earned if no accident costs at all are produced in the contingency period, with a pay off that is graded relative to the maximum in proportion to actual savings (and where the balance is an initial benefit to the incentive provider). Thus, if the maximum

Figure 2 Expected risk reduction per unit of time against cost of time for different incentives per kilometre driven, and for all-or-nothing (i) and proportional (I) schemes. Results apply to a 18,000 km contingency criterion.



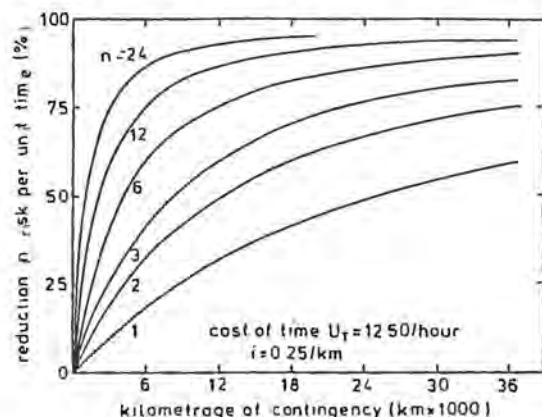
incentive to be earned were set at an amount I the group would get $1/2I$ if accident costs were reduced by $1/2$, $1/3I$ if they were reduced by $1/3$, and so on. One can write out quantitative expressions, resembling expression (5), for the effects to be expected from proportional incentive schemes (see Janssen, in press). These can then be compared to the effects to be expected from all-or-nothing schemes. It appears to be the case that proportional rewarding will always yield better results than the corresponding all-or-nothing scheme, see Fig. 2 for typical results.

The reason is that the incentive provider in an all-or-nothing scheme pays for the high percentage of drivers who would not have had an accident anyway while, in a proportional scheme, the driver gets only what he (and his colleagues) has earned himself.

3.3 Group versus individual contingencies

Making the extension of an incentive contingent upon the safety performance of a group of drivers aims at creating per group pressure towards the achievement of the required performance. Whether such pressure will in fact emerge is an empirical

Figure 3 Expected risk reduction per unit of time as a function of group size ($n = 1-2$ hour) and of the incentive contingency.



question. In terms of the model we have been implying thus far the interesting thing is that if n people must simultaneously meet an all-or-nothing accident criterion each of them must change his behaviour more than under an individual all-or-nothing scheme. Expressions describing this may be written down, and the outcomes inspected. Fig. 3 gives an example of theoretical expectations.

3.4 Direct versus lottery extension of incentives

When, in any given year, about 95% of drivers are accident-free each of them would only be eligible for their small share of the total incentive funds. This could be altered by rewarding, by lot, only 5 or 10% of accident-free drivers and give them a 20 or 10 times larger bonus.

In terms of the model no differential effects of the direct or the lottery extension of an incentive should be expected. There would be a beneficial cost effect to the provider of the incentive in case of a lottery, since rewards would now only have to be paid to small numbers of people.

4. RESULTS FROM INITIAL LAB STUDIES

Certain implications of the simple utility approach as described above have been tested by studying decision taking in an operational game, i.e., a simulation of a risk taking task. The task is described elsewhere (Janssen, 1988, 1989). Basically, it required subjects to select a speed at which they would drive to cover 3000 kilometres on average highways. An hourly time loss was specified, and the probability of having an "accident" – with its associated cost – was defined according to Nilsson's (1984) power function of speed for property damage accidents. Subjects earned money for their participation as a function of the total loss over a series of speed choices in terms of accumulated hourly losses and accident costs at the chosen speeds. Without going into detail I will display some results that have a particular bearing on the model.

4.1 Experimental conditions

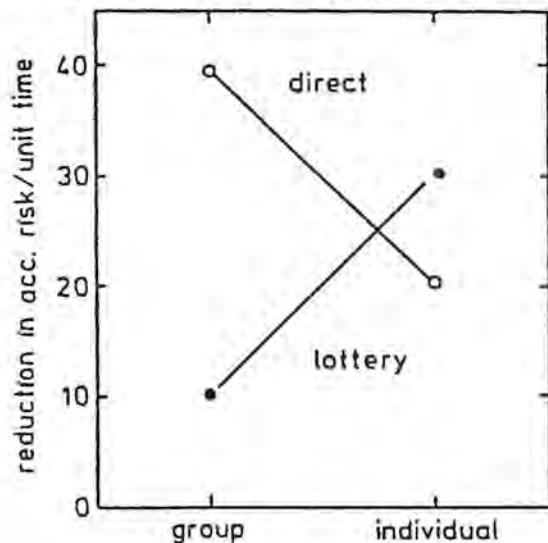
The following variables were factorially combined:

1. group versus individual provision of the incentive, where groups consisted of 6 persons
2. "direct" versus "lottery" extension of the incentive, where the lottery consisted in earning a ticket that gave, with probability 0.1, a prize of 100x the incentive of the 'direct' condition
3. magnitude of the required contingency, where the number of consecutive choices of a simulated speed required to meet the criterion for damage free performance was either 1, 6 or 12. The contingency itself thus always was of the all-or-nothing form. The dependent variable was the reduction in risk (percentwise) relative to a baseline condition without incentive, preceding the incentive condition.

4.2 Results; groups versus individuals

A t test performed on the comparison between groups of 6 persons working under the "1 choice" all-or-nothing contingency and individuals working under the "6 choice" contingency showed no significant differences. That is, the expectation of section 3.3 that these conditions would lead to identical results was not contradicted. In the present experiment, therefore, there was no reason to assume group processes in the social psychological sense to play a role above and beyond the sheer effect of number as following from the simple utility model.

Figure 4 Risk reductions for groups ($n = 6$) and individuals under "direct" and "lottery" extension of incentive in all-or-nothing contingency scheme.



4.3 Direct versus lottery extension of incentives

A significant interaction was obtained between the group/individual variable and the direct/lottery variable. An incentive's effect was largest when it was a *direct* incentive contingent upon *group* (all-or-nothing) performance. The effect, for the particular set of parameters used in the experiment, was a $\pm 40\%$ drop in risk level. When groups were to earn their incentive by means of a lottery the effect dropped to a comparatively slight $\pm 10\%$; see Fig. 4.

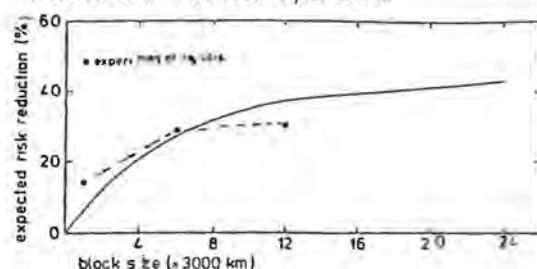
For individual extension of the incentive there was not a large difference between the "direct" and the "lottery" condition, though the lottery condition seemed to work somewhat better.

The finding that groups reduce their risk levels much more when the incentive is a direct reward instead of a ticket in a lottery contradicts a purely utilitarian point of view. Informal observation during the experiment gave the impression that subjects were very disappointed when, after "behaving" themselves for the benefit of the group, they did not win the prize in the lottery. This then seemed to make them lose interest, or indeed to become somewhat rebellious, to such an extent that the overall result in the group x lottery condition ended up relatively unfavourably. Extending the incentive as a lottery ticket may be just one step too many in a group contingency, where the link between behaviour and reward is already fairly indirect.

4.4 Effect-of-magnitude of contingency

There was an appreciable gain when the contingency was extended from 1 to 6 consecutive damage-free

Figure 5 Effect of magnitude of contingency to be achieved a reduction in accepted risk: experimental results versus theoretical expectation.



choices. However, no further gain was achieved when the contingency was extended to 12 choices. Fig. 5 shows the data in relation to the theoretical expectations on the basis of equation (5).

Thus, although something will be gained in making the criterion extend over a larger interval it also appears that there is a limit to what one can expect, i.e., to what one can request from the user's patience.

5. CONCLUSIONS

There are many ways to give an incentive-dollar away, not all of them equally effective. One way of coming to grips with the problem is to have a theoretical framework, be it ever so simple, permitting initial guesses as to what would be the best way to proceed as well as permitting the development of coherent research questions. Utility considerations, as I have hoped to demonstrate, can fulfil these functions at least some way. Needless to say the list of variables discussed here that affect the outcome of incentive programmes is not exhaustive. Managerial as well as administrative factors also determine a programme's ultimate success (see Wilde, 1988, for discussion on these issues).

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COMMENTS ON SESSION 1: MODIFYING INDIVIDUAL ROAD USER BEHAVIOUR

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Background

The initiative taken by OECD and CEMT as I have understood it is to table and discuss present knowledge and recent work in the area of influencing road user behaviour through enforcement and reward. Enforcement according to my dictionary means to compel obedience (normally of a law) by force. Enforcement is consequently in principle a repressive and negative process – a punishment. This concentration on punishment and reward means in my opinion that we are dealing with the classical questions of learning although here it is limited to road traffic and road user behaviour.

We would like to know where the front line of knowledge concerning the use of reward and punishment to modify road user behaviour is presently situated. We would like to hear the most recent results and the latest ideas in the field.

To which extent do the papers presented in this session manage to answer such questions? Another and may be more fruitful way to analyze the session could be to ask some general questions comparing the way reward and punishment are studied in psychology with the way they are used in road traffic. A third way could be to ask if road user behaviour in the main driver tasks is influenced and if the main behavioural errors are diminished through the reward and punishment strategies applied.

Some general questions

The conference title "Enforcement and rewarding: strategies and effects" as is indicated initially really the essence of traditional learning psychology. Being so why do we not see more reference to all these learning studies carried out over the last 100 years in psychology when we are now discussing how we might influence road user behaviour? Why are we not using this abundant amount of knowledge in reward and punishment strategies and effects when we are designing both experiments on road user behaviour modification and real efforts to influence road users one way or the other?

Reward and punishment are the two classical means to influence behaviour of human subjects. In traditional psychology reward has attracted the most interest and also given the best results. However in road user behaviour modification it is for some reason very rare to study the effects of reward on behaviour modification. Punishment on the other hand has received much attention and several studies are focusing on which effects punishment might have on behaviour. Why is that? Why are there

so few studies of the effects of various rewards on road user behaviour?

Thirdly, in psychological learning studies using reward and punishment the main interest is normally focused on the initial learning process. This is natural considering that modifying an established behaviour requires much more energy, effort, time, and resources compared with doing it right from the beginning.

However again we find a difference in comparison with road user studies. Here most of the studies deal with trying to modify an established road user behaviour. Why is that? Why do we not use our knowledge in learning psychology to shape the correct behaviour from the beginning?

A fourth general question concerns the behavioural target. In basic psychology studies the aim is normally to teach the subject to perform well in terms of production, efficiency, safety etc. But in road user studies the main target seems to be to teach the subject to perform and behave in accordance with prescribed and rigid rules that are not necessarily intimately related to efficiency, safety etc. Why is that? Why do we not try also in road user training to teach the skill of cooperating in traffic in more goal oriented terms instead of prescribing in detail how to behave, often irrespective of the specific conditions?

General question number five deals with the type of behaviour that we try to influence in road traffic and in general behaviour modification studies. In other fields we find very diversified studies trying to influence behaviour in a large number of ways. The aim seems to be to influence especially those activities that are one way or the other crucial for carrying out the task in question. In road traffic however, only a few activities are studied from the point of view of influencing critical behaviour by means of punishment and reward. Why is that? Are really the activities we are trying to influence the most critical ones from e.g. safety point of view?

My sixth general question concerns the time and size aspect of reward and punishment. In general psychology the time aspect of feedback has always attracted the main interest. The delay in feedback has been found to be of critical importance, while the size of the feedback (reward or punishment) has not been equally interesting. However in road traffic the size of the feedback seems to have been the most studied aspect. Why is that? Why have we not been more interested in the swiftness of the reward or the punishment?

The seventh general question deals with the target for and the probability of the punishment and reward. In traditional psychology the target is with few exceptions the specific individual whose behaviour we would like to modify. The probability of receiving feedback in the form of reward or punishment is consequently very high unless we are really studying probability learning. In road traffic however the situation is different. Normally the control is of a

general character even if the punishment and reward as a rule hits the individual with a certain and limited probability. Why is that? Why do we not aim directly at the individual and why do we not increase the probability of being punished by doing the wrong thing and being rewarded for doing the right thing?

One problem is how reward and punishment influence behaviour as single variables. Another problem is how such a treatment could be combined with other measures that might interact with the single measure so as to either strengthen or weaken the effects.

Road traffic applications seem to be superior to basic psychology studies in the respect that such interactions are rarely studied in psychology but often studied in road traffic.

Is this true also for this session?

In psychology it is almost compulsory to find out if the applied reward or punishment procedure really worked the way the hypothesis suggested and how the outcome obtained was reached.

In road traffic the follow up studies were earlier almost exceptional and the well controlled follow up studies are even more rare. How about the studies presented in this session?

We know from science in general and also from learning psychology that as long as we do not base our experiments and studies on some kind of model or theory the results tend to be of an ad hoc character. We cannot generalize from one study to another, we cannot really accumulate our knowledge. It is like collecting stamps without having a system. We cannot see how they relate, we cannot see what is missing. It does not initiate or generate new hypothesis and studies. But this seems to be exactly what we are continuously doing in road traffic studies - also those trying to modify road user behaviour through punishment and reward strategies. We have a large number of stamps but no real collection. We have no theory, no model. But we continue to do studies. Why is that? This is my ninth general question.

The tenth question finally is a more pragmatic one - the strategy proposed to apply punishment or reward might influence road user behaviour the way we

want, but is it a cost effective way to reach a higher level of road safety compared to other means? Do the papers presented in this session have something to say on these general questions?

Driver tasks and driver errors

If we want to know whether some punishment and reward strategies really are effective in influencing road user behaviour and thereby e.g. improving safety it seems to me logical to start with the question: What is it we want to influence? The answer on that question must depend on what we consider to be a) important and critical to influence in the driving task and b) what is often made wrong by many drivers.

In order to find out what that might be we could look at some driver task models and/or some driver error analyses.

There are in the literature a large number of driver models.

However it seems to me that the three level cognitive model outlined in figure 1 is presently the most generally accepted model. In my opinion it is favourably complemented on the tactical manoeuvring level by the more perceptual model suggested already in 1938 by Gibson and Crooks (see figure 2).

According to Rumar (1988) the driver errors might be divided into four groups depending on the main factors behind them.

These four groups are:

Physiological: general and inherited; e.g. inadequate night driving vision.

Psychological: individual but rather general and acquired; e.g. driving too close in a queue, behavioural adaptation

Sociological: some group specific, some general, acquired; e.g. aggression through lack of communication, anonymity and possession of power

Physical: rather general influenced by the physical conditions, acquired; e.g. straight, smooth and wide roads and high speed cars create high speeds.

Figure 1. A three level cognitive model structure of the driver task (after Janssen 1979)

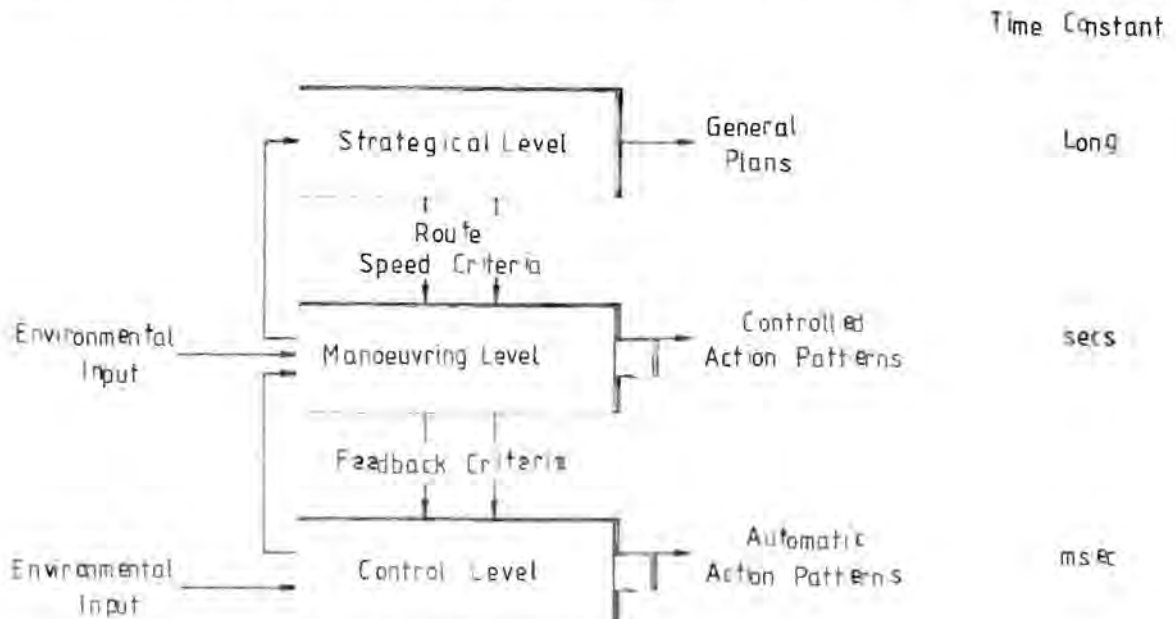
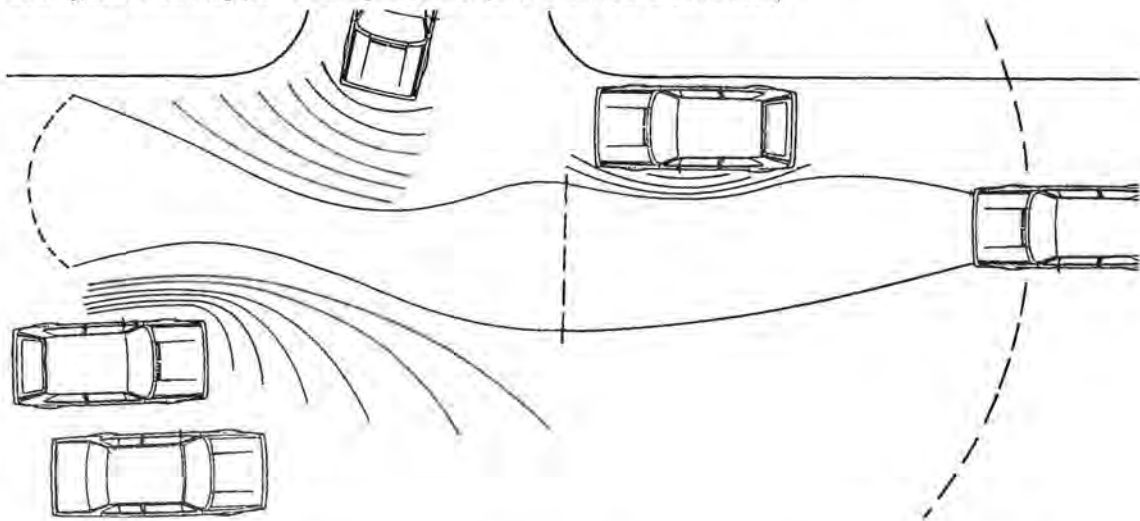


Figure 2. A perceptual model of the field of safe driving that, depending on speed, direction, friction and stability, is immediately perceived by the driver (after Gibons & Crooks 1938)



Fuller (1990) uses a more cognitive basis for his error analysis. He argues that there are two types of errors – those that are caused by ignorance about the potential danger and those that are caused by gambling with the probabilities that the danger might appear. Janssen (1990) uses utility models to show that drivers normally behave according to utility expectations but that these often do not coincide with society utility.

Do the studies presented in this session try to influence behaviour in the tasks outlined in the models mentioned? Do they try to diminish any of the errors mentioned here?

Psychology – road traffic

None of the papers presented are based on any of the many basic psychological studies dealing with reward and punishment. We can find reference to learning theory in Huguenin & Aebischer, in Fuller, in Geller, in Janssen. The rest are treating punishment and reward as something specific for their road traffic purposes.

Of the presented ten papers six deal only with negative feedback which is normally called enforcement. Geller is not really studying reward but has room for it in his taxonomy. Grant & Wilson mention reward as an improvement. Fuller is discussing the problems of built-in strong rewards for unsafe behaviour (e.g. high speeds) and introduced weak punishment for the same behaviour. Hagenzieker is comparing the effects of reward and punishment and Janssen is dealing with utility including both reward and punishment.

As far as I can see only Fuller discusses the basic learning procedure of drivers. He points out the favourable effects of immediate reward as compared with delayed punishment and states that this is one of the key problems in present road traffic. All the others are in their studies trying to modify already existing behavioural patterns that are for some reason or another considered no good. The main reason for this skewness is probably that the term enforcement normally refers to controlling behaviour in relation to a fixed rule.

Janssen and Fuller discuss influencing behaviour in order to reach safe driving. All the others are studying the way the road users are following a rule, a

regulation, a law. Three of the studies deal with enforcement of speed limits, three deal with seat belt wearing, one studies driving and drinking and one the use of direction indicators. Speed, seat belt wearing and drinking are admittedly very important safety aspects of driver behaviour. The use of direction indicators is probably also important but it is not to the same extent substantiated. Again, the main reason for this tendency may very well be the word enforcement.

When it comes to the temporal aspects of enforcement and reward only one paper, Ross, is discussing and studying the effects. The quantity aspect is also treated by Østvik & Elvik, Hagenzieker and Janssen.

The probability that the feedback shall really hit the relevant individual when he has deserved it (reward or punishment) is discussed from effectivity point of view by almost everybody. But most of the studies carried out deal with group values and group reactions. Janssen specifically tries to compare group and individual schemes.

The interaction between the reward/punishment treatment and some other measures is discussed by almost everybody. Public information seems to be an effective support or vice versa (de Bruin & Røsjer). Interactive effects are obviously something that road traffic researchers are open for. Also, most of the papers are trying to establish the effects of the treatment and they also try to explain how the effects were reached. Nilsson even predicts by means of simulation what would happen if some of his aims were fulfilled.

The theoretical background to the studies or models which generate hypotheses for the studies are in large measure missing. The main exception is Janssen who uses utility theory to formulate hypotheses that can be empirically tested. Mainly Fuller but also Huguenin & Aebischer, Nilsson and Geller use models and theoretical analyses to some extent.

The cost/benefit or cost/effectiveness of the measures being studied is discussed by Ross, Geller, Grant et al and Janssen. However very few studies in this session (Østvik & Elvik) really reach the ultimate measures – accident and injury. Without such measures benefits are hard to estimate.

Why so little psychology?

There must be some reasons why punishment and rewarding are treated so differently in psychology and in road traffic studies. The road traffic situation contains in itself a large number of immediately rewarding incentives (e.g. short headways) which make our artificial low probability reward and punishment efforts look very weak. The road traffic situation is not self-instructive except concerning a few tasks like steering. We could draw a parallel with the intensive destructive publicity for reckless driving (in e.g. movies and TV-programmes) compared with the very weak safety publicities.

Another main cause is certainly that driving is a self-paced task. That is to say the driver himself regulates mainly by his speed how difficult a traffic situation will be. Also the utility to the individual is often not the same as utility for society. Still another reason is that there are a hundred ways or more to do a manoeuvre acceptable and equally many to do it wrong. It is very hard for us to specify what we mean with good driving behaviour. Bad driving behaviour is easier, especially if we use the rules and laws for setting the limits. Another cause is that most of the driver behaviour is very difficult to quantify. Furthermore the driver is not under continuous control like subjects in psychological experiments.

All these differences make it difficult to generalize from psychology to road traffic. They make it difficult to treat other behaviour patterns than rules where the difference between right and wrong is comparatively easy to specify. They make it difficult to reach, monitor and give immediate feed-back to the individual driver.

But I cannot see any good reason why rewards are so rare in road traffic behavioural studies, why most of the interest is on modifying already established behavioural patterns, why especially the temporal but also the probability aspects of reward and punishment receive so little attention and finally why so few of the studies on road user behaviour modification are based on models or theories.

If enforcement and reward will also in the future be limited to behaviour in relation to rules and laws – then it really is important what kind of rules and laws we are writing. They must be highly and clearly correlated with safety (or which other goal we are aiming for), the relevant behaviour must be possible to measure and it must be possible to set limits.

Driver tasks and errors

Only Fuller and to some extent Janssen try to work from ideas about what the basic driver tasks are. The use of alcohol (Ross) and the three studies of belt usage are activities treated in this session that could be described as strategic tasks. The other activities (speed and use of direction indicator) are tasks of a tactical character. Speed choice could also be described in Gibson's terms of ecological perception. But of course this is not correct when the task is to obey a speed limit sign.

Reward and punishment could certainly be used to modify road user behaviour on both strategic, tactical and vehicle control level. The strategic level is important from travel pattern point of view, and thereby also through exposure for safety. But it seems to me as the most difficult and most critical level from safety point of view is the tactical level. Both previous research and the studies presented

here support, as I see it, that statement. Whether we are talking about the target level of risk or the attitudinal influence in group discussions or efforts to make drivers go slower we are discussing modification of behaviour on the tactical/manoeuvring level. That is where we should concentrate our efforts. On this level the perceptual aspects are in my opinion very important. Few studies deal with this aspect.

As regards the error analysis Fuller gives a good description of development of errors of the psychological character. Huguenin & Aebischer try to explain how some erroneous psychological reactions to introduction of rules may develop. Janssen deals primarily with errors of utility character and Nilsson concentrates on the overlooked physical errors.

I am missing efforts to influence some higher order but crucial errors like attention errors, expectation errors, prediction errors, errors in assessing one's own abilities and performance.

Such errors are normally on the tactical/manoeuvring level and they are especially important in driving due to the mentioned self-paced character of that task.

A Swedish study

Finally I will take the opportunity to tell you about a Swedish study in this area of reward and punishment to influence road user behaviour in the direction of higher safety. It is however an exploratory corporate study which lacks a theoretical background.

The purpose was to compare different strategies to reduce accident risk and accident costs among the drivers in the Swedish Telecom Company (Gregersen & Morén 1990). The different measures to influence driver behaviour were of the traditional type as follows:

- Special driver training
- Group discussions
- Bonus for no-claim
- Campaigns

In each group 900 drivers were matched and selected. This means that 3 600 drivers participated in the experimental groups and that another 900 constituted the control group. The results in terms of accident risk and accident costs were followed up in three consecutive 6 month periods. The study started 1987 and the treatments were finished in the end of 1988.

The special training contained three parts: driving in a low speed driving technique and manoeuvring area, driving on slippery surfaces, talking driving were the driver continuously gives an account of his observations and intentions.

The group discussions were based on Misumi's studies (1980). In a structured procedure the intention is to discuss and identify safety problems in the working situation and to make the individuals take personal decisions how to try to avoid these problems.

The bonus system has been based on groups of roughly 30 vehicles where each vehicle initially received 200 SEK which makes 6 000 SEK per group. During the following 12 month period 100 200 SEK has been subtracted per accident. The remaining sum was given to the drivers. The campaign was carried out in five meetings during one year. Information material concerning safe driving

Table 1 Treatment costs in relation to accident costs per 10000 km driven

	Cost of treatment (sek) per 10000 km 1987/88	Change of accident costs (sek) per 10000 km		Calculated time (years) to recover costs
		1987	1988	
Training	2575	-160	-368	7
Group discussions	649	-90	-555	1.2
Bonus	454	-102	-279	1.6
Campaigns	938	-26	-342	2.7

in general and specific topics depending on the time of the year were presented and discussed.

The initial results show that driver training was the most expensive and the bonus treatment was the least expensive measure. The accident risk was significantly reduced for the group discussion and the special training groups, 54 and 38 percent respectively. The treatment and accident costs are given in table 1. From there it can be seen that the accident costs were lowered for all groups but most significantly for the group discussion group, which consequently is the most cost effective treatment in this study.

Final words

Enforcement strategies are more effective the more they meet the criteria of classical learning theory concerning especially swiftness and probability of the feed-back. Reward is most probably an underestimated possibility. It faces presently some criteria measurement problems. Here we have room for inventions. Information support increase enforcement effectivity.

It would be advantageous if we could include natural feed back into the normal traffic situation. That would make the road user task self-instructive. Thereby we would be able to form driver behaviour on the tactical/manoeuvring level already from the beginning and would not have to try to modify behaviour at a later stage.

As some of the authors point out the present huge information technology programmes of Prometheus and Drive aim at producing equipment that might make it much easier to reach every individual driver and give him continuous feed back on his behaviour - both positive and negative. If these efforts succeed it will mean a revolution in our possibilities to influence the behaviour of the individual driver. Many talk about the tremendous enforcement capacity of such systems.

Personally I am more interested in the general feed-back possibilities, which can be used to literally build in a personal driving instructor in each car. Just to inform the driver of his good and bad behaviour could be effective. Such more or less neutral feed back has been quite successful in other learning situations. An important question to study before information technology is how to make best use of automatic enforcement equipment.

Finally we should take the positive results presented in the Dutch and the Swedish corporate studies presented to our minds. There are other ways to be more effective ways to influence road user behaviour in direction of safety than the traditional public

enforcement strategies. Social control is a method used too seldom in road traffic.

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CONCLUSIONS AND RECOMMENDATIONS BY THE RAPORTEURS OF SESSION 1

18

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Le rapporteur de cette session a une tâche difficile : les débats ont duré duré un jour et demi, de nombreuses idées ont été échangées, un très intéressant exposé liminaire du M. Hale a posé le cadre théorique de cette session et Kåre Rumar nous a offert une évaluation très complète de ce qui a été dit par les conférenciers: il sera difficile d'aller plus loin. Je vais quand même essayer de reprendre les grandes lignes du débat mais avant de résumer ce qui s'est passé, je voudrais vous lire ces quelques mots:

"Bien que nous ayons toujours à la bouche ce principe que récompense et châtiment sont les deux piliers de l'Etat, je ne l'ai jamais vu mis en application ailleurs qu'à Lilliput. Là-bas, quiconque peut établir de façon probante qu'il a strictement observé les lois de son pays depuis soixante-treize lunes, a droit à certains privilèges variables selon sa naissance et sa condition, ainsi qu'à des récompenses en argent, payées sur une caisse spéciale et également variables. Il reçoit en plus le titre de Snilpall, c'est à dire Loyal, qu'il ajoute à son nom, mais qui n'est pas héréditaire. Et quand je leur dit que chez nous les lois s'appliquaient à grand renfort de châtiments, mais qu'on ne parlait même pas de récompense, ils s'étonnèrent de cette prodigieuse faute politique."

260 ans après que Jonathan Swift ait écrit ces lignes, on peut se demander si nos sociétés sont mieux disposées à utiliser des récompenses pour changer le comportement des individus et l'orienter vers le sens souhaité.

Mais d'abord, cela est-il possible ?

Les psychologues disent que oui. Ils sont d'accord pour considérer que le comportement des conducteurs peut être modifié dans le sens d'un plus grand respect des règles de sécurité par l'application de récompenses. Les études expérimentales montrent que des stimulants symboliques, des primes ou des cadeaux peuvent modifier les comportements individuels; ainsi, peuvent amplifier le port de la ceinture de sécurité.

On a vu que ces stimulants sont efficaces pour une partie des individus mais pas pour tous; par ailleurs, la durée de vie des comportements ainsi modifiés est plus ou moins longue, ces comportements sont sujets à extinction.

On a pu remarquer, parfois pour le regretter, qu'il n'y a pas de réglementation légale pour récompenser ou rétribuer les comportements qui vont dans le sens recherché et on s'est demandé si l'on doit encourager les pouvoirs publics à s'engager sur cette voie.

Du côté de l'application de la loi, les choses semblent compliquées. La répression pure et simple des comportements illégaux n'est pas la solution la plus efficace puisqu'elle ne semble pas stopper le phénomène de récidive. On a pu montrer que les contrôles ponctuels sont d'autant plus efficaces qu'on en a fait la publicité. L'effet de halo produit par la publicité renforce la crainte d'être contrôlé. Des stratégies de dissuasion basées sur des contrôles efficaces et des sanctions rapides et certaines sont rentables, notamment dans le cas de l'alcool.

On a considéré aussi qu'il serait assez artificiel de séparer le comportement individuel du contexte social dans lequel il est inséré. Peut-on se contenter de prévenir les accidents et de modifier les comportements individuels sans intervenir sur le système de transport fondé sur la prédominance du transport individuel, sans s'interroger sur les intérêts économiques liés à la production et la diffusion de l'alcool, sans intervenir sur la valorisation culturelle du risque, sans contester l'encouragement de l'individualisme.

Quel est l'avenir ? Va-t-on vers des systèmes de contrôle électronique avec le cortège de problèmes éthiques que cela suppose ?

On a beaucoup parlé de la surveillance de ses comportements individuels et du travail de la police, on s'est demandé s'il on doit remplacer ou compléter le travail des policiers par des dispositifs automatiques. Est-ce avantageux au plan des enjeux économiques compte tenu du coût des machines ? Est-ce avantageux du point de vue des investissements humains, l'oeil électronique compense-t-il vraiment la présence du policier sur la route ? Est-ce acceptable au plan social, la société est-elle prête à admettre le contrôle permanent et anonyme de ses membres ?

On a parlé aussi d'une sorte de "big brother" installé au bord du véhicule et qui surveillerait le style de conduite, cette option s'accorde assez bien avec les hypothèses behavioristes selon lesquelles le comportement des individus peut être influencé par l'appréhension des conséquences : le châtiment immédiat ou à très court terme des comportements illégaux par des moyens électroniques peut être une façon de faire pression sur ces "motivation intrinsèques" dont parlent les psychologues. Même si elles sont techniquement possibles, ces options seraient certainement très difficiles à faire admettre par les opinions publiques et seraient considérées par beaucoup des gens, ceux notamment qui respectent les règles, comme des punitions. Nous pouvons certainement imaginer quelque chose de mieux pour le conducteur que de l'enfermer dans un système de stimuli aversifs. Nous touchons là les limites de la liberté individuelle et c'est bien là dessus que trébuche la psychologie du comportement. Nous savons aussi comment l'électronique peut être manipulée et bridée et plus, ce contrôle électronique ne pourrait s'effectuer sur la totalité du réseau et nous verrions s'établir une disparité importante de comportements entre sa partie

surveillée et sa partie libre: nous verrions resurgir ailleurs les comportements indésirables que nous aurions supprimés ici.

Je dirais, de mon point de vue, que l'on pourrait économiser toute une partie des efforts consentis pour construire des machines électroniques compliquées et coûteuses en instaurant une mesure technique toute simple qui est la limitation de vitesse des véhicules à la construction. Mais ceci est un rêve et nous touchons à un tabou...La théorie de la dissuasion présentée par M. Ross, qui revient à faire simplement appliquer la loi mais toute la loi en impliquant l'ensemble des institutions concernées, est sans doute plus réaliste.

Du point de vue de Swift, on ne s'intéresse pas assez à la récompense. Il faudrait continuer d'établir des taxinomies d'actions, de préciser les types de récompense en fonction des populations visées, de s'interroger sur l'efficacité des récompenses différées ou immédiates....Ces actions auraient en plus des résultats bénéfiques sur l'image sociale de la Sécurité Routière en montrant que celle-ci n'est pas simplement une entreprise de distribution de mauvais points.

Je conclurai en disant que la récompense ultime pour le conducteur et ses passagers est l'évènement de l'accident, de la blessure, de la mort. Les psychologues savent que le comportement individuel est fortement déterminé par l'environnement. Cela signifie que pour modifier le comportement individuel il faut changer l'environnement: cette évidence est celle de la psychologie moderne, scientifique et matérialiste.

Alors, modifions l'environnement physique du conducteur, offrons-lui des véhicules sûrs, une infrastructure routière lisible et qui pardonne à l'erreur de conduite, modifions son habileté en améliorant sa formation, modifions son environnement mental, ses valeurs individuelles par des actions de persuasion de grande ampleur.

DISCUSSION SESSION 1 CONCERNING SPEED ENFORCEMENT

Short statements after papers of Nilsson, Rooijers and Østvik

A short presentation of the DRIVE-project AUTOPOLIS was given which ended up like 'Big brother of 1984 is coming and you won't notice it.'

It was questioned what the practical implications of speed enforcement are, if the police keeps an upward range before fining someone. Is an upward shift of 3-5 km/hour possible? Presented was a gametheoretical approach to model these effects.

It was stated that the police view on national experiments with speed limits is that there is a need for more resources, however the allocation of resources themselves could be optimized too.

Discussion

The Dutch police stated that the police have more tasks than only their traffic tasks. Not everything that has been studied can be practised on legal grounds. The police needs extra support. It is possible to do more tickets but the legal system cannot deal with much more cases.

Some disagreement followed by the argument that

the police should take the safety problem and the violation of speed limits more seriously. Public space is the place, for police activity in general.

With regard to speed limits and safety the question was raised whether the absolute level of speed is as important as the variance of the speeds.

Comments on the paper of Göran Nilsson concerning the acceptance of accident risk versus the avoidance of danger.

Markku Saalujärvi asked Shalom Hakkert about the coverage of accidents reported by the police and how the allocation influences the representativity of the statistics as a feedback to the system. Made also a remark to Østvik, Elvik and Rooijers on the special effect of directed enforcement versus the halo-effect on enforcement.

It was too mentioned that an increase in the use of radar detectors in the USA could be observed and it was suggested that they should be outlawed.

Two additional points were made from the french side. One stating that the actual speeds are important and that speed limits are not, a view that is strongly supported in light of knowledge over existing systems. The other point concerned tolerance limits. A complete analysis is needed concerning the logic in police activities. It deserves to be designed and to be managed by integrated management methods, like in industry.

The dependencies between changes in speeds, accidents and police enforcement asks for the optimal level of enforcement, because one doesn't collect any money if nobody is violating the rules. What is the optimal level of fined violations?

Final statements of the panel

Göran Nilsson commented to several questions. With regard to risk taking and danger avoidance, the last is more general. Radar detectors are forbidden in Sweden but they still do exist. The tolerance level is a result of history. There is an optimal speed control for each road.

Ton Rooijers argued that also the margin should be enforcement and that drivers show an underestimation of their shortcomings.

Talib Rothengatter pointed to the fact that the legal system is not capable of the administrative follow up of offences. For example: radar detectors give automatic enforcement. Suppose the value of fine is 10 ECU, then the total in the EC would ask for the administrative handling of 45 billion ECU of fines.

Rune Elvik opposed this view and noted that it is not logical to abandon automatic enforcement because it works. Radar detectors are no problem. Cost effectiveness is excellent, gives back 5 - 1.

Shalom Hakkert expressed the opinion that the issue of speed variation is the central one and that more attention should be given to the reduction of the speed variation.

Cor Kuijten remarked that he didn't ask for more police officers. Radar detectors are allowed and like electronic alcohol testers the devices are very efficient. Automatic speed enforcement however works locally only through its fixed positions.

Session2 : **Influencing individual and
group safety values and
norms**

Séance 2 : **Influence des valeurs et
normes de sécurité des
individus et des groupes**



INFLUENCING INDIVIDUAL AND GROUP SAFETY VALUES AND NORMS

19

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"Incentives for Safe Driving and Insurance Management". So read the caption of the expert opinion offered by Gerald J. S. Wilde in the framework of an "Inquiry into Motor Vehicle Accident Compensation in Ontario." Here, reward as a means of furthering the motivation for avoiding accidents is rated higher than the classic "Three Es" applied in the campaign against accidents (p. 478):

"In contrast to safety promotion efforts through education, enforcement and engineering, economic interventions do not only appear to be more potent, but their implementation is also relatively simple and cheap. Furthermore, it would seem much easier to stimulate people's motivation for safety through economic inducements than it is by attempts to directly influence the cultural and social values or personality traits that have a bearing upon the level of risk they prefer."

This viewpoint is primarily and in particular the result of evaluative studies done on the campaign for safety at the workplace and further work in company traffic safety. He comments on his thesis as follows (pp. 501-502):

"The interested reader may well be surprised that the relatively modest bonuses for safe conduct on the road as well as in industry are apparently capable of producing major reductions in the accident rate. This is possible due to the intrinsically interesting challenge posed by incentive schemes ('Can I achieve the safety criterion or not?'), plus the *social recognition* that comes with attaining the objective. Human conduct is replete with examples showing that behaviours that lead to or reflect economic success rapidly become the norm as to what is the proper thing to do. At any rate, the observation that minor benefits to safe conduct reduce the accident rate to a major extent is in general agreement with an observation made by Starr who [in 1969] found evidence that in an unsafe activity (i.e., various kinds of mining) the accident rate (injuries per man-hour) was exponentially related to hourly wages: accidents rose with the third power of the financial benefit. Thus, augmenting the benefit accruing from safe behaviour by a small amount should reduce the accident rate by a comparatively large amount."

In his expert opinion, Wilde cites a series of further studies on the effect of "incentives for Safety in Industrial Settings" and concludes from a personal research reports (p. 474) namely that:

"Incentive systems tend to be more effective if employees are told how accidents can be avoided. Thus, this does not mean that incentives will not work if this educational component is missing,

but in industrial settings it has been found to be helpful."

He sees, however, financial incentives as the most effective. Let us assume that this is the case. Based on his discourse, one further comes to the conclusion that, until now, evaluative studies of incentive programs have been made more often in industry than in the area of traffic safety. This is due mainly to the fact that in industry there is also someone – and when none other, certainly the employer – interested in a profit which may be gained from a reduction of accidents, the one to whom incentives are not addressed.

We must ask ourselves whether the incentive factor has played a sufficient role in the campaign against traffic accidents conducted by the state and its institutions. Then, in evaluative studies on the effect of state-sponsored incentives for the avoidance of traffic accidents the advantage for social welfare gained through avoided accidents is seldom expressed in money values and identified as a personal profit for a public representative. The Department of Motor Vehicles in California seems to be the exception. Repeatedly, and with much admiration, attention has been drawn to the California evaluative research (e.g. E. Spoerer, 1974), also in particular as early on, economic criteria were included in the evaluation of traffic safety work.

Here is not the place for further discussion of this matter. In connection with the planned theme of this session the following areas are, however, of interest: the applied incentives, the procedures which were used to make them effective and finally, the methods used for evaluation.

Wilde (1988, p. 473) summarizes the approach and results of an "innovative and relatively large-scale experiment" which Harano and Hubert finished in 1974 as follows:

The incentives were directed to drivers "who caused collisions or committed violations in the previous year and thus had incurred recent demerit points. These drivers were informed by letter that they would receive a free 12 month extension to the validity of their driver's licenses on the condition that they achieve a clean record during the forthcoming year. Apart from the financial incentive amounting to a few dollars per year, this offer also implied deferral of the obligation to again submit themselves to the written part of the driver's examination, which in California is administered repeatedly through a driver's career. A control sample of another 9976 drivers was not approached in this manner, but they too were followed up along with the experimental group over a period of several years. The findings include the following. In the first follow up year, there were significantly fewer accident-involved drivers in the experimental group, particularly among the younger drivers and among those drivers whose license renewal was to come up within one year after receipt of the letter. In this latter group, the accident

rate was 22% lower than in the appropriate controls. The drivers who actually earned the bonus after one year showed 33% fewer accidents in the second follow-up year than did the controls."

My comment: Apparently, even modest incentives motivate traffic safety.

Two pertinent questions arise here:

1. How important – how incisive must enforcement be in order to bring about similar effects as with incentives?
2. What is the effect of benefits based on a larger scale?

Concerning question number one, an example from Germany:

The "license on probation" – introduced on January 11, 1986 – is an enforcement instrument. Although presented as learn situations, further consequences are connected with accidents caused by the driver or with traffic violations not involving an accident for which the driver is punished: for example, taking courses or preparing for a new test. In the mean time, the first evaluations of the "license on probation" program in Germany are now available (e.g. List, 1990) which show that this procedure is capable of "reducing the high risk of young drivers" (p. 237).

For the quoted author the question remains as to how – in spite of the significant change – the success should be evaluated. List establishes a connection and – by reference to G. Kroj and G. Weßbrodt (1989) – states the following:

"The latitude for possibilities of modification in a country with highly developed traffic has become smaller. Looking at the effect of a "license on probation" in our "motorized society" from this viewpoint, the reduction of accidents by beginners at driving on an average of 4 to 6% points means to have achieved much."

The estimated small latitude for modification refers apparently to experiences with public administrative enforcement. This fundamental assessment of enforcement possibilities within the framework of public administration should be kept in mind by further discussion of this subject.

The evaluation of administrative measures with which incentives were applied in California need no qualification as regards the potential for change in order to come off well. Are incentives then more effective than enforcement?

To aid with the answer to this question, evaluations of measures applied in private firms – whether in the interest of traffic safety or prevention of accidents on the job – can offer some help. Here, a second example which Wilde also mentions. Since 1957 the German branch of the Kraft Company has continuously implemented an incentive program in the interest of traffic safety which apparently is used worldwide. It led to a significant reduction of the accident rate (accidents per 100,000 km driven) and accident costs (accident costs in Deutsche Mark per 100,000 km driven) involving the firm's own motor vehicles. Results for the German subsidiary are as follows:

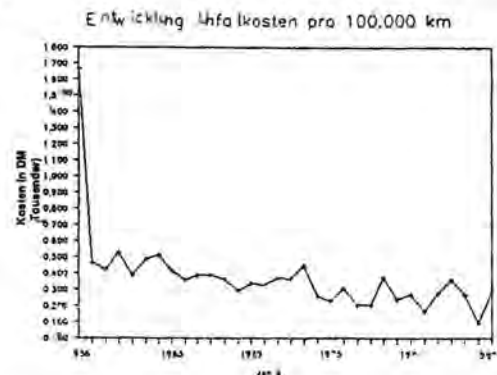
In 1956, the year before commencement of this program, the rate of accidents estimated to be avoidable, in accordance with a company oriented

evaluation scale, was at "2.02 accidents per 100,000 km. From 1981 to 1988 this rate fluctuated between 0.25 and 0.42 accidents per 100,000 km driven." (Fig. 1).

Figure 1: Number of accidents per 100.000 km



Figure 2: Costs of accidents per 100.000 km



"The rate of accident costs in 1956 was at 1,669.00 Deutsche Mark per 100,000 km driven. From 1981 to 1988 it was scattered between 296.00 and 99.00 Deutsche Mark per 100,000 km driven" (Fig. 2); (Gros, 1989, S. 246).

The example from the Kraft Company for the evaluation of company oriented traffic safety campaigns shows that a risk reduction of 75% or even 86% of the initial rate can indeed be achieved.

Wilde derives his above mentioned thesis from this (presumably, then he does not say explicitly), which states that incentive systems can achieve far more than the 'three Es', to which, of course, public enforcement belongs.

It must be said, however, that the examples taken from traffic safety measures which are used as proving evidence do not originate from purely incentive programs, while the examples used for evaluation of enforcement measures present tendentious isolated attempts.

Particularly the Kraft Drive Safely Program (Tschernischek, 1983; Gros, 1989) contains a variety of measures and it is carried by the will of the entrepreneur in the interest of raising traffic safety as part of corporate identity. This also means the creation or reinforcement of motives for avoiding risks on the part of individual drivers. Then, he or she is a Kraft employee. We may therefore assume that such a broadly laid out campaign, exactly that is being supported which the theme of this session 2: "Influencing Individual and Group Safety Values and Norms" expresses. The identification of each

employee of the Kraft Company with the values and norms of the firm.

Unfortunately, reports about such developments and the achieved successes in Europe are far too few. In the USA this is different because corporate identity is carried much more strongly in the presentation and advertising of the company.

The widely disseminated "employee assistance program" – EAP – (Schneider, 1987 and 1989) is an example of working an activity for risk reduction into the company image, which may also include traffic accident risks. EAP attempts to place values and norms under the keynote theme of preservation and expansion of health and productivity. Perhaps traffic safety activity lacks such an integration into a keynote theme which is recognized by a wide part of the population as a dominant motive (Schneider, 1990).

I think that such a dominant motive should also be incorporated into the guidelines for enforcement as a prerequisite for its effectiveness. Today, this is neither generally realized nor is it so estimated in public awareness there where, for example, it is in initial stages with the driver's license on probation. If, however, public measures for enforcement are not considered to be occasions for a change of attitude, then they will also not be integrated into a value system for avoiding risks. In the consultations which are to be conducted here as regards the value of enforcement, much will depend upon which category of values into which enforcement is placed from the viewpoint of the persons concerned. This, however has not been sufficiently researched. I suppose that there is hardly an indication that anyone who has contact with police enforcement in road traffic uses this as an occasion to change his or her basic attitude toward avoiding this risk. This is also the case when he or she changes his behavioral strategy in order to avoid further contact with police traffic supervision. As long as it is not equipped to the extent that occasions for learning, which means changing driving behavior, are regularly the result, hitherto police enforcement can only then sufficiently contribute to the avoidance of accident risk when the will – not to get caught in the future – of persons who have contact with its supervision is in the exact same direction and is effective to the same degree as it would be with a change of behavior achieved through a learning procedure with the goal of reducing risk. It is, however, particularly in this area that I see deficits.

In the planned discussion, it should be taken into account further that individual and group safety values and norms will not exist and be effective independent of general values which influence the life style of each person.

The norms expressed in traffic regulations, a behavior code for road users, are based on a sense of responsibility that one is to protect the others – the weaker ones – from danger. Simply said: Behavioral norms are based on an altruistic principle.

Enforcement and reward are, however, a disadvantage and advantage for the individual or the group. In principle then, they belong, according to this, to egotistical norms and values.

By a discussion of this, it must then be taken into consideration whether one can influence individual and group safety norms with enforcement and reward. Then, namely, egoism – "to suffer or cause no accident is to my advantage" – must be

combined in a parallelogram of forces with altruism – "my wish and my will is to cause no damage or injury to others in traffic" – so that a synergy in the interest of safety results.

To date, this problem remains unsolved, in the theory of behavior modification on the part of the road user as well as in actual practice. One theory which can help us further is that of the US American pedagogue Lawrence Kohlberg which is found in his 'Essays on Moral Development' from 1981.

Here, the avoidance of sanctions is assigned to the lowest individual as well as social stage of moral development. He characterizes this stage of development as follows:

"Stage 1 is the stage of punishment and obedience. Content: Right is literal obedience to rules and authority, avoiding punishment and not doing physical harm.

1. What is right is to avoid breaking rules, to obey for obedience's sake and to avoid doing physical damage to people and property.

2. The reasons for doing right are avoidance of punishment and the superior power of authorities.

Social perspective: This stage takes an egocentric point of view. A person at this stage doesn't consider the interests of others or recognize they differ from actor's and doesn't relate two points of view. Actions are judged in terms of physical consequences rather than in terms of psychological interests of others.

Authority's perspective is confused with one's own."

I cannot imagine any democratic society in which the citizen is considered to be of this moral status permanently. Independent of this, the empirical question is whether and how many road users remain in this stage of moral development.

Following the study of Kohlberg, much points toward the conclusion that adult persons from our cultural circle remain in stage 4 ^{1/2} which he has subsequently introduced in his system. He characterizes this as a developmental stage in transition.

"This level is postconventional but not yet principled. Content of transition. At Stage 4 ^{1/2}, choice is personal and subjective. It is based on emotions, conscience is seen as arbitrary and relative, as are ideas such as 'duty' and 'morally right'.

Transitional social perspective: At this stage, the perspective is that of an individual standing outside of his own society and considering himself as an individual making decisions without a generalized commitment or contract with society. One can pick and choose obligations which are defined by particular societies, but one has no principle for such choice."

Our traffic regulations are based, however, on a stage of moral development which is above the quoted stage 4 and which is characterized by Kohlberg as 'Postconventional and principled level'. Moral decisions are generated from rights, values or principles that are (or could be) agreeable to all individuals composing or creating a society designed to have fair and beneficial practices."

With this theory in mind, a discussion of the question whether one can succeed with an incorporation of the behavioral influences reward and punishment at all and when yes, with what changes can they be incorporated in a promising traffic safety program. The prospect of successes for what I believe to be a necessary new strategy will result only from the

theme of this session: We must produce values and norms with these means. Otherwise, they will remain elements in behavior modification foreign to the social system.

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NORMATIVE BEHAVIOUR IS UNATTRACTIVE IF IT IS ABNORMAL: RELATIONSHIPS BETWEEN NORMS, ATTITUDES AND TRAFFIC LAW

20

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INTRODUCTION

A necessary first step in the attempt to influence road user behaviour is to understand why road users display certain behaviour in specific situations. Unfortunately, there are large gaps in our knowledge about the processes underlying road user behaviour. At present, there is no generally accepted model that can adequately describe road user behaviour (Michon, 1985), and most research has focused on specific areas such as driver performance or error analysis. However, many of the problems related to road user behaviour have little to do with lack of abilities or decision errors, but are more likely to be subject to motivational processes (Rothengatter, 1990). In the area of road user behaviour, the role of motivation has largely been neglected, other than in relation to risk. Undeniably, risk is a motivating factor in road user behaviour, but it is unlikely to be the only one. Moreover, for the development of countermeasures it is more important to know why road users drive at excessive speeds or drive after having drunk, rather than to know why at times they refrain from taking these disproportionate risks.

The neglect of the motivational processes underlying road user behaviour is undoubtedly a reflection of the general state of affairs in psychology, that has prevailed until Fishbein & Ajzen (1975) proposed their theory of reasoned action, which distinguishes between social norms (that is, what others think you should do) and attitudes. Attitudes are thought to depend on what a person believes the consequences of a certain behaviour will be, and how this person evaluates these consequences. Hence, it is, according to this theory, necessary to change road users' attitudes to make them change their behaviour. On the other hand, behaviourist theories postulate that behaviour is simply dependent on its contingencies, and that these contingencies need to be changed in order to achieve behavioural change. These two theoretical positions correspond closely to the two alternative approaches to influencing traffic behaviour: mass media campaigns are generally attitude-oriented, while traffic law enforcement is directly behaviour-oriented.

NORMS, ATTITUDES AND SPEEDING

Speed choice is an excellent target behaviour for studying the relationships between norms, attitudes, intentions and behaviour as it can be considered as a volitional act of the car driver. Drivers' speed choice is consistent over time and locations (Wasielewski, 1984) and speed is easily registered and equally

easily enforced. Moreover, inappropriate speed choice is a serious problem: about 50% of the Dutch drivers regularly exceed the speed limit in any given situation, and in most other European countries (with the possible exception of the Scandinavian countries) the situation is not much better.

Speed appears to be determined by four motivational factors, which have been termed 'pleasure in driving', 'traffic risks', 'travel time' and 'driving costs'. Speeders and non-speeders differ significantly on all four factors, but for 'pleasure' and risk these differences can be mainly attributed to differences in beliefs about the *likelihood* of pleasurable or risky consequences, whereas in relation to travel time and costs these differences were found in relation to the *evaluation* of the consequences (Vogel & Rothengatter, 1984). In other words, drivers who exceed the speed limit on a regular basis believe this will give them more pleasure and do not believe this will increase risk. They value time more and costs less than those drivers who keep to the limits. However, not only the attitude towards speeding determined the actual speed choice. In addition, the attitude towards the *speed limit* itself played a significant role. In terms of the theory of reasoned action, the speed limit acts as a factor influencing speed choice independent of the attitude towards speed as such. This is not related to considerations concerning the likelihood of being caught while speeding, which was included in both the factors 'pleasure' and 'risk'. Consequently, speed choice has to be regarded as a behaviour determined by two different attitudes: one towards speeding behaviour and the other towards 'breaking' the speed limit.

INFLUENCING SPEED CHOICE

There have been numerous attempts to influence speed choice, and many of these studies have provided useful practical guidelines for practitioners. This is not the place to go into the detailed results or the methodological merits of these studies. Rather, it will be attempted to extract some general observations.

Firstly, obtrusive police enforcement that does not increase the objective probability of detection does not seem to affect speed choice or attitudes towards speed choice (Shinar & McKnight, 1985; Riedel, Rothengatter & De Bruin, 1986). Police enforcement that increases both the objective and subjective probability of detection, on the other hand, does increase compliance level, but does not change the motivations, attitudes or indeed the perception of the safety of the road. If this seems plausible, it should be realised that other measures that do not aim to increase the objective risk of detection, do have a demonstrable effect on speed choice. A series of experiments, initiated by Van Houten & Nau (1983), has demonstrated beyond any doubt that simple feedback signs, indicating the overall level of compliance, do have a marked effect on speed choice. The 'implied threat' theory proposed by Shinar & McKnight (1985) to explain these effects is

not satisfactory. Firstly, because it still remains to be explained why this mechanism does not work in the case of obtrusive police enforcement and secondly, because providing feedback also affects drivers' beliefs, in particular, the belief that one is seriously violating the traffic law when exceeding the limit, and that exceeding the limit implies a deviation from the speed choice of 'other' drivers. Feedback also changes the perception of what 'other' drivers normally do, and the largest speed changes are found in those drivers who consider a deviation from the 'normal' speed as negative. Apparently, speed choice is not only dependent on tangible consequences such as probability of detection or safety, but also on an innate wish of on the part of at least some of the drivers, to do what everybody else does. Since drivers generally overestimate the average speed driven on a particular road, feedback will change their ideas about what is a 'normal' speed on a particular road and hence will change their speed choice.

Publicity campaigns usually do not aim to induce people to behave as everybody else does, but generally aim to increase the public's awareness of the possible negative consequences of the target behaviour. The philosophy behind this approach is that if drivers start to evaluate these consequences more negatively, this will affect their attitude towards the behaviour concerned, and hence, they will be less inclined to display the behaviour. However, the available experimental evidence indicates that (a) in many cases publicity campaigns are totally ineffective in influencing the target behaviour, and that (b) if they are effective, the behavioural effects precede the attitude changes, if the last occur at all. Publicity campaigns stressing the need for behavioural change appear to be even more effective than publicity campaigns appealing to attitude changes (Rooijers, 1988). These findings can be interpreted as being in line with the findings discussed above: telling the road user what is expected of him seems to be more effective than telling him what he should expect of himself.

If norms are an important determinant of road user behaviour, it still has to be determined why Fishbein and Ajzen's theory of reasoned action does not seem to be able to predict the attitudinal and behavioural changes that can be achieved. Firstly, it should be pointed out that the model is a static model, in the sense that it is adequate for describing motives underlying a specific behaviour, but it is not adequate for predicting behavioural change. Secondly, an important factor seems to be overlooked so far. Traffic behaviour is not only a function of what we think other actors (police, passengers, family, the government) feel we should do, but more importantly a function of what we think our fellow road users actually do. From this point of view, the function of enforcement then is a matter of punishing those other road users who do not behave in accord with the norm, and not punishing the road user himself. This would predict, for example, that seeing another road user being stopped (i.e. punished) when displaying deviant behaviour would have a more substantial effect on the road users witnessing this event than it will have on the actual victim. It would also explain the substantial effects of warning letters sent to actual offenders, which, in essence, remind them of the fact that they have violated a norm, rather than the actual traffic law.

TRAFFIC LAW CHANGES

The mechanism postulated above can easily be tested in relation to the two speed limit changes that

were recently implemented in Sweden and the Netherlands.

During the summer of 1989, the speed limit on Swedish motorways was reduced from 110 km/h to 90 km/h (Nilsson, 1990). The resulting average speed reduction was a staggering 14.4 km/h on motorways and 11.1 km/h on two lane roads. Unfortunately, it is not clear to what extent the speed limit change was accompanied by publicity campaign activities and increased enforcement. Nonetheless, it is a result that is a challenge for any theory to explain. Firstly, it demonstrates the importance of the speed limit per se. It is unlikely that even Swedish drivers would have spontaneously reduced their speed without a speed limit change. More importantly, Swedish drivers should, according to the theory outlined above, consider the speed limit as an important behavioural determinant. Unfortunately, there is, to my knowledge, no Swedish data available, but a cross-cultural study involving Norwegian drivers (De Bruin, Vaa & Østvik, 1989) does offer some indications. Firstly, Norwegian drivers consider all speeding violations to be more serious than their counterparts in the rest of Europe. Secondly, Norwegian drivers consider speeding violations to be more serious than do Norwegian police. This trend is not found in other European countries. Assuming that Swedish drivers are more akin to Norwegian drivers than, for example, Irish or Spanish drivers, it is reasonable to assume that the success of the Swedish speed limit change is attributable to the drivers' initial positive attitude towards speed limit compliance and not to the drivers' attitude towards speed choice as such. In other words, the change in traffic law in fact reinforced normative behaviour in Sweden.

In the Netherlands, the reverse situation occurred. Whereas the official speed limit on Dutch motorways was 100 km/h, virtually every road user violated this law on a regular basis. Enforcement of the speed limit was logistically impossible because it would have required the registration and processing of an impossible number of violations each day. Exceeding the limit with up to 30 km/h was not considered to be a serious violation either by the road users or by the police (Rothengatter, 1989). Moreover, attitude surveys indicated that the vast majority of the Dutch driving population was in favour of a 120 km/h limit. On the first of May, 1988, the speed limit on the majority of the motorway network was changed to 120 km/h. In Italy, this resulted in an substantial decrease in the average speed because virtually all road users kept to the new limits. This had demonstrable positive effects in terms of traffic safety, fuel consumption and air pollution. Over the course of time, however, the average speed crept back to its initial levels. The introduction of the new limit did create more homogeneity in the realized speeds: the fastest drivers reported to decrease their speeds, while the slowest drivers increased their speeds (Rooijers, 1989a & b). Again, the attitude towards speeding did not change, notwithstanding the fact that the beneficial effects of speed limit change were widely publicized. Even though the risk of apprehension while speeding was perceived as being substantially increased and became a stronger motive not to speed, in general, the effects of the speed limit change must be considered transitory due to two factors: (a) road users were used to habitually exceeding the limit and continued to do so after the speed limit change (i.e. the speed limit did not function as a norm) and (b) road users did not receive any systematic feedback about the normal travel speeds after the speed limit change.

CONCLUSIONS

There have been many attempts to influence road user behaviour either by changing the contingencies, mainly through police enforcement, or by changing the attitudes, beliefs and motives underlying the behaviour. It is postulated that these attempts have not been particularly successful because one important factor has been ignored. This factor could be termed the normative factor, but this may in the present context have a double meaning. Normative not only refers to what ought to be done, but also what is usually done. Thus, normative behaviour in the first sense becomes unattractive if it is abnormal. Normative behaviour becomes attractive, if road users perceive that most road users comply to it, and that those who do not comply get confronted with the negative consequences. In addition to enforcement, feedback should be considered as a major factor influencing road user behaviour because it is the only way to tell the road user that it is normal, hence acceptable, to be normative.

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SANCTION ET BÉNÉFICE SOCIAL

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Récompenser et punir ressortissent fondamentalement à une même dimension, la sanction, au sens neutre et juridique du terme. ("Peine ou récompense prévue pour l'exécution d'une loi." Robert, Dictionnaire de la langue française). Ce concept ne prend lui-même sens qu'en regard de ceux d'autorité et de pouvoir, c'est-à-dire que comme expression d'un rapport social dissymétrique entre un centre et des sujets. Toutefois, dans ce rapport, la récompense et la peine ne sont pas les modalités positive et négative d'un même acte. La punition est le résultat d'un écart (trop important) à une norme, à un comportement normal. Elle a donc une signification holistique, la norme se définissant en fonction du plus grand nombre et valant pour l'ensemble de la collectivité – qu'elle soit endogène, intrinsèque, ou exogène, imposée. La récompense est quant à elle le produit d'une action méritoire. Elle ne procède donc pas de l'application d'une norme, s'il est vrai qu'un comportement normal ne confère aucun mérite particulier. L'obéissance à une loi ne vaut récompense que si cette loi n'est pas celle du groupe. Le délinquant est sanctionné; le citoyen honnête ne reçoit aucune récompense (et n'en réclame pas). L'élève dissipé est puni; l'élève appliqué est récompensé, du moins dans les petites classes. La "bonne conduite" à l'école n'est pas pour l'enfant une loi du groupe, mais obéissance à la loi des adultes.

Que la récompense soit un sujet de réflexion pour un colloque sur la sécurité routière n'est pas sans signification (et parler plutôt d'incitation ne changerait rien à l'affaire). La bonne conduite de l'automobiliste a peut être plus à voir avec la bonne conduite de l'élève qu'avec le comportement de l'honnête citoyen. La loi que l'État a à faire respecter sur la route n'apparaît pas comme une des lois "normales" de la société globale. En attendant qu'une éventuelle évolution des mœurs – résultat des "campagnes de sensibilisation" régulièrement lancées par les pouvoirs publics ou produit naturel des changements sociaux – l'ait fait accéder à ce rang, ce n'est que de manière concrète, c'est à dire fragmentée, en termes de groupes, de classes

(sociales), de tranches d'âge, de bandes de milieu, etc., que l'on peut aborder le problème de son application.

Du point de vue de l'individu, considéré en tant qu'acteur et non plus en tant que sujet d'un rapport d'autorité, le concept pertinent n'est pas celui de sanction, mais celui de bénéfice, entendu ici comme bénéfice relatif – dans le sens où l'on parle de nombre relatif, c'est-à-dire affecté d'un signe positif ou négatif, incluant la notion de perte. Le bénéfice d'une action peut être matériel et économique, ou symbolique et psychologique. Ces différents aspects sont évidemment le plus souvent indissociables. Une augmentation de salaire est un fait éminemment concret, mais, dans une société où l'argent est plus que de l'argent, elle prend une signification essentiellement symbolique et constitue une gratification psychologique bien au-delà de la satisfaction matérielle. A l'inverse, l'accès à des mondanités, le succès symbolique que représente une invitation à un dîner en ville ont souvent pour conséquence – si ce n'est pour fin – les avantages matériels que procurent les "relations".

La notion de champ social

Cette intrication du matériel et du symbolique est un des fondements du concept de champ tel que l'a élaboré et utilisé Bourdieu. Un champ est un "espace de jeu proposant certains enjeux", ces enjeux et les intérêts ainsi définis étant spécifiques et ne pouvant être perçus de "quelqu'un qui n'a pas été construit pour entrer dans ce champ". Les exemples avancés par Bourdieu concernent généralement l'ensemble de la société. (Il évoque les champs politique, artistique, scientifique, etc.). Mais il peut tout aussi bien s'agir du "champ restreint" constitué par un groupe. Le terrain offre à l'analyse anthropologique des micro-champs dont chacun est doté d'une relative autonomie et relève d'une approche spécifique. Ainsi, une classe (au sens de groupes d'élèves) a une réalité propre, irréductible à l'ensemble des traits que l'on peut attribuer à la classe (au sens de niveau scolaire) à laquelle elle ressortit. La position des individus qui la composent, les rapports de force qui la traversent, les intérêts communs et les intérêts de chacun, tout cela constitue un micro-champ unique, que rien a priori ne permet d'identifier à celui constituée par la classe voisine. Cependant, cette classe – ce micro-champ particulier – peut, choisie de façon pertinente, servir de paradigme pour tout un ensemble de classes considérées d'un certain point de vue et présentant avec elle un certain nombre de traits communs. Tel est du moins le postulat qui fonde la démarche de l'anthropologie sociale.

Bénéfice social et sens des sanctions

Pour un individu engagé dans un champ social, le bénéfice d'une action consiste dans son résultat quant à la position qu'il y occupe : gain – ou perte – statutaire, gain de prestige, de pouvoir, etc.

¹⁾ Max Weber parle ainsi des "bénéfices [Prämien] psychologiques" de la conduite éthique déterminée par une religion (M. Weber, "Les sectes protestantes et l'esprit du capitalisme" in L'éthique protestante et l'esprit du capitalisme, suivi d'un autre essai, Paris, Plon, 1967, p. 390).

²⁾ P. Bourdieu, Questions de sociologie, Paris, Les Éditions de Minuit, 1988, p. 34.

³⁾ Ibid., p. 114.

L'appartenance elle-même, l'entrée ou le maintien dans ce champ, constitue un enjeu fondamental et permanent. "Les nouveaux entrants doivent payer un droit d'entrée qui consiste dans la reconnaissance de la valeur du jeu (la sélection et la cooptation accordent toujours beaucoup d'attention aux indices de l'adhésion au jeu, de l'investissement) et dans la connaissance (pratique) des principes de fonctionnement du jeu". Cette adhésion partagée crée une "complicité objective" qui transcende toutes les rivalités internes, tous les antagonismes et toutes les tensions. L'existence même du champ, sa pérennisation, représente un bien collectif et des intérêts communs. Ce bien est d'autant plus précieux qu'il doit sans cesse être mérité individuellement. Entrer dans un groupe nécessite une probation initiale, s'y maintenir et s'y affirmer implique de prouver sans cesse que l'on possède les qualités premières. Et la première de celle-ci est la connaissance et la reconnaissance des règles du jeu (le terme règles signifiant ici les lois, les interdictions, mais aussi et surtout la façon de bien jouer, les principes de bénéfice).

Evidemment ces règles ne sont pas les mêmes d'un endroit à l'autre, d'un groupe à l'autre. En cela réside la difficulté de sanctionner, de récompenser ou punir. Si l'autorité, le détenteur du pouvoir de sanction, et l'auteur de l'action à sanctionner se situent dans le même champ, le problème n'est que d'adéquation et d'application, c'est-à-dire de cohérence interne. Cela est notamment le cas lorsque le motif de la sanction a une signification suffisamment générale pour transcender les divers champs particuliers. Ainsi, la punition de certains crimes – par exemple les meurtres d'enfants – ou à l'inverse la récompense de certains actes méritoires – par exemple les sauvetages – sont admises de façon universelle, même si des divergences peuvent exister quant à leur montant. Par contre, lorsque l'individu sanctionnable et le porteur de l'autorité se situent dans deux champs différents, l'efficacité de la sanction est réduite, voire annihilée par la non-coïncidence des bénéfices – relatifs – et des principes de bénéfice dans l'un et dans l'autre. Pour reprendre l'exemple de la salle de classe, il est évident qu'un acte de chahut n'a pas la même signification négative pour le groupe des élèves que pour le professeur. A l'inverse, un comportement valorisant aux yeux de celui-ci, par exemple la participation active au cours, le fait de répondre volontiers à ses questions peut être totalement négatif pour le groupe et passer pour de la flagornerie. Toute récompense, sous forme de félicitations, de bonnes notes, etc., ne fera alors qu'"enfoncer" davantage l'élève aux yeux de ses camarades. En revanche, à propos d'un acte universellement reconnu comme négatif, tel qu'un vol (surtout s'il est commis à l'intérieur de la classe) la sanction prononcée par le professeur sera acceptée, sans inversion de sens, par l'ensemble des élèves.

Plus un groupe s'est construit en marge de la société globale, voire en opposition avec elle, plus est

difficile, illusoire et susceptible d'effets pervers la sanction d'un de ses membres par une autorité extérieure. Plus un champ restreint est éloigné du champ d'où parle le détenteur du pouvoir, moins la sanction sera reconnue et acceptée, quel qu'en soit le motif. Le simple fait qu'une récompense soit perçue comme telle, c'est-à-dire comme acte d'autorité provenant de la société dominante, peut alors suffire à occulter toute perception d'un bénéfice, ou à rendre négatif tout bénéfice. Les enseignants savent bien qu'il est des classes plus difficiles que d'autres, qu'il en est sur lesquelles ils n'ont pratiquement pas prise, et que le phénomène est étroitement lié à des facteurs "socio-culturels". L'enseignement est une tâche plus ingrate dans les banlieues défavorisées que dans les quartiers habités par la bourgeoisie intellectuelle.

Cet éloignement, cette déconnexion de la société dominante, n'est pas observable seulement dans le cadre scolaire. Il concerne en fait toute une fraction de la population jeune – en France tout au moins – durablement privée par la crise économique d'une insertion normale dans le monde du travail, et donc dans le monde adulte. L'exclusion a naturellement entraîné sinon des phénomènes de repli et de fermeture, du moins l'émergence de champs autonomes plus ou moins étendus, correspondant à des groupes réels ou virtuels, et dont la somme a engendré une culture – ou une sous-culture, une contre-culture – spécifique. L'appartenance à ces groupes, l'adhésion à cette culture revêtent une importance essentielle pour le jeune en mal d'insertion sociale et sont donc, comme telles, l'objet d'un investissement primordial. Tous les comportements – y compris les comportements routiers – prennent leur sens dans cette perspective. L'anxiété permanente est celle d'être exclu, dépassé. Le souci constant est donc de réaffirmer et de prouver sans cesse sa connaissance et sa reconnaissance des règles. Dans ce contexte, toute influence extérieure est dangereuse, car elle expose l'individu à la suspension de la validité des règles du groupe, et elle expose le groupe à la déstructuration. Un adulte – éducateur ou autre professionnel de l'"action sociale" – qui veut exercer une influence sans risquer une réaction de rejet a priori doit évidemment éviter de se cantonner dans un simple rôle d'autorité, mais aussi donner en quelque sorte des gages de non-agressivité et montrer que le groupe n'a pas à craindre une telle déstructuration. Une incitation ou a fortiori une injonction doivent être compensées par la reconnaissance et l'acceptation d'un trait normalement non blâmé dans la culture dominante. Un exemple nous en a été fourni par l'observation de plusieurs groupes de jeunes chômeurs suivant des "stages d'insertion sociale et professionnelle" organisés par les pouvoirs publics. Le tabac y constitue un important support de sociabilité, les cigarettes étant utilisées dans un jeu serré de dons contre dons, sollicitations, acceptations plus ou moins contraintes et refus plus ou moins polis. Ces comportements se manifestent surtout dans les premiers temps du stage, c'est-à-dire durant la période où le groupe se structure durablement.

Parallèlement, la cigarette médiatise le rapport collectif des jeunes stagiaires aux adultes. Les règlements relatifs au tabac – à possibilité ou à interdiction de fumer, les pauses-cigarettes, l'attitude à cet égard des éducateurs, leur façon de l'imposer, constituent pour eux un souci permanent et sont constamment soumis à évaluation et à jugement. Un adulte qui se comportera sur ce point

⁴⁾ Ibid., pp. 115-116.

⁵⁾ Cf. J.-F. Gossiaux et P.E. Baffonnet, *Automobilisme et société locale: les jeunes et l'auto dans la vallée de la Meuse. Une approche anthropologique*, Rapport INRETS no 113, Paris, INRETS EHESS, 1990.

⁶⁾ Cf. J.-F. Gossiaux, *Avoir seize ans dans les Ardennes: "Insertion sociale" des jeunes et groupe familial*, Paris, Laboratoire d'Anthropologie Sociale, 1987.

de manière rigide et voudra appliquer une réglementation standard sera immédiatement perçu comme le représentant d'un monde extérieur, indifférent ou hostile, et perdra toute chance d'exercer une influence réelle.

Trois exemples d'"effets pervers" en matière de politique routière

Le fait automobile est ce que les anthropologues appellent un "fait social total", c'est-à-dire un phénomène, une institution, un morceau de la réalité sociale qui touche à tous les aspects – ou à de nombreux aspects – de cette réalité, qui les met tous en œuvre, qui se situe à leur intersection. Il en est de même pour la sécurité (ou l'insécurité) routière.

Et, comme telles, l'auto et la route constituent des éléments majeurs à l'intérieur des multiples champs autonomes qui coexistent dans la société française. En même temps, les comportements automobiles et la sécurité routière sont soumis à l'autorité de l'État, au niveau le plus élevé, donc, de la société. On se trouve typiquement dans le cas où l'individu sanctionnable et le détenteur du pouvoir de sanction se situent dans deux champs distincts. Nous allons voir trois exemples, pris dans trois milieux différents, des effets pervers et des détournements d'autorité liés à une telle situation.

Le "boulevard périphérique" qui entoure Paris est une voie autoroutière urbaine où la vitesse est limitée à 80 km/h. Cette limitation n'est pas toujours respectée par les voitures et, lorsqu'elle l'est, c'est plus souvent en raison de la densité de circulation que par souci du règlement. Cependant, même si le seuil est spontanément fixé à un niveau plus élevé que le plafond légal, les automobilistes exercent un relatif contrôle sur leur allure. Les motocyclistes, quant à eux, y roulent sans contrainte de façon tacitement admise par tous, chacun ajustant sa vitesse aux circonstances. Evidemment les conduites individuelles ne s'agrègent pas en un flux parfaitement autorégulé, et certains articles de presse n'ont pas hésité à comparer le périphérique à une jungle. Cette jungle est utilisée comme terrain de jeu – au sens ludique et sportif du terme – par une élite de motards qui vont jusqu'à y organiser de véritables compétitions, des "courses contre la montre" avec chronométrage et record du tour). Il faut noter que des circuits réservés aux motos et spécifiquement conçus pour ce type de divertissement existent en région parisienne. Mais il est évident que la valeur de la performance est rehaussée par son illégalité, par la limitation officielle de la vitesse, qui, même si elle n'est que platonique, en souligne le caractère dangereux. La satisfaction est encore accrue du fait que c'est l'excès même, fruit de la virtuosité, qui rend inaccessible aux poursuites et aux sanctions.

Le deuxième exemple concernera non plus les motards mais les automobilistes, non plus la vitesse mais l'immobilité. La circulation dans les grandes villes, et notamment à Paris, constitue un problème difficile et permanent, aussi bien pour les individus que pour les pouvoirs publics. Ce problème est doublement lié à celui du stationnement : les véhicules qui stationnent gênent ceux qui circulent, et par ailleurs les autorités peuvent penser que des dispositions restreignant le stationnement décourageront certains automobilistes d'utiliser leur voiture et donc amélioreront la circulation. Et il est de fait très difficile, voire quasi impossible par endroit, de garer sa voiture dans les rues de Paris – sauf à être en

infraction. Pourtant le nombre de véhicules qui circulent – et qui cherchent à stationner – ne diminue pas, bien au contraire, comme ne diminue pas le nombre des stationnements illégaux. Tout se passe comme si l'automobiliste régulier, l'utilisateur quotidien de la voirie parisienne, acceptait de payer une taxe sous forme d'amendes, une taxe perçue de façon aléatoire mais dont le montant serait bon an mal an à peu près constant et prévisible. L'augmentation du tarif ou de la fréquence des amendes suscite d'ailleurs des réactions typiques de "consommateur". Et nous sommes bien ici dans une logique de consommation – de consommation de luxe. Les transports en commun sont relativement commodes, s'ils ne sont pas toujours confortables, et ils sont massivement utilisés par les Parisiens. L'utilisation régulière de la voiture est un luxe, avec la double notion de confort et de distinction contenue dans ce terme. La sanction de l'infraction, en fonctionnant comme un prix, est le processus qui crée ce bien de consommation.

Notre troisième exemple, enfin, nous fait quitter les milieux parisiens et aises pour la province et les endroits fréquentés par les jeunes des milieux populaires. Les accidents qui ensanglantent les routes de France se produisent, pour une grande partie d'entre eux, en fin de semaine, principalement la nuit, et les victimes en sont très souvent des jeunes de vingt à vingt-cinq ans). L'alcool est régulièrement en cause, le motif de ces déplacements nocturnes étant la fréquentation des boîtes de nuit installées çà et là dans la campagne. Une action de prévention a été tentée par les pouvoirs publics, dont une des mesures était l'installation d'alcootests en libre-service à la sortie de certains de ces établissements, afin de permettre aux clients d'évaluer leur état avant de reprendre éventuellement la route. Ces appareils ont effectivement rencontré quelque succès... à la manière de ces dynamomètres de fêtes foraines dont il s'agit de faire monter l'aiguille le plus haut possible.

Qu'il s'agisse de réglementation, de sanction ou de prévention, l'action des autorités a dans les trois cas évoqués été inefficace parce qu'elle a pu être pervertie par ses destinataires (ou par certains d'entre eux), qui l'ont utilisée pour améliorer ou assurer leur position dans leur champ respectif. Les motards du boulevard périphérique s'appuient sur la transgression du règlement commun pour manifester leurs valeurs compétitives et élitistes. Les automobilistes parisiens trouvent dans la sanction pécuniaire un profit de distinction, une marque de "classe". Les jeunes clients des boîtes de nuit utilisent la dérision pour affirmer leur autonomie vis-à-vis des valeurs officielles et donc la primauté de leur attachement au groupe, un bénéfice secondaire au sein de celui-ci pouvant de surcroît leur être assuré par la qualité de leur performance en la matière.

Quelle prise les "pouvoirs publics" peuvent-ils avoir sur une réalité sociale atomisée et résistante tout à la fois? Une réponse globale et radicale peut toujours être trouvée dans l'intensification de la répression. Il

) Ce phénomène a fait l'objet d'un reportage télévisé ("Moto kamikazes", Émission M 11 – je, A2, 6 mai 1987) qui a rencontré un large écho parmi les jeunes.

) Cf. PE. Barjonet, J. F. Gossiaux, "Drinking and Driving and the Search for Identity: an Anthropological Survey on Young Car Drivers", 11th International Conference on Alcohol, Drugs and Traffic Safety, Chicago, Oct. 1989.

est évident que, portée à un certain niveau, la perte matérielle infligée par une sanction ne peut être compensée par le bénéfice symbolique que l'individu en retire dans son champ social. Pour reprendre l'exemple des amendes de stationnement, le coût peut en devenir prohibitif, et s'il ne l'est pas encore suffisamment, il est toujours possible de jouer sur un autre registre de peines, comme la confiscation provisoire du véhicule. Cependant les détenteurs du pouvoir ne peuvent ou ne veulent pas toujours eux-mêmes assumer le coût politique ou humain de ce genre de solutions.

Si l'on se tourne dès lors vers les récompenses, les incitations ou simplement la persuasion, force est de constater que les pouvoirs publics se trouvent demunis, dans la mesure où il leur est bien sûr impossible d'adapter leur action à la multiplicité des groupes et micro-champs concernés. Ceci ne signifie évidemment pas que rien ne doit être tenté ni qu'aucune "solution approchée" ne puisse être trouvée, même si elle est de toute façon trop générale pour s'appliquer exactement en tout point. Les assurances s'imposent à cet égard comme un support idéal pour des mesures d'incitation, en raison de leur définition contractuelle, qui diminue le risque d'effets pervers suscités par la perception d'un rapport d'autorité. Elles sont d'autant plus un moyen d'action à privilégier qu'elles représentent actuellement, par leurs tarifs discriminatoires et leur coût excessif, un problème majeur pour les jeunes conducteurs, qui doivent précisément constituer une des "populations-cibles" des campagnes de sécurité routière. La question qui se pose dès lors est celle de la compatibilité d'une telle fonction dévolue aux assurances avec leur nature de produits marchands⁹⁾. Elle ressortit à la vaste question des rapports entre l'économie privée et l'intérêt public. L'automobile est bien un "fait social total".

⁹⁾ G. Wilde a démontré à propos de l'Ontario qu'un contrôle public sur les assurances automobiles aurait un effet positif sur la sécurité.

G.J.S. Wilde, Incentives for Safe Driving and Insurance Management. Report Commissioned by and Submitted to the Inquiry into Motor Vehicle Accident Compensation in Ontario, 1987.

POLICE SURVEILLANCE METHODS AND POLICE RESOURCE ALLOCATION MODELS

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INTRODUCTION

This paper presents models for the deployment of traffic police forces on interurban roads. The deployment programme can be used by the regional police commander or national headquarters as an efficient tool for decision-making in aspects that deal with the deployment of forces and equipment on road sections. The models are centred around the concept that it is a major aim of the traffic police to achieve a reduction in the number of road accident casualties, with special emphasis on the number of fatalities.

In Israel, with a population of about 4.5 million (in 1988), 953,000 vehicles travel over seventeen milliard vehicle kilometers annually. The degree of motorization in the country is still relatively low (about six persons per private car), but the travel density on interurban roads is already very high. The level of road safety is not among the world's nations highest. The number of fatalities per hundred million vehicle kilometers is 3.0, which is considerably higher than in some western motorized countries. For most West European countries this rate varied in 1988 between 1.5 to 3.0. In comparisons of the number of fatalities per 100,000 persons, Israel, with a motorization rate of 168 cars per 1,000 persons in 1988, takes an intermediate position. Its rate of 11.4 fatalities per 100,000 persons is better than many countries but, on the other hand, there are many countries with much larger numbers of cars per person and much lower fatality levels - Great Britain, Sweden, the Netherlands, Italy.

In Israel, the law requires drivers to report any accident in which a person is injured. In 1988, 15,497 such accidents were reported, of which 2,927 included at least one seriously injured person (hospitalized for at least 24 hours), and 455 fatal accidents (with 511 fatalities). Information on traffic volumes on interurban roads is also collected by the Central Bureau of Statistics (CBS), which also maintains a data base on road sections and intersections.

The data for the present study were taken from the accident files maintained by the Central Bureau of Statistics. These files contain information on injury accidents reported to the police. The police collect and process the data which is then transferred to the CBS. Fifty percent of fatal road accidents occur on interurban roads compared to only about twenty

percent of the accidents with casualties. It is therefore logical that enforcement which is aimed at reducing the more serious accidents should initially concentrate on interurban roads.

LITERATURE

Police enforcement is meant to deter, prevent and punish violators in such a way as to induce voluntary acceptance of the law and driving accordingly. Quantification and measurement of the effects of enforcement encounters many difficulties, as has been shown in the literature. Strategies should be developed which will result in:

- an increased likelihood that a violating driver will be detected, apprehended and sanctioned, and
- an increase in the public perception of the likelihood of detection, apprehension and sanctioning.

The main effect of police enforcement is achieved through drivers' visual observations about the enforcement, through increased awareness of police activity, or through the driver's perception of an increase in the risk of being caught. The threat of enforcement on a road section generally has an immediate effect on drivers; an effect which may last for a number of kilometers (five to six) beyond the location of enforcement (Hauer, 1979), and may last for a number of days (up to ten) (Nilsson, 1979; Armour, 1984). The effects of police enforcement depend upon its duration, intensity and configuration. Most studies support the notion that police enforcement has a positive effect on driver behaviour and on road safety. Spolander (1977) in a survey of 25 studies reports that in 21 cases, enforcement influenced driver behaviour positively.

The links between police enforcement, violations and accidents are not clearly understood. There is little quantitative evidence in the literature to relate specific types of enforcement to changes in the number of accidents and their severity. Evidence exists to support the notion that static enforcement in marked cars is more effective than enforcement by moving vehicles or in unmarked cars (Nilsson, 1979; Council, 1970).

Most of the research done on police force resource allocation applies to urban public safety. A number of researchers developed models for police force scheduling, including Chaiken (1978), who developed a patrol car allocation model. Most models apply to the urban environment and try to minimize response time to an accident. Schneible (1973) proposed a traffic deployment model which attempted to match police presence to the amount of accidents per time unit. Lee (1979) also developed a deployment model using integer goal programming. One of the larger experiments in police enforcement was conducted in England, called Project 2001 (Moncaster, 1977). Four basic assumptions were made:

1. Traffic situations with higher than average accident risk can be identified and characterized.

2. Traffic pattern can be defined by means of simple and quantifiable measures;
3. The patterns are cyclic;
4. Police tactics can be used to achieve risk reductions

THE DATA

As stated in the introduction, initial attention was focused on the interurban network. In 1988, interurban roads accounted for 40 percent of the total road length in Israel (5,300 out of 13,000 kilometres) carried 50 percent of the vehicle-kilometres travelled (8.2 out of 17 milliard vehicle-kilometres), had about 50 percent of the total number of fatalities (270 out of 511 fatalities).

For one of the models described in this paper, data were selected from one police district (Haifa) which accounts for about 10 percent of the total interurban fatalities, accidents and travel. As the traffic police forces in Israel are nationally trained, coordinated and supervised, it was felt that this district would not bias the findings unduly.

The other two models apply to the whole interurban road network.

MODEL DESCRIPTION

This paper describes three models dealing with deployment of police forces and their allocation on the road network. The first model was developed at the Technion-Israel Institute of Technology in close cooperation with the police. This model will be termed the regional model. Almost simultaneously, the research branch of the police developed a fairly similar model – the interurban model. To put this model in operation a certain reorganization in the police routine was required. Some local autonomy was lost; some resources had to be shared; road sections had to be redefined. As a result of these changes, and taking practical limitations into account, a third model evolved – the Practical model. This model was put in regional operation in some police districts in mid 1989. Too little time has passed to enable an assessment of its operation.

The Regional Model

The Haifa police force deployment model has two stages. The first stage deals with the development of a methodology for the identification of hazardous locations, using statistical tools. The second part of the model presents a deployment programme using mathematical programming. Both parts are described below.

To circumvent the problematic and vague chain enforcement violations accidents, a direct relationship between enforcement and types of accidents was sought. Various accident types were grouped according to enforcement tasks which are in line with the capabilities and limitations of the traffic police. Three enforcement categories were defined and termed: "Speed," "Lane Discipline," and "Intersection." The categories were grouped so as to be related specifically to types of police enforcement and also relate to various accident types. Speed was linked to various types of single vehicle accidents and loss of control; lane discipline to vehicle collisions (except rear end) and pedestrian accidents; intersection to all types of intersection accidents. A fourth type of enforcement – following too closely – is associated with rear end collisions, but no kind of practical enforcement is available at present so was

therefore excluded from further consideration.

Special enforcement tasks such as driving under the influence of alcohol, technical vehicle inspections, were not specifically considered but could be added to the enforcement tasks.

Accident density (the number of accidents per kilometre) was selected as the measure of risk for each road section. Although accident density is not necessarily a good measure of risk, not explicitly taking into account the travel volume, it was felt that from a cost-benefit point of view it possibly was the best measure to associate with enforcement. This is one point of major difference between the regional model and the interurban model (see following section). The road section scores require a measure that would also consider the type of accident and its severity. The measure selected combined the accident fatality in the enforcement category with its frequency, and was derived from the estimate of the intersection probability of fatal accidents and the total number of accidents occurring in each category. The estimate is directly proportional to the number of fatal accidents in a certain category, and is inversely proportional to the total number of accidents in the population. As the basis for the calculations, the accidents that occurred during the most recent three-year period in the northern district were used.

The interurban Haifa police district was selected as a basis for this study. The district was divided into road sections, depending on their design characteristics, traffic volume, and road conditions. Each section belonged to only one road and is bound by two major intersections. Twenty four sections were defined in the Haifa district in this way. Each accident on a road stretch was classified into the appropriate enforcement category and weighted accordingly. The total weighted number of accidents per kilometre in each category during the last three years served as the risk score for the road section. The risk score matrix for the 24 road sections in the Haifa district served as the basis for enforcement allocation, and is a substitute measure for the output of each enforcement unit. The objective function aimed to maximize the coverage achieved by the enforcement under given constraints.

The constraints are partly a result of police resource limitations, operational decisions by the police district commander, and of the condition that each section receives only one assignment unit at any allocation period. The deployment problem was defined first as a minimum cost flow problem and secondly as a binary programming maximization problem. The resulting allocation showed that most enforcement is allocated to the "lane discipline" enforcement category. This is a result of the relatively high fatality of this category.

Various sensitivity analyses were conducted to test various assumptions of the model. For these sensitivity analyses, a method of fines was developed under which each repeated allocation to the same road section and same enforcement category received a fine, reducing the risk score by 25 percent. Each deployment result was compared with the previous run and an equivalency index was defined. The general philosophy of these analyses was to assume a certain time halo effect of the enforcement and also to assure that less urgent sections with fewer accidents are also patrolled.

The percentage coverage of accidents on the network achieved increases with increased flexibility

of the police force, and with an increase in the number of police units. The marginal increase in coverage is, however, decreasing, and reaches one percent only, after the fourteenth police unit, with a 47 percent flexibility in its task assignment matrix.

The maximization problem was solved with a normal simplex algorithm, but the solution was always in integers. This enables the solution of large assignment problems with the aid of the computer.

Another problem was defined, to determine the minimum number of patrol units needed to achieve a given coverage of enforcement on the road network. For this purpose, the objective function was converted to a minimization problem for minimum enforcement units, with the use of an integer programming routine. This served as a substitute for a cost optimization model. An index that can translate risk scores to monetary terms, or alternatively, can translate the number of police units to risk scores would enable the definition of a joint objective function for maximum coverage under minimum cost.

The deployment model developed shows that a methodological definition of the problem and assignment of police resources, based on operations research techniques, can achieve efficient use of the traffic police forces.

The Interurban Model

A second traffic police deployment model was developed by the Operation Research Unit of the Israel police. It was aimed at the selection of road sections for enforcement, on the basis of days and shifts, enabling the most efficient allocation of resources in terms of manpower and vehicles, taking into account a rational distribution between police units. The model identifies candidate road sections on the basis of a risk score based on two criteria:

- the number of injury accidents per road section length;
 - the average traffic volume on the road section.
- "Standard" scores are composed for each road section, normalizing the traffic and accident data and arranging sections in a descending order relative to the average for all sections in terms of the standard deviation according to $(\text{The Average} - \text{the section data}) / \text{the standard deviation}$.

For each section a "standard" accident score and a "standard" traffic score are calculated. The risk score is the weighted average of the two scores using weights of α and $1 - \alpha$. In the present model a weight of 2/3 was given to accidents and 1/3 to traffic volume. The reasoning behind the selection of this objective function was that the police should demonstrate its presence at sections which have high risk levels and at sections where their presence will be noticed and felt most.

The interurban road network in Israel with a length of 3,500 kilometers was divided into basic units of five kms. Each enforcement section was defined with a minimum length of 1.5 kms and maximum of 30 kms. The model studied various possible combinations of road sections as follows:

- a continuous enforcement section along a certain route;
- an enforcement section based around a certain junction.

For each section the risk score was calculated, and at this stage M out of N possible enforcement

sections were selected. The selection was made such that the simultaneous risk score of the independent sections would be highest using a linear programming technique, which meant that the resources allocated would achieve maximum coverage. The process results in the optimization of police resources (one patrol unit per section selected) over the M sections selected for enforcement.

Finally, the results were modified to enable the enforcement to be arranged in a way which allowed it to begin and end at easily recognized points, such as an intersection or other marked location. The model can be applied to various modes or characteristics needed for planning and operational purposes such as: total accidents by day of week and shift; certain types of accidents; certain parts of the day or week.

The Practical Model

This is the model actually adopted for daily use by the traffic police and is a combination of the two previous models, making certain operational adaptations. The interurban network (3,500 kms.) was divided into some 200 enforcement sections varying in length between 10 and 25 kms. The division into sections was based on a quantitative analysis, taking into account certain restrictions such as police district boundaries, number of lanes per road, crash barriers along divided highways, etc. The final selection was computerized, making it possible to obtain the number of accidents and other data for each section. A standard, numbered system for all road sections was adopted compared with previous systems where each district used its own system. Periodically (once or twice a year) a risk score (as described in model two) is calculated for each section. All road sections are sorted and ranked in order of risk. The sorting results in three types of enforcement priority:

- Priority A - Sections requiring two shifts per day;
- Priority B - Sections requiring one shift per day;
- Priority C - Sections requiring two shifts per week.

Each police unit has 20-30 enforcement sections in its jurisdiction which are sorted and ranked according to the above-described procedure. The sections receive the enforcement accordingly. Each enforcement section receives a data sheet describing quantitative and descriptive section details (number of section, start and end kilometers, number of lanes, traffic volume, location of serious accidents on the section, location of black spots during the previous year). This deployment model enables the rational planning of police resources on the interurban network. It also allows for the allocation of additional resources when available according to specific plans or special operations. The model is presently implemented in part by some police units. Certain developments are considered, including: 1) full implementation by all police units; 2) preparation of weekly and monthly optimal enforcement schedules; 3) identification of specific types of enforcement on the sections selected. The table on the next page presents a typical enforcement program for a police unit based on the method described.

ENFORCEMENT ON URBAN ROADS

Traffic and accident patterns on urban roads are very different from those on the interurban network, and therefore need a different approach. Some of the characteristics are:

- a dense network of roads, including intersections

Serial No.	Priority	Descr. of Section	Section length (kms.)	Unit	Quantitative Accidents			data	
					89	88	87	Av. per km.*	Av. flow **
1	A		14	Dan	87	70	82	5.7	8,250
2	A		17	Dan	52	61	67	3.5	10,000
3	A	Descriptive	26	Eylon	91	84	89	3.4	8,000
99	B		28	Haifa	12	11	13	0.4	2,000
100	B		20	Jerus.	8	19	10	0.6	1,500
101	B		21	Tel Aviv	10	12	5	0.4	1,900
208	C		17	Gall	1	1	2	0.08	150
209	C		17	Sharon	2	1	0	0.06	200
210	C		16	Dan	1	2	0	0.06	165

* Average no. of accidents in 3 years divided by section length
** Average daily traffic on section

and parking lots requiring a spatial approach;

- areas of differing characteristics (business district, shopping, residential industrial, parks and open spaces;
- different types of accidents, pedestrian, intersection, etc;
- problems of congestion and peak hours;
- a lack of detailed information on traffic volumes.

Because of these characteristics, the Israel police are now considering an approach based on accident mapping to be used in the main cities (Tel Aviv, Jerusalem, Haifa). Accidents of the last three years are mapped with the aid of a computerized process and are presented in visual form, indicating areas with high accident concentration. Computer mapped information can be presented on a large number of accident characteristics (such as pedestrian accidents, night accidents, accidents with children, etc.) This enables the conduct of specific campaigns and enforcement plans. The computerized mapping procedure used was developed by Professor A. Degani of the Tel Aviv University.

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ACTIONS INCITATIVES ET STYLES DE RÉCOMPENSE : LES CAMPAGNES POUR LA SÉCURITÉ DES ENFANTS

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On s'est assez rarement demandé si la publicité, les campagnes d'information, les mesures persuasives, pouvaient être considérées comme des récompenses ou des punitions et si, à ce titre, elles pouvaient influencer le comportement des usagers de la route. Il faut dire que les chercheurs s'intéressent d'abord à l'efficacité des campagnes, à leur impact, à leur capacité à faire évoluer les opinions et les comportements dans le sens requis. Quant à la problématique récompense/punition, elle trouve son application plutôt dans le champ de la répression des comportements interdits par le Code de la Route ou dans celui de la rémunération objective des conduites souhaitées plutôt que dans la récompense symbolique et de la sanction sociale. Cela signifie notamment que, dans la plupart des cas, la dualité récompense/punition se situe dans le cadre d'une action d'recte auprès de l'usager, qu'on le gratifie ou qu'on le réprime, qu'on lui impose une peine ou qu'on lui alloue une récompense.

Notons que lorsqu'il s'agit de récompenser les conducteurs directement, on agit souvent sur une motivation autant essentielle que primaire : l'argent. On offre ou on retire une somme d'argent aux conducteurs pour les persuader d'obéir aux règles de sécurité. C'est le cas pour les chauffeurs de certaines entreprises de transport routier. C'est aussi le cas avec les compagnies d'assurance qui récompensent les conducteurs sans accidents en diminuant la prime grâce au bonus. Le permis à point est une autre façon d'agir le levier récompense/punition bien qu'il s'agisse surtout de pénaliser les conducteurs qui commettent des infractions. Le système ne prévoit pas de récompenser ceux qui suivent les règles du code, partant du principe que les comportements qui vont dans le sens de la légalité et de la sécurité n'ont pas besoin d'être renforcés par des récompenses. L'idée sous-jacente, la morale, est qu'on ne récompense pas les individus qui agissent dans le sens prescrit par la société : on considère que les individus trouvent la source de leurs motivations ainsi qu'une récompense inhérente dans l'accomplissement positif de leur vie sociale, notamment lorsqu'il s'agit de conduire une voiture.

Pourtant, on a pu montrer, au moins expérimentalement, que des récompenses, par exemple le renouvellement gratuit du permis dans certains pays, pouvaient accroître l'utilité perçue des comportements de sécurité. On a pu aussi inciter des conducteurs, par un système de primes et de cadeaux, à utiliser plus souvent leur ceinture de sécurité (Geller, Paterson et Talbot, 1982).

Dans le domaine de la sécurité des enfants quelques expériences ont été tentées. Par exemple, on a récompensé les parents par des bons d'achat s'ils incitaient leurs enfants à utiliser leur siège de sécurité (Roberts et Turner, 1986), on a récompensé les enfants eux-mêmes s'ils bouclaient leur ceinture de sécurité (Roberts et Fanurik). Mais la littérature que nous avons consulté ne cite pas d'action d'envergure dans ce domaine.

L'intérêt des méthodes d'action sur les motivations des conducteurs a été souligné par les psychologues (Murdoch et Wilde, 1980, Wilde, 1987) parce qu'elles permettent d'agir sur le comportement des individus par des méthodes non purement répressives et surtout parce qu'elles rendent plus explicite à certains individus l'utilité d'adhérer aux règles de sécurité. Cependant, sa mise en œuvre pose certaines questions, notamment sur les populations à récompenser et la nature de la récompense (Hurst, 1980). On s'est aperçu, par exemple, que la récompense des conducteurs en cours de réhabilitation était un élément positif en ce qui concerne l'apprentissage des comportements de sécurité. En fait, la récompense semble mieux acceptée par les conducteurs en réhabilitation que par les autres.

Campagnes d'information et récompense symbolique.

En matière de publicité et de propagande, les choses sont différentes. Les sanctions et les récompenses sont indirectes ou symboliques. Heureusement ou malheureusement, les gens ne sont pas obligés de regarder les messages de la sécurité routière à la télévision, ils ne sont pas rémunérés quand ils le font, ils ne sont pas punis lorsqu'ils ne le font pas.

On peut penser cependant que la publicité peut avoir une fonction de récompense ou de punition en présentant des scènes gratifiantes ou des situations désagréables. Par exemple, on estimera que les messages évoquant la peur ou montrant de telles situations de violence routière sont des punitions pour le spectateur. Ce point de vue a été rarement envisagé, cependant les études montrent que les messages à forte tonalité de violence ne répondent pas aux effets qu'on attend d'eux parce que le réflexe naturel est d'éviter ou de refouler les scènes trop pénibles ou traumatisantes (Wilde, 1971). On considère souvent que pour être efficace, la violence doit être "dosed" (Leventhal, 1965). A cet égard, on peut penser que les messages publicitaires contenant une trop forte dose de violence sont refusés par les spectateurs parce qu'ils n'impliquent aucune gratification symbolique.

Cependant, l'idée selon laquelle le spectacle de la violence routière ou d'autres types de violence d'ailleurs, est perçue comme une punition, est à considérer avec précaution. Par exemple, beaucoup de films présentés à la télévision sont très violents ce qui n'empêche pas les gens de les regarder et d'y prendre peut-être plaisir.

A l'inverse, on dira que les messages gratifiants ou édifiants, qui renforcent les comportements de sécurité, qui en montrent le bien fondé et l'utilité, sont des récompenses. Mais pour qui sont-ils des récompenses? Principalement pour ceux qui sont attachés à la sécurité routière et qui respectent les règles. Pour les réfractaires à la sécurité, ces messages peuvent apparaître comme des punitions.

Les usagers de la route ne sont pas les seuls acteurs concernés par cette question de la récompense ou de la punition à travers les campagnes d'information. Une campagne peut être une récompense pour ses promoteurs. Pour les autorités publiques, la signature d'une campagne publicitaire et la mise en oeuvre d'une dimension médiatique, c'est d'être perceptible par des millions d'individus et non pas seulement dans le cercle étroit des techniciens et des gestionnaires. C'est d'être valable, parfois même quelle que soit l'efficacité de la campagne effectuée. Les gestionnaires de la sécurité et de la circulation, comme beaucoup de gens d'ailleurs, suivent ce principe bien étudié par la psychologie sociale selon lequel agir conformément aux principes ou aux comportements socialement valorisés est en soi une récompense (Moscovici, 1981).

Les campagnes destinées aux enfants : gratification et apprentissage social.

Si l'on accepte ces quelques idées, qui sont plutôt des évidences empiriques que des hypothèses, on dispose d'un canevas un peu plus précis pour l'analyse d'un type de campagne qui nous intéresse spécialement: celles sur la sécurité des enfants. Elles sont intéressantes spécialement parce que, plus que les autres campagnes, elles mettent en scène des situations gratifiantes dont on peut supposer qu'elles sont perçues positivement par les populations principalement visées par les campagnes: les enfants; mais en plus elles impliquent d'autres populations, les parents qui jouent le rôle de relais ou de médiateurs, et bien sûr, les institutions de promotion.

Les campagnes de sécurité pour les enfants sont fondées sur le double principe de la gratification et de l'apprentissage social. L'attention de l'enfant est attirée et retenue par des personnages valeureux (Zorro en France) ou gentils (Yupi en Belgique) ou amusants (Hector le chat australien, Squawk le perroquet anglais), qui font partie de la mythologie enfantine. On considère que la présentation de ces personnages est en soi une récompense et de cette façon, on n'envisage pas de présenter à l'enfant des scènes désagréables. On cherche à ce que les modèles comportementaux proposés s'inscrivent dans une tonalité émotionnelle positive que les images associées à la sécurité soient positives; on espère ainsi favoriser le copiage des règles et faciliter l'apprentissage.

De nombreuses campagnes de publicité destinées aux enfants s'appuient sur le principe de l'apprentissage social, dont on a pu montrer l'efficacité (Rothengatter, 1981). On parle d'apprentissage social, de modelage des comportements, en référence aux théories post-behavioristes. Selon celles-ci (Bandura, 1980), c'est par l'observation des comportements d'autrui que se font nos principaux apprentissages, par observation des comportements et des conséquences des comportements. Contrairement aux théories traditionnelles de l'apprentissage qui postulent que les individus doivent expérimenter effectivement les

conséquences de leurs actions pour les contrôler, la théorie de l'apprentissage social considère que nous anticipons les conséquences de nos actions: nous connaissons déjà nos patrons de comportement parce que nous les avons appris, le véritable apprentissage étant un apprentissage cognitif. "Une part importante de l'apprentissage social survient sur la base d'observations simples et directes du comportement au moment où il est accompli par d'autres personnes dans des situations de tous les jours... une autre source importante d'apprentissage social est fournie par l'abondant modelage symbolique fourni par la TV, les films, les médias visuels." (Bandura, 1981).

Allen et Bergman (1976) ont appliqué ces principes pour inciter les mères de famille à faire utiliser par leurs enfants les sièges et les ceintures de sécurité; ils ont principalement utilisé des messages filmés qui décrivaient l'intérêt et les manières d'utiliser les systèmes de rétention.

Il serait exagéré de prétendre que les campagnes d'information s'inspirent directement de ces théories mais certains principes empiriques des publicitaires s'y rapportent. Ainsi, la publicité pour les enfants - comme toute action publicitaire - est basée sur cette idée qu'on peut toucher les enfants à distance, qu'on peut les influencer, qu'on peut éliminer les mauvais comportements en montrant leurs conséquences néfastes et inspirer de bons comportements en montrant des effets heureux.

Les types de récompense

En fait, la gratification contenue dans ces messages est à plusieurs niveaux. Le premier, formel, est le spectacle d'un personnage aimé ou attractif ou d'un autre enfant placé dans une situation intéressante, c'est à dire qui attire le regard de l'adulte. L'autre niveau, qui se rapporte au contenu et à la stratégie de communication, est plutôt celui de la récompense promise, du bénéfice attendu; ceux-ci sont d'ordre pratique: évitement d'un ennui, d'un problème mais aussi plus indirectes: en se conduisant bien, en traversant dans les passages réservés, en ne jouant pas dans la rue, on attire l'attention positive des parents. Ainsi, l'apprentissage ne se résume pas à une imitation simple des comportements proposés, non plus qu'aux bénéfices concrets attendus mais il implique une motivation sociale: être conforme aux souhaits des parents ou de l'autorité légitime.

Récompenser les parents

La publicité pour les enfants utilise aussi les parents comme prescripteurs des comportements recherchés. Dans certains cas les parents doivent eux-mêmes obéir à des règles relatives à la sécurité des enfants, c'est le cas où l'enfant est passager de la voiture et où les parents doivent l'obliger à s'installer à la place arrière. De nombreuses campagnes ont incité les parents à placer leurs enfants à l'arrière. Le bénéfice attendu est la réduction de la gravité de l'accident si celui-ci advient. Le bénéfice symbolique est de se conformer à l'image de parents sérieux, avertis des risques et aptes à les prévenir. Christophersen et Gyu lay (1985) ont montré que des médecins peuvent influencer durablement des mères de famille en montrant le bénéfice qu'elles pouvaient attendre quant à la santé de leurs enfants, en les obligeant à utiliser des sièges de sécurité. Dans d'autres cas, les parents sont incités à influencer directement le comportement de leurs

enfants dans le sens de la sécurité. C'est le cas de la campagne française "Apprenons la rue à nos enfants". Il s'agit d'un cas intéressant puisque le Ministre des Transports lui-même s'est adressé directement aux conducteurs en les félicitant longuement des progrès qu'ils ont fait sur l'insécurité. Le message est adressé aux parents par le biais de la télévision, de la radio et de la presse, sans qu'il s'agisse à proprement parler de publicité. Le message sécuritaire est ainsi plus direct que lorsqu'il est converti en termes publicitaires et qu'il passe par la mise en forme publicitaire. L'impact de la gratification risque donc d'être plus direct. Quoiqu'il en soit, la logique de la communication s'inscrit dans le cadre de l'efficacité supposée de la récompense symbolique: la louange du ministre aura-t-elle un effet gratifiant. La louange est un degré dans la récompense, il s'agit d'un appel à la morale et aux devoirs du citoyen; c'est une position de principe qui est affichée et valorisée plutôt que la prescription d'une liste de comportements spécifiques.

Notons cependant qu'il n'y a pas que des messages gratifiants, il y a des messages inquiétants. En 1986 une campagne belge diffusait une affiche représentant une petite fille, le visage suturé avec comme texte: "Vous avez votre ceinture. Et votre enfant? Faites clic à l'arrière aussi.". Les sondages ont montré une opinion très favorable à cette affiche. (Prigogine, 1986)

Quelle importance accorder à ces dimensions gratifiantes sous-jacentes ?

Il y a donc différents types de récompense symbolique dont il est évidemment très difficile de tester l'efficacité. Et c'est peut-être là le fond du problème: celui de la maîtrise des instruments de communication sociale. Nous connaissons bien les niveaux d'impact des campagnes, l'opinion, les comportements effectifs, la fréquence et la gravité des accidents. Mais quand nous pouvons dire qu'une campagne a été un succès à un certain niveau, nous restons incertains sur la dimension communicative, sémantique qui a été à l'origine de ce succès ou d'une grande partie de celui-ci. Ainsi, comment reconnaître l'utilité d'une approche plutôt gratifiante ou plutôt répressive alors que ces dimensions sont la plupart des cas sous-jacentes ? En fait, nous maîtrisons mal les instruments de la communication sociale sans doute parce que nous ne possédons pas les instruments méthodologiques dans le champ de la sémiologie, la science des signes et des significations, qui nous permettrait de statuer d'une manière raisonnée sur tel ou tel effet des messages diffusés.

Si l'on pense que les usagers de la route doivent être encouragés à adopter ou à conserver des comportements sécuritaires et non simplement menacés par des sanctions, alors on doit définir des stratégies de communication qui vont dans ce sens en n'oubliant pas que les messages diffusés par les mass media trouvent leur efficacité globale, leur rentabilité dans le fait que justement, par nature, ils s'adressent à des millions de gens: parents, enfants et administrateurs. En France, les media ont un rôle considérable à jouer pour orienter et modeler les comportements.

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1. INTRODUCTION

The effectiveness of police enforcement has been the subject of a series of recent studies in the Netherlands. These studies were concerned with the use of seat belts, speeding (outside urban areas) and drinking and driving. The purpose of the studies has been to compare and improve the effectiveness of different types of enforcement by means of small scale campaigns. The design of the campaigns was based on literature surveys (Gundy, 1983) as well as on the results of preliminary studies. The adoption of effective types of enforcement was promoted in several ways such as manuals.

In this paper the results of the studies will be summarised in section 2. In section 3 the results are being discussed with the aim of making more general conclusions about the effectiveness of police enforcement. The last section of the paper describes the development of a program of integrated enforcement. Such a program is based on a selection of unsafe (but frequent) traffic violations, forms a combination of successful elements of enforcement of separate traffic rules and makes use of all the police resources available for special traffic enforcement for a long period of time. This program is currently being introduced and evaluated in the region of Leyden.

2. STUDIES ON POLICE ENFORCEMENT

The use of seat belts

In 1984 a combined enforcement and publicity campaign was conducted over a period of two months in the province of Friesland. This local campaign went simultaneously with a national publicity campaign on seat belts. Gundy (1988) reports on this local campaign and its effects. The enforcement was planned to be stationary by teams that were easy to recognise. Actual enforcement activities were poorly documented, but relatively few tickets were issued during the campaign. The base level of seat belt use varied around 50% for both experimental and control area (depending on in or outside urban area, age and sex of driver). At the end of the campaign the level had improved with about 25% in Friesland only. After two years 15% improvement was maintained. However, it cannot be decided if this is the residual effect of the campaign or partly the effect of repeated, local activities. Awareness of the campaign was high. At the end of the campaign about two thirds of drivers knew about the publicity and the enforcement, but the percentage of drivers who admitted having been checked by the police had hardly changed.

Another local campaign combining enforcement and publicity was held in 1987 in the province of Gelderland (Gras and Noordzij, 1987). Although the duration was one month, the level of enforcement (as crudely measured by the ratio of police checks to population size) was similar to that in Friesland during two months. This time the level of belt usage improved with about 20% shortly after the campaign.

Speeding outside urban areas

Except for motorways the speed limit outside urban areas in the Netherlands is 80 km/h. The Traffic Research Centre of the University of Groningen did a number of studies on the effectiveness of different types of enforcement to lower the number of speeding violations on such roads. These studies are reported in Riedel, Rothengatter and de Bruin, 1986 (a summary report is given in Riedel, Rothengatter and de Bruin, 1988). In one study radar checks, stationary (obtrusive) police cars with or without police officers stopping offenders, moving police cars or motorcycles were used in combination or in succession. The number of cars exceeding 90 km/h showed a base rate of between 45 and 50%. With a combination of radar checks and stationary cars with police officers stopping offending drivers ('stationary enforcement'), this rate went down with about 10%. In a second study the improvement was only 5%. The results also suggest that alternating this type of enforcement with stationary police cars only or by starting with a high level of enforcement and then reducing the level is equally effective. Another study is reported in which a three week publicity campaign in the province of Groningen was combined for the last two weeks with stationary enforcement at selected locations. The immediate result of one week publicity was a reduction in the percentage of cars exceeding 90 km/h of more than 10%. During the next two weeks the effect of enforcement was a further reduction of about 5%. Five weeks after the campaign the speeds at the control location (with publicity only) were almost back to the original level, whereas at the enforcement locations the effect was still about 10%.

Drinking and driving

In the city of The Hague a program of random breath testing in combination with publicity was introduced in 1986 (Verschuur and Noordzij, 1988). This type of enforcement was based on the results of preliminary studies including a survey into the habits and motivation of drinking drivers, a survey among police officers into the practices and problems of enforcement and a roadside experiment to measure the detection rate of traditional enforcement. The program lasted for eight months in which special alcohol patrol teams were on the road on Friday and Saturday nights from 22:00 till 04:00 o'clock. The teams had to stop and test as many drivers as they could and to change from one site to another after a period of an hour. The teams were highly visible. Drivers were stopped without any suspicion of drinking and tested (again without suspicion) with a

portable, electronic breath tester. If the roadside test gave a reading over the legal limit of 0.5 g/100ml, this was followed by an evidential breath test at the police station. Although the number of drivers being stopped was several times higher than before, the level of enforcement is still low if compared with the very successful program of random breath testing in New South Wales where the number of breath tests over a period of three years equals the number of drivers licenses. In The Hague a period of sixty years would be needed for that. The percentage of drivers during weekend nights with a BAC over 0.2 g/100ml decreased from 22 before the start of the program to 16% during the last months of the program. A control city showed exactly the opposite trend. About one third of the weekend night drivers were aware of the program. The level of awareness was higher among those who reported more frequent drinking and driving.

3. GENERAL DISCUSSION AND CONCLUSIONS

In all three cases (seat belts, speeding and drinking and driving) enforcement was found to be effective. It is interesting to see which elements of effective enforcement are common to all of them. First of all it is difficult to organise enforcement activities, in particular if they are different from normal practice. Much attention and effort is needed to convince and motivate police personnel to cooperate even for short periods of experimentation. A more practical problem is the availability of manpower. In these studies the level of enforcement was dependent on the manpower already available for existing enforcement activities. Therefore, the positive effects were obtained with relatively low levels of enforcement. This suggests that it is not necessarily the level of enforcement or the actual risk of a penalty that makes enforcement effective. Rather it seems necessary to give the impression that the actual risk of detection is higher than it was before, or at least that the risk of a penalty is real instead of non-existent.

Advance publicity and some evidence of actual enforcement is very essential with these low levels of enforcement. Advance publicity informs the public that the police is capable and willing to detect traffic violations. More specifically, it provides information on which traffic rules are going to be enforced, on which parts of the road network and during which time periods. A general interpretation of the results of the study can be given: road users show a tendency to test the validity of this information. This explains the effectiveness of highly visible, stationary enforcement. Because of this testing tendency, enforcement activities have to be distributed over the road network over time periods and over road users on a random basis. Otherwise, road users may get the suggestion that they can predict and avoid the risk of detection. Another consequence is that from time to time road users have to be reminded of enforcement activities.

A comparison of the studies on seat belts with those on speeding and on drinking and driving indicates a difference in effects. The improvement of seat belt usage was more easily transferred to other times and places. In other words, the tendency to test the limits of enforcement seems to be marginal in the case of seat belts. In the case of speeding the effects have been more limited in time and place, indicating that the information on enforcement has been less convincing or the tendency to test the limits has been stronger. The same is suggested in the study on random breath testing, since the change in drinking

and driving was only found at the end of the eight months program.

4. PROGRAM OF INTEGRATED ENFORCEMENT

The program of integrated enforcement in the region of Leyden forms a combination of successful elements of police enforcement of four selected traffic rules: drinking and driving, speeding, the use of seat belts and the proper use of helmets by moped riders. All the available manpower for special traffic enforcement has been planned for the whole year of 1990. Other major features of the program are:

- publicity in advance and at regular intervals during the year,
- the selection of concrete goals in terms of a reduction in the proportion of violations for each traffic rule,
- combined enforcement of more than one rule whenever practical, highly visible, stationary types of enforcement,
- special facilities to save time with the processing of offenders,
- simple administration for interim evaluation and modification.

In more concrete terms the program consists of 38 (mostly weekend) nights of enforcement on drinking and driving (in combination with enforcement of the use of seat belts), 70 days of enforcement of speed limits in as well as outside urban areas (in combination with enforcement of the use of seat belts during morning hours, plus on drinking and driving at later hours), 10 days of enforcement of the proper use of helmets by moped riders during the summer season (in combination with technical checks of the moped).

The goal for enforcement on drinking and driving is a reduction of the percentage of drivers with an illegal BAC (over 0.5 g/100ml) during weekend nights from 7 to 3%. This is a rather ambitious goal and 5% is seen as more realistic. Enforcement is by means of random breath testing as described in section 2. Drivers who are stopped for speeding offenses during the evening are also breath tested. Random breath testing had already been in operation in this region during 1989 and police data for the end of the year suggest a decrease in drinking and driving. Enforcement of speed limits is concentrated on major roads in and outside built up areas, with the goal of halving the proportion of speeding violations. The enforcement is of the stationary type with radar checks and police officers stopping as many offenders as they can (the rest of the detected offenders is photographed and ticketed by mail). Similar to the random breath testing, the special teams change from one location to another after an hour.

The use of seat belts is enforced in combination with either speeding (during daytime) or drinking and driving (during nighttime). The goal has been set at a wearing rate of 90% (with the national level of belt use at about 60% inside built up areas and about 80% outside).

By showing consistency in the selection of violations and in the type and amount of enforcement over a long period, this program is expected to have substantial long term effects. However, the realization of such a program is much more difficult than of the small scale campaigns of the earlier studies, in particular since the cooperation of several police forces is needed to cover the whole region. The effects of the program will be evaluated with

roadside measures and interviewing of drivers whose behaviour has been measured.

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AUTOMOBILE ADVERTISING AND TRAFFIC SAFETY - POINTS OF CONFLICT AND INTEGRATION POSSIBILITIES

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Introduction

Traffic safety and automobile advertising - what do they have in common? The traffic safety programme involves the attitudes, motives and behaviour of car drivers. Its purpose is to reveal the possibilities available for enhancing safety consciousness and reinforcing behaviour patterns that promote safety. The purpose of automobile advertising is to increase sales and is usually the culmination of thorough market and motivational research. It is therefore an indicator of the current interests, desires and expectations of car drivers and a constant source of information for us as safety experts.

Naturally this is just one side of the coin. There is also another. 20 years ago German traffic psychologists had grouped drivers with a high frequency of violations, traffic offences and accidents in contrast to another group of drivers with good records, drivers with no or low levels of involvement in accidents or traffic offences. These driver groups were then compared using every conceivable test procedure. The comparisons disclosed the differences between the reliable drivers and the less reliable ones: Their attitude towards the vehicle tended to be sober rather than emotional. They were more inclined to be inconspicuously carried along by the flow of traffic than to skillfully exploit advantages. They tended to be skeptical about their own driving skills. They did not attribute their own responsibility to external factors. Based on the results of the study, the authors developed "models" for traffic education which are still just as valid today. Typically, even then automobile advertising was found to contain a contrast programme to these models of traffic education. (Schneider and Spoerer, 1969)

About the conflict between automobile advertising and traffic safety

In the conflict between the objectives of automobile advertising and traffic safety, safety experts are not interested in criticizing automobile advertising per se. After all, there are very different ways of advertising to convince the public to buy cars, and advertising is incontestably an instrument of the market economy. Safety experts have only contested messages which

- (1) establish an attitude towards the vehicle which overemphasizes its performance and dynamics of movement,
- (2) employ self assertion and an impulse to dominate as sales arguments and
- (3) extol the safety features of a vehicle, especially equipment for active safety, as a type of "safety guarantee"

These criteria are based on various concepts of traffic

psychology which regard behaviour in road traffic as occurring in a system of conflicts between the non-functional motives of the driver and the reality over everyday traffic. Naatänen and Summala speak of "extra motives", for example, meaning motives which do not arise directly from the task of driving as such. Under this they list propensities toward competitiveness, aggression, "hedonistic" tendencies (driving for fun), enjoyment of risk (thrill), etc. In characterizing tendencies toward self assertion and hedonism they also draw on examples from automobile advertising, particularly advertisements in which the enjoyment of high speeds and acceleration rates is placed in the limelight. In addition they explain the high risk to young drivers primarily on the basis of such highly developed non-functional motives. In his review of research regarding the causes of accidents, Klebelsberg interpreted behaviour in road traffic as a function of the "general development of motorization":

(1) Development from the symbolic to the instrumental function of the motor vehicle

At the beginning of the learning process the vehicle is perceived as a symbol for a new form of independence, liberation, freedom and blossoming of performance. The "intensive effect of fascination" promotes the identification of driver with his vehicle so that the "performance of the vehicle can be experienced as personal performance". As the motorization age increases, the fascination and symbolic effect of the vehicle decreases and its importance as a commodity increases. Safety increases in this process.

(2) Development from individualistic to social behaviour

The fascination promotes an "egocentric perspective with road traffic being perceived as a possibility to satisfy one's own rights, and the associated prospects for success being viewed as a question of personal self-assertion". It is not until experience is gained that the driver recognizes that road traffic can only be maintained by relinquishing some individual rights. Increasingly, other road users come to be perceived as equal partners in the overall system of "road traffic". This, too, is a precondition to greater traffic safety.

(3) Convergence of subjective and objective safety

The widespread tendency of motorists to overestimate their skills and the typical discrepancy between safety as it is subjectively experienced by novice drivers and the objective safety conditions as they actually exist gradually yield to a more differentiated perception of the objective risk. The driver recognizes that the "essentially safe vehicle" is a fiction and that the built-in safety features cannot be effective until the driver uses them in an appropriately safety oriented manner.

A very large percentage of the findings of driver behavioural research is associated with these developmental tendencies. The conclusion that is to be drawn is that greater safety basically results only by proceeding in the direction of the described

Figure 1: Percentage of content category "Economic efficiency/utility value" of all contents of the advertisement texts and advertisement headings per year

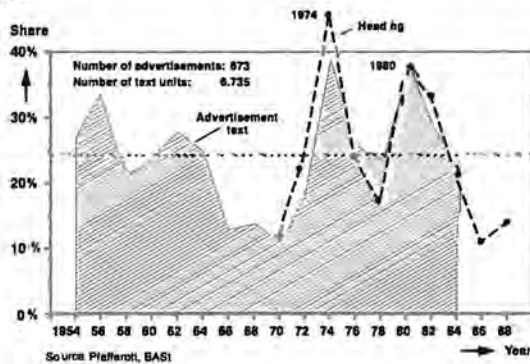


Figure 2: Percentage of content category "Sportiness/performance" of all contents of the advertisement texts and advertisement headings per year

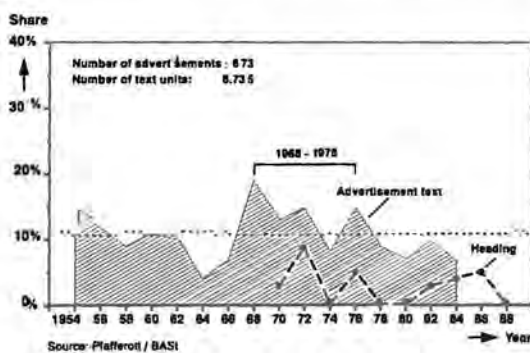


Figure 3: Percentage of content category "Safety" of all contents of the advertisement texts and advertisement headings per year

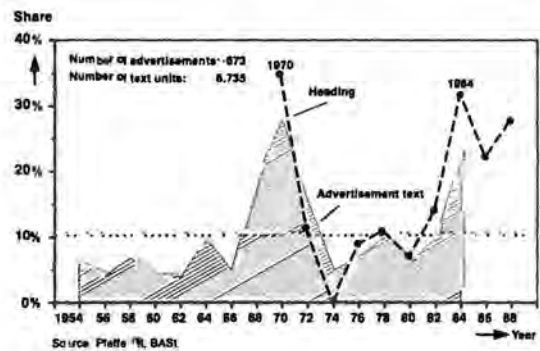
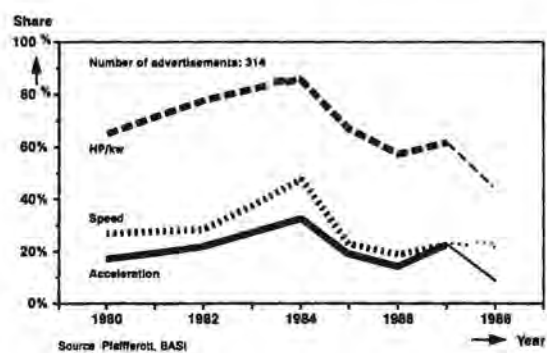


Figure 4: Percentage of advertisement text containing performance data per year



developmental tendencies: the unilateral accentuation of the "opposite direction" cannot contribute to traffic safety.

Empirical analyses of automobile advertising

Most empirical results on the topic of automobile advertising are only at the level of content analyses. Long-term trend analyses of advertisements in Germany (Pfafferott, 1984) disclose primarily that there are "boom" periods for advertising that conflict with safety, that the advertising responds sensitively to market-relevant factors (such as energy crises) and that intervention due to safety considerations can help to reduce problematic advertising. The trend analyses in Germany are based on approx. 750 systematically selected advertisements in Germany's most read motorists' magazine from the period 1954 to 1988. The following questions were posed regarding the individual advertisements:

(1) What technical data does the advertisement contain?

We recorded whether an advertisement contained data on engine performance, top speed, acceleration and fuel consumption.

(2) What is the message in the advertisement's heading?

For this purpose we developed a system of categories to which we were able to assign the contents of the headings. These categories were economic efficiency/utility value, comfort/appointments, safety, sportiness/performance, engineering, other.

(3) What is the message in the bodies of the texts?

The texts of the advertisements were broken down into individual message elements which, once again,

were allocated to the above-named categories.

Wherever necessary, several evaluators participated in the analysis of content in order to avoid subjective distortions.

What were the most important findings of these analyses? First of all, the long-term observations reveal radical fluctuations in the arguments of the automobile advertisements. Take, for example, the largest category quantitatively, i.e. "Economic efficiency/utility value": 25% of all advertising messages over the entire period fall in this category. Until the 1960s the economic efficiency of the automobile played the leading role in the advertising argumentation. At the end of the 1960s this topic lost importance in advertising for a long time, only to experience a sudden resurgence after the energy crises of 1973/74 and 1979/80. In recent years this topic's share has again been clearly below the average for all the years considered (Fig. 1). The category "Sportiness/performance" stands in reverse relationship to this "rational" advertising argument. It did not develop until the end of the 1960s but very quickly assumed the leading position among the advertising topics. Its importance declined for a while, primarily due to the energy crisis, but in the first half of the 1980s the performance topic again experienced a powerful surge. In 1984-85, however, this type of advertising again became involved in political discussion, this time in connection with the topic "dying forests" and "speed limit".

While the sportiness and performance argumentation decreased thereafter, it is still higher than the average for all the years (Fig. 2).

Let us cast a glance at the category "Safety". Except for the years 1968 to 1976, it has never progressed

beyond its wallflower existence. The extremely low share this category has enjoyed in the advertisement headings indicates that it is only in exceptional cases that "safety" is a "grabber", an effective advertising argument (Fig 3).

The technical data in the advertisements presents quite a good reflection of contemporary trends and the prevailing economic situation. The changes in connection with performance data overall as the result of initiatives on traffic policy (middle of the 1980s) is characteristic and, for our efforts, welcome. Following our participation in the most disparate committees in which we supported greater concern for safety interests in automobile advertising, use of the performance argument decreased. The curves of the indicators for engine performance, speed and acceleration clearly reflect this decrease (Fig.4).

On the basis of an extensive media analysis in Switzerland, Huguenin et al (1985) come to the conclusion that automobile advertising there contains far more information in conflict with road safety aims than information that promotes road safety aims. Identified as in conflict with safety were: sporty driving, superiority, performance/dynamics and enjoyment of driving. Results of polls taken at the same time disclose that the persons who could be negatively influenced by such information were primarily young drivers and the fast drivers among the adults. They are more attracted by and very interested in automobile advertising.

In a laboratory experiment Wollenhaupt 1974 has studied the effect of risk inducing advertisement on the choice of speed (driving simulator). His main result was that drivers, influenced by such advertisements, tend to drive faster. The differences between test persons who had seen risk inducing and those exposed to safety oriented advertising, were significant. Not significant, but clear in tendency, was the potentially negative influence on drivers normally tending to drive carefully.

The results of the media analysis should not be overestimated however as they come from only a few tests with limited application. Of much greater importance for traffic safety appears to be the fact that the behavioural models important for traffic safety and the behavioural models propagated by sporty-aggressive product advertising are, in principle, irreconcilable.

All efforts invested in modifying automobile advertising are based on this conviction. Clear scientific evidence of the negative effect of automobile advertising does not exist and is difficult to achieve. Whether we will ever be successful in obtaining this kind of evidence, depends on the interest of those applying the required know how to the difficult task of analysing effects of this nature and on the readiness of the public authorities providing the funds for scientific studies on what may be called marginal areas of traffic safety. However, whether scientific evidence is actually required to initiate policy action of any kind whatever, is a question to be decided by everybody concerned. Our concern here was mainly the pointing out of the principal problems in this context.

What, now, do we know about the initiatives taken to counter/combat the problematic contents of advertising?

Steps in the direction of advertising concepts in conformance with road safety aims

As far back as 1972 the automobile manufacturers in Germany agreed to voluntary control of advertising and to refrain from any direct or indirect appeals to

an inappropriate dominance of one road user's will over another". This agreement was revived in 1984. In 1988 the Association of the German Automobile Industry installed a "staff of observers" which was to examine its own advertisements from the aspect of traffic safety. The Association of Vehicle Importers concurred with the agreements of the German automobile manufacturers. In 1987 a prize was awarded by a German Road Safety Organisation (Deutsche Verkehrswacht) to automobile and motor cycle manufacturers who had succeeded in "bringing product advertising into accord with the comprehensive interrelationship of the central concepts of traffic safety to date". The annual award is associated with the expectation that manufacturers and advertisers will continue to increasingly base their product advertising on safety criteria.

In other countries too, motor vehicle advertising also has increasingly become a current topic in traffic safety efforts. The competition of the Swiss Accident Prevention Bureau (BfU) is comparable to the German Road Safety Organization, even although the established criteria are formulated somewhat differently than in Germany. In France an agreement has existed between automobile manufacturers and the government since 1985. Luxembourg followed suit in 1986. In 1986, Spain introduced an article into its highway code with the purpose that information supplied to the users of motor vehicles should not encourage them to drive too fast or recklessly. Some other countries have general codes for advertising practice which also include the standards for automobile advertising (Denmark, Portugal). In the United Kingdom the Independent Broadcasting Authority reviews all advertising before it is screened in order to ensure that it is in conformity with standards as "advertisements should neither condone nor incite to violence or anti-social behaviour" "show or advocate dangerous behaviour or unsafe practice" (see ECMT, 1989). In other countries, there seem to be no comparable agreements, either voluntary or jointly supervised.

Table 1: Measures adopted in different European countries to stem advertising that conflicts with traffic safety aims (overview).

Recommendation for voluntary control	CH
Voluntary control	D
Voluntary control with pre-examination	UK
Control in accord with governmental agencies	F, L
Control by regulations of the Road Traffic Act	E
Prizes for positive advertising examples	CH, D

Source: ECMT, 1989

Finally, the fact that the topic "motor vehicle advertising and traffic safety" has also been addressed by the traffic safety committee of the European Conference of Ministers of Transport (ECMT) is further proof of movement in this sector. The committee agreed that an internationally coordinated action is necessary against advertising which conflicts with traffic safety aims and drafted a report on this topic. The report includes clear recommendations to the governments of ECMT member countries (ECMT, 1989).

The degree to which these activities will be followed by concrete action directed at advertising concepts in conformance with safety aims will depend on the one hand on the emphasis with which the steps initiated to date are pursued. On the other hand, the

manufacturers and advertisers must be more prepared to repeatedly solve the conflict between the aims of product advertising and traffic safety

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COMMENTAIRE ET EVALUATION DE LA SESSION 2 "INFLUENCE SUR LES VALEURS ET NORMES DE SECURITE DES INDIVIDUS ET DES GROUPES"

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Après avoir lu et écouté les communications présentées à ce symposium, je pense que, comme moi-même, bon nombre de conférenciers se sont longuement interrogés sur la meilleure façon de s'insérer dans le cadre conceptuel et problématique proposé par les organisateurs.

La logique globale qui structure ce symposium me paraît pouvoir se résumer ainsi:

- les sociétés contemporaines qui ont généralisé l'usage de l'automobile sont confrontées à un très grave problème d'insécurité résultant de cette forme de mobilité.
- le comportement des conducteurs apparaît comme l'élément clé de ce problème.
- pour influencer favorablement ce comportement il convient de comparer les mérites respectifs de la sanction et de la récompense.

Cette apparente simplicité du raisonnement recouvre en fait des problèmes d'une très grande complexité.

- en ce qui concerne le premier point, le problème de société que représente l'insécurité routière, je noterai simplement que nous, chercheurs et praticiens de la sécurité routière, avons naturellement tendance à ne considérer, dans les enjeux politiques et sociaux de ce problème, que ce qui concerne directement les accidents en minimisant les dimensions de mobilité. Une simple comparaison des investissements consacrés à la mobilité automobile par rapport à ceux consacrés à la sécurité routière éclaire singulièrement la vraie nature de la réaction profonde du corps social à ce problème

- le deuxième point, le comportement du conducteur, est tout à fait symptomatique de la représentation dominante du système de circulation routière et de ses dysfonctionnements. Par rapport aux autres modes de transport, la sécurité y a été beaucoup moins intégrée dans une conception globale du fonctionnement du système et s'est essentiellement développée sous forme de d'actions palliatives et correctrices à mesure que l'usage de l'automobile se généralisait tout en se diversifiant. Ceci n'est pas dû au hasard mais au principe même qui explique le succès de l'automobile et sa situation prépondérante: l'autonomie.

En déléguant au niveau de chaque conducteur les fonctions de décision et de régulation, le système est tout à la fois le plus adapté à la multifonctionnalité, au découpage socio-économique de l'espace et le plus défavorable à la sécurité.

De ce point de vue, le conducteur est donc bien le point nodal du système mais il est aussi l'élément sur lequel il est le plus difficile d'agir pour améliorer la sécurité.)

La session 2 de ce symposium se proposait d'analyser les voies ouvertes à l'influence sur les valeurs et normes individuelles et de groupe. A mon sens il faut comprendre le terme "individuelles" comme la résultante au niveau de chaque conducteur des valeurs et normes de ses divers groupes d'appartenance et de référence, toute norme ou valeur se référant nécessairement à un contexte social. Nous rencontrons là un problème conceptuel majeur pour la sécurité routière. La conduite automobile s'est insérée au sein des pratiques quotidiennes de la très grande majorité des individus, de façon en quelque sorte transversale, multiforme, sans se rattacher à un cadre de référence, à un statut clairement délimité: activité domestique, professionnelle, de loisir etc. D'où le paradoxe que la conduite automobile tâche complexe, exigeante, à haut risque relève d'abord de l'initiative et de l'interprétation individuelles. On peut en voir une traduction dans le phénomène des styles de conduite. L'interprétation personnelle de la tâche qui dans les autres modes de transport entraînerait très rapidement la disqualification de l'opérateur.

Les professionnels de la sécurité routière se trouvent ainsi confrontés à la mission, particulièrement difficile, d'améliorer par des mesures correctrices un système de transport dans lequel la sécurité n'a pas été systématiquement évaluée, planifiée et intégrée.

En raison de contraintes économiques et sociales évidentes, les modifications radicales de l'usage de l'automobile sont hors du domaine d'intervention des institutions chargées de la sécurité routière. Celles-ci doivent alors orienter l'essentiel de leurs efforts vers des modifications des comportements qui ne portent pas atteinte à la mobilité automobile.

L'influence sur les comportements est ainsi devenue le véritable paradigme de l'action de sécurité routière et ce symposium en fournit une excellente illustration. Il faut souligner sur ce point la très forte analogie de cette problématique centrale de la sécurité routière avec la question de l'influence sociale qui a été et reste l'objet majeur des recherches et des développements théoriques et empiriques en psychologie sociale.

Il ne me revient pas dans le cadre de ce symposium de passer en revue les divers modèles et théories proposés par la psychologie sociale qui paraissent les plus pertinents vis à vis de l'influence que peuvent exercer sanction et récompense sur les comportements des conducteurs. Je me propose seulement d'en dire quelques mots sous forme de

1) La remarquable prévalence du concept de "facteur humain" des accidents évoque le phénomène de "l'erreur fondamentale" (Ross 1977) dans la théorie de l'attribution pour expliquer la causalité d'un événement. L'observateur extérieur surestime les facteurs liés à l'individu et sous-estime les facteurs liés à la situation.

conclusion après avoir commenté la session 2.

En préambule je signalerai que la traduction française du titre de cette session pouvait être source de confusion entre l'influence "des" normes et l'influence "sur" les normes, cette dernière formule correspondant au titre anglais. En définitive je pense que ceci n'a pas nuit à la cohérence de la session et a même pu contribuer à enrichir les débats.

Je ne reviendrai pas sur l'introduction générale du M. Schneider qui a bien mis en évidence le rôle essentiel que jouent les petits groupes dans les processus d'influence. Ceci se vérifie particulièrement dans le cas de la récompense, matérielle ou symbolique: on remarque que la plupart des exemples d'actions efficaces proviennent de groupes restreints au sein desquels existe une communauté de valeurs et d'intérêts: usines, entreprises, bases militaires, etc...

La présentation de T. Rothengatter offrait le grand intérêt d'associer des hypothèses théoriques et des données empiriques sur le problème fondamental des relations entre normes, attitudes et comportements. Il a aussi souligné l'importance des effets vicariants dans l'apprentissage social, évoqués également par P. E. Barjonet.

Le thème de la vitesse est particulièrement approprié à cette analyse: la vitesse constitue en effet la variable comportementale la plus démonstrative de la régulation qu'opère le conducteur en réponse à l'ensemble de son environnement physique et social.

Dans cet environnement global je pense que le comportement majoritaire n'est qu'un élément de la norme individuelle. L'une des fonctions symboliques de l'automobile est la distinction qui s'opère tant dans le choix du véhicule que dans le style de conduite: là encore les individus sont fortement influencés par les normes et valeurs de leurs groupes d'appartenance et de référence. On peut en voir une démonstration dans la répartition très variable des infractions aux limitations de vitesse selon la catégorie socio-professionnelle du conducteur.

La norme d'usage se manifeste aussi dans les caractéristiques données par les constructeurs à leurs véhicules qui traduisent une logique technique de l'accroissement constant des performances. Dans cette logique le respect de la norme réglementaire légitimée par le seul critère de la sécurité, peut devenir "anormal".

L'exposé de J.F. Gossiaux a constitué une contribution originale et éclairante dans le domaine de la sécurité routière en y apportant le point de vue de l'anthropologie sociale.

Gossiaux souligne d'emblée le problème conceptuel que soulève la notion d'une bipolarité entre sanction et récompense. Rejoignant la problématique de Rothengatter, Gossiaux pose le problème de la "normalité" de la réglementation routière: la récompense du respect de la norme ne se justifierait que si cette norme est en fait extérieure à l'individu ou au groupe.

De ce point de vue, je pense qu'on ne peut analyser globalement la normalité de la réglementation routière qui varie selon les comportements prescrits et se constitue sans doute en référence à l'image et à l'usage de l'automobile et non de la sécurité. Ceci pourrait contribuer à expliquer que certains comportements, en particulier le port de la ceinture

de sécurité, sont beaucoup plus susceptibles de modification obtenues en laboratoire et sur le terrain que d'autres comme la vitesse.

En se référant au concept de "champ" selon Bourdieu, Gossiaux souligne aussi ce problème qui me paraît central: l'absence d'un champ spécifique de la sécurité pour ceux qui participent à la circulation routière (à l'exception, peut être, des acteurs institutionnels). C'est donc probablement au niveau de "micro-champs" que les approches de l'influence seraient les plus pertinentes.

Or la réglementation routière, même si elle se réfère à des valeurs universelles comme la protection de la vie qui transcendent les multiples micro-champs, demeure externe à ces micros-champs en ce qui concerne les prescriptions comportementales pour lesquelles elle ne bénéficie pas d'une légitimité reconnue par tous.

On est là au cœur du débat de cette session: en poussant le raisonnement, chaque conducteur devrait être sanctionné (négativement ou positivement) par ses pairs. On constate au contraire qu'en matière d'infractions routières, l'application de la réglementation s'oriente de plus en plus vers l'automatisme et la non-individualisation, divergeant d'ailleurs en cela des principes généraux du droit pénal.

La présentation de A.S. Hakkert, A. Yelinek et E. Efrat s'inscrit clairement dans une conception behavioriste classique de l'action de la réglementation sur les conducteurs, fondée sur le principe de la dissuasion par la probabilité du contrôle, elle propose en quelque sorte une ingénierie de l'utilisation optimale des moyens disponibles.

Par rapport au modèle explicatif de la dissuasion, développé notamment par H.L. Ross au sujet de l'alcoolisation des conducteurs, il s'agit ici du premier élément, la probabilité subjective qu'un comportement infractionniste soit détecté, en l'occurrence par "contact visuel" direct entre conducteur et personnel de police. Le mécanisme supposé de l'influence paraît donc bien du type Stimulus → Réponse.

Les auteurs parlent "d'effet positif sur le comportement du conducteur et sur la sécurité routière" mais rappellent que la relation entre intensité des contrôles, infractions et accidents est mal connue. Je partage à ce sujet le point de vue exprimé, parmi bien d'autres, par Sariola (1989) à propos de l'efficacité comparée des diverses formations à la conduite: les modèles behavioristes classiques ne sont pas adaptés à la complexité de la réalité sociale dans laquelle s'inscrit l'usage de l'automobile.

Le modèle sous-jacent à ce type d'action paraît comporter au moins deux hypothèses: la conduite sûre se définit par le strict respect de la réglementation - les comportements infractionnistes sont conscients et volontaires. L'analyse détaillée de ces deux hypothèses pourrait fournir le thème de plusieurs symposiums.

Dans une perspective opérationnelle, les modèles d'optimisation décrits par Hakkert paraissent très rationnels et bien construits à partir d'une analyse typologique des accidents et du risque. J'ajouterais une simple remarque qui s'inscrit aussi dans le

contexte des normes et valeurs de groupe: ce travail semble refléter une très bonne symbiose entre les centres d'intérêt des chercheurs et ceux des personnels de police qui ont accepté de planifier leurs activités en fonction d'un modèle théorique. Parmi les nombreuses difficultés de l'expérimentation sur le terrain en sécurité routière, la modification de pratiques de contrôle fondées sur l'expérience et l'intuition personnelle des agents n'est certes pas la moindre, comme l'a rappelé aussi Noordzij dans son exposé.

Il serait intéressant de connaître de façon détaillée les résultats de cette expérience: évolution des comportements (mesurée par d'autres critères que le nombre d'infractions constatées, variable qui est liée aux consignes données à la police), évolution de la probabilité des contrôles estimée par les conducteurs, mise en relation avec les caractéristiques des conducteurs etc.

Sur ce même problème de l'influence des contrôles, P.C. Noordzij et M.P.M. Mathijssen apportent un éclairage complémentaire: les effets combinés contrôles + campagne d'information. Par rapport à l'expérience précédente, le modèle sous-jacent est plus complexe puisqu'on tente d'agir à la fois sur l'évaluation directe et sur l'évaluation indirecte de la probabilité du contrôle.

Outre son intérêt pour l'action préventive, la synthèse des nombreuses expériences menées aux Pays-Bas me paraît souligner encore une fois le caractère singulier de la sécurité routière parmi les domaines d'intervention de l'Etat, en position intermédiaire entre criminologie et hygiène publique; existe-t-il d'autres domaines justiciables du droit pénal où de telles expériences sont concevables?

L'exposé de Noordzij souève plusieurs problèmes complexes:

- d'abord celui de la relation entre l'intensité des contrôles et la modification des comportements et, plus précisément, de l'existence d'un effet de seuil. L'examen de l'abondante littérature consacrée à cette question montre que les moyens mis en oeuvre et les résultats obtenus varient considérablement d'un pays à l'autre. C'est dans le domaine de l'alcool au volant que l'hypothèse de la dissuasion par la probabilité subjective de la détection a été le plus directement opérationnalisée avec l'instauration, très controversée, des contrôles aléatoires et les multiples expériences qui y ont été associées. De ce point de vue, on note (par exemple en comparant les communications présentées aux conférences de l'International Committee on Alcohol, Drugs and Traffic Safety de 1969 à 1989) une évolution caractéristique de l'intérêt majoritaire des chercheurs qui se transfère de l'analyse du risque à l'étude des effets de la réglementation.

L'intérêt d'une action combinant le renforcement des contrôles et l'information paraît confirmé. Je partage l'opinion de Noordzij sur la nécessité d'un équilibre optimal entre ce qui est dit et ce qui est fait pour assurer la crédibilité de l'ensemble, les conducteurs ayant notamment leurs estimations de la fréquence des contrôles en fonction de ce qu'ils perçoivent directement et indirectement.

- Autre question de taille: la variabilité de l'efficacité des contrôles et des campagnes selon le comportement visé. Le cas le plus favorable en termes d'ampleur et de durée des effets paraît être le port de la ceinture de sécurité pour plusieurs raisons:

comportement "manifeste" directement repérable, comportement dichotomique (port/non port) qui ne relève pas d'attitudes centrales pour l'individu. Lorsque les taux de port sont peu élevés il existe donc une potentialité importante de gains de sécurité pour les actions incitatives dans ce domaine.

Dire, comme le font dans leur introduction P.E. Barjonet et B. Cambon de Lavalette, que "l'on s'est rarement demandé si la publicité et les campagnes d'information pouvaient être considérées comme des récompenses ou des punitions" me paraît un euphémisme. Si j'en juge par les travaux antérieurs de l'O.C.D.E. (Wilde et al. 1971) ou par des publications récentes (Elbit 1989, Vingilis 1990), ni les chercheurs, ni les praticiens ne se sont posé la question dans ces termes. Généralement l'action informative est considérée comme une forme d'intervention spécifique et souvent même comme une alternative ou un complément à la répression. Je salue donc la heureuse apparition d'une interrogation nouvelle dans un domaine fortement investi par les pétitions de principe et les assertions dénuées de fondement.

Vis à vis d'une problématique récompense sanction, les campagnes qui s'adressent directement aux enfants sont intéressantes: d'une part sanction et récompense sont étroitement associées à l'éducation des enfants, d'autre part une déontologie implicite mais bien respectée proscrit l'utilisation dans ces campagnes d'images violentes et de menaces directes.

Les publicitaires jouent donc sur des dimensions symboliques jugées pertinentes à l'univers de l'enfant, notamment l'exemplarité du "bon" enfant qui respecte les prescriptions et en retire des bénéfices non seulement en termes de sécurité mais aussi de conformité, d'intégration, de "compliance" selon la terminologie des psychologues anglo-saxons.

Si l'on en juge par l'attrait qu'éprouvent les enfants pour les messages publicitaires et, plus généralement, pour tout ce qui présente un caractère répétitif ou rituel, on peut admettre que les campagnes constituent une forme de récompense. Que les enfants en déduisent une relation cognitive ou affective vis à vis des comportements réels dans la circulation est un tout autre problème.

S'adressant aux adultes l'utilisation d'images violentes peut effectivement être envisagée comme une sanction, plutôt d'ailleurs du point de vue de l'émetteur que du récepteur du message.

Sans reprendre les multiples travaux et les résultats contradictoires sur l'efficacité de ce type de message, on peut rappeler que la "cible" n'étant ni captive ni passive dispose de tout une gamme de comportements d'évitement et de contre-offenses si le message est perçu comme une agression ou une menace.

A noter aussi que le même message peut constituer une récompense ou une sanction selon le degré de conformité de celui qui le reçoit. L'alternative entre renforcement positif ou négatif fait part de des questions auxquelles sont régulièrement confrontés les responsables des campagnes.

J'ai relevé avec intérêt la remarque de P.E. Barjonet et B. Cambon de Lavalette sur le caractère gratifiant des campagnes pour leurs promoteurs: elle ne me paraît pas anecdotique et mériterait un

approfondissement de ses conséquences sur le choix des actions au sein des politiques de sécurité routière et aussi sur l'évaluation des campagnes.

En ce qui concerne la conclusion de cet exposé, mon point de vue est moins optimiste. L'adéquation des mass-média aux problèmes de sécurité routière peut paraître évidente parce que ces problèmes concernent des millions d'individus. Je pense que cette évidence peut masquer la complexité des mécanismes d'influence, information et persuasion, liés à l'hétérogénéité de cette "macro-cible".

L'utilisation des mass-média a plutôt été, me semble-t-il, le miroir aux abîmes de l'action préventive par la fascination particulière qu'elle exerce sur les décideurs. La très faible progression, pour ne pas dire la stagnation, des pratiques dans ce domaine par rapport aux recommandations émises en 1971 par l'OCDE me paraît à cet égard significative.

Toute action d'information ou de persuasion comporte des dimensions de crédibilité et de légitimité liées aux caractéristiques attribuées à ceux qui émettent les messages. Ces dimensions ont été peu étudiées dans le domaine de la sécurité routière (Durand 1974, L'Hoste 1982). Je pense que le discours tenu par la Sécurité Routière institutionnelle est perçu, à des degrés divers selon les usagers, comme légitime dans le domaine normatif de la réglementation mais l'est beaucoup moins pour ce qui relève de l'automobile et de son usage. D'autres intervenants médiatiques sont mieux placés dans ce domaine, en particulier les constructeurs automobiles et les journalistes spécialisés.

L'exposé de I. Pfafferot m'a paru fort intéressant à cet égard. J'ai relevé, entre autres, la formule "la sécurité routière doit prendre en compte d'autres points de vue que ses propres centres d'intérêt". Il y a, me semble-t-il, effectivement en sécurité routière une concentration trop exclusive sur l'environnement causal ou circonstanciel immédiat des accidents qui minimise leur contexte global : mobilité, conditions de vie, comparaisons inter-modales, socio-économie des transports, etc. Ceci contribue à faire de la sécurité routière un champ clos pour la recherche et pour l'action.

Il paraît donc tout à fait fondé d'analyser, sans esprit d'affrontement, le discours médiatique de ceux qui conçoivent et commercialisent le produit automobile.

Je ne pense pas qu'il y ait réellement de concurrence directe entre publicité automobile et messages de sécurité routière. Si effectivement la comparaison strictement comptable de leurs budgets respectifs est impressionnante (celle des budgets alloués aux recherches dans les deux domaines serait encore bien plus) on ne peut les comparer comme on le ferait par exemple pour deux marques automobiles visant le même segment du marché.

On peut même constater qu'il existe des règles implicites mais respectées de part et d'autre dans les argumentaires. Les publicités automobiles ne contestent jamais directement les positions des pouvoirs publics : ceux-ci en réciprocité n'utilisent pas d'arguments de sécurité qui iraient à l'encontre de l'usage de l'automobile, par exemple en conseillant le choix de modes de transport plus sûrs. Ces limites tacites s'appliquent même à des données aussi objectives et solidement établies que le risque relatif d'accident par marque et type de véhicule qui, à ma connaissance, n'a jamais fait l'objet d'une

information systématique des utilisateurs.

Deux points me paraissent d'un intérêt particulier dans le travail de quantification présenté par Pfafferot

- le poids comparé des arguments "performances" et des arguments "sécurité".
- l'évolution chronologique de l'utilisation de ces arguments.

L'analyse de contenu du discours publicitaire confirme objectivement la nette prépondérance de l'argumentaire "performances-sportivité". Ceci a priori ne surprendra personne, mais on peut pourtant s'interroger sur la rationalité économique de cette stratégie.

L'industrie automobile est un secteur de pointe dans le domaine du marketing et, comme l'a dit Pfafferot, les études de motivation dont elle dispose sont d'un grand intérêt pour les chercheurs en sécurité routière (dans la mesure toutefois où ils peuvent y avoir accès).

De multiples enquêtes quantitatives indiquent que, parmi les motifs déclarés d'achat d'une voiture, les performances occupent un rang très modeste, loin derrière des caractéristiques comme l'économie, la fiabilité, la sécurité. On connaît aussi par enquêtes les conditions réelles d'utilisation des véhicules : par exemple en France (Orfeuill et al. 1989) 95% des trajets en automobile s'effectuent sur des distances inférieures à 25 km. La vitesse moyenne, calculée sur la durée de vie d'une automobile, est d'environ 45 km/h.

Pourquoi, dans de telles conditions objectives, l'industrie automobile, secteur très compétitif où les enjeux économiques sont énormes, met-elle en avant des arguments de vente d'une rationalité aussi discutable?

Sans évidemment prétendre répondre à cette interrogation, je proposerai seulement quelques hypothèses :

- le concept de sécurité est très polysémique : il s'interprète très différemment selon que l'on est ingénieur de l'automobile ou professionnel de la sécurité routière. Les constructeurs automobiles considèrent volontiers que la vraie sécurité est la sécurité primaire apportée par les qualités dynamiques du véhicule et que le mauvais usage qui peut être fait de ces qualités ne relève pas de leur responsabilité.

- la création publicitaire ne privilégie pas la rationalité : elle est plus sensible aux connotations symboliques, aux courants socio-culturels qu'elle paraissent porter même s'ils sont très minoritaires. Nous retrouvons là la question des micro-champs : le milieu publicitaire est très typé par l'importance qu'il accorde aux valeurs de compétition, de dynamisme, d'hédonisme. C'est préférentiellement dans cet esprit que les publicitaires cherchent à transcender la banalité du produit automobile.

- en dépit des crises successives de l'énergie, des limitations de vitesse, de la saturation du réseau, le plaisir et le prestige de la vitesse et des accélérations sont toujours des motivations importantes dans le choix d'un véhicule même si elles sont rationalisées sous des formes diverses. Ceci n'est pas manifeste dans les enquêtes quantitatives mais apparaît dans les études qualitatives bien menées.

- enfin, d'un point de vue strictement commercial, les plus fortes marges bénéficiaires sont dégagées sur les véhicules les plus performants qui sont aussi censés "tirer l'ensemble de la gamme vers le haut".

Pfafferot nous a rappelé l'hypothèse formulée par Klebelsberg: l'évolution historico économique de l'usage de l'automobile irait d'une symbolique individualiste à une rationalité collective. Cette hypothèse séduisante suggère une analogie entre d'une part l'évolution individuelle, en fonction de l'âge, des attitudes vis à vis du risque et d'autre part l'évolution, au niveau d'un pays, du risque relatif en fonction du taux de motorisation. En ce sens elle évoque le débat de l'éthologie sur les similitudes entre l'évolution ontogénétique et l'évolution phylogénétique.

Une hypothèse assez voisine avait été formulée il y a 25 ans sur l'évolution du comportement des conducteurs français (Lucet 1965). On a constaté depuis lors en France, comme dans la plupart des pays industrialisés, une forte décroissance du risque; dans cette amélioration, la part attribuable au comportement des conducteurs par rapport aux véhicules et à l'infrastructure n'est pas chiffrable mais les analyses psychosociologiques successives ne montrent pas d'évolution significative des conducteurs français vers une plus grande rationalité (Barjonet 1977, 1989).

Dans le prolongement de cette réflexion sur la publicité automobile, il serait intéressant d'élargir le débat à l'influence sur les normes et valeurs, de la mise en scène de l'automobile dans l'ensemble de la production cinématographique et télévisuelle (Greenberg 1983, Steudler 1987, Huguenin 1988).

Ce problème de l'évolution des normes et valeurs nécessiterait à l'évidence une mise en perspective sur le long terme. Les travaux consacrés à la sécurité routière portent essentiellement sur les effets immédiats ou à court terme; on manque beaucoup dans ce domaine d'études longitudinales qui suivraient et compareraient des cohortes de conducteurs sur plusieurs décennies.

Le rituel de la communication scientifique veut que l'on conclue en préconisant de nouvelles recherches. Sans prétendre déroger à la règle, je l'appliquerai avec quelques nuances dans l'évaluation globale de cette session.

A la problématique complexe proposée par les organisateurs de ce symposium, les intervenants ont répondu en apportant des éclairages théoriques et empiriques très ouverts. Ceci n'a rien de surprenant car le titre de la session 2 "Comment modifier les normes et valeurs de sécurité individuelles et de groupe" proposait de dégager les principes d'une démarche pragmatique à partir de concepts qui renvoient à des débats théoriques fondamentaux.

Cette session a donc permis la utile confrontation de propositions théoriques et de constats empiriques. Comme je l'ai dit en préambule, elle me paraît bien refléter l'état actuel de la sécurité routière où, après avoir mis en place de multiples réglementations, on s'interroge de plus en plus sur les possibilités d'une meilleure gestion des comportements dans la circulation.

La session 2, et plus globalement l'ensemble de ce symposium, soulèvent donc à nouveau la question des passerelles entre recherche et application. Je pense, comme cela a été dit par ailleurs (Haight, Hauer, 1988) qu'il s'agit de deux domaines distincts qui ne relèvent pas des mêmes compétences.

Parler du "régne de l'ignorance en sécurité routière" (Hauer, 1989) me paraît sévère mais il est vrai que les

transferts de connaissances entre recherche et action y sont rarement satisfaisants: les autorités responsables de la sécurité routières sont plus motivées par l'action que par la réflexion à long terme et sont rebutées par les délais de réponse inhérents aux recherches. Mais il n'en demeure pas moins vrai que les milieux de la recherche ne sont pas exempts de toute responsabilité dans cet état de fait.

J'ai souligné dans cet exposé l'étonnante similitude entre ce qui me paraît constituer le paradigme actuel de l'action de sécurité routière et l'une des questions les plus centrales de la psychologie sociale: le processus d'influence.

Je trouve surprenante la très faible perméabilité entre les théories, en particulier phénoménologiques et opératoires, de la psychologie sociale et les recherches concernant le comportement des conducteurs qui restent très marquées par le behaviourisme classique et les doctrines utilitaristes.

La lecture des manuels de psychologie sociale est démonstrative à cet égard: les exemples de recherches ayant pour objet le comportement des conducteurs y sont rarissimes.

Comment expliquer que le "regard psychosocial" (Moscovici, 1984) ne se porte pas sur cette pratique quotidienne de millions de gens, soumise en permanence à l'interaction sous toutes ses formes et dont les enjeux sont d'une telle importance? Les raisons de ce phénomène sont sans doute multiples, tant concrètes que symboliques: objet de recherche peu valorisé dans les milieux universitaires qui, notamment dans les critères de publication, accordent plus d'importance à la rigueur méthodologique qu'aux enjeux sociaux, complexité et intrication des variables, difficulté de l'observation et de l'expérimentation contrôlées.

Pourtant les exemples présentés au cours de ce symposium, parmi bien d'autres, démontrent que l'analyse des comportements dans la circulation offre des potentialités heuristiques considérables et que la rigueur de l'approche scientifique lui est parfaitement applicable.

Pour organiser et interpréter la somme des données recueillies il revient, me semble-t-il, aux chercheurs en sécurité routière de s'interroger davantage sur les possibilités et l'intérêt d'une transposition à leurs problématiques des modèles et théories développés dans d'autres domaines par la psychologie sociale. Pour ne citer brièvement que quelques travaux parmi les plus classiques en rapport direct avec le thème de ce symposium: les théories de la cohérence, en particulier l'analyse de effets paradoxaux de la récompense (Festinger 1957, Gerard 1974, Nuttin 1975) la soumission (Freedman et Fraser 1966, Milgram 1974, Beauvois et Joule 1988) la conformité (Asch 1955) l'attribution (Kelley 1967, Jones et Davis 1965, Hewstone 1988) l'engagement (Kiesler 1971) la catégorisation sociale (Festinger 1954, Tajfel 1981) la conformité supérieure de soi (Codol 1975) etc.

J'ai parlé de transposition car je suis convaincu que la conduite automobile comporte des spécificités non réductibles aux diverses situations qui ont fait l'objet de ces travaux.

Les évolutions des paradigmes en psychologie sociale ont souvent été consécutives à la reformulation et à la validation scientifiques

d'énoncés du sens commun. L'une des idées les plus répandues concernant l'automobile est qu'elle "change l'homme". Les scénarii classiques de l'étude des processus d'influence pourraient être reconsidérés en prenant en compte certaines dimensions essentielles de la situation de conduite automobile telles que la cinétique, la concurrence pour l'espace, la pression temporelle, le risque.

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CONCLUSIONS AND RECOMMENDATIONS BY THE RAPPORTEURS OF SESSION 2

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The Kraft (Schneider) safety program produced dramatic reductions in the accident rate during the first year of operation, but gains have been limited since that time. However, the savings in terms of cost per accident continues to rise because the cost of accidents is increasing. Other companies have conducted safety programs, which were as successful as the Kraft program, and the consistent element in these programs was the effort to develop corporate norms and values which promote safety at all times (on- and off-the-job) through support by management and the involvement of employees in the program. Involving employees in the program helps to ensure that the norms and values of the employee group are incorporated into the program. There is need for increased publication of results from other corporate safety programs.

Mr. Schneider concluded his statement with asking how to implement successful reward and punishment programs. He pointed out that it is important we encourage the development of positive values and norms as part of road safety programs. He also pointed out that rewarding systems, can be preferred to enforcement systems from a moral, theoretical point of view.

Mr. Rothengatter pointed out the need for data research to help to understand the influence of motivation on road user behaviour. He said that traffic behaviour is a function of what we think our fellow road users actually do. Feedback should be considered a major factor influencing the behaviour.

There is a basic conflict in our society between the value of safety and the value of speed. In addition to this dimension there is also a conflict between the desire to be an acceptable road user and the value of speed. It may be that we can influence road user behaviour more if we influence the desire to be an acceptable road user rather than the more general desire for safety.

Mr. Gossiaux expanded on this theme and said that group norms are essential to the actual behaviour. He also pointed out that it is difficult to state what are rewards and what are punishments, because this could vary from person to person. In particular legal norms may conflict with social norms. The latter need enforcement, while enforcing legal norms may have limited effects.

It is important to be knowledgeable about the norms and values of subgroups of the road user population because these norms and values may influence how subgroups respond to safety programs. In some cases these norms and values produce perverse or negative safety benefits. For example, in a study which demonstrated the efficacy of using a feedback sign to reduce speeding one group, young male drivers, actually drove faster. When perverse effects occur there are two options available: change the norms and values, or modify the program. It has been argued that changing norms and values is very difficult, but that making minor adjustments to programs may be feasible. For example, if drivers start to view parking fines as a fee for parking it may be necessary to dramatically increase the fines. In another example, motorcycles might be restricted from the Paris ring road in order to reduce their use of it for thrill seeking purposes.

Mr. Hakkert produced a very interesting model for maximizing police efforts.

The data used for determining the allocation of police resources may have been biased because of under-reporting of accidents, but the problem is not unique to this study and the bias is towards the more serious accidents which are the ones of greater concern. The police resources were concentrated on only 25% of the road network, but this part of the network accounted for 75% of the vehicle kilometers travelled. Also, although the allocation system might call for some portions of the road network not to be patrolled it was decided that all sections must receive some attention to ensure that users perceived that all sections were being patrolled.

The discussion following these presentations showed that many delegates are aware of the importance revealed that even in such a program the police had to move from place to place, due to cost/benefit ratio.

This points out that the statement from Mr. Elvik might be important. It is a possibility that we might come into the never ending circle where more enforcement must lead to less enforcement because successful enforcement brings about its own demise.

Mr. Barjonet told us about how information campaigns could be designed for children. This review should be conveyed from the audience to those being responsible for such in our respective countries.

Mr. Noordzij gave an overview of enforcement studies in the Netherlands and stressed the importance of introducing enforcement programs together with public campaigns. He also pointed out that specific goals should be set for the police in connection with the enforcement.

A 1971 OECD report made recommendations about the influence of advertising by automobile manufacturers on road safety. The recommendations presented by Pfaffertog suggest that finally, after twenty years, something is being done in response to

those recommendations. The current recommendations are not implemented yet, but have been given tentative approval by the European Conference of Ministers of Transport and are more precise than those that appeared in the OECD report. If regulations are established to limit the content of advertising by manufacturers of automobiles they must also apply to parts suppliers such as tire manufacturers and accessory suppliers.

There was a concern stated that regulations limiting the ability of vehicle manufacturers to advertise the sporty fast characteristics of their vehicles in the European Economic Community might lead to an increase of this type of promotion in eastern Europe where there is a pentup demand, and where there is likely to be resistance to government control of advertising.

Current advertising is more subtle at promoting aggressivity than it was 20 years ago. Frequently advertising promotes a safety feature while at the same time highlighting the vehicles performance and speed. In addition, advertising which promotes increased occupant safety of a vehicle does not present information on the potential effects of this on the safety of other road users. Qualitative analysis was not possible with Pfafferott's data.

It may be more important to consider the driver role models that are seen in the programming which appears on television than to be concerned about the effect of advertising. The lack of concern for road safety, and the minimal consequences of accidents portrayed in many television programs represents a serious problem for those trying to promote road safety. In addition, the volume of material directed at promoting safety is very small compared to the volume of material which promotes other values for road users, and this makes it difficult for the safety message to have an influence.

What conclusion can then be drawn from session II:

1. We have little exact knowledge on rewarding systems and their effects, but many papers indicate that these incentives should be used.
2. Feed-back systems should be developed for influencing normative behaviour.
3. We also should expand our research in traffic on how to influence social norms.
4. Then still many questions are to be answered on how police strategies should be designed.
5. We should also ask ourselves how it is possible to influence motor companies to really be interested in traffic safety.

The concern of road safety researchers for dealing with practical issues has reduced our reliance on theory for understanding road user behaviour. There is a need to restore the value of theory development and application in road safety research.

**Session 3: Influencing corporate and
public safety decisions**

**Séance 3: Influence des décisions
relatives à la sécurité des
pouvoirs publics du secteur
privé**



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I would like to thank the organizers for allowing me to participate in this important conference. During this third session we examine the role of incentives and rewards in the influence of corporate, government, or political behavior. Thus, we ask whether there is really any such thing as corporate behavior other than an interaction of the behavior of individuals within an institutional setting.

INCENTIVE AND REINFORCEMENT AS APPLIED TO INDIVIDUAL BEHAVIOR

From preceding papers, we know there is an extensive research literature on the effect of incentives on individual behavior. I would like to state four points as they apply to road user behavior. For a reward or punishment to function properly:

1. The targeted behavior should be specific rather than general.
The behavior should be precisely specifiable – the more so, the better. Thus, it is appropriate to target seat belt wearing, for example. That behavior is easier to reward than a generalized behavior such as "being courteous."
2. The behavior should be goal relevant.
The behavior should have a demonstrated link to safety – a link that is worth pursuing. The more specific the link, the better.
3. The behavior must be observable and measurable.
In order for reward to work, it must have a direct link to the targeted behavior. Therefore, the behavior must be observable and subject to measurement so that the incentive can follow occurrence of the targeted behavior. If the reward is sometimes given in the absence of the appropriate behavior, its influence on the behavior is not as strong. On the other hand, the desired behavior need not be rewarded every time. It is well known that intermittent reward results in stronger behavior than does continuous reward.
4. The targeted behavior must not be overwhelmed by competing value or reward systems.
Previous papers have already addressed the principles of behavior control that apply to individual behavior like fastening a seat belt. The behavior of fastening a seat belt is specific, goal relevant, and it is observable and measurable. For most people, there are not competing values or reward systems that interfere with this behavior. For some, however, buckling a seat belt is in competition with other value systems (comfort and freedom). This competition with other value systems makes reward

of belt wearing less effective than it might otherwise be.

DO THESE PRINCIPLES ALSO APPLY TO CORPORATE, GOVERNMENT, OR POLITICAL BEHAVIOR?

The answer is not entirely clear to me. To help us decide let us consider four situations:

1. Government influence over another level of government.
2. Government influence over corporations.
3. Government or corporation influence over individuals.
4. Individuals influence over a government or corporation.

1. Government influence over government:

Within in the USA, there are examples in which the national government attempted to influence state or local governments in regard to road safety. I will give two examples in which financial incentives were not used and two instances in which they were.

No Financial Incentives:

A. The USA National Highway Traffic Safety Administration (NHTSA) has written a number of safety "standards" for the individual states. These standards are not mandatory in the same sense that Motor Vehicle Safety Standards regulate the corporations. Rather, they are guidelines. These minimum standards concern such things as state programs for driver licensing, driver education, motor vehicle inspection, alcohol control, and traffic law enforcement. Although there is theoretically a financial penalty if a state does not comply with the standard, in fact no penalties are imposed.

Despite the lack of penalties, there is, nevertheless, reasonably good compliance by the states. That compliance probably relates to other means by which officials are given recognition and acceptance within the fraternity of professionals who advocate road safety. The particular standards include goals which most road safety officials endorse. However, there is no strong incentive for a state to come into full compliance, and many states have not done so.

B. Another attempt by the U.S. federal government to influence state government without financial incentives, pertains to the matter of seat belt laws. Beginning in 1984 the federal government encouraged states to pass seat belt laws. One feature of the federal government's position was the promise that, if enough states passed the law to cover two-thirds of the USA population, the requirement for cars to be equipped with automatic restraints including air bags would be rescinded.

Note that the federal administration then in power presumably thought in terms of "freeing" the country from air bags as an incentive. Among some state

legislatures, removal of the "threat" of air bags was indeed regarded as a positive incentive. That was not true in all states, however. Some state legislatures regarded the "anti air bag" feature of the federal provision as being a negative incentive.

To this date, about 30 states have passed belt laws. This is a good showing but falls short of universal compliance.

Financial Incentives

A. On the other hand, there are other situations in which financial incentives have been present. During the 1980's, the federal government enacted regulations designed to persuade the states to increase the age for legal consumption of alcohol from 18 to 21. To persuade states to act, the federal government established financial disincentives such that if the states did not enact the required legislation, they stood to lose 10 percent of their federal highway construction funds (a large sum indeed).

All states passed the law. In some cases they did so reluctantly, being resentful of the federal pressure. However, it was a relatively easy political decision to make because the 18-21 year age group is a high risk group and are not politically powerful, and the sum of money involved was large.

B. Finally, there was another initiative during the 1970's which failed. In this one the federal government attempted to withhold certain modest funds from states that failed to enact motorcycle helmet laws. Nearly all the states had such laws at that time. The federal government, for political and legal reasons, was not, in fact, able to withhold federal funds from states without helmet laws. During later years many states that had previously passed helmet laws under the threat of this loss of funds have now repealed such laws.

Summing up.

1. The federal government has usually attempted to influence state government through specific rather than general programs (which is consistent with one of the principles of behavior management). Thus, they have influenced specific legislation as to drinking age, use of seat belts and helmets, but have not dealt with general goals such as "reduce crashes by 10 percent."

2. Financial incentives succeeded in the case when the disincentive was large (construction funds). State politicians were willing to restrict drinking among the young (in the 1980s) to avoid a large financial disincentive, but (in the 1970s) were willing to risk a small financial disincentive with respect to helmet legislation.

2. Government influence over corporations:

A prominent example of the U.S. government influencing corporate behavior in safety relates to the Federal Motor Vehicle Safety Standards which the U.S. government imposes upon all manufacturers selling cars in the U.S.

In view of this sort of power, it is perhaps not useful to think in terms of principles of behavior or incentives. Nevertheless, the principles of rewards are perhaps still relevant because corporations, though obliged to obey, nevertheless have means for delaying the process if they fully exercise their various

appeals, etc. When the government considers incentive procedures there is, perhaps, less litigation and delay.

It is interesting to note that the US government has set up a sort of incentive program for car manufacturers regarding air bags. I refer to the fact that FMVSS 208 requires an automatic restraint -- either an air bag or automatic seat belts. In order to achieve a larger number of air bags, NHTSA grants additional credit toward compliance if an air bag is chosen to meet the requirement.

There are other examples in which a government might use financial incentives. For example, it might be possible to tax alcoholic beverage differentially based on the alcohol content, such that the lower the alcohol in the beverage, the lower the tax. This might serve as an incentive to produce and sell low alcohol beer. The same concept might be undertaken in taxing motorcycles as a function of engine power. Thus, high powered motorcycles might bear a tax burden sufficient to discourage sales. Obviously, there are political and philosophic barriers to this kind of action. Some people do not believe it is appropriate to use tax policy to achieve social goals.

3. Government or corporate efforts to influence the individual:

I will give an example of an attempt to influence individual behavior that succeeded for a time, and then lost its effectiveness. At the time of the 1973 oil crisis speed limits all over the US were reduced to a 55 mph maximum. This required legislation at the federal government level and on the part of all 50 states.

The reduction of the speed limit to 55 mph was accomplished rather easily even though it involved strong intervention by the federal government. That is perhaps because, at the time, there was a real and visible threat to society's mobility. It was understood that reducing speed would save petrol and might also save lives.

However, political support for the 55 mph speed limit largely disappeared by the mid 1980's. One of the factors was that President Reagan, consistent with his approach to many social programs, made clear his lack of interest in federal support for the 55 mph limit. Members of the public could presumably recognize a distinct incentive to drive faster. Driving 65 mph instead of 55 represented an increment in speed of 18 percent. This was apparently persuasive even though, on most trips, the time saving amounts to only a minute or two.

For many citizens there was no disincentive against driving faster in the time of seemingly plentiful fuel and low fuel costs. Whereas the average driver can readily perceive the benefit of driving faster, the driver cannot readily perceive the associated difference in crash risk since the risks are low at 55mph and at 65mph.

4. Individuals influence over a government or corporation:

It was difficult to think of an example in this category. The only thing I could think of is the so-called "one issue politics." There is an increase in the U.S. of pressure groups seizing on single issues and bringing enormous political pressure to bear on government leaders to comply on that one single issue. Abortion

policy is a good example. The political behavior targeted by the pressure groups is quite specific and the reward is specific as well, in terms of criticism versus praise and financial support. "Single issue" politics seems to work rather well in the USA, much to the dismay of politicians. Politicians hate this approach – perhaps because it is effective. In turn, perhaps the effectiveness is an outgrowth of sound behavioral principles.

WHAT IS TO BE MADE OF THESE POINTS?

As we move across the scale from individual behavior to group behavior to corporate behavior, do we move more and more away from a context in which the rules influencing individual behavior are applicable, or do these principles apply at the group level as well? Let us review the principles stated in the beginning:

It is better to be specific rather than general. We might prefer that the government enact specific measures, with target behavior clearly specified and highly goal relevant (i.e., a link to safety). With those conditions satisfied, then the behavior is observable and measurable, so that the appropriate consequences can be applied.

CONCLUSION

Misuse and misstatement of the principles of human behavior have been observed in road safety endeavors over the years, thus, it is good to see that this conference deals with the scientific factors that influence human behavior.

Road user behavior is central to safety; therefore, effective programs to increase safety should proceed on a scientifically based understanding of the means to influence behavior. Reward and incentive conceptions are a basic part of this effort.

DE RÉAGIR AUX NOUVEAUX CONTRATS - 10%

COMMENT INFLUENCER LES POLITIQUES LOCALES ET PRIVILÉGIER LES ACTIONS VERS L'USAGER

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Les accidents de la circulation sont nés avec l'automobile et on a pu constater, en France, que l'insécurité routière s'était détériorée au rythme de son essor jusque vers les années 1972. A cette époque, la prise en charge au niveau gouvernemental de ce problème et la définition d'une politique ambitieuse a permis une véritable rupture de cette progression. En effet, après un quasi doublement du nombre de morts sur les routes entre 1960 et 1972, année la plus catastrophique en France avec après de 17000 tués, la politique mise en oeuvre s'est traduite directement et immédiatement par une baisse importante de 4500 tués en 6 ans pour atteindre 12500 tués en 1978. Cette politique visait non seulement l'amélioration de l'infrastructure, du véhicule et des secours, mais aussi la modification du comportement de l'utilisateur par l'adoption des premières grandes mesures réglementaires et par la naissance d'une politique de communication.

Toutefois, force était de constater au début des années 80 que si les gains en vies épargnées se consolidaient, les progrès se stabilisaient et on semblait être entré dans une phase de stagnation: 12500 tués par an, au-delà d'une statistique qui semblait ne plus vouloir évoluer, ce chiffre représentait des drames humains inacceptables pour la société toute entière. La réglementation et l'action classique sur les infrastructures bien qu'indispensables restaient insuffisantes et le Gouvernement a pris conscience que pour obtenir de nouveaux gains il était indispensable de développer au niveau local une mobilisation plus forte, une prise en charge plus importante de l'insécurité routière. Celle-ci ne devait plus être considérée comme de la seule responsabilité de l'Etat mais de celles de tous les responsables locaux: il fallait sensibiliser l'ensemble du corps social aussi bien les élus, les administrations, les techniciens que les associations ou les milieux socio professionnels pour toucher directement l'utilisateur et tenter de faire changer son comportement.

A la base de cette politique, deux programmes essentiels ayant pour principal objectif la mobilisation locale ont été décidés en 1982: le programme *Réagir* et le programme *Objectif -10%*.

Le programme *Réagir* dont le sigle signifie: "Reagir par des Enquêtes sur les Accidents Graves et par les Initiatives pour y Remédier" a été décidé en partant du constat que chaque mort sur la route est inacceptable, que l'accident n'est pas une fatalité et que, pour éviter qu'un accident se reproduise, il faut l'avoir compris.

Trois principaux objectifs ont donc été assignés à Réagir:

- Mobiliser au niveau local autour du drame que représente l'accident.
- Améliorer les connaissances en essayant de mieux le comprendre.
- Promouvoir des actions de prévention pour éviter sa reproduction.

Ainsi, à l'instar des accidents de train, d'avion ou de car, il a été décidé que chaque accident mortel ou très grave de la circulation ferait l'objet d'une enquête technique distincte de l'enquête judiciaire. Réalisée par une équipe pluridisciplinaire cette enquête n'a pas pour objectif de rechercher des responsabilités mais de rechercher l'ensemble des causes ayant pu intervenir et jouer un rôle avant, pendant et après l'accident. Ces causes concernent aussi bien l'utilisateur, l'environnement, l'infrastructure, le véhicule que l'intervention des secours et des soins et pour chacune d'elles, la commission d'enquête doit faire des propositions d'actions pertinentes de façon à ce qu'un tel accident ne se reproduise pas. Chaque enquête fait alors l'objet d'un rapport adressé par le préfet à tous les partenaires susceptibles de mettre en oeuvre les actions proposées.

Pour réaliser les enquêtes, il a été décidé, dans un souci de mobilisation et de diffusion des connaissances, non pas de créer un corps de "spécialistes" mais de faire appel à tous ceux qui sur le terrain, sont concernés. Tout en restant dans leur différente famille d'origine et en continuant à assurer leurs tâches habituelles, techniciens de la route, représentants de la police, des services de secours et de soins, des associations d'utilisateur et des milieux socio professionnels apportent chacun dans leur domaine, leurs compétences et leur sensibilité. Par ailleurs, sensibilisés par une formation initiale de deux jours et par leur confrontation à l'accident sur le terrain, ces enquêteurs deviennent de véritables relais et mobilisent autour d'eux pour la cause de la sécurité routière.

Lancé en 1983, le bilan de ce programme est largement positif aussi bien en ce qui concerne la mobilisation des partenaires, l'amélioration de la connaissance que la modification du comportement de l'utilisateur.

En effet, sur le terrain près de 8000 enquêteurs ont été formés et sensibilisés à la sécurité routière, plus de 15000 enquêtes ayant fait l'objet de débats, d'entretiens, de rencontres avec les témoins ou les proches des victimes ont été réalisées et diffusées aux partenaires locaux. La pression sociale a entraîné la mobilisation de la classe politique facilitant l'adoption d'un certain nombre de mesures nationales telles que l'alcool ou la ceinture. Les collectivités locales, informées et associées aux enquêtes se déroulant sur leur territoire, se sentent beaucoup plus directement impliquées.

Au niveau de la connaissance, les 15000 enquêtes réalisées sont rassemblées dans une banque de

données nationale accessible à tous les partenaires. Ces enquêtes ont notamment permis de mettre en évidence la multiplicité des facteurs intervenants dans un accident ainsi que leurs croisements; cette connaissance acquise depuis longtemps par les chercheurs n'était jusqu'alors pas prise en compte par les services ou par les usagers. Les exploitations thématiques ou les synthèses de l'ensemble des enquêtes réalisées aussi bien au niveau national que local ont fait l'objet de larges publications mettant en évidence que le comportement de l'usager intervenait dans 94% des accidents mortels. Enfin, on a pu constater une amélioration de la culture générale en accidentologie de chaque partenaire grâce aux rencontres, aux discussions aux échanges et au travail en commun réalisé par les enquêteurs sur les accidents.

Mais, ce programme d'également influencer les politiques locales car nombreuses sont les propositions qui formulées dans le cadre de Réagir ont été mises en oeuvre: ainsi, et de façon non exhaustive, on peut noter la réalisation, le plus souvent très rapide, de la plupart des propositions relatives à l'infrastructure, certaines collectivités ayant même décidé de créer une ligne budgétaire spécifique pour réaliser dans les plus brefs délais ce type d'actions. La mise en évidence des problèmes d'alerte et de secours a été à l'origine de l'amélioration ponctuelle de certains plans de secours, de nombreuses campagnes relatives à l'alerte et d'actions de formation aux gestes élémentaires de survie. Enfin, le fait le plus important est le fort développement des actions de communication locale: il n'existe pratiquement plus un département n'ayant pas réalisé une action de communication suite à une proposition Réagir et nombreux sont ceux dans lesquels des enquêteurs Réagir font des interventions dans les entreprises, des écoles, des collectivités, des clubs du 3ème âge pour échanger avec les participants sur les problèmes du comportement des usagers.

Toutefois au delà du programme Réagir qui visait principalement la mobilisation des services, il fallait trouver un moyen mobiliser de façon beaucoup plus intense les responsables politiques locaux. Le Gouvernement en 1981 s'était fixé un objectif de réduction d'un tiers en cinq ans du taux de mortalité sur les routes et il était évident que cet objectif ambitieux ne pouvait être atteint que s'il était partagé par l'ensemble des partenaires et notamment par les collectivités locales d'où l'idée du programme Objectif -10%.

Le principe en était simple: toute collectivité d'au moins 50000 habitants qui décidait de mener des actions pour réduire d'au moins 10% le nombre d'accidents corporels sur son territoire sur une période de 12 mois par rapport aux 12 mois précédents avait la possibilité d'obtenir des aides financières de l'Etat. Dès son engagement, une dotation initiale d'incitation sur la base de 1 franc par habitant avec un minimum de 100.000 F. et un maximum de 500.000 F. dès l'atteinte de l'objectif -10% et à chaque atteinte d'objectif une dotation de réalisation d'objectif basée sur le nombre d'accidents évités avec 10.000 F. par accidents en moins en ville et 20.000 F. par accident en moins en rase campagne.

Le bilan de ce programme, qui a pris fin en décembre 1988 est tout à fait positif au niveau de l'adhésion des collectivités et des résultats obtenus. En effet, pratiquement 90% des collectivités

concernées se sont engagées et 87% d'entre elles ont atteint au moins une fois l'objectif (41% au moins deux fois, 14% au moins trois fois, 5% quatre fois et 1% cinq fois).

Le bilan est plus difficile à faire en ce qui concerne son impact sur la mobilisation effective des collectivités et sur l'utilisation des crédits affectés à ce programme soit en moyenne 70 millions de francs par an. Toutefois, il est certain que cette politique a eu des effets tout à fait positifs et est à l'origine d'évolutions significatives pour une prise en charge de la sécurité routière dans un grand nombre de collectivités. Ainsi, on a pu constater une organisation nouvelle des services pour la prise en charge de la sécurité routière, la constitution de fichiers d'accidents, la création d'une ligne budgétaire spécifique sécurité routière et l'émergence de nombreuses actions de communication et dans une moindre mesure d'éducation et de formation suite à une prise de conscience de la nécessité de mener d'autres types d'actions que celles relatives à l'infrastructure. Sans l'apport des crédits -10%, ces actions aux dires de certaines collectivités n'auraient pas été menées.

Réagir, Objectif -10%, la politique locale développée à partir de 1982 a eu pour principale conséquence de mobiliser un nombre croissant de partenaires et de multiplier les actions visant la modification du comportement de l'usager. Ainsi, par exemple, en 1988, l'état a eu connaissance de 250 actions de communication réalisées sur le terrain alors qu'on n'en comptait qu'une dizaine environ avant 1982.

Devant cette diversité d'actions et d'acteurs agissant le plus souvent de façon indépendante, voire désordonnée, il a semblé indispensable de proposer à tous les partenaires publics et privés d'un même département de se rassembler pour fédérer l'ensemble des actions. Dès lors, et depuis 1988, à la demande du Premier ministre, un plan départemental d'actions de sécurité routière (PDABR) est établi chaque année sous la responsabilité du préfet. Cadre de cohérence et de concertation des acteurs, il a donc pour objectif de développer, rassembler, fédérer l'ensemble des actions publiques et privées. Le PDABR s'appuie sur un diagnostic de la sécurité routière (et notamment sur la synthèse départementale de 5 enquêtes Réagir), organise la concertation des acteurs et recherche la coordination des propositions.

Son élaboration fait donc l'objet de réunions de l'ensemble des partenaires regroupant les services de l'état (Préfecture, Forces de l'Ordre, les Services de Secours et de Soins, la Justice, l'Education Nationale...), les collectivités locales, les enquêteurs Réagir, les milieux associatifs et socio-professionnels... à partir du travail d'un groupe permanent opérationnel ou des réflexions menées au sein de sous groupes thématiques.

Les plans départementaux d'actions de sécurité routière élaborés dans pratiquement tous les départements regroupent de très nombreuses propositions dans les différents domaines: l'infrastructure mais aussi et surtout l'éducation, la formation, la communication, la surveillance et les contrôles, l'alerte et les secours. Ces actions (en dehors des actions d'infrastructure) qui visent prioritairement la modification du comportement de l'usager peuvent obtenir une aide financière de l'état d'environ 20 MF par an pour l'ensemble du territoire, à condition qu'elles correspondent aux objectifs

gouvernementaux et qu'elles impliquent des partenaires locaux dans leur mise en oeuvre.

L'évaluation des premiers plans réalisés en 1988 a montré une très grande diversité d'action, l'émergence d'actions pertinentes dans les différents domaines et l'implication de nombreux partenaires dont certains avec lesquels on avait peu l'habitude de travailler. Toutefois, elle a également mis en évidence dans un certain nombre de départements le manque d'implication des collectivités locales. Il fallait donc réfléchir à une nouvelle politique contractuelle avec ces dernières les incitant à mener une démarche identique sur leur propre territoire et à être des partenaires à part entière dans le cadre de l'élaboration et de la mise en oeuvre des actions proposées au plan départemental.

Fin 1988, il a donc été décidé de mettre un terme au programme Objectif -10% et de proposer une nouvelle politique contractuelle. Elle devait permettre d'aider un plus grand nombre de collectivités souhaitant mener des actions pour l'amélioration de la sécurité routière.

En effet, la précédente procédure c'est-à-dire le programme Objectif -10% ne permettait d'aider financièrement qu'environ 70 collectivités par an sur les 214 engagées (celles qui atteignaient l'objectif) et l'état n'avait aucun moyen d'orienter l'utilisation des crédits affectés.

La nouvelle politique appelée "contrat de programme local de sécurité routière" est proposée à toutes les collectivités de plus de 30.000 habitants et est prévue sur trois années de 1990 à 1992. Elle est basée sur un contrat négocié, signé et financé paritairement par l'état et la collectivité locale. La participation financière de l'état, jamais supérieure à celle affectée par la collectivité, est calculée sur la base de 1 F. par habitant avec un maximum de 800 000 F. pour une collectivité de plus de 800.000 habitants.

Tout type d'actions justifié par un problème de sécurité routière peut faire l'objet d'un contrat. Toutefois, de façon à privilégier les actions visant à une modification de comportement de l'utilisateur, le coût des actions relatives à l'infrastructure et aux équipements pour l'alerte et les secours ne doivent pas dépasser 50% du montant global du contrat. Le budget de l'état affecté aux contrats en 1990 étant de 40 millions de francs ceci signifie qu'au titre de ce programme 40 millions de francs minimum seront affectés à des actions d'éducation, de formation, de communication ou de contrôles. Compte tenu des 20 millions de francs affectés aux plans départementaux d'actions de sécurité routière ce sont 60 millions de francs minimum qui en 1990 permettront de financer des actions vers l'utilisateur. Aujourd'hui, le problème n'est donc plus un problème financier mais plutôt un problème de capacité à faire et de pertinence des actions proposées.

Enfin, de façon à "récompenser" les collectivités ayant obtenu une réduction de leurs accidents une prime aux résultats est proposée aux collectivités la deuxième et la troisième année du contrat. Pour cela, la collectivité doit avoir diminué d'au moins 10% le nombre des accidents corporels sur son territoire pour la première année par rapport à l'année avant signature du contrat (année de référence) et d'au moins 15% la seconde année de signature par rapport à cette année de référence.

Bien entendu un certain nombre d'engagements lient les contractants et notamment celui pour la collectivité de participer à l'élaboration et à la mise en oeuvre du plan départemental d'actions de sécurité routière dans lequel doit bien entendu être inscrit le projet de contrat.

Au 1^{er} juillet 1990, 180 collectivités ont signé un contrat avec l'Etat et les actions vers l'utilisateur représentent 57% du montant global affecté par l'Etat et les collectivités ce qui est tout à fait remarquable, avec principalement des actions de communication puis d'éducation et de formation. Près de 10% des crédits restant sont affectés au diagnostic c'est-à-dire création de fichiers accidents, équipement en logiciel et matériel ou encore étude spécifique permettant une meilleure définition des actions pour les années à venir.

L'adhésion et les actions proposées représentent un premier succès de cette nouvelle politique. Toutefois, il est évident, que ce soit dans le cadre de ces contrats, de Réagir ou des plans départementaux d'actions de sécurité routière qu'il faut maintenant apporter plus de technicité pour franchir une nouvelle étape et donc plus de compétence à ceux qui ont la charge, l'élaboration et la mise en oeuvre des propositions notamment dans deux domaines importants que sont le diagnostic et la communication. Dans ces deux domaines des actions de formation sont d'ores et déjà proposées aux opérateurs locaux.

En conclusion, nous sommes persuadés que la modification des comportements et des mentalités en matière de sécurité routière passe par un débat social large et permanent qui ne peut être suscité et animé qu'au niveau local, au niveau de la vie des usagers. La mobilisation locale est donc essentielle pour l'amélioration de la sécurité routière.

La baisse des accidents enregistrée depuis 1983 correspond à un phénomène complexe. Toutefois, il est certain que les programmes développés depuis cette date, même s'ils ne peuvent en être la seule explication, y ont largement contribué.

EVALUATION OF A STIMULATION PLAN FOR MUNICIPALITIES IN THE NETHERLANDS

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1. Road safety policy in the Netherlands

Early in 1987, the Dutch National Road Safety Plan for the years 1987-1991 was published called 'More kilometres, less accidents'. The Dutch Government considered the standard of road safety to be unacceptable and announced extra policy efforts. In the plan two main directions are distinguished.

"-we are looking for new ways to focus the attention of citizens and governments on the improvement of road safety;

-we will select a small number of 'profitable priorities' as central themes in the new policy".

A quantitative goal was set for the first time: a 25 percent reduction in casualties by 2000.

With the formulation of the task '-25% in 2000' today, the intention is to keep the subject of road safety on the political agenda for a number of years in succession in order to enhance the probability of achieving the essential aim - a reduction in the road toll.

A Minister alone cannot manipulate fourteen million road users in the Netherlands, nor 13 ministries, 12 provinces, 700 municipalities and many tens of social factors. The extent to which the goal '-25% in 2000' will draw the support of politics and society cannot be stated in advance. Although its simplicity and verifiability is appealing, will the goal be attractive to others - not only to the Central Government? The Dutch Government attempted to increase public support for road safety policy along several lines. The most important of these was the 'Stimulation Plan Actie -25%' directed at municipalities. The combination of a quantitative goal and the Stimulation Plan for municipalities constituted one of the cornerstones of road safety policy in the Netherlands.

2. 'Stimulation Plan Actie -25%': aim, philosophy and organisation

The aim of Actie -25% is to encourage municipalities to develop and implement more and better road safety policy resulting in a reduction of the number of road casualties, especially on the nationally set priorities.

The basis for the policy developed for Actie -25% can be found in France and Austria. In 1982, France commenced a programme called 'Objective -moins 10%' (Brühning, 1985). In this programme, the

French government created the opportunity for (large) municipalities and arrondissements to receive a subsidy if they improved road safety to a certain extent. The underlying intention was to focus social, political and administrative attention on this issue. Emulating this French initiative, Austria commenced a plan called 'Aktion Minus 10%' (Risser et al., 1987). This plan also granted municipalities (relatively minor) extra funding, although the scheme relied mainly on the presumed stimulating effect of public praise for local government achievement.

Central to the philosophy behind the Dutch Plan Actie -25% is the thought that a financial bonus would stimulate municipalities to broaden and enhance their road safety policy, thus delivering an extra contribution to achieve the ultimate goal: '-25% in 2000'. Moreover, the transfer of relevant information was seen as vital.

The Stimulation Plan was intended to initiate a process of change in the municipalities. In order to do so, the thought was to increase local awareness of the problem by confronting the municipality with the number of road accident casualties every year. Furthermore, municipalities had to realise that the number of road accident casualties could be reduced through their own efforts. They had to be made emphatically aware of the number of casualties over the past year and rewarded for a reduction in the number of casualties. By spreading the plan over a number of years, the intention was to bring about a structural change in municipal policy, rather than an incidental, brief change - this would be brought about by a temporary boost in finance. The money received by the municipalities could be spent as they saw fit.

The policy of not placing specific demands on how the funding should be used was based firstly on the generally accepted thought that local governments are in a better position to conduct policy 'close to home' than are other government levels. Also, past experience has shown that the imposition of demands (planning obligations, legal consequences) was not always effective, nor efficient.

The municipalities were confronted with an invitation by national government - an invitation which held out an offer to broaden their financial scope and to provide special know-how. In responding to this invitation, municipalities would certainly receive a financial advantage by (formally) stating their intention to improve road safety, while no demands were made on how they should achieve this nor how grants and bonuses should be spent.

Every municipality could participate in the scheme provided it had at least 20 000 inhabitants; smaller municipalities could join together to reach that number. Participation was realised through a formal statement of commitment by the town council. Every participating municipality received an initial grant, amounting to Dfl 1 per inhabitant, with a minimum of Dfl 10 000 for each municipality involved and a maximum of Dfl 100 000.

The Stimulation Plan Actie -25% covered 1987, 1988 and 1989. At the end of every year the number of road casualties was compared with a reference (number of road casualties in 1984 + 1985 + 1986 divided by three). In 1987, the number of casualties had to be 5% less than the reference, in 1988 10% and in 1989 15%. If this drop was achieved, the municipality or group of municipalities received Dfl 5,000 per casualty saved as an achievement bonus. This bonus could be spent at the behest of the councils. Every year financial awards could be given to municipalities, private organisations, companies or individuals that had made a special contribution in the area of road safety. These awards were given in each province. A jury decided who was eligible for an award; a sum of Dfl 50,000 was reserved annually for each province.

The Ministry offered the municipalities two fold assistance – by sending information at quarterly intervals and through so-called Regional Road Safety Agencies, rendering assistance free of charge. Today, each province in the Netherlands has such a platform – created to coordinate and stimulate the road safety activities.

The government aimed for a participation of about 230 larger municipalities and 50% of the smaller municipalities.

In the middle of 1987, immediately prior to the Minister's official launching of the Stimulation Plan, Parliament responded in a largely negative way. Doubts were voiced about the effectiveness of the plan. Furthermore, ethical objections were raised to varying the payout according to reduction in road casualties. Members of Parliament also criticised the system on its method of calculating the payout, as the influence of chance fluctuations would be great. Finally, criticism was directed towards the concept of encouraging municipalities by means of a reward system. Furthermore, is it acceptable in a decentralised state, where various government levels have their own responsibility, for the Central Government to impose a moral obligation on municipalities?

Despite these criticisms, the Minister persisted. However, she did consent to have 'Actie -25%' accompanied by an evaluation study.

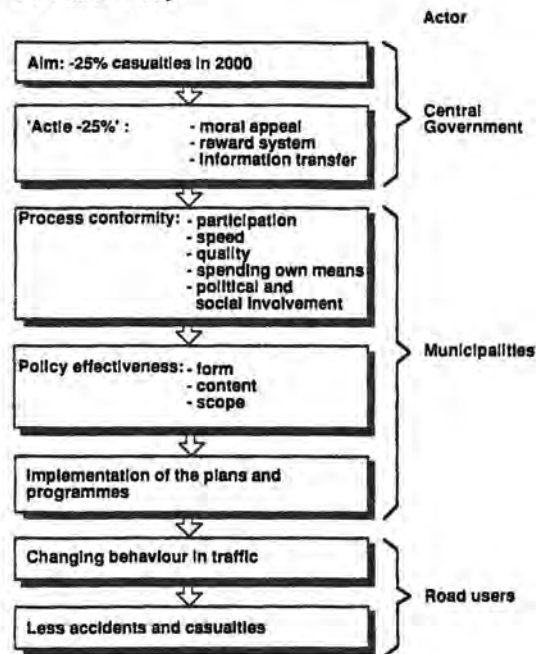
3. Setup of the evaluation study

The SWOV Institute for Road Safety Research was assigned to conduct the evaluation study. Two central questions were at issue:

- Did Actie -25%, i.e. did the extra (municipal) activities resulting from Actie -25% lead to fewer road accident casualties?

- In which ways did the organisation of Actie -25% lead to extra (municipal) activities? Can one expect changes in organisation and implementation to lead to increased or better participation of municipalities? The outline of the evaluation study is given in Diagram 1.

Diagram 1. The causal chain as basis for the evaluation study



Two surveys were conducted amongst all Dutch municipalities to examine their reaction to the various parts of the Plan (response in the summer of 1988 58% and in 1989 51%). A case-evaluation of ten municipalities was conducted to examine whether in fact road safety policy had intensified and improved. An accident study was carried out to assess whether the Plan intervention can be traced to the accident pattern. A report has not been submitted on the accident study as yet. In the meantime, it looks as though we shall be unable to make scientifically valid statements about the extent to which the Stimulation Plan contributed to an increase in road safety. Some of the more important results from the evaluation studies are described below.

4. The response of the municipalities

The Plan commenced in early July, 1987. The response of the Dutch municipalities was extremely good. Before the application date of October 1, 1987, 91% of all municipalities had registered. This figure has increased to 98%.

Table 1. Response of the Dutch municipalities to 'Actie -25%' and the amount of money spent

	1987	1988	1989	Total
Total number of municipalities	714	705	702	
Participating municipalities (in %)	651 91%	684 97%	689 98%	
Initial grants (Dfl. in mill.)	13.3			13.3
Achievement bonus (Dfl. in mill.)	12.3	7.4	3.5	23.2
Number of municipalities receiving a bonus	250	200	80	
Awards (Dfl. in mill.)	0.6	0.6	0.6	1.8
			Total amount	38.3

As the Ministry wanted quick results with the project, it was decided to allow municipalities to earn an achievement bonus beyond 1987, even though this was not likely to be due to any extra municipal activities issuing from the Plan.

Table 1 gives an overview of municipal participation and the initial grants paid by the Government. This table also shows how many municipalities were granted achievement bonuses and the amounts received.

The survey (Miedema et al., 1989) divided the decision-making process of municipalities into various levels: strategic (participation, type of cooperation, scope of municipal efforts), tactical (policy content and distribution of means available) and operational (implementation of policy). Decisions at a *strategic level* have caused almost all Dutch municipalities to participate. Small municipalities (< 20,000 inhabitants signified a joint effort) did not apply to any lesser degree, nor were they slower to respond; therefore, the collaboration requirement did not prove to be an obstacle. In about half the cases, this requirement led to collaboration in practice. About 30% expected to continue this collaboration.

Almost all municipalities stated they would use the initial grant and any achievement bonus on road safety. Over one quarter (28%) provided extra money (an average of Dfl. 130,000) and manpower; 19% provided only additional manpower.

Why did the municipalities respond (so quickly) to the Plan? The case-studies (Boskma et al., 1990) showed that in all (10) municipalities studied, the official recommendation to the council with regard to participation was positive: the Minister's request did not impose any burden on the municipalities, improvement of road safety was already an official policy aim and the financial opportunities of the municipalities would be enhanced. Complaints were sometimes voiced at political level, similar to those heard in Parliament. Furthermore, mass participation led to social pressure on non-participating municipalities.

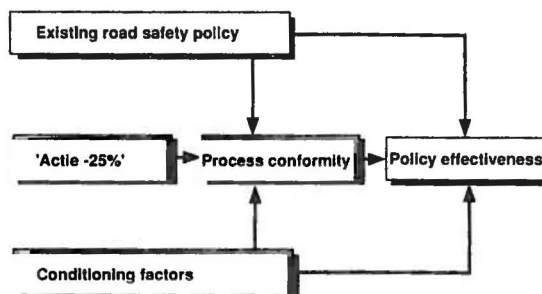
The *tactical decision level* relates to the type and content of road safety policy. About 20% of the municipalities stated that the initial grant was used to set up a road safety plan. By the middle of 1989, over 10% of the municipalities still had not allocated the initial grant to any plan. Almost 50% financed new measures with the money. Measures in the field of education and public information increased, while attention to infrastructural measures relatively decreased. Similar conclusions can be drawn for achievement bonuses.

Developing a road safety plan is one way to improve road safety on a more organised basis. Another is to introduce changes to the bureaucratic organisation. The number of road safety coordinators was increased by over 30%. A last option is to intensify consultation with citizens and society; this was not brought about by the Plan.

When we consider the results of the in-depth study, it appears that both with regard to scope, form and content of policy, improvements could be noted. These improvements varied greatly from one municipality to another. They could relate to a large number of factors, such as those represented in the conceptual model used in the case-studies (Diagram 2).

The researchers have described process conformity using five variables and policy effectiveness using

Diagram 2. Conceptual model as used in the case studies.



three variables (see Diagram 1). A verdict in summary is expressed for both.

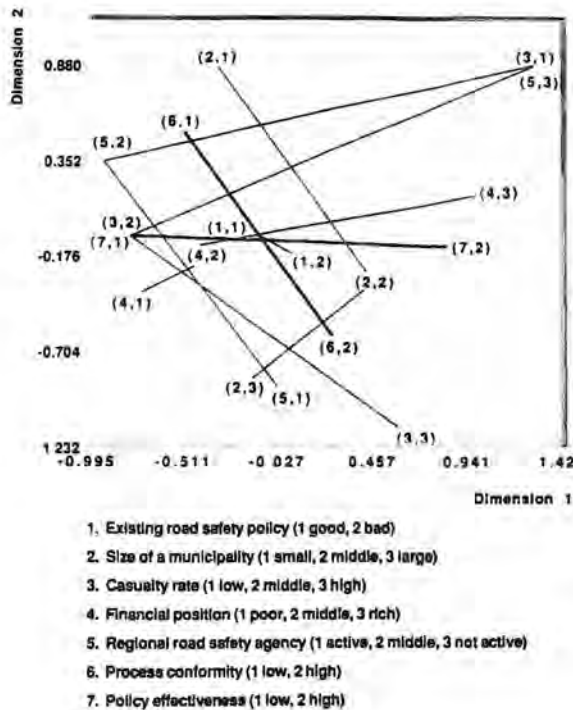
In the case-studies hypotheses were formulated about the effect of Plan elements and conditioning factors on process conformity (are municipalities acting in accordance with the aims of Actie -25%) and policy effectiveness (can the policy adapted be expected to lead to a reduction in the road toll?). The basis for these hypotheses was formed by the suppositions proposed by the designers of the Plan. For further information on the study method, we refer to the study report (Boskma et al., 1990).

In order to assess the extent to which relationships existed between Plan elements and conditioning factors on the one hand and process conformity and policy effectiveness on the other, the case studies used a cross-table analyses (bi-variate hypothesis check) in combination with separate process analyses per case (municipality). To get a better understanding of the complete relational structure of the conceptual model a correspondence analysis has been carried out, using the HOMALS-programme (Diagram 3). Correspondence analysis is a descriptive technique, resulting in a graphical representation of relations between concepts, such that similar concepts (frequent combinations of categories) are pictured close together and opposites far apart in the representation space. A detailed description of this and related techniques is found in Gifi (1981).

The analyses showed that the road safety policy used before Actie -25% had no influence on process conformity, nor on policy effectiveness. Municipalities that conducted good policy were not inhibited, municipalities that conducted poor policy were not stimulated to any greater degree. The larger cities (>30,000 inhabitants) conducted a policy that better fitted the wishes/ideas of national government (greater process conformity) than did smaller municipalities. This is not the case where a Regional Agency was active. Frequent contact with a Regional Agency did hardly lead to greater process conformity; in all probability, an active Regional Agency is certainly not a 'conditio sine qua non' for policy effectiveness, but can be very helpful. It is intriguing to note the relationship between a municipality enjoying a favourable financial position and achieving greater policy effectiveness. This seemed to relate particularly to the increase in financial means (policy scope).

Of course, to assess the degree and quality of any improvements remains extremely difficult, if not impossible, if they are considered separately from actual implementation of the measures and their consequences for road safety. In the following section, the study results of decisions made at the

Diagram 3 Correspondence analysis on data from case studies.



operational level will be discussed: implementation of the proposed measures.

5. Changes in municipal road safety policy

The next step in the causal chain is to examine how municipalities actually executed measures that resulted from Actie 25%. The study results clearly show that municipalities were considerably slower in implementing policy than was expected. They did not seem to be intent on pursuing the achievement bonus. In 1988 and 1989, the same number of measures were taken as in previous years, however, a shift did manifest itself: more activities in the field of education/information and less police enforcement and infrastructural measures.

Why have the municipalities responded so slowly, or is there only question of tardiness in the light of a too-high tempo as presupposed by the designers of the Plan? The entire Plan in fact had something contradictory. Municipalities were encouraged to act quickly, although they were still expected to do so on a systematic basis. A paradox where, at least we would like to think, the municipalities proved to be the wiser. The study showed that municipalities have difficulty in planning and conducting innovative road safety measures (Davelaar, 1990). The tradition is lacking, as is know-how and experience in many cases, they miss a well-oiled organisation. The surveys have also made it clear that implementation of policy took longer than the municipalities themselves anticipated when the Plan commenced. Both municipalities and the Central Government were evidently too optimistic about the speed at which local road safety policy could be implemented.

In recent years national road safety policy in the Netherlands has seen a certain broadening in scope. Not only with regard to infrastructural measures, more attention was also paid on influencing behaviour through information plans, police enforcement and education. The municipalities appear not to have advanced from this broadening

tendency; rather, they have created a shift. A number of explanations could be offered: education and public information seems to be cheaper than adaptation of the infrastructure and enforcement. This is of interest because the financial position of Dutch municipalities deteriorated during the period under consideration. It could also be true that over a three year perspective, municipalities expected faster results from education than from infrastructural measures. This may be due to the relatively short duration of the Plan. The shift in policy seems to be rather contradictory with the finding that municipalities expected more favourable effects from infrastructural measures than from police enforcement and educational measures.

When we consider the results of the Plan in the light of 'more and better policy', we may conclude that almost all municipalities in the Netherlands paid extra attention to road safety, that they were very keen to conduct more and better policy, that a limited number of Dutch municipalities have created conditions for more and better policy (safety plans, appointment of coordinators) and that road safety policy has been given a financial shot in the arm. All money made available was spent on road safety and municipalities have also added their own funds. But the study has taken place (too) prematurely to arrive at any definitive judgement on the effectivity of the Plan in terms of structural improvements of road safety policy in Dutch municipalities and in terms of reduction in casualties.

The evaluation study results indicated, however, that a Stimulation Plan is very promising and should be continued, albeit in a different form.

6. Recommendations for a continuation of the Stimulation Plan

Although the concept of the achievement bonus fits in well with the quantitative goal, a better method should be found. The method used to date depends too much on accident statistics alone, where municipalities seem insufficiently capable of realising a positive change through their own activities. Furthermore, the wish to reward actual achievement resulting from plans and programmes implemented conflicts with the wish to give an achievement bonus on an annual basis. This is dependent on the degree of safety per municipality and the anticipated drop in the annual number of casualties. To unfairly receive or miss out on bonuses must be weighed up against the stimulus issuing from annually received (and perhaps undeserved) payments. It may be better to accord less weight to payment on the basis of accident statistics, preference might be given to reward policy carried out, for which the anticipated positive effect is otherwise established. This type of bonus does however require policy to be assessed on the basis of effectiveness/efficiency. It is further recommended that municipalities be considered for incentive payments from the State for a much longer period of time. It is expected that an annual discussion by many municipal councils on the subject of road safety - for example, discussion about the allocation of bonuses received - will be more effective (in the light of 25% in 2000) than a discussion in just a few municipalities that have 'earned' large reward amounts.

Finally, it is recommended that greater attention be paid to the transfer of knowledge and help in the implementation of projects. The creation of a network of experts (professionals who have the latest knowledge at their disposal, knowledge that is made

available in an attractive manner) is a vital factor for the further development.

The evaluation study has provided much information about the course of the Plan and the reaction of municipalities to stimulation by the State. Based on the results of the evaluation study, the Minister has decided to continue with this strategy, a decision which Parliament agreed to early in July, 1990. However, a number of adaptations will be introduced.

Achievement bonuses with respect to casualty figures remain unchanged. However, they are decreased while the requirements to qualify for a bonus are changed. Transfer of knowledge is intensified. Awards continue to be offered. New, however, in the Stimulation Plan: under certain conditions municipal activities may be subsidized. It has been decided in principle to allow 'Actie -25%' to run until the year 2000. A new study will have to demonstrate whether or not the newly-designed system is living up to its expectations.

7. Success and failure factors for municipal road safety policy

The approach to road safety in municipalities remains complicated. This is due to the nature of the problem, the fact that there are many different ways to approach it and a lack of administrative experience in this area. Furthermore, a particular lack of knowledge exists about the relationship between policy content and the effect on road safety. If the policy is to have an effect, a number of conditions must be satisfied, formulated in terms of success and failure factors. They relate to a mixture of political will, organisation and means and knowledge (as shown in Diagram 4). All elements are essential to the end result, which is therefore dependent on the weakest link in the chain. One element cannot be replaced by several of the two other elements.

With regard to *political will*, it may be noted that road safety policy cannot be conducted without emphatic support from the municipal council. A good policy will never be realised if the council does not regularly discuss the problems and their solution. The municipal council can pledge itself to years of continuous effort for the improvement of road safety on the basis of a quantitative goal. Improvement of road safety is a question of tenacity - not one for (politically interesting!) short-term successes. Without such a quantitative goal, more likely than not lip service only will be paid to road safety policy.

Diagram 4. Success and failure factors: a mixture of political will, organisation and means and knowledge.



The officialdom and their managers must realise that the improvement of road safety requires in their *organisation* the necessary time, manpower and money in policy preparation, implementation and evaluation. It is not a subject that offers quick and easy results. The approach to road safety cannot be managed by one person, one discipline, one department. An effective approach must go beyond the walls of the town hall. Organisation and collaboration is therefore required. The basis for a good organisation and collaboration can be formed by an integrated road safety plan. A coordinator in road safety - an official contact - will here prove his usefulness, particularly when adequately supported by officialdom. Such a coordinator should foster collaboration without leaning on formal authority. Cooperation can be achieved both inside and outside the municipalities, for example through the assistance of 'expert groups'. These would be responsible for professional knowledge, a better understanding of the issues and active involvement; they should motivate and impress the importance of quality.

Finally, *knowledge* and knowledge transfer is of great importance. Knowledge about what is and what is not effective, knowledge that neutralises incorrect preconceptions. A problem-oriented approach is recommended, based on the analysis of accidents and on the processes that cause - or increase the probability of - accidents. This knowledge will have to be offered in an attractive manner if it is to be used.

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THE BEHAVIOUR OF PUBLIC BODIES AND THE DELIVERY OF ROAD SAFETY

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The behaviour of an individual road user is said to influence unsafety and therefore may need to be modified by incentives and dis-incentives. The modification of road user behaviour is the charge of public bodies responsible for the delivery of road safety to society. The delivery of road safety is the set of purposeful actions the aim of which is to influence the level of road safety. If so, the level of safety is influenced by what public bodies do. Therefore, just like for the road user, one may ask whether the behaviour exhibited by the public bodies which deliver road safety needs to be modified, and if yes, how this can be done.

How public bodies behave when they deliver road safety is determined by a mix of three kinds of forces: public perceptions, personal convictions and interests, and knowledge of facts. It is argued that at present the knowledge of facts is insufficiently influential in the mix. It follows that the behaviour exhibited by public bodies needs to be changed so as to endow fact-based professionalism with more influence.

Why the influence of factual knowledge on the delivery of road safety is inordinately weak has been explored earlier. In essence, the effect on safety of some program, action or design is not visible to the naked eye. Fairly wide implementation often has to precede the estimation of safety effect. Thus, by the time estimation of effect is possible, many have a vested interest in the action already implemented and few have a tangible interest in finding out whether it is useful.

To increase the influence of factual knowledge in road safety delivery requires clear recognition of the fact that, just as the road user, public bodies have self-interest and are therefore subject to incentives and disincentives. A government agency which implements or runs a program must be persuaded to believe that often the effect of this program will be independently and scientifically estimated and that the results will be published. This will be an incentive for basing actions on what is known since such actions are less likely to be found ineffective; it will be a disincentive to actions based on popularity or prejudice because their estimated effect will become publicly known.

1. ANOTHER VIEWPOINT

Scientists talk and write about how to modify the behaviour of road users be it by training, threat or inducement. This seems a natural focus because programmes and actions such as driver education, drinking-driving legislation or speed limit enforcement

all require some guidance from science. However, it is important to recognize that if one is concerned about road safety in society, only a part of the picture is in focus. The dominating point of view is incomplete and lopsided.

We are accustomed to adopt the point of view of some public body—the Ministry of Transport, the Attorney General's Office, the Police, the City Hall. Naturally, the public body is the *regulator* and occupies the (moral) high ground while the road user is the *regulatee*. Also naturally, the flow of action is unidirectional; it emanates from the public body and streams towards the road user. And similarly naturally, the relationship is asymmetrical; the behaviour of the road user is viewed as needing change while the behaviour of the public body is assumed to be given and benevolent. While this asymmetrical relationship between the public body and the road user may seem natural, it has to be recognized that the asymmetry is not inherent in the task of road safety delivery. This I will attempt to show.

Action is directed at the road user because: (a) the behaviour of road users affects road safety and, (b) because by modifying road user behaviour, public bodies can increase road safety¹⁾. It follows then that what public bodies do also affects road safety (for otherwise they should not attempt to modify the behaviour of the road user). Therefore, from society's point of view, the situation is symmetrical; (a) what road users do and what public bodies do affects road safety and, (b) by modifying what road users and public bodies do one can increase road safety. It follows that the behaviour of public bodies should also be the target of extensive inquiry and, if required, subject to thorough modification.

Were it not for the inertia of habit, I should not have to argue so hard for what is obvious. It is public bodies who design and build the road system; it is

1) The philosophical heritage of Bentham and Mills holds that people's tastes and preferences are the only legitimate source of value. While this theory of value may be faulted, it would seem that due to the lack of a widely accepted alternative theory, it is still the dominant ideology of modern government. Whenever one attempts to explicitly justify a government programme, whatever the technique, it must always be derived from the preferences of those affected.

For the delivery of road safety this may present a problem. It implies that measures initiated by public bodies must be the preferred choice of the road users and others. Thus, e.g., one must believe that motorists on the whole would prefer to have their seat belts on. If one squirms at this thought, seeing that without legislation only few would do so, the economist will use three arguments: I, the argument of uncompensated externality—if I do not buckle up, others in the car are endangered; II, the argument of reinsurance—if you become a quadriplegic my insurance premium will pay for it; III, the argument of imperfect knowledge—the road

public bodies who prescribe rules of conduct on the road, supervise it and control the operation of the road system, it is public bodies who set standards which vehicles must meet. In short, the system of road transport into which road users are born and socialized is created by public bodies. The entire machinery of road safety delivery, composed as it is from procedures for driver licensing, speed limit enforcement by police, breathalysers, traffic signals, snowplows, ambulances, defensive driving courses, airbags, railroad crossing gates and child-seat loan programmes, all this and more, is done by public bodies. The public bodies which make this big machine hum are states, municipalities, legislatures, highway and traffic engineers, bureaus of motor vehicles, police forces, safety councils, traffic psychologists, trauma centres and a host of other actors. So, there can be no reasonable doubt that the level of road safety which materializes in a society is influenced not only by what road users do but, to a large extent, by what public bodies do.

It is therefore incomplete and lopsided to think mostly about what road users should do and to worry little about what public bodies do or should do. This partiality of view is perhaps a reflection of the immediacy with which actions of other road users endanger and irritate us while the actions of public bodies are remote. Perhaps it is that many of us are in the employ of the public bodies, while next to nobody is in the employ of the road user. Perhaps our emotions and beliefs are still of the time when authority was right and man was a sinner. In any case, since what public bodies do has a profound effect on safety, there is no escape from the need to examine how public bodies behave in this respect. At least the science-community should make an effort not to be afflicted by the monocular vision of the layman.

2. HOW PUBLIC BODIES BEHAVE

The symmetry of the situation extends further. The behaviour of the road user is the result of the various human abilities, limitations, skills, experiences and motivations. Similarly, the behaviour of public bodies is the result of factors which can be named. In general terms, the behaviour of public bodies can be said to be influenced by three factors:

1) perceptions of their actions by the public;

user does not know the risks of driving and the benefits of being belted. Arguments I and II sound weak and contrived. The same arguments could be used with more force for most of our daily actions which nobody thinks of regulating. To use the argument of imperfect knowledge requires that somebody be able to say what the road user would prefer if her or his knowledge was perfect. This amounts to a complete collapse of the ideology which one is purporting to implement. For, now the values emanate not from the road user but from someone who knows better.

One can not honestly speak about influencing the road user of attempting to change the norms of conduct for a group without conceding that current tastes and preferences which are the foundation of the behaviour which one wishes to alter are not regarded as the only source of value. This must mean that values must be extracted from some other source and the use of the usual tools of normative economics is severely circumscribed.

2) The published version has been somewhat abridged by the editors. The later version is available on request.

II. opinions and interests of persons in positions of leadership or responsibility who have influence on the public body;

III. knowledge of facts. The question is, in what proportions do these factors mix.

At present, considerations of popularity, opinions of influential non experts and the interests of bureau cracy or corporation often dominate, while knowledge of fact is often poor and marginally influential. I have provided chapter and verse of this argument elsewhere (Hauer 1988, 1989) and will give only a gist of it here.

The field I know best is that of building and operating a road system. How little we know about the safety consequences of our road design decisions and about the repercussions of our traffic control actions is simple to demonstrate. One needs only to ask the engineer: "Approximately how many accidents per year do you expect to occur with design X?" While the engineer might venture an opinion, in truth, the arsenal of knowledge at the disposal of the North American engineer just does not suffice to give an answer. This means that one can not say whether design alternative A for roads in a new residential neighbourhood is safer than design alternative B; nor can one say whether replacing stop signs by signals at a certain intersection will enhance safety; nor can one state that a substandard sight distance on the crest of a hill will degrade safety. The consequence of this paucity of factual knowledge is that safety considerations become a matter of unsubstantiated "professional judgement". Decisions about design standards, procedures and warrants have to be made without a reasonable anticipation of what their safety repercussions might be.

The situation does not appear to be substantially different outside of engineering. One can again ask "Approximately what is the safety effect of action X?", replacing X by such programmes as publicity campaigns, vision tests for drivers, periodic motor vehicle inspection, speed limit enforcement, defensive driving courses, crackdowns of various kinds, demerit points systems and the like. An answer based on fact will seldom be forthcoming. It follows that the decisions to introduce and keep these actions and programmes are governed by considerations other than an anticipation of their influence on road safety. In summary, in the delivery of road safety, knowledge of fact often plays a minor role.

To steer clear of the rocks of exaggeration, it needs to be said that some substantive knowledge does exist. Moreover, it also seems to be true that in the second part of this decade a great deal of substantive knowledge has emerged in the field of vehicle standards, drinking and driving and occupant restraint. Still, even when substantive knowledge is available, its influence is difficult to discern and slow to show.

At this point it is useful to adopt a wider perspective, one which encompasses other fields of endeavour. Where action of any kind is considered, the last five centuries can be seen as the gradual shedding of unsubstantiated opinion and its replacement by facts based on observation. This is true not only of the hard sciences or of technology which deals with inert matter. It is also true of people-oriented activities such as warfare or the delivery of health. In warfare one might regard the trend to more science and less magic as regrettable. In health care most would

agree that sanitation and modern medicine are an improvement on shamanism. As the influence of fact on decisions increases, the authority of shamans declines. Thus, there exists a long historical and universal trend to extend the influence of knowledge-based professionalism, a trend which is only weakly manifest in the delivery of road safety.

I regard the delivery of road safety to be similar to the delivery of health or of drinking water; much of it is a question of knowing the why's and how's. Therefore, I think that we would deliver road safety better if knowledge-based professionalism had a larger influence on decisions which affect safety. It follows that the behaviour of public bodies needs to be influenced so that fact-based professionalism can gradually dislodge public-relations-oriented shamanism.

Four points have been made so far. *First*, that public bodies have a large influence on road safety because it is their actions which shape the road and the traffic control systems, prescribe vehicles' crashworthiness and occupant protection, determine the rules of the road and their enforcement and set the level for the skills of the road users. *Second*, that the decisions which public bodies make, are usually only weakly influenced by fact-based professionalism. *Third*, that the tendency to deliver road safety as if it was mainly a matter of common sense and good public relations bucks the universal trend of replacing unsubstantiated opinion by facts based on observation. And *fourth*, that road safety to society

3) A more exhaustive description is provided in references 1 and 2.

4) Stewards of public bodies at times express annoyance that when knowledge-based professional advice is needed, it is either not forthcoming or the experts sound an uncertain trumpet. If one can buy sound advice from metallurgists, experts on malaria or geologists, why is off-the-shelf knowledge based expertise not available on road safety? Part of the answer is of course in the relatively short time during which concern about road safety could have been converted into scientific knowledge. Another part is in the intrinsic complexity of this subject matter and the difficulty of finding out what works and why. However, there is also a deeper reason. There is an active market for knowledge about metals, diseases and ore deposits. Knowledge has value and better knowledge gives one an edge in competition. This is what makes expertise in metallurgy, medicine and geology grow. In contrast, there is no private market for the road safety expert (except, perhaps, in driver training). The only potential customers are public bodies and their only immediate reason for the use of knowledge based expertise is that it might increase the chance of success for the contemplated programme. However, since knowledge based advice may restrict one's freedom of choice when it conflicts with considerations of popularity or lay prejudice, and because the objective results of the contemplated programme may never be known, the real advantage which a public body may expect from scientific knowledge is slight.

5) That instruments of the state can be a systematic hindrance to the progress towards observation-based knowledge should not come as a surprise. After all there are many historical precedents. But, for some reason one tends to believe that the modern state strives for knowledge based management. The idea that in a western style democracy the absence of knowledge makes for better public relations and is therefore in the interest of public bodies takes some getting used to.

would be delivered better if knowledge replaced opinion and fact replaced prejudice. In short, that the behaviour which public bodies exhibit needs to be modified and that it has to be modified so as to increase the role of factual knowledge in their decision making.

3. WHY PUBLIC BODIES HAVE LITTLE USE FOR SOME FACTS

We want to understand why road users behave the way they do in the hope that this will help us influence them. Similarly (and symmetrically), before thinking about how to change the behaviour of public bodies one ought to know why they behave the way they do. I will try to describe briefly my understanding of the matter.)

In our society we want public bodies to respond to people's concerns. Unlike the private sector which responds to what people wish to buy, public bodies have to respond to concerns for which there is no market, such as the desire to have safe roads. For a public body, a "response to people's concerns" means that "programmes" are initiated, funded and implemented. Once a programme is born, careers and jobs are tied to it. For the people involved in these programmes, it becomes important that the public body be seen as responding to people's concerns and that what the public body does be seen as successful. This is important because an organization which fails to look good runs the risk of budget cuts, reorganization or demise, and this affects adversely all the people associated with the organization. Thus, to look good, is important for those whose jobs and political or professional careers are tied to the public body and its programmes.

Now, it is the nature of road safety that it is not visible to the naked eye. Nobody can tell whether a programme was a success or a failure unless trained and independent researchers are given the opportunity to devise and carry out long-term studies. By the time estimation of programme effect is possible, the public body has already developed a large stake in its success. Under these circumstances why should the stewards of public bodies wish to find out what effect their programme has had? Nobody is attracted by the possibility of political, institutional, professional or personal embarrassment. The upshot is that programmes are rarely evaluated, and if evaluated this is done "in-house", with successes eagerly sought and failure unpublicised. In this inhospitable soil, spindly flowers of factual knowledge grow in the shadow of the weeds of misinformation.

On the next occasion that some programme is contemplated, the public body would like to have some input from road safety professionals). However, since the pursuit of factual knowledge has not been cultivated, the available evidence is weak and its carriers, the road safety professionals, can not imbue it with authority. As a result, its influence on the mix of factors which affect the decision continues to remain small. This closes the vicious circle.

4. HOW TO INCREASE THE INFLUENCE OF FACT-BASED PROFESSIONALISM

The picture may not be as stark and bleak as I have painted it. But even had I used more pastels, two basic themes would be clearly visible. First, that the road user (and the taxpayer) would benefit if the influence of factual knowledge in the delivery of road

safety was increased; second, that at present the intrinsic advantage to a public body from the use of factual knowledge is slight, while the threat which the knowledge of fact poses to the interests of the public body is real. This, I think, is a grave problem for democracy, inasmuch as it tends to make public bodies a hindrance to knowledge of fact when success or failure can not be told apart without systematic study.)

What then can be done? Present thinking is dominated and misdirected by the habitually made assumption that the self-interest of the road user has to be kept in line by employees of public bodies who, themselves, are thought to be immune to self-interest. This image is plainly in discord with reality and the thinking guided by it needs to be changed. The key to change is the adoption of the symmetrical point of view advocated early on. Self-interest is not the reserve of the private sector and the road user. Public bodies (ministries, municipalities, professions) are also motivated by self-interest. Action on self-interest, when it affects others, requires surveillance and occasional intervention. At present, surveillance and intervention are almost exclusively directed towards the private sector and the road user. Because of the symmetry inherent in the task of delivering road safety to society, surveillance and intervention also need to be aimed at public bodies including professions.

The next question is what form this surveillance and intervention should take. We attempt to influence road user behaviour incentives and disincentives. What system of rewards and sanctions can be devised for public bodies? The answer is relatively simple. Looking good is the central interest of a public body. If the programmes which it initiates and implements are shown to be beneficial by an independent professional evaluation, the public body will look good. Conversely, if its programmes are shown by an independent evaluation to be a flop, the public body may face the sanctions of diminished budgets and organizational upheaval. Thus, the lever of change is the requirement that the effect on safety of costly programmes (design procedures, standards) be estimated, that the estimation be done by professionals whose personal interest is not affected by the outcome of their work, and that the results be published in the open literature after a peer review.

Think now that this "requirement" is in place and a public body is contemplating some initiative. Even at this early stage it now becomes important to have road safety professionals give advice on the design of the initiative and on the chances of its success. It would be risky to implement a measure mainly because it looks like a good idea and appears to be popular. To disregard professional advice courts the chance of a visible programme failure; the use of factual knowledge enhances the chance of success. In this setting, professional advice when based on fact acquires new value and the influence of professionalism will increase. Society benefits in that fewer useless initiatives are undertaken and those which reach implementation have a better chance of being cost-effective.

Naturally, the professional in this utopia has better founded insight into road safety than others and therefore the professional's "good ideas" have a better chance of proving effective, than those of influential lay persons. For this reason the increased influence of professionalism will begin even earlier, at the instigation and initiation stage.

Since in this utopia professional advice is essential for the success of the organization, public bodies will want to establish employment positions and attractive career paths for road safety professionals. This will create demand for trained road safety professionals and translate into a need for training. Training, in turn, will require textbooks; textbooks, in turn, need factual knowledge to be put into them.

Unfortunately there is a loose end. The utopia is predicated on the assumption that there are road safety professionals who have knowledge-based advice to give. There indeed are people trained as psychologists, police officers, engineers, economists, surgeons, sociologists, epidemiologists and ergonomists who possess substantive insight into road safety. However, none is trained as a road safety professional. To establish systematic professional training in road safety two conditions need to be met. First, there must be jobs for road safety professionals. Second, there must exist a substantial corpus of factual knowledge.

The first condition will be met if the "requirement" is implemented. However, I have lamented earlier the reign of ignorance in road safety, specifically, that our ability to foresee the safety consequences of many actions, decisions and programmes is at present severely circumscribed. If so, do we have a corpus of knowledge to be put into a textbook from which the would-be professional learns and on the basis of which later authoritative and useful advice can be given?

I will leave the question hanging for a paragraph and complete the sketch of the utopia first. Imagine now that an initiative has been implemented. Because the "requirement" is in effect, the impact of the initiative on safety will be professionally estimated, the study reviewed by peers and its results published in the open literature. All will know the nature of the initiative, its circumstances, the estimated extent of its success or the magnitude of its failure. This should effectively cure the now prevailing impediment to learning which is caused by lack of evaluative research, by research deficient in method, by conclusions tainted with interest in the outcome, and by the inclination to report successes but not failures. With the requirement in place, gaps in knowledge will be gradually filled in. A fact-based state of the art will evolve and will be incorporated in textbooks.

But that idyllic state does not now exist. So the hanging question has to be answered tentatively. Yes, one can train road safety professionals today because a great deal is already known but no, professionals now trained will not be able to give authoritative advice on many important questions. Clearly the vicious circle has to be broken into and the only point of entry into which I can find a "requirement".

Can the utopian "requirement" be made reality? To a limited extent an internal oversight function is already a part of our system of government. In the U.S., for example, there is the General Accounting Office, in Canada the Auditor General. Thus, it appears that the need to watch what public bodies do has already been recognized. However, for our purposes we require that the professionals who engage in evaluation research have no stake in the outcome of their study, a condition which can not be met in a body the mission of which is to identify waste. In addition, we require that the results of studies be reviewed by peers and published in the open.

literature – this again is not usually the function of the oversight bodies. The institution through which the “requirement” could come into reality is more like a place where specific questions about the safety effect of programmes, intervention, design standards and the like are scientifically investigated and answered.

The implementation of the “requirement” is in the interest of society. However, I think it unlikely to be favoured by the public bodies who have responsibilities in road safety. The only realistic hope, however slim, is to place one’s trust in the wisdom of enlightened, influential and concerned elected politicians who will recognize the need to make the “requirement” into law. We have separated church and state, executive and legislative functions, we now need to separate evaluation from implementation.

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ROAD SAFETY LEGISLATION - PERSUASION AS AN ALTERNATIVE TO ENFORCEMENT

32

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INTRODUCTION

In recent years there has been a change in emphasis within the United Kingdom on ways to improve road safety.

In the past, road safety campaigns have tended to take the form of isolated initiatives promoted by Central or Local Government, Insurance Companies, Interest Groups or the Police Service. Little heed was taken of the conflicting demands or differing priorities of each group with the net result that the final product was not as effective as it might have been.

This however is now changing with many of the groups and organisations involved recognising that a corporate approach based on the concept of the "3 E's":

- (i) Engineering
- (ii) Education
- (iii) Enforcement

is likely to provide better results due not only to utilising resources in a more efficient manner, but also by reducing the likelihood of conflicting information being placed before the ultimate consumer, the motorist.

INCENTIVES AND REWARDS

Despite this fundamental change in approach to road safety issues, little has been done by Local or Central Government in the UK to move away from our traditional 'punitive' based system to one of encouraging improved driver behaviour by means of incentives and rewards. It is the insurance industry which does, of course, have a vested interest in reducing accidents that has led the way by offering generous discounts for those with accident free records and loading premiums for those with poor records - the carrot and the stick. A more interesting move in recent years is the practice of some large fleet owners to make cash payments annually to employees who maintain an accident-free record and in some more imaginative schemes employees are rewarded with an improved quality of car from a higher vehicle range in the following year. In other schemes the reverse applies and we understand that one large company, following a second culpable accident, the employee is expected to pay for his own insurance.

The UK has not experimented with any of the schemes operating in the US whereby accident free drivers are rewarded for instance with a reduction in the renewal cost of their driving licences. Because of the fact that driving licences need not now be

renewed in the UK until the age of 70 years, the scheme is not open to us but with a much improved and integrated computerised vehicle licensing system it would be possible to offer a reduced excise duty on motor vehicle relicensing for safe drivers, although the initial costs to set up such a scheme would be astronomical and some of the problems virtually insurmountable.

A number of locally based "prize schemes" have operated with some success for a number of years in the UK whereby those improving their skills through cycle proficiency testing, safe horse riding and advanced motor driving competitions and courses receive awards and prizes. Nationally some legislation has been introduced to act as an incentive, the most successful being the restriction of learner motorcyclists to the small and less powerful machines until they have undergone the necessary training and proved that they have the necessary skills to ride the larger machines.

POLICE AND THE ENFORCEMENT ROLE

Of the "3 E's" in road safety, enforcement is really the last resort, although the threat of prosecution does, of course, act as a deterrent. Clearly the Police are not in a position to offer substantial tangible rewards to improve driver behaviour. The nearest we come today in the UK is local "Police good driving campaigns" whereby motorists driving well or showing courtesy to other road users are stopped and congratulated on their driving and sometimes given key rings or stickers by way of encouragement.

What we have done in the UK in recent years, however, is to move away from purely punitive-based enforcement to deterrent-based policing and in the case of defect vehicles we have embarked upon what can be described as a "quasi reward or incentive" type system. Examples of this gradual movement are reported under the following headings:

Drinking and Driving

Prior to the introduction of the Road Safety Act in 1967 although the United Kingdom had drink driving legislation, it relied for evidence on simple sobriety tests similar to those encountered in certain states in America. The Road Safety Act saw the joint introduction of both roadside breath analysis in the form of a chemical tube and bag device, together with a prescribed limit offence with blood/alcohol and urine/alcohol limit set by legislation. One of the major drawbacks of the then new legislation was that Police Officers had to have reasonable suspicion of alcohol consumption by the attending motorists before a breath test could be administered.

The legislation was, however, initially extremely effective but by 1976 the impact had been lost and the Government set up a working group under an eminent Judge to review the law and of the recommendations made by the group the following were the most important:

i) The introduction of breath analysis at Police Stations in order to do away with the need to take blood or urine samples.

ii) Permitting the Police to have the unfettered discretion to subject motorists to breath tests without the need to have reasonable suspicion of alcohol consumption.

The Transport Act 1982 introduced substantive breath testing devices in Police Stations but the only move in respect of Police powers was to move the requirement to have reasonable suspicion from before stopping until after he had been stopped. The question of Unfettered Discretion or Random Breath Testing as it became known was left in abeyance as it was felt to be too politically sensitive. To be fair, the Police Service did not push the matter with any fervour as they believed that the introduction of Unfettered Discretion would possibly have an adverse effect on Police public relations as there was some doubt about public support for the proposed new powers.

Matters stayed virtually unchanged until 1988 when there was a massive swing in public attitude on the issue of drinking and driving with it now being regarded as being socially reprehensible to drink and drive. The attitude of Chief Constables also changed and as a result of information gleaned from colleagues in the Australian state of New South Wales, it became clear that not only could the public's attitude on this issue be changed and harnessed for the good, but a deterrent-based enforcement system was more effective at reducing drink-driving fatalities than was the traditional enforcement model.

It has become apparent to members of my Committee that a corporate approach involving education and a deterrent-based enforcement system could give the flagging U.K. drink drive initiative the boost which it required. To this end, we have over the last eighteen months sought to persuade Her Majesty's Government of the need to give the Police the wider powers we seek which would, we believe, persuade motorists that the chances of their being stopped by the Police and breathalised had increased considerably, thus deterring them from taking the risk of driving after having consumed alcohol. Our overall aim is not to catch and prosecute more motorists, quite the contrary. We aim to deter them.

It was with great regret that we learnt in early January this year that Her Majesty's Government had decided at the highest level that Police powers were sufficient to deal with the problem and that other avenues, notably greater use by the Police of existing powers, should be examined to resolve the problem.

Although not an example of a reward type initiative, the foregoing does, I believe, show that despite early success traditional enforcement practices have in respect of drink driving perhaps served their purpose. New means of dealing with old problems must evolve, prosecution alone will not provide the solutions and methods must be found to deter motorists from embarking on a course of abhorrent anti-social behaviour.

The Vehicle Defect Rectification Scheme (VDRS)

Perhaps I might now turn from a situation where traditional methods do not appear to be maintaining

their effectiveness, to an area where I believe a quasi reward incentive type scheme is showing itself to be effective in influencing driver behaviour in road safety terms.

The traditional method for dealing with the driver of a defective motor vehicle was to summons the offender to appear before magistrates in order to answer a charge of 'using' a defective motor vehicle. The courts would, if the charge was proved, impose a fine and in certain circumstances endorse an offender's licence. A similar procedure was also adopted in respect of the owner of the vehicle if he or she was not the driver at the time the vehicle was stopped.

The above procedures not only placed undue stress on the resources of the magistrates court system but offered no guarantee that the original defect was rectified or the vehicle repaired.

In the early 1980's a scheme was initiated by the Nottinghamshire Constabulary, whereby the drivers of vehicles with certain defects, which it was considered did not render the vehicle manifestly dangerous, were given the opportunity to have the defect repaired and presented at a Police Station within a limited period for verification of the repair, so avoiding a court appearance. If, however, they failed to have the defect rectified within that timescale normal court proceedings would ensue.

After initial success in Nottinghamshire, the scheme was piloted in a number of other force areas in the U.K. The trials proved that with minor modifications the scheme was not only worthy of adoption on a national basis, but was well accepted by both the motoring public and the motoring organisations alike.

The scheme was introduced on a national basis on 1st August 1986 with very few modifications. The scale of the national scheme meant, however, that Police Forces could no longer provide the inspection and verification facilities required. As a result of tripartite discussions between A.C.P.O., the Home Office and the Department of Transport, it was agreed that the inspection and certification of repair of defects would be undertaken by the Department of Transport Vehicle Testing Stations.

The scheme is only applicable to Motor Cars, Motor Cycles, Mopeds, Dual Purpose Vehicles, Motor Caravans and Small Goods Vehicles (under 3,500 kgs gross vehicle weight) although one Force is currently carrying out a pilot scheme which includes heavy goods vehicles. The drivers of such vehicles, provided that they agree, can take advantage of the system to have minor vehicle defects rectified. Three possible courses of action are open to them which are to (i) rectify any defects forthwith and submit the vehicle for inspection at a Department of Transport authorised garage, (ii) scrap the vehicle, (iii) do nothing and face prosecution.

Only an authorised Department of Transport testing station may inspect the vehicle. If the defect(s) are rectified to their satisfaction they will certify the VDRS form and stamp it. The driver must then return the completed form to the issuing Force within fourteen days of issue. If he fails to do so, proceedings will be initiated.

Alternatively, the owner may scrap the vehicle by disposing of it to a recognised scrap dealer who must supply written proof of disposal. The owner of

the vehicle once again must return all the relevant papers to the issuing Force within fourteen days in order to prevent the institution of proceedings.

Although the Vehicle Defect Rectification Scheme is voluntary and is not encompassed in legislation it has, since its introduction, been well accepted by the Police Service and the public alike. Uniquely it was not created with a blaze of media publicity but has quickly been assimilated into the rituals of motoring as a fair and acceptable method of dealing with minor vehicle defects.

The major benefits as far as the Police Service is concerned are threefold:

i) It ensures the rectification of vehicle defects, something which traditional enforcement methods do not do and by improving the roadworthiness of vehicles it makes our roads safer places and reduces the risk of death and injury.

ii) The scheme is simple to operate in practical terms and does not take officers away from patrol to complete lengthy paperwork. This is an acceptable trade-off against the administrative back-up system which the scheme requires.

iii) It takes the strain off the already overstretched magistrates courts in that it removes all but the worst cases and those where the driver fails to take advantage of the scheme from the criminal justice system.

As far as the motoring public is concerned, once the defect has been repaired they have nothing further to worry about, there is no cost to them over and above the cost of repair and the garage charge. These he would have had to pay in any case. Finally, there is not the stigma of having to appear before the magistrates courts.

The Extended Fixed Penalty System (E.F.P.S)

This is a scheme which can be used in conjunction with or independently of the V.D.R. Scheme.

Although the Fixed Penalty System cannot be considered a reward or incentive based scheme in its truest sense, in that it is still basically a punitive enforcement system, it could be considered like the V.D.R. Scheme, to fall into the category of a 'quasi reward' incentive scheme. By accepting a fixed penalty ticket, the motorist accepts his guilt and is offered a mitigated penalty, the payment of which discharges his liability.

The original fixed penalty system was introduced into the U.K. in the 1960's. However, it consisted of only a handful of offences centred around the parking of motor vehicles in restricted areas.

Problems related to the non payment of parking tickets and the general inefficiency of the system led to its complete review in 1980/81 by a working group comprised of members from Government Departments, the Police Service and Court Officials.

Arising from recommendations made by the group, the Home Office and the Department of Transport extended the system to cover nearly 200 static and moving traffic offences rather than the previous dozen or so offences.

The extended system allows Police Officers to deal with Endorsable and Non Endorsable offences, that

is, those offences which attract penalty points for a driver and those which do not, in a simple manner without the offending motorist having to attend court.

As far as the motorist is concerned, all he has to do is accept the ticket and pay the penalty which is either 18 or 32 depending on whether the offence carries penalty points. In the latter case, he must also forward his driving licence to the magistrates courts office for endorsement. With non-endorsable offences, mere payment of the fixed penalty ticket is sufficient to discharge any liability.

A safeguard for the motorist is added in that should the offender change his mind, he can within a specified time period notify the court that he no longer wishes the matter to be dealt with by means of a fixed penalty notice but wishes a full hearing. Obviously, in this case he makes himself open to the full range of penalties available.

Conversely, should the motorist decide to do nothing and not pay the ticket within a set period, the penalty is enhanced by 50% and is registered as a fine with his local magistrates court. Should he continue to ignore the new penalty, a warrant for default in payment can then be issued to ensure his appearance at court.

Again motorists, motoring organisations and the Police Service have embraced the extended system, possibly on the grounds that they know from the outset what the penalty will be, it is a simple process and they are spared the social stigma of a court appearance.

What cannot be accurately ascertained from the introduction of either the V.D.R.S. or the extension of the Fixed Penalty System is the extent to which they have influenced road user behaviour. The evidence is not easily obtainable and would require detailed and expensive research. My instinct, however, as a Police Officer of thirty-six years standing, is that in the case of V.D.R.S. it is beneficial to the interests of road safety and that both V.D.R.S. and the Fixed Penalty System are cost effective in that they release scarce Police resources to other important demands on Police time.

Seat Belt Legislation

It may be worthwhile mentioning our experience in the field of the compulsory wearing of seat belts as it proves that in some areas both reward and compulsion are the only way forward.

Prior to the introduction of this legislation, the wearing of seat belts in the United Kingdom was often viewed as being an encumbrance and an intrusion into a driver's civil liberties. Education projects, based on the road safety benefits to be gained from the wearing of seat belts before the introduction of the legislation, had little positive effect.

As part of the joint initiative undertaken by the Department of Transport, the Home Office and the United Kingdom Police forces high visibility publicity campaigns were organised outlining the positive benefits to be gained from wearing seat belts in road safety terms, as well as the negative aspects in respect of the punishments likely to be encountered as a result of non compliance.

As a result, the initial take up rate was well over 92% and a lone stage, reached the dizzy heights of 96%.

plus. It subsequently flattened out at 9.3% but nevertheless proves that if the public can be convinced that a certain law is in their own interest the majority will abide by it.

CONCLUSION

It will be apparent from my contribution that apart from what is being done by the private sector little progress has been made in the UK towards purely reward-based road safety schemes as an alternative to enforcement.

Having said this, Police Forces have moved from our traditional isolationist position to a corporate approach mixing enforcement with education and publicity. I believe that this approach has merit in terms of road safety. The difficulty, as always, with experiments of this kind is that the measures which we have for judging our success, often only Road Casualty Figures, can be influenced by so many variables that it is often impossible to identify individual trends. In addition, the timescale for change is often such that the results of new initiatives cannot be measured in the short term and gains might only become obvious some time after their introduction.

As to the possible reasons for the apparently slow movement for change in the U.K., it can be attributed in some respects to the relatively low priority given to road safety issues. The changes outlined have not been without their critics, the traditionalists believe that the changes have been made at the cost of trivialising Road Safety issues, whilst others believe that we are dragging our feet. Nothing could be further from the truth, the Police Service welcomes change and recognises the need for it.

We do at the same time, however, have a responsibility to ensure that all sections of the community are protected by any change to existing practices.

What then of the future? With the coming in 1992 of the single European Market I believe it not only important that we move closer together in terms of road traffic legislation enforcement measures but we learn from each other in such a way the community as a whole benefits from new initiatives. It would be sad if road safety issues became bogged down in a bureaucratic morass. Human life is our most precious commodity and road safety, uninteresting as it is to many, is about saving lives and reducing injury on our roads whether we drive on the left or the right.

LES ACTIVITÉS DE CAMIONNAGE ET LA SÉCURITÉ ROUTIÈRE

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Dans une période de déréglementation économique du transport routier par camions, il est extrêmement difficile de parler des effets des processus d'incitation, sous forme de sanction ou de récompense, visant à diminuer le niveau de l'insécurité routière lié à la circulation des poids-lourds. D'une part, il existe peu d'études systématiques sur cette question, notamment en termes de description et d'évaluation des actions menées, d'autre part, le problème se pose en des termes particuliers pour les activités de camionnage. Ce sont les termes du débat qui, au regard des connaissances acquises, vont être développés ici.

1. LA ROUTE ET LES AUTRES SYSTEMES DE TRANSPORT.

Une des caractéristiques distinctives de la circulation routière tient au fait qu'elle se réalise dans le seul système de transport dont la principale fonction de régulation est assumée au niveau même des conducteurs. D'une certaine manière, il s'agit d'un système ouvert car la génération des flux et leur niveau sont du ressort des seules décisions des usagers qui gardent toute liberté de choisir les moments de circulation, les itinéraires qu'ils empruntent, les manières de conduire, le respect ou non des règles élémentaires de circulation et de conduite. Même prescrites, les règles de circulation et de conduite sont, dans la pratique, davantage considérées comme des incitations que comme des obligations absolues. Elles peuvent être transgressées sans qu'il en coûte automatiquement une interdiction de conduire à celui qui les enfreint. A contrario, les systèmes ferroviaires ou aériens de transport sont des systèmes fermés dans la mesure où le niveau des flux et les itinéraires sont organisés par des ensembles de procédures de planification, de prescriptions et de contrôle qui définissent les moments de départ, d'arrivée, les itinéraires et les modalités de la conduite des engins. La plupart des procédures sont établies par des agents sédentaires contrôlant techniquement les flux, les pilotes et mécaniciens de motrices doivent adapter leur mode de conduite aux impératifs définis par ces derniers. Ces prescriptions de route, de vitesse, de conditions et de moments de départ ou d'approches assurent la fiabilité et la sécurité du système global à l'intérieur duquel les mécaniciens ou pilotes font circuler les engins de transport. Dans ces systèmes de transport, l'impératif de fiabilité se confond le plus souvent avec celui de la sécurité. Autrement dit, les comportements de conduite y sont assués. Les impératifs et règles de sécurité sont au principe même de la sélection, de la formation et de la certification des pilotes et des mécaniciens qui sont

régulièrement entraînés aux procédures de conduite et soumis à des examens périodiques de leurs connaissances, capacités et habiletés tant techniques qu'humaines (test de savoir, de résolution de problèmes et d'habileté; visites médicales d'évaluation des capacités humaines). Les règles et procédures sont régulièrement transformées et réactualisées en fonction de l'évolution des moyens techniques intégrés aux systèmes de transports. L'incitation à la sécurité est intégrée à la conception des moyens techniques et à la formation des agents de conduite et des pilotes. Elle constitue l'élément principal de leur qualification. Sans application stricte des procédures sécuritaires de circulation et de pilotage, il n'est pas possible de devenir et de rester mécanicien du ferroviaire ou pilote de l'aviation civile. Par contre pour conduire une automobile ou un deux roues, il faut et il suffit de posséder le permis "ad hoc", donc de répondre à une évaluation des savoirs et des capacités minimum qui sont de plus, rarement réactualisés.

Comme système ouvert, organisé selon les modalités esquissées, la circulation routière engendre un niveau de risque d'accidents sans commune mesure avec celui que produisent les systèmes fermés ferroviaires et aériens.

Tableau 1: Taux de tués par milliards de passagers (véhicules)

Rail	0,09
Avion	0,20
Tpt en commun (bus & autocars)	1,20
Voitures Légères	18,50
Motos (+ 125 cm ³)	135,60

En France, route a fait 400 000 morts en trente ans et vingt fois plus de blessés.

La "régulation technique" de ce système est extrêmement complexe. Car en fait, elle résulte d'une forme de "régulation sociale" entre des groupes différents. L'ensemble des actes sociaux qui vont de la conception, la normalisation et la construction des routes et des véhicules, à la gestion des flux et à la conception des règles et à la mise en oeuvre des procédures de contrôle, de sanction et de répression, en passant par les comportements réellement actualisés sur la route, s'articulent sur des processus de décision non homogènes. Le compromis entre les "logiques" à l'oeuvre dans ces divers champs de la pratique sociale est au principe de la régulation entre les groupes produisant les éléments matériels et institutionnels constitutifs du système de circulation, les différents groupes d'usagers du site public. Cette régulation se heurte à

1) Cf. Jean-Pierre Cauzard, Revue "Metropolis" N° 60/61 - 1984.

Tableau 2: Accidents corporels de la circulation en 1989

	Ensemble des accidents	Accidents avec des véhicules Lourds		Accidents avec voitures particulières	
Accidents	170590	13231	7,7%	148877	87,2%
Décès	10528	1861	17,6%	8660	84,1%
Blessés	235999	18001	7,6%	210395	89,1%

l'in-homogénéité des capacités techniques des véhicules et des infrastructures, à celle des situations routières rencontrées, des capacités humaines pour les affronter, à celle des vitesses... La concurrence par rapport à l'espace, entre les usagers de la route, disposant de la liberté de circuler quand et comme ils l'entendent, a pour corollaire le renforcement des effets des écarts entre les performances des hommes, des machines, entre les capacités des sites et l'infinie diversité des situations. Au principe de la constitution du système routier de transport, dont l'histoire montre à l'évidence qu'il s'est construit par adjonction d'éléments, les idées d'accessibilité, de fluidité et de vitesse ont joué un rôle majeur. Il a fallu attendre que l'automobile ait modelé l'espace et la vie sociale pour que l'exigence de sécurité apparaisse.

2. LES CAMIONS ET LA SECURITE ROUTIERE.

Depuis le début des années 1980, la circulation croît à un rythme soutenu, notamment sur les autoroutes. Constituant 18,9% de la circulation autoroutière en 1989 pour 17,6% en 1986, les poids lourds représentent en moyenne 31 % de la circulation de nuit, 60% sur certaines autoroutes. Le taux d'augmentation annuelle de la circulation des poids lourds est de 13,3%, celle des véhicules légers est d'environ 10%. Une telle croissance peut, à terme, poser des problèmes de cohabitation entre véhicules légers et véhicules lourds.

En France comme ailleurs, le système de la circulation routière engendre un niveau de risque global important. Si le risque d'implication des poids lourds (6% des accidents pour environ 15% de la circulation globale, avec un taux ramené à l'exposition de 57 pour 100 millions de kilomètres parcourus) est plus faible que celui des automobiles (87,2% des accidents pour environ 79% de la circulation globale, avec un taux ramené à l'exposition de 77,8 pour 100 millions de kilomètres parcourus), il reste que le taux de gravité des accidents impliquant des poids-lourds est beaucoup plus important: 14,1% de tués dans l'ensemble des accidents impliquant au moins un véhicule lourd pour 5,8% de tués dans les accidents impliquant au moins un véhicule léger.

Par ailleurs, le niveau de risque d'implication des poids lourds croît avec le tonnage (de même que la gravité des accidents): il est fonction du type d'infrastructure: les autoroutes sont moins dangereuses que les routes nationales et a fortiori que les chemins départementaux. Or les tailles et poids des véhicules lourds ne cessent de croître.

L'ensemble des efforts visant à l'amélioration des performances du système routier de circulation se sont traduits néanmoins par une baisse tendancielle du niveau de risque. En regard de l'augmentation vertigineuse des flux de circulation. Tout se passe comme si le niveau d'insécurité du système de circulation déclinait, sous l'effet conjugué de

l'amélioration des capacités techniques des infrastructures et des véhicules, des compétences des conducteurs et de l'écrêtement des facteurs de "dangerosité" les plus flagrants, par le biais des mesures d'abaissement des vitesses autorisées, du port obligatoire de la ceinture de sécurité et du contrôle du taux d'alcoolémie. Ainsi, sur les dix dernières années, le risque d'implication ou le niveau de risque global tend à s'abaisser pour les poids lourds comme pour les autres usagers.

Pour produire le même niveau de risque d'implication que 8 automobilistes, il faut 11 conducteurs professionnels. Cette différence est la marque de la plus grande homogénéité de la population des professionnels. Cette homogénéité résulte davantage d'une communauté de "savoirs faire" acquis par l'expérience quotidienne de la conduite que d'une qualification acquise lors d'une formation, d'un stage de recyclage ou d'épreuves de certification se rapprochant de ce que connaissent les pilotes de l'aérien et les mécaniciens du ferroviaire. Car en fait, si pour conduire une automobile il faut et il suffit d'obtenir le permis de conduire, il en est de même pour la plupart des conducteurs professionnels de poids lourds ou d'autocars. Ainsi, moins de 1% des conducteurs de poids-lourds ont suivi une formation professionnelle longue (Certificat d'Aptitude Professionnelle) et 9% ont eu l'occasion de préparer leur permis de conduire, dans une institution de formation professionnelle dispensant des enseignements de courte durée (5 à 10 jours). Les conducteurs professionnels font rarement des stages de recyclage à l'exception de ceux qui transportent des matières dangereuses, doivent, par obligation réglementaire, suivre un stage de formation de cinq jours, tous les quatre ans. Ces stages sont d'ailleurs plus orientés vers les mesures de sécurité liées aux produits, qu'à la conduite proprement dite.

3 - LA SECURITE ROUTIERE, COMME ELEMENT DE LA SECURITE DU TRAVAIL INDUSTRIEL.

Néanmoins, les conducteurs se différencient sur le plan du risque en fonction de façon marquée. Nous avons pu démontrer qu'il existait une relation entre les durées et les rythmes de travail des conducteurs, leur expérience et le niveau du risque d'implication. Globalement, le niveau du risque relatif d'implication croît avec l'amplitude de travail. De plus, il est différent selon les moments de la journée. Plus fort la nuit que le jour, il croît de façon régulière avec le déroulement de la journée (celle-ci commençant à

¹⁾ cf. La plupart des données numériques concernant le travail et les carrières des conducteurs sont issues du rapport "Situations et conditions de travail des conducteurs de poids lourds transportant des marchandises: origines sociales et carrières professionnelles: éléments du genre de vie". 1985, Patrick Hamelin avec la collaboration de Marie-Ange Cambois et Catherine Gore. INRETS-ON SER, Paris.

6h) pour atteindre un maximum entre 0 heure et 4 heures. Nous avons pu ainsi, définir des seuils "dangereux" de la temporalité, à partir de 11 heures d'amplitude de travail et dans la période de 20h et 7h, par opposition à des horaires plus "normaux" pratiqués par la plupart des autres ouvriers. Les calculs montrent par ailleurs, que les conducteurs les plus jeunes (≤ 30 ans) produisent un niveau de risque supérieur à celui des plus anciens (≥ 40 ans).

Un résultat plus intéressant pour le propos d'aujourd'hui, permet de différencier les conducteurs selon les types d'entreprises qui les emploient. La branche d'activité de l'entreprise définit le cadre de travail et résume les différences liées à l'expérience quotidienne, répétée des conditions concrètes de réalisation des opérations de transport dans lesquelles ils apprennent jour après jour à résoudre les mille difficultés routières, techniques, organisationnelles, administratives liées à l'acheminement, à la livraison, au chargement et au contrôle des marchandises, sans parler du contrôle des conditions dans lesquelles ils circulent. Ainsi on peut mettre en évidence des différences liées aux apprentissages acquis au quotidien de la réalisation du travail qui permettent de mobiliser des ressources différentes face aux situations les plus contraignantes.

Les conducteurs de la "branche transport" connaissent un risque brut d'implication de $10,7/10^6$ heures-conducteurs conduites leurs collègues dans les "autres branches" de l'activité économique ont un risque de $7,7/10^6$ heures-conducteurs. Les conducteurs de la "branche transport" ont ainsi +39 % de (ma)chance de plus que leurs collègues d'être impliqués dans les accidents. En d'autres termes le risque d'implication dans les accidents corporels est de $63/1000$ conducteurs dans la "branche transport" et de $34/1000$ conducteurs dans les "autres branches".

Concernant la gravité (c.à.d addition du nombre de morts dans les six jours suivant l'accident et du nombre de blessés hospitalisés, considérés comme blessés graves) des accidents dans lesquels sont impliqués les poids-lourds, les données sont les suivantes: conducteurs de la "branche transport" = $5,3/10^6$ heures conducteurs conduites, conducteurs des "autres branches" = $3,7/10^6$ heures conducteurs (pour les décès, les taux sont respectivement de $1,7/10^6$ heures conducteurs et $0,7/10^6$ heures conducteurs). Le risque de mort (la sienne ou celle d'un autre usager de la route) est de $9,8/1000$ conducteurs de la "branche transport" et de $3,2/1000$ conducteurs des "autres branches" (soit respectivement $31,2/1000$ et $16,6/1000$ pour le risque de produire au moins un blessé grave). D'ailleurs les assureurs ne s'y trompent pas. Ils font payer aux entrepreneurs de transport routier des primes calculées à un taux de "480/1000" véhicules assurés, aux entrepreneurs des "autres branches" disposant de camions, ils appliquent le taux de "220/1000" et aux automobilistes le taux de "98/1000". Ils traduisent ainsi, à la fois le niveau des coûts des dommages des accidents plus graves dans lesquels sont impliqués les poids lourds et l'écart du risque encouru entre les différents types d'entreprises utilisant des camions.

Le risque global de mort ou de blessures produit par la circulation des poids lourds ne concerne les conducteurs que pour 1/5ème de son niveau. En effet pour un conducteur professionnel au moins blessé, cinq "autres usagers de la route" le sont. Le risque routier constitue la partie la plus grave du

"risque industriel" global encouru par les conducteurs de poids-lourds, mais il n'en est qu'une partie. En effet, la conduite ne représente que 60% du temps de travail des conducteurs de la "branche transport", 50% pour les conducteurs des "autres branches". A l'arrêt, les accidents liés aux opérations de manutention, aux manoeuvres, aux déplacements à pieds (notamment lors de la descente de la cabine) à l'intérieur des entrepôts ou usines dans lesquels ils livrent ou chargent les marchandises, dans les sites douaniers ou de restauration dans lesquels ils s'arrêtent sont très fréquents.

Les "risques du travail" des conducteurs se composent de deux éléments, le risque routier et le risque à l'arrêt. L'ensemble du "risque du travail" des salariés de la branche des transports est connu. Le taux de risque d'accident du travail le plus élevé est produit par la branche du bâtiment et des travaux publics, la branche des transports se situe en seconde position. Mais elle est en première position pour le taux de gravité des accidents, notamment, le risque de décès qui concerne, presque exclusivement, les conducteurs. Pour les conducteurs des autres branches le risque global du travail qu'ils encourent n'est pas identifiable, il est noyé dans le risque global des nombreux employés sédentaires qui composent les branches d'activité des entreprises qui les emploient.

³) cf Patrick Hamelin :

a - "Les conditions de travail des conducteurs professionnels et sécurité routière" Le Travail Humain, 1981, vol 44, n° 1, 5-21, édition des Presses Universitaires de France, Paris.

Les résultats résumés dans cet article proviennent d'enquêtes réalisées par l'auteur en 1975 et 1976. Par ailleurs, la méthode de calcul de l'exposition en fonction de la durée de l'amplitude et du moment du travail y est présentée.

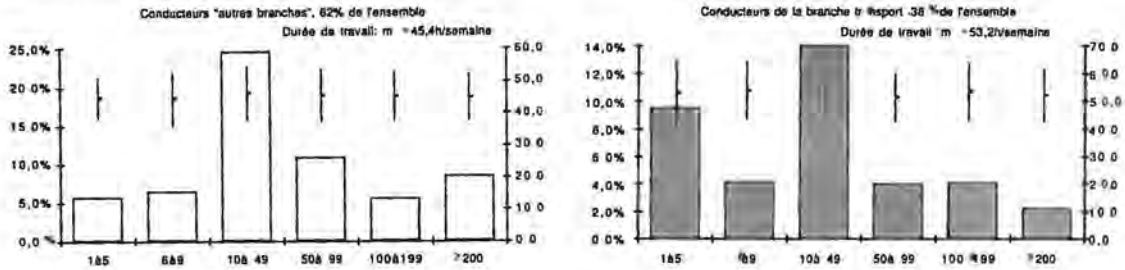
b - "Lorry driver's time habits in work and their involvement in traffic accidents", 1987, Ergonomics, vol 30, n° 9, 1323-1333, Taylor & Francis, London.

Dans cet article sont présentés une partie des résultats d'enquêtes menées par l'auteur en 1982 et 1983. Par ailleurs, une première comparaison entre les conducteurs de la "branche transport" et ceux des "autres branches" de l'activité économique y est présentée au regard de leur risque d'implication, en différenciant les périodes et les durées de travail définies comme "dangereuses" par opposition aux périodes et durées plus "normales" de travail que connaissent la plupart des autres ouvriers.

⁴) La croissance du taux de risque entre les "heures normales" et les "heures dangereuses" est plus forte pour les "anciens" que pour les "jeunes". Tout se passe comme si, à partir de certains seuils de la durée d'activité, les "savoirs faire" ou l'expérience ne compensaient plus les effets de la fatigue, comme si la capacité de récupération et de mobilisation des forces physiologiques déclinaient avec l'âge, ce qu'attestent les résultats des physiologistes.

⁵) Traduites en risque selon le kilométrage, en tenant compte des vitesses moyennes des conducteurs des deux catégories (conducteurs de la "branche transport" = 60 km/h, conducteurs des "autres branches" = 52 km/h), ces données permettent d'établir que le niveau du risque encouru par les conducteurs de la "branche transport" est de $70,9/10^6$ Km parcourus contre $59,8/10^6$ Km parcourus pour les conducteurs des "autres branches".

Tableau 3: Répartition des conducteurs salariés et indépendants, selon la branche d'activité de leur entreprise et la taille de celle-ci (en nombre de personnes occupées), Moyenne et dispersion des durées de travail hebdomadaires selon la taille de l'entreprise.



4. SENSIBILITE DU NIVEAU DU RISQUE D'IMPLICATION DES POIDS-LOURDS A LA STRUCTURE DE PRODUCTION.

Les raisons de telles différences entre les deux grandes catégories de conducteurs quant au risque d'implication peuvent être attribuées à de multiples éléments différenciant factuellement les conducteurs. Ainsi, le fait que les conducteurs de la branche transport conduisent plus souvent des véhicules de plus gros tonnage ou le fait qu'ils sont plus jeunes, pourraient être avancés comme explication. Mais à camions de poids et de silhouettes équivalents, à groupe d'âge égal, les conducteurs appartenant aux deux branches du camionnage se différencient toujours selon les tendances décrites.

Il faut donc tirer toutes les conséquences du fait qu'en moyenne les conducteurs de la branche transport ont une durée hebdomadaire de travail supérieure à celle de leurs collègues, d'une quantité équivalente à une journée de 8 heures et ceci, quelle que soit la taille de l'entreprise qui les emploie (cf. tableau 3). Les rythmes de travail irréguliers des conducteurs de la branche transport contrastent avec les horaires réguliers que connaissent les conducteurs des "autres branches". Tout se passe comme s'ils ne faisaient pas le même métier. Par ailleurs ils n'ont pas du tout les mêmes caractéristiques de carrières.

Dans les entreprises industrielles et commerciales équipées de camions pour le transport de leurs propres produits, les opérations de camionnage s'intègrent comme un des éléments de la chaîne des opérations diverses (approvisionnement, production et commercialisation) commandées par l'organisation générale du processus économique réalisé par l'entreprise. De la sorte le processus de travail des conducteurs se caractérise par une grande régularité des chargements véhiculés, des horaires, des horaires et des rythmes de travail proches de ceux de leurs collègues sédentaires. Le travail est prévisible, il est planifié, il s'inscrit dans un planning

général commandé par les rythmes des divers processus interdépendants, organisés comme les séquences d'un même ensemble homogène. La question de la rentabilité propre des opérations de camionnage n'est pas essentielle, c'est la rentabilité de l'ensemble du processus contrôlé par la firme qui est visée.

Par contre la principale fonction économique et sociale des entreprises spécialisées dans le transport est d'offrir une disponibilité de moyens matériels et humains à un ensemble de clients "chargeurs". Il s'agit pour les transporteurs de produire de la flexibilité entre des processus de production et de commercialisation, autonomes dans leur organisation, dont les besoins et les rythmes ne sont pas "naturellement ajustés".

Pour produire cette disponibilité de moyens et cette flexibilité des délais, quelques grandes entreprises (moins de 50 sur les 30000 entreprises de transport) ont mis en oeuvre une offre de transports rapides (en 48h ou 24h) vers tous les points du territoire. Elles sont structurées "en réseau", avec des succursales à tous les points importants du territoire qui sont chargées de réaliser "l'enlèvement" et la "livraison" des marchandises. Les mouvements de marchandises entre les agences sont assurés par des "navettes" roulant de nuit. La fiabilité du service exige une attention particulière portée à la qualité du matériel assurant ces rotations de nuit et aux horaires des conducteurs des navettes qui, soumis à des horaires fixes et stricts, doivent toujours être dans la "meilleure forme" pour assurer leurs parcours. Ils travaillent moins que leurs collègues de la branche transport, à des horaires fixes et réguliers, de plus, ils n'effectuent que des tâches de conduite.

Mais, dans la plus grande majorité des entreprises de cette branche, les conducteurs sont les principaux agents régulant la temporalité du processus de transport et gérant les divers aléas, qui en affectent le déroulement. La journée étant le seul moment où les opérations de chargement et de déchargement peuvent être effectuées, les pertes de temps lors de ces opérations pouvant être importantes et mettre en cause la suite des transports à effectuer durant la semaine, bien souvent, ils doivent conduire la nuit ou au petit matin pour assurer les délais de livraison. Ils produisent la flexibilité requise en ajustant leur propre rythme de repos aux impératifs liés aux transports qu'ils effectuent. Le fait que les conducteurs aient à gérer les contraintes de temps est la raison essentielle de l'autonomie relativement large dont ils jouissent dans la réalisation de leurs tâches. Leur compétence ou leur qualification professionnelle consiste à produire de la disponibilité et de la flexibilité dans les meilleures conditions possibles d'efficacité et de sécurité. Le tribut de cette compétence est payé en terme d'irrégularité des périodes et des durées de

6) La structure des transports publics de marchandises en France est équivalente à celle qui existe dans les principaux pays d'Europe du nord et aux USA, les pays de l'Europe du sud ont des structures encore plus marquées par le poids des toutes petites entreprises dont le propriétaire est aussi le conducteur. Pour la France, la répartition des entreprises selon la taille:

0 à 5 salariés	74% (dont la moitié sans salariés)
6 à 9	1.1%
10 à 49	13.3%
50 à 99	1.1%
100 à 199	0.4%
200 et plus	0.2%

repos et de sommeil et, plus généralement, par des durées de travail dépassant largement les normes horaires vécues par la plupart des autres salariés et des autres conducteurs

Le "turn-over", plus important, des conducteurs de la branche transport constitue une réponse globale à des conditions de travail plus dures. Environ 16 à 17% des conducteurs de la branche transport la quittent chaque année, et près d'1/4 des plus jeunes! Certains se font embaucher, comme conducteurs, dans des entreprises appartenant aux "autres branches" de l'activité économique, d'autres quittent définitivement les métiers de la conduite.

A la différence des entreprises des "autres branches" effectuant des opérations de camionnage, les entreprises de la branche transport, sont en concurrence entre elles pour assurer le chargement de leurs camions. Ce qu'elles vendent c'est une capacité de transport, leur rentabilité dépend de leur capacité à faire le maximum de "kilomètres en charge". A part les très grands transporteurs, dominant le marché des frets à transporter, qui peuvent par des contrats directs avec les chargeurs équilibrer les rotations de leurs camions (en charge à l'aller et au retour) minimisant ainsi les parcours "à vide", la plupart des transporteurs moyens ou petits (qui très souvent ont aussi des contrats en direct pour au moins une partie de chaque rotation) doivent réaliser des transports en sous-traitance d'affrêteurs et de grands transporteurs pour assurer tout ou partie de l'équilibre de leurs rotations.

La concurrence entre les entreprises de la branche est extrêmement vive. Elles sont nombreuses à pouvoir se substituer les une aux autres. La guerre des prix est féroce. Aux temps encore récents où les prix étaient réglementés par une tarification routière obligatoire, ils étaient souvent négociés à des niveaux de 10 à 20 % au dessous du plancher des seuils réglementaires! Aujourd'hui, avec la libération complète des prix, ils s'effondrent. En tendance moyenne, ils baissent de 5 à 10% par an, selon le type de produit.

Les coûts généraux des entreprises continuant d'augmenter, malgré la baisse des prix, la pression sur les conditions horaires de travail des conducteurs reste très forte. Dans la mesure où beaucoup d'entreprises ne peuvent, vu leur taille, opérer des économies d'échelle. Les marges de rentabilité des entreprises de transport se rétrécissent, les rachats et les restructurations se multiplient, le taux des faillites augmente.

Le système du camionnage public (effectuée par les entreprises de la branche transport) est ainsi structuré par la domination de grandes entreprises gérant la demande de transport et maîtrisant une partie du fret à transporter (l'autre partie étant transportée directement par les producteurs ou les commerçants ayant leurs propres camions pour véhiculer leurs produits) et les nombreux rapports de sous-traitance qui lient, pour totalité ou partie du fret qu'elles véhiculent, les petites et moyennes entreprises aux grandes entreprises. L'offre, le plus souvent en sur capacité, de cette multitude de petites et moyennes entreprises produit une concurrence acharnée à l'obtention du fret qui génère une tendance à la baisse des prix. La

flexibilité du tissu des entreprises de transport, soumise au formidable "turn over" d'une partie d'entre elles, régénère constamment la surcapacité de l'offre. Le fonctionnement économique de ce système structuré de relations de sous-traitance a pour corollaire la "flexibilité de l'usage de la main-d'oeuvre" de conduite. Usage particulier de la main-d'oeuvre, lui-même rendu possible par un marché du travail très ouvert. La population des conducteurs de la branche transport est constamment régénérée. Le très significatif "turn over" des conducteurs, n'empêche pas le nombre de conducteurs d'augmenter. L'important potentiel de main-d'oeuvre disponible est à la mesure de la facilité d'entrer dans la profession. 1.550 000 personnes sont titulaires d'un permis de conduire les véhicules lourds, 380.000 emplois de conduite des véhicules lourds sont occupés!

Comme cela a été démontré par l'évolution récente le système routier de transport de marchandises est assez flexible pour continuer à connaître le succès. Pourtant, à la source de cette flexibilité globale, on trouve celle de l'offre multiforme et substituable des entreprises de transport qui repose sur celle d'un usage de la main-d'oeuvre de conduite hors des normes communément admises. Cela se traduit par des coûts sociaux externalisés à l'ensemble de la société, par le biais du niveau du risque routier produit et des risques de santé pour les conducteurs.

5. L'INCITATION A LA SECURITE ET LE CAMIONNAGE.

Des pouvoirs publics dépendent la qualité et la sécurité offertes par les infrastructures ainsi que la définition des conditions d'usage de la voie publique et le contrôle de l'application des règles. Concernant la circulation des véhicules lourds, les pouvoirs publics ont longtemps eu l'ambition de réguler les termes de la concurrence entre les entreprises, en octroyant les droits de faire des transports. Ceci est abandonné, mais l'intention de réguler les règles de la concurrence reste présente, notamment dans la réglementation sociale européenne, appelée "règlement de sécurité", dans lequel les normes de durée de la conduite et du repos devraient permettre de s'assurer contre les risques liés à la fatigue et de promouvoir des conditions équivalentes d'usage de la main-d'oeuvre de la part des entreprises.

On peut constater que les pouvoirs publics, fautes de moyens et probablement aussi faute de cohérence entre les nombreuses administrations effectuant des contrôles trop spécialisés, sont démunis pour faire respecter les règles édictées.)

- Plus de la moitié des véhicules de plus de 38 tonnes dépassent les vitesses autorisées de 80km/h
- 30% des poids lourds à deux essieux dépassent le 100 km/h et 14% les 130 km/h
- Le tiers des poids lourds sont en surcharge
- Concernant les règles sociales, le quart des conducteurs ont des repos journaliers insuffisants et la majorité des conducteurs de la branche transport (65 %) dépassent largement la durée de travail hebdomadaire autorisée.

Comme cela a été mentionné, par la plupart des observateurs, les normes réglementaires ont au moins de poids que les conditions économiques pour façonner les comportements réels.

Des entreprises dépend que soient gérées correctement au moins deux facteurs qui contribuent

) voir "Contrôles de la réglementation dans les transports routiers", 1990. Conseil National des Transports, Paris

à la production du niveau de risque engendré par la circulation des poids lourds :

- l'état des véhicules;
- le niveau des capacités des conducteurs, leurs compétences et la fatigue engendrée par le travail.

Concernant l'état des véhicules, la conjoncture de la production, le niveau de la demande de transport et la concurrence entre transporteurs, peuvent avoir un effet global négatif. Durant la période de la déréglementation américaine, n'a-t-on pas vu l'âge médian des véhicules poids lourds passer de 6 ans à 7,7 ans dans une conjoncture de forte concurrence durant laquelle le nombre d'entreprises de transports publics a été multiplié par deux et où les faillites sont passées de 200 en 1979 à 1500 en 1986 (soit 150/10000 compagnies dans le transport, alors que la moyenne pour l'ensemble des activités s'établissait à 115/10000 compagnies).)

Pour ce qui concerne les conducteurs, on a vu que les conditions de leur recrutement et de leur perfectionnement par la formation ne correspondaient pas à l'idée que l'on se fait habituellement de la gestion rationnelle des "ressources humaines". La plupart d'entre eux acquièrent leurs "savoirs-faire" sur le tas, en produisant. Concernant la charge de travail qu'ils accomplissent, pour la plupart, elle fluctue en fonction de la demande. Ainsi, la période de la déréglementation des transports aux USA a produit une augmentation de 15% des accidents impliquant des poids-lourds. Les experts se sont querellés pour savoir si la déréglementation en était la cause. Ils ont conclu que non, que l'augmentation du millage effectué durant la période permettait de dire qu'il y avait une trop légère augmentation du niveau du risque d'implication pour la décrire significative. Mais, il semble pourtant que, lorsque tous les pays connaissent une baisse tendancielle du niveau du risque d'implication, cette stagnation indique que les conditions économiques plus dures ont mis les entreprises de transport en face d'un problème de rentabilité. Les investissements de sécurité les plus habituels, comme le renouvellement et la maintenance du parc de véhicules, sont donc passés immédiatement au second plan des priorités. Quant à la pression sur le travail des conducteurs, les journaux américains s'en sont largement fait l'écho dans de nombreux reportages.

Dans les activités du camionnage, les processus d'incitation à la sécurité, les sanctions et les récompenses qui leur sont liés, s'inscrivent dans une structure sociale et économique particulière de division du travail et des risques qui donne aux préoccupations d'amélioration de la sécurité une place annexe par rapport aux arguments financiers et à la logique des pratiques économiques.

Ainsi, on pourrait penser que des mécanismes apportant des récompenses économiques seraient de nature à améliorer la situation. Mais, le coût des assurances intervient pour 4% dans le coût global d'exploitation des véhicules (ces assurances sont taxées à 35% du prix de la prime). Une politique de gains en sécurité apporte en fait, sauf pour les entreprises exploitant de très grosses flottes, des

gains économiques assez faibles, au mieux 1% sur le coût global d'exploitation des camions.

Concernant le coût global de la cotisation des entreprises aux assurances qui couvrent le risque du travail, les primes sont modulées aux résultats de l'entreprise, en terme de santé et de sécurité, à condition que celle-ci ait plus de 300 salariés, soit moins de 0,1% des entreprises, les autres paient une somme forfaitaire, dont le calcul du montant est lié aux résultats de l'ensemble de la branche. Les caisses d'assurance maladie ont lancé une initiative, visant à passer des contrats avec des entreprises de moins de 300 salariés pour l'amélioration de la sécurité, moins de vingt entreprises ont souscrit à de tels contrats, donnant droit pourtant à un prêt pour investir!

Concernant les conducteurs, ils touchent en général une prime de non-accident, une fois sur deux elle est à la fois prime de non accident et d'entretien du matériel. Elle représente environ 3,5% du salaire de base. Elle est retenue sur la paye du mois où s'est produit l'accident éventuel. Sa retenue, comme le montant des frais de routes (en fonction de nuances effectives) sont assez souvent des sujets de négociations entre l'entrepreneur et son salarié, au cas par cas.

Le tableau peut paraître désolant. Mais, ça n'est pas parce que les incitations institutionnelles semblent peu attractives, que la préoccupation de sécurité n'existe pas dans les entreprises de la branche transport. Elle est très liée à la préoccupation de la fiabilité du respect des délais du contrat de transport. La contradiction entre les impératifs de délais et la capacité de conduire dans des conditions difficiles de fatigue se négocie au sein de l'entreprise entre l'entrepreneur et le salarié. La préoccupation du risque existe dans chacune des décisions et des actes des chauffeurs qui savent, même s'ils en parlent rarement, qu'ils font un métier dangereux. Cette gestion diffuse, informelle, reposant sur la connaissance des hommes et de leurs capacités, joue indéniablement un rôle régulateur dans la plupart des petites et moyennes entreprises. On a pu montrer par exemple) que les conducteurs de la branche transport, dont le niveau global de risque d'implication est supérieur à celui de leurs collègues, avaient dans les périodes horaires très dangereuses, une progression de leur risque d'implication trois fois plus faible que leurs collègues des autres branches. Tout se passant comme si, la connaissance et le "savoir-faire" liés à l'expérience journalière, de conditions de travail plus difficiles, de la lutte contre la fatigue, leur permettaient de mieux gérer les dangers que constituent la fatigue et la conduite d'ennui. D'une certaine manière, on peut dire qu'ils compensent une partie de l'insécurité attendue, vues leurs conditions de travail très dures.

Il existe, dans l'univers du camionnage, des situations qui sont des exceptions ou des contre-exemples intéressants de gestion moins diffuse du risque: les grandes entreprises "à réseaux", offrant des services intégrés et le transport de matières dangereuses.

Dans les grandes entreprises offrant un service régulier, l'organisation de la fiabilité du service repose sur la prévision et la division des tâches. Il y a des exemples de réussite reposant sur l'intégration de la sécurité et de la fiabilité du système de transport organisé par l'entreprise. Il s'agit d'entreprises de grande taille, organisées en réseau, maîtrisant l'accès direct à la clientèle par l'offre qu'elles proposent,

⁶⁾ Cf. "Gearng up for Safety, Motor Carrier Safety in a Competitive Environment". 1988, Congress of the United States, Office of technology assessment, OTA SET 39.3, Washington, DC.

⁷⁾ Cf. note 3

assurant l'équilibre de leurs trafics en gérant des flux importants de marchandises, elles ont les moyens d'investir et d'améliorer la productivité d'ensemble du système d'offre qu'elles ont mis en place. Pour le transport des matières dangereuses, c'est probablement l'action croisée dans les différents domaines qui concourent à la sécurité qui en font un secteur où le risque d'implication semble être plus faible. La mobilisation sociale autour de la qualité technique des véhicules, de la formation des conducteurs, les précautions prises à tous les moments du processus, l'attention des assureurs et la limitation plus strictes des vitesses de circulation, auraient un effet bénéfique sur la sécurité.

Le problème de l'incitation à la sécurité dans les activités de camionnage impliquerait la même attention et probablement une stratégie cohérente de mesures croisées du même ordre.

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L'ASSURANCE AUTOMOBILE PEUT-ELLE ET VEUT-ELLE INVESTIR DANS L'ACTION PRÉVENTIVE?

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1.1 La fonction essentielle de l'assurance, dans le domaine automobile comme dans tous les autres domaines d'exercice est de fournir une compensation monétaire, totale ou partielle aux dommages constatés à la suite d'un événement particulier, tel que l'accident; plus généralement l'assurance réalise une mutualisation des conséquences monétaires de l'accident et une substitution à la responsabilité engagée par le souscripteur du contrat. C'est ce qu'exprime fortement la devise des LLOYDS: "The contribution of the many to the misfortunes of the few" (La contribution de tous aux revers de fortune de quelques uns, cité par Denis Kessler).

Dès l'origine, l'assurance s'établit comme une institution de **réduction de l'incertitude** attachée aux conséquences d'événements négatifs de toutes natures et, plus directement d'événements résultant de l'action humaine.

Ce faisant, l'assurance a permis et permet toujours le développement de l'action et l'initiative de l'entrepreneur ou de l'aventurier. La mutualisation des conséquences monétaires de l'imprévu ou de l'aléa est un puissant **facilitateur** de l'engagement et de l'activité: beaucoup d'analystes considèrent que cette forme d'organisation et de socialisation est au cœur du développement de l'économie depuis la Renaissance.

1.2 La prime d'assurance est le prix dont l'assuré paye cette sécurité qui équivaut à une réduction de l'incertitude. **La prime s'analyse comme la perte certaine mais maximale** que peut, en matière monétaire, subir l'assuré. Dès lors, l'assurance peut être considérée comme le moyen qui permet, ou même qui encourage à s'engager dans des activités présentant un risque, même important. Sans même parler des "effets pervers" (ou "**risque moral**") de modification défavorable des comportements de l'assuré, sur lesquels nous reviendrons, il est vrai qu'en générant la certitude d'un risque monétaire maximal défini (égal au montant de la prime) l'assurance "produit" de manière mécanique un risque indéniable: par exemple on peut affirmer que sans l'institution de l'assurance la "civilisation de l'automobile" n'aurait pu gagner progressivement toute la planète, peu d'individus conscients et informés étant disposés à courir le risque d'assumer les conséquences monétaires de l'accident grave: dès lors en permettant la formidable libération de la mobilité induite par la généralisation de l'automobile l'assurance a indirectement contribué à la survenue de millions d'accidents.

1.3 Ainsi, à la réduction d'incertitude en matière

monétaire qui génère un certain type de sécurité s'oppose la production d'une insécurité d'autant plus réelle que des "**effets pervers**" de l'assurance sont parfois constatés, par exemple dans le domaine de l'assurance contre le vol ou contre l'incendie on connaît la réalité de ce que les assureurs nomment pudiquement le "risque moral" et qui va de la négligence facilitée par la possession d'un bon contrat à l'escroquerie délibérée. En fait, en matière automobile, et spécialement dans le domaine du risque corporel, on peut penser que ces **effets pervers** éventuels sont **très marginaux** puisque ce qui est fondamentalement en jeu dans l'accident de la route c'est d'abord un risque pour la vie et pour la santé, et plus encore un risque pour soi et pour les proches: par définition ce risque pour soi et pour les proches n'est pas mutualisable.

1.4 Finalement, si l'assurance est un formidable instrument de la mutualisation des conséquences monétaires de la variabilité des événements, elle est au fond **neutre et indifférente** à l'égard de la survenue de ces événements socialement définis que sont les accidents: il est à cet égard significatif que l'auteur d'un "petit dictionnaire d'économie de l'assurance", présenté aux journées scientifiques d'une grande compagnie ne mentionne jamais le terme de "prévention" (tout en nommant "auto protection" le comportement qui conduit à limiter la fréquence des sinistres).

Au delà de l'anecdote ce qu'il faut retenir c'est que **l'assurance prend le monde comme il est**: son projet dont nous avons vu l'importance dans l'histoire de nos sociétés ne consiste pas à transformer le monde ni même à l'infléchir **si ce n'est indirectement** par le biais de la socialisation et de la mutualisation des conséquences monétaires des accidents ou aléas.

Dès lors, on pourrait à bon droit se demander si la question même qui inspire cette communication, "l'action préventive de l'assurance" n'est pas stupide quoique bien intentionnée?

2.1 L'assurance n'est pas directement et naturellement orientée vers la maîtrise et la prévention du risque, d'autant qu'à la limite un risque très faible peut rendre l'assurance inutile.

Et pourtant divers facteurs identifiables conduisent à nuancer le constat et à reconnaître les **potentialités de la prévention** développée par l'assurance automobile:

2.1.1 L'histoire de l'assurance montre que l'institution a joué un rôle significatif dans la production d'une action préventive qui a pris selon les cas, la forme d'une **réglementation ou d'une normalisation** des matériels, des conditions d'usage et d'exploitation, des procédures d'entretien et de maintenance, d'organisation du secours... la forme de **l'agrément préalable**... la forme de **la recherche technique** appliquée à la maîtrise de certains risques... ou même la forme institutionnelle du **contrôle** et du

label. En fait tout se passe comme si l'énormité du coût de certains événements, accidents ou catastrophes conduisait d'une part à une socialisation élargie (techniques de réassurance) des conséquences monétaires et aussi, d'autre part, à l'émergence d'une **expertise du risque** partiellement orientée vers et par la recherche d'une réduction de sa probabilité d'occurrence. Dès lors nous pourrions nous demander pourquoi l'assurance ne consent pas les mêmes efforts de prévention dans tous ses domaines d'intervention.

2.1.2 La fraude à l'assurance est une forme de comportement pervers que l'assureur doit connaître et combattre; à cette fin il est conduit à construire une catégorisation et une spécification du contrat (clauses d'exclusion, règles à respecter par l'assuré...) et une capacité de vérification, de contrôle, d'expertise. Même si la prévention n'est pas l'intention et le motif premier de cet effort, elle en bénéficie pourtant indirectement.

2.1.3 Surtout, même lorsqu'existe une obligation d'assurance (cas de l'assurance automobile obligatoire dans la plupart des pays) le coût du risque peut générer des niveaux très élevés de la prime, niveaux qui peuvent être insupportables pour une partie de la population.

Il en résulte un marché instable et malsain, avec croissance des effets pervers tels que le refus d'assurance; plus simplement le coût de l'assurance peut devenir tel qu'il freine le développement de la mobilité et de l'équipement et menace l'extension et le renouvellement du marché de l'assurance lui-même. Le cas des **jeunes conducteurs novices** devrait être l'occasion d'une analyse des effets de l'inflation des coûts d'assurance, c'est-à-dire d'une partie significative des coûts d'accès à la mobilité automobile.

Face à de tels problèmes l'assurance peut certes, comme il est naturel, agir en ordre dispersé, par exemple en sélectionnant les "bons risques" (les "bons jeunes"). C'est le jeu du "mistigri" dont on connaît les charmes et les limites; mais, peut-être, à considérer l'assurance dans la logique de l'économie, la question de l'action préventive acquiert-elle ici une nouvelle légitimité?

2.2 Il reste pourtant qu'il serait illusoire de ne pas inventorier des obstacles à l'engagement de l'assurance automobile dans la prévention, d'autant plus lourds que la prévention ne fait pas naturellement partie de la culture de l'assureur. Mentionnons brièvement quelques uns de ces obstacles permanents:

2.2.1 Le premier et le principal de ces obstacles réside sans doute dans l'incertitude sur la nature, le contenu, les modalités d'une prévention efficace en matière automobile. Alors que dans divers domaines du "gros risque" (aérien, maritime, indus. tels...) les assureurs pensent pouvoir orienter et infléchir les mécanismes de production du risque tout se passe comme si dans le domaine du "risque diffus", et notamment en matière automobile les assureurs considéraient que pour l'essentiel ils n'ont pas la maîtrise de la genèse des risques: soit parce qu'elle renvoie à des acteurs puissants considérés comme non influençables (par exemple l'industrie automobile) soit parce qu'elle s'éparpille et se dissout dans la masse de millions d'individus, inconnus et dissimulés.

2.2.2 Le marché de l'assurance automobile est un **marché concurrentiel** qui, normalement, induit une exigence sur les prix et la qualité de service. Le coût de la prévention, variable selon ses formes, son contenu, ses ambitions peut être considéré comme une charge d'autant moins acceptée qu'elle serait très inégalement répartie. En effet, compte tenu de la réalité de l'insécurité routière l'assureur peut considérer que ses éventuels effets en matière de prévention ne peuvent être directement rentabilisés par des résultats spécifiques puisque indirectement, les concurrents bénéficient aussi de l'accroissement de la sécurité routière même s'ils ne s'engagent pas dans une politique de prévention. C'est cette particularité de l'assurance automobile et du risque routier qui explique la préférence de l'assurance pour une action préventive menée par des organismes professionnels horizontaux.

3. Pourtant en dépit de ces obstacles l'assurance automobile est certainement l'une des institutions objectives bien placées pour concevoir et pour développer une action de prévention.

3.1 D'abord, en raison de son **caractère d'universalité**: en effet, dans les pays développés c'est la presque totalité des usagers de la route qui s'établissent dans une relation contractuelle avec l'institution de l'assurance; même lorsque l'obligation légale stricto sensu n'existe pas, ce qui reste rare, l'usager de la route s'assure parce qu'il connaît l'enjeu du risque financier et, plus généralement, parce qu'il adhère au modèle social et culturel dominant qui fait à l'assurance une place centrale dans le fonctionnement de nos sociétés.

3.2 Mais le contrat possède une **dimension personnalisée**: c'est l'usager lui-même qui fait son choix et qui s'engage dans cette relation contractuelle. L'institution qui utilise cette situation dans sa politique commerciale a donc la possibilité de la mettre au service d'une action de prévention, par exemple en **communicant**, sous les formes de son choix, avec l'assuré.

3.3 D'autant que l'institution de l'assurance dispose de **moyens de connaissance** de l'assuré, outre la récolte des informations de base nécessaires à la spécification du contrat et à l'application d'une tarification l'assurance peut développer des moyens de récolte de l'information et d'analyse, elle peut par exemple, plus peut-être que n'importe quelle institution publique de sécurité, établir le cursus de l'assuré, ses habitudes, ses usages de l'automobile et bien entendu son implication dans les accidents et le degré d'engagement de sa responsabilité. Certes cette connaissance a un coût que l'institution de l'assurance peut apprécier; mais c'est aussi cette connaissance qui permet d'élaborer des stratégies, d'éclairer une gestion et de décider par exemple de l'intérêt d'une action de prévention personnalisée.

3.4 L'institution de l'assurance, armée par cette connaissance dispose de nombreux moyens pour **influencer l'assuré**. Outre la sélection initiale, une sélection continue est à l'oeuvre puisque l'assureur peut dénoncer un contrat, refuser d'assurer certains risques ou réviser les termes du contrat; plus généralement, en utilisant l'**outil de la tarification**, l'assureur peut chercher à influencer l'assuré usager de la route.

4.1. Par exemple, les systèmes de tarification du type **bonus-malus** cherchent à personnaliser le montant de la prime en intégrant le passé de l'assuré pour

moduler sa contribution financière. Ce système prétend corriger par une dimension personnelle les résultats fournis par la catégorisation tarifaire et les données agrégées.

Conçu pour répondre à une demande de plus grande justice des tarifs formulée à l'origine par les associations de consommateurs le système de bonus-malus est aussi un "système de **récompense-sanction**" qui se propose d'influencer le comportement des usagers en les "récompensant" d'une diminution du risque constaté, en termes de sinistres déclarés.

Les bonnes intentions originelles du bonus-malus sont donc incontestables puisqu'il s'agit de rendre plus juste une tarification et de récompenser le résultat positif, mais hélas l'enfer est pavé de bonnes intentions; dans le cas du bonus-malus nous constatons que la structure du système conduit inévitablement, en quelques années, à un profond **déséquilibre de la répartition des primes** puisque près de neuf assurés sur dix bénéficient d'un bonus! Surtout l'influence sur les comportements est bien vérifiée, y compris dans ses aspects pervers les plus contestables: par exemple, l'enjeu lié à la perte d'un bonus accumulé est tel que les conduites aberrantes de fuite ou de refus de déclaration d'accident ne sont plus exceptionnelles. En fait, à notre connaissance, les effets éducatifs et préventifs du bonus-malus n'ont pas été démontrés; par contre ce système, complété par l'adjonction de franchises a permis de faire diminuer de manière très significative le pourcentage des sinistres matériels donnant lieu à déclaration effective et à prise en charge par l'assurance. C'est d'ailleurs sans doute cet effet minorateur du bonus-malus qui explique partiellement son maintien. Nous constatons donc que le potentiel d'action a été mis au service d'une **action préventive** conçue de manière **abstraite et théorique** et sans réel souci de modifier les mécanismes de survenue de l'accident. S'agit-il d'une simple mésaventure de la prévention? Doit-on au contraire considérer que l'institution de l'assurance a utilisé l'esprit d'un système de prévention au profit de ses finalités d'équilibre financier? La discussion est ouverte.

4.2 Les jeunes conducteurs débutants produisent un risque objectivement constatable sensiblement plus élevé que celui des conducteurs confirmés; que l'on raisonne en termes de mortalité ou en termes de morbidité (accidents graves avec séquelles par exemple), en nombres absolus ou en indices composites (par exemple perte d'espérance de vie) l'insécurité routière des jeunes conducteurs débutants est un enjeu considérable qui justifie de la part de la société entière et des grandes institutions une action ambitieuse. Que pouvons nous dire à cet égard de l'institution de l'assurance automobile qui par définition, est l'interlocuteur obligé de tous les jeunes conducteurs débutants?

4.2.1 La réponse majoritaire de l'institution à ce phénomène préoccupant de l'insécurité des jeunes débutants réside dans le principe général de la "vérité des prix": les primes appliquées aux jeunes conducteurs débutants sont beaucoup plus élevées que les primes appliquées aux conducteurs confirmés et cette majoration est appliquée a priori avant même toute mise à l'épreuve. L'institution, fidèle à sa logique dominante et à l'organisation concurrentielle du marché, applique un niveau de prime qui se rapproche du coût du risque; ce faisant elle constate parfois, dans certains milieux, des réponses "adaptatives" perverses allant jusqu'à la

conduite sans assurance, plus souvent encore elle constate que le coût de l'assurance pèse lourdement sur le budget consacré à l'automobile par le jeune conducteur, en concurrence avec le coût d'un équipement correct (voitures d'occasion) ou avec le coût de l'entretien minimal du véhicule. Le bilan en termes de sécurité n'est pas disponible.

4.2.2 La réponse minoritaire, mais qui existe dans plusieurs pays, consiste au contraire à privilégier un principe de **solidarité entre les générations** au moyen d'une **péréquation partielle ou totale du niveau** des primes des conducteurs débutants ou confirmés. Il s'agit au fond de ré-introduire la durée dans la calcul des primes; la vérité des prix n'est pas mise en défaut elle est simplement respectueuse du fait que l'expérience acquise par le conducteur confirmé a demandé du temps de constitution.

En fait, on l'aura compris, il ne s'agit pas de simples fantaisies comptables: ce qui sépare les deux réponses mentionnées ("vérité des prix" immédiate ou péréquation entre les générations) c'est en fait la conception du fonctionnement social et des valeurs régulatrices qui l'orientent.

Ce qui est remarquable c'est que l'institution de l'assurance a produit les deux réponses: en un certain sens et à des conditions qui peuvent être définies (nature de la réglementation et politique des pouvoirs publics) l'institution de l'assurance s'accommode de réponses très dissemblables.

4.2.3 Ceci mérite d'autant d'être souligné que nous devons constater que ni la "vérité des prix" ni la "solidarité inter-génération" ne posent le problème de l'insécurité des jeunes conducteurs débutants en termes de prévention. Nous nous contenterons ici de remarquer que l'institution de l'assurance confrontée à ce phénomène de l'insécurité routière des jeunes conducteurs débutants ne propose aucune réponse en termes de formation et d'éducation. Ce constat nous conduit à poser deux questions:

- cette **absence d'investissement en matière de formation** et d'éducation des jeunes conducteurs signifie-t-elle que, tout bien pesé, l'institution de l'assurance n'accorde pas grand foi en la possibilité de modifier sensiblement le niveau de risque au moyen de la formation et de l'éducation?

Divers signes semblent indiquer que ce scepticisme semble fréquent.

- Cette réserve signifie-t-elle, au contraire ou au surplus que l'institution de l'assurance est soucieuse d'affirmer son identité en refusant de se disperser dans d'autres finalités que celles de la mutualisation des risques financiers? Si tel était le cas il faudrait admettre que cette **concentration sur l'identité institutionnelle** ne peut laisser qu'une place mineure et marginale à l'action de prévention, qui est tentative de maîtrise et de modification des processus naturels.

4.3 Plus généralement nous remarquons que le potentiel de connaissance du risque dont l'assurance dispose est surtout utilisé dans la perspective de l'affinement de la tarification, cette connaissance des facteurs de risque n'est pas pleinement mise au service d'une politique volontariste de maîtrise et de diminution du risque.

Par exemple tout se passe comme si, sauf exception rare, l'assurance constate et mesure des

différentiels de risque des différents types de véhicules produits par l'industrie automobile; cette mesure se traduit certes dans la tarification appliquée ... Mais l'assurance comme institution n'intervient ni dans le processus du choix de la gamme ni même en tentant d'orienter le choix d'achat des automobilistes à qui on ne fournit pas les indications objectives que l'étude épidémiologique comporte à nouveau la remarquable prudence de l'assurance doit être mentionnée; une sorte de "neutralité" à l'égard des états du monde qui est à l'évidence loin de la volonté et des valeurs qui animent le projet de la prévention.

5. En forme de **conclusion provisoire**, nous constatons l'existence d'une **tension** entre d'une part cette "neutralité" qui manifeste la centration de l'institution sur son identité première d'instrument de mutualisation des conséquences financières des risques et, d'autre part, la mobilisation, l'engagement et la "prise de risque" de toute action de prévention ambitieuse. La dissymétrie constatée au profit de l'identité première de l'institution doit être soulignée si l'on veut faire preuve de réalisme.

Dès lors la question qui se pose paraît être la suivante: quelles **nouvelles forces** faut-il introduire dans ce champ de forces dissymétriques pour rendre des perspectives sérieuses à l'action préventive de l'assurance? C'est un débat important et difficile; deux pistes seront seulement signalées ici:

- les consommateurs ont montré depuis quelques décennies qu'en amont du choix que représente l'achat ils peuvent s'organiser pour produire une connaissance, élaborer et spécifier une demande, mettre en cause une qualité insuffisante, promouvoir les instruments techniques, informatifs et réglementaires d'un progrès objectivable. A l'égard de l'assurance automobile les **consommateurs** usagers se trouvent dans leur situation classique de demande d'un produit amélioré (formes et contenus des contrats, clarification, transparence, efficacité, rendement ...); mais ils peuvent aussi reconnaître dans l'assurance son puissant potentiel de connaissance et d'action préventive et demander qu'il soit valorisé au service de la sécurité routière.

- Les **Pouvoirs Publics** qui exercent partout une tutelle plus ou moins lointaine sur l'institution des assurances devraient aussi reconnaître ce potentiel mal employé. Malheureusement, jusqu'ici, ils n'ont pas su exprimer de manière concrète la nécessité d'un engagement au service de la prévention, mais une évolution est possible et l'entreprise n'est pas hors de portée.

A condition d'être "mis en mouvement" par la demande des consommateurs et l'incitation des pouvoirs publics les institutions de l'assurance automobile ont les moyens de réexaminer en profondeur les objectifs de prévention qu'ils doivent définir et les moyens et modalités d'une réelle contribution à l'effort collectif pour une sécurité routière améliorée.

REWARDING IN INSURANCE: RETURN OF PART OF PREMIUM AFTER A CLAIM-FREE PERIOD

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Approximately 70% of the total direct costs to society of road accidents are compensation costs and administrative costs for the insurance companies. It's obviously of great interest for the insurance companies to cooperate in order to reduce the number of traffic accidents and consequently the compensation costs. The question is what insurance companies can do. Different ways are given in a report from OECD (1989) and I will not go into detail here.

However, the insurance companies have measures that in principle can improve safety and where the insurance companies are the only ones to do something. It is by way of the design of the insurance conditions that should be developed in line with theories supporting safety on the roads. The insurance conditions should motivate the insured to buy safe vehicle, install and use safety devices and to drive safely on the roads.

REWARDING/PUNISHING TO PROMOTE SAFETY

Insurance systems.

A number of rewarding elements are to some extent used by most insurance companies (OECD, 1989). The bonus-malus system is widely used in Europe. Bonus on the yearly premium is given for years free of accidents, and consequently rewarding careful driving not causing accidents. In Norway it's possible to obtain 80% bonus on the basic premium after 15 years without accidents. However, is it likely that driving habits are influenced by this possible loss of bonus? Normally, the driver and the insured himself are directly exposed to the risk. It therefore seems likely that the risk of being bodily injured or to hurt other persons will influence driving habits more than insurance conditions.

Other rewarding elements of insurance that influence decisions of more permanent character may yield more benefit to the safety on the roads. Examples are reduction of premium to all who guarantee that seat belts are used by all passengers in all seats (DoT, 1986) or for motorcycle drivers who always use special suits with good protecting performance. A number of rewarding measures are developed by insurance companies to attract customers with potential few accidents ("good risks") and to avoid customers with bad reputation ("bad risks"). These measures will not improve safety in the society as a whole, and can therefore not be included in a list of safety measures.

Incentives versus punishing

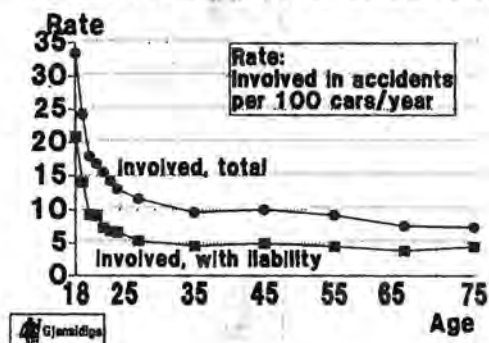
A number of studies give indications that incentive systems for accident-free driving can be effective and superior to schemes with punishments after accidents (Wilde et al., 1982). The bonus-malus system is a combination of rewarding and punishment. However, the punishment, expressed as amount of money, after an accident is more severe than the reward after an accident-free year. This extra bonus gives only a modest reduction of premium and is not presented to the insured as a reward.

To make the reward after an accident-free period more visible than the bonus on the next year's premium, the idea of repayment of a part of the premium as a reward was developed. Wilde et al. (1982) reported that a Canadian insurance agency, run by the government, would refund 25% of the premium after an one-year period to those under the age of 25 who had no accidents and no more than five penalty points. However, no study on the effects of this program was reported.

It's important to notice that the incentive program was applied to young persons only. It is well-known that young drivers have high accident rates compared to older and more experienced drivers. Figure 1 is based on data from Gjensidige Insurance, insuring 500 000 cars, or more than 25% of private cars in Norway. This figure expresses the number of accidents per year per 100 insured cars for different age groups of owners. The driver is the owner of the car at 80% of accidents with vehicles belonging to people under the age of 25.

Figure 1: Rate of reported claims after collisions or single vehicle accidents per year per 100 insured cars. Total number of claims and claims with liability. Gjensidige Insurance, Norway, 1989

Accident Rates by Age of Car Owner



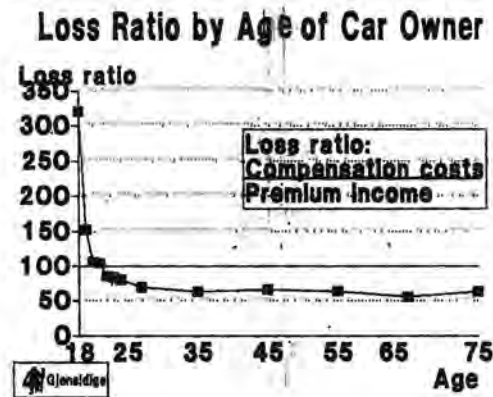
The upper line shows the number of cars involved in accidents per 100 insured cars and the lower line involvement rate with liability for the drivers considered. At the age of 18 the total accident rate is 33 out of 100. Only 21 accidents out of 100 insured vehicles are with liability or at fault.

For the experienced driver, fortunately, accidents are

rare. According to figure 1, less than 5% of owners over 30 years have an accident with liability during one year. On average more than 20 years free of accidents elapse between two accidents if only claims with liabilities are considered. A rewarding system encouraging drivers with accident-free year has no chance to be effective if almost everyone consequently gets a small reward.

The young car owner problem seen from an insurance company is illustrated in figure 2 where the loss ratio for different age groups in 1988/89 is displayed. Loss ratio is compensation costs divided by annual premium. "Break even" is 100, exclusive of administrative costs.

Figure 2: Loss ratio for age groups. Gjensidige Insurance, Norway, 1988/89.



This figure shows that an 18 years old car owner costs the insurance company more than three times the yearly premium for the same age group. Keep in mind that the premium per year paid by young people is high in a bonus malus system. In most of the period considered, it was no extra charge for young drivers except a higher "own risk". After the age of 22 only the loss ratio is less than 100. Young owners and drivers are subsidized by more experienced drivers - or the insured young car owner have to pay relatively more for motor insurance at a more mature period in their lives. It's therefore important for every insurance company that young people stay with the company even after the first five years.

A Norwegian company introduced from september 1. 1989 new insurance conditions for young car owners. The motives were to combine the potential accident reducing effect of incentives for accident-free driving with the request to keep the insured loyal to the insurance company. These new conditions introduces an extra reward for 3 to 5 accident-free years in addition to the sanctions of the bonus malus system.

Many insurance companies add an extra charge to the premium for young drivers. The extremely high loss ratio for young people displayed in figure 2, will consequently be reduced. However, the special arrangement was that this extra charge should be returned to the policyholder after an accident-free period as a reward.

Policyholders younger than 23 years insuring cars for private use, should pay an extra annual premium. This extra premium is decreasing from NOK 1 000 (USD 150) yearly at 18 years of age to NOK 600 (USD 90) at 22 years of age as shown in figure 3.

This extra premium is paid every year to an account for each individual policyholder. The sum on the account will be paid back to the policyholder after five years from the first year of insurance, or finally at the age of 25 years if the policyholder has no claim affecting the bonus, and the policy is still active.

The value of the extra premium eventually returned, is adjusted according to the inflation rate. The maximum of the extra sum paid back after 5 years is NOK 4000 (USD 600), corresponding to more than the average annual insurance premium for a private car.

Figure 3

Extra Premium for Young Car Owners

Age	NOK	USD
18 years	1,000	150
19 years	900	135
20 years	800	120
21 years	700	105
22 years	600	90
Maximum sum	4,000	600

Reward for Claim-free Driving:
Sum of Extra Premium

EVALUATION

A preliminary evaluation of the incentive effects of the rewarding system is carried out by a simple before and after study with control groups. The experiment period is the eleven months period from september 1989 to july 1990 which is compared to the corresponding period previous year.

The target group, the 18 to 22 years old car owners, was included in the rewarding group gradually on due day from 1. september 1989 to 31. august 1990. Consequently, a large part of the target group was not included in the experiment or reward group a shorter or longer part of this initial one year period. The 18 to 22 years old car owners who were not so far included in the reward group in the experiment period, served as a control group.

The design of the study is presented on figure 4. Analysis are carried out on three groups; all ages, the owners aged 23 to 29 years who not are included in the incentive system and the target group from 18 to 22 years old.

Results

The accident rate is expressed as number of reported claims per year per 100 insured vehicles (table 1). This rate is presented for the before and after periods in figure 5 for the groups considered. The reduction in accident rate for all groups expresses the general improvement in road safety caused mainly by a mild winter. However, the reduction in the accident rate for the car owners in age 18 to 22 years with reward agreement, is higher than for other groups.

The changes in accident rates are presented in figure 6. The reduction in accident rate for all groups and

Table 1. Accident rates before and after introduction of the rewarding system. (Accident rate = claims per 100 cars) (N = number of accidents in group)

Period	All ages	23-29 years	18-22 years
Before; 9/88-7/89	11.6 (N=49.3')	13.4 (N=7.6')	20.7 (N=6.4')
After; 9/89-7/90 (Control)	10.1 (N=44.3')	11.8 (N=7.2')	18.0 (N=3.7')
After; 9/89-7/90 (Reward)			13.4 (N=1.6')

Figure 4

Evaluation of a Rewarding System for Young Motorists

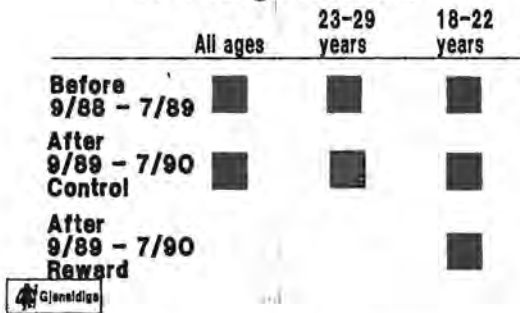


Figure 5

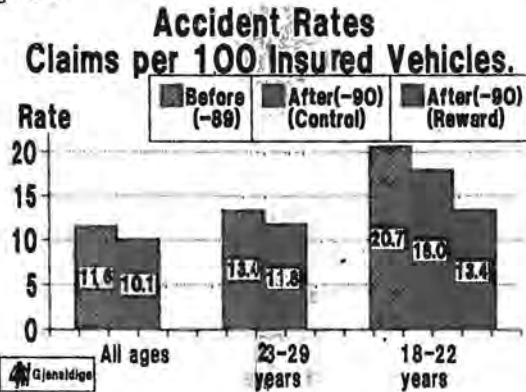
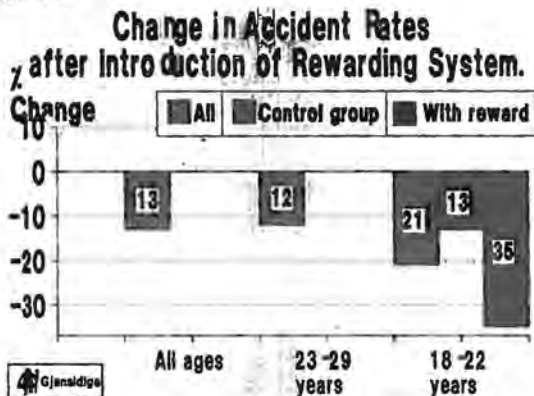


Figure 6



the 23-29 years group are 13% and 12% respectively. For the 18 to 22 years group, still not included in the reward system, the decrease in accident rate is on line with other groups with 13% reduction. However, the experiment group, or the reward group, has a 35% reduction in reported claims.

With over 90 thousand accidents totally in the study and 1 600 in the smallest group, the differences are highly significant.

This result is promising. However, it's unlikely that the rewarding system has changed the drivers behaviour so dramatically that this change explains the improvement in the number of reported claims. Alternative explanations for the improvement may be:

1 Underdeclaration

A greater share of accidents really occurred is not reported.

2 Risk selection

- "Good risks" attracted by the rewarding system
- "Bad risks" left the company after the extra premium is added because they don't think they would receive the reward anyway.

3 Real effect on behaviour

However, this preliminary study is not sufficient to give any conclusion. Further studies in a prolonged period and with other factors included are necessary before we can conclude on this matter.

FINAL COMMENTS

The insurance companies interests in cooperating in order to reduce the compensation costs are questioned. However, at least in short term, the reduction in compensation costs will increase the companies net profit because the premium is paid in advance. In the longer term the premium costs should decrease and consequently affect the total volume of the business. In a society with competition between companies, measures that can give basis for a reduction of the individual premium are appreciated.

In this respect they have joint interests with road safety authorities and the customers who will benefit from it.

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ISSUES THAT REMAIN: COMMENTARY ON SESSION 3

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It goes without saying that it will not be possible to review the papers presented in Session Three to the level of detail that would do justice to them. This commentary will, therefore, focus on several issues that have not received the amount of attention in Session Three - or perhaps more generally at this conference as a whole - that they may deserve. I assume that it is our aim to fully discuss the existing expertise and implications regarding reward and punishment, and reward versus punishment, for the purpose of advancing safety.

I have grouped my comments in the following categories:

1. Some issues in the evaluation of countermeasure effectiveness.
2. The role of the insurance industry in accident prevention.
3. Have all important points in designing effective incentive programmes been covered?
4. A proposed remedy for the malady diagnosed by Ezra Hauer.
5. Some nagging benefit cost considerations.

1. ISSUES IN EVALUATION

I would like to make several comments on issues of empirical evaluation of the effectiveness of interventions for the purpose of greater safety. The first is relatively mundane in nature and has to do with what is known as regression towards the mean. Secondly, I wish to call your attention to the very marked association over time between the unemployment rate and the per capita traffic accident rate in one and the same country. The third comment is much more fundamental; it relates to the question of what is actually meant by the term 'greater safety', and thus with the question of what it is exactly that we wish to achieve. Finally, there is the question of how that goal can best be achieved, by focussing our countermeasures upon intermediate criteria or upon the ultimate yardstick of safety.

1.1 Regression towards the mean

Accident rates are notorious for their unreliability. They fluctuate from year to year in any jurisdiction and the fluctuations are usually more pronounced as the jurisdictions are smaller. Jurisdictions that show higher than average accident rates in one year will usually show lower rates in the next, while jurisdictions showing lower than average rates in one year will usually show higher rates in the following year.

These phenomena are called regression towards the mean when there is no specifically known variation in factors that cause accidents, and thus the

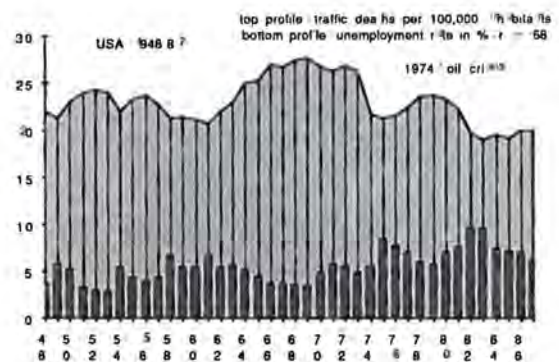
fluctuations are attributed to chance. Consequently, a drop in accident rate in some jurisdictions that occurred following some accident countermeasure may either be due to chance or to that countermeasure, and additional information is needed before we can decide that the countermeasure had a beneficial effect indeed. Information useful for this purpose may be that the countermeasure implementation was not made to depend on the accident rate and that the accident rates did not fall (or not as much) in jurisdictions in which the countermeasure was not implemented. Thus, in the absence of such information we cannot conclude that the countermeasures implemented in France and in the Netherlands and reported by Madam Steinhart and Mr. Wegman at this conference influenced the accident rate, however promising these countermeasures may be.

1.2 Effect of the unemployment rate

Simple before-after comparisons of accident rates, that is without external controls, are not good enough to show countermeasure effectiveness, because any shift may be due to factors other than the countermeasure. One of these other factors that have attracted considerable attention in recent years is the from-year-to-year fluctuation in the economic juncture (Partyka, 1984; Mercer, 1987; Wilde, in press a and b). When we take the unemployment rate as a reflection of the ups and downs in the economy, a strong negative relationship can be seen between the traffic fatality rate per 100,000 inhabitants on the one hand and the unemployment rate as a percentage of the workforce on the other - the higher the unemployment rate the lower the death rate on the road (Figures 1-7).

Compare, for instance, the top and bottom profiles in Fig. 1 which relate to a 40 year period in the USA ending in 1987. Virtually every increase in the unemployment rate from one year to the next is associated with a drop in the traffic death rate per head of population, decreases in the unemployment rate are associated with increases in the fatality rate. We are inclined to interpret these patterns of

Fig. 1: Unemployment rate and traffic death rate per 100,000 people, USA 1948-1987 (from Wilde, in press a)



relationship as being due to an effect of the economic juncture upon the accident rate; not to a causal influence in the opposite direction, and this not only because the increases in the fatality rate are not high enough to relieve unemployment to a significant extent (nor do we believe that both variables are simultaneously being caused to vary by some third factor). To us it would seem that what happens is more likely like that whenever the economy is in a down period, the amount of accident risk people are willing to accept will be reduced because of the increased costs of accidents and their consequences relative to real income. Moreover, there is a greater cost of driving because of cars and gasoline becoming a comparatively heavier burden on income. Also, the potential benefits associated with extensive and fast driving are diminished, because in a recession the amount of extra money that can be earned by making more and speedier kilometres is reduced. To put it popularly: time is money and in a recession time is worth less money. When time is worth less money, then the willingness to risk an accident in efforts to gain time is also reduced. Consequently, the accident rate should decline.

Close inspection of Fig. 8 suggests that the reduction in fatal accidents in recession periods is brought about in two ways: there is a reduction in the death rate per mile driven and there is also a reduction in road traffic mobility. So, there is a reduction in the amount of driving and the distance that is still being driven is driven more prudently.

The marked effect of the economy upon the accident rate has in my opinion two major implications for our discussions at this conference. First, the accident rate is clearly under the influence of motivational variables and that information can be used to design effective accident countermeasures. Second, against the background of the powerful effect of the economy it becomes increasingly difficult to demonstrate any accident reducing effects of deliberate countermeasures such as mandatory seatbelt wearing or anti drinking and driving laws (supposing such effects existed).

1.3 Safety per head or safety per kilometre travelled?

As is true for other conferences and for other publications in the area of road safety, the discussion about accident countermeasures often fails to be explicit as to what goal is actually being pursued: do we wish to reduce the accident rate per unit distance driven or per head of population? That these two criteria do not go hand in hand and should not tacitly

Fig. 2: Unemployment rate and traffic death rate per 100,000 people, Canada 1960-1986.

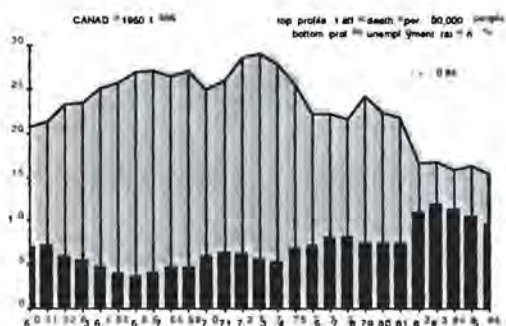


Fig. 3: Unemployment rate and traffic death rate per 100,000 people, United Kingdom 1960-1985.

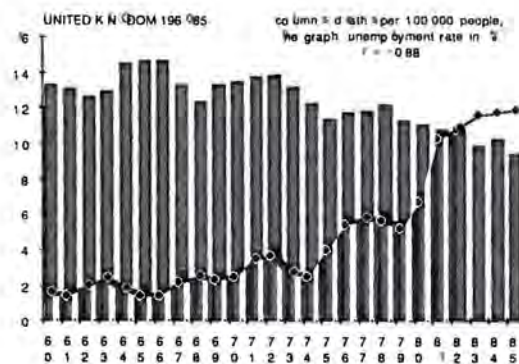


Fig. 4: Unemployment rate and traffic death rate per 100,000 people, West-Germany 1960-1983.

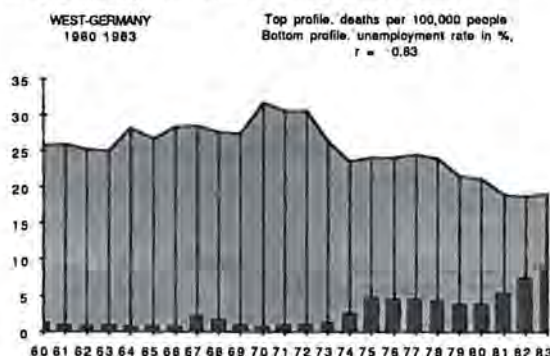


Fig. 5: Unemployment rate and traffic death rate per 100,000 people, Sweden 1962-1987.

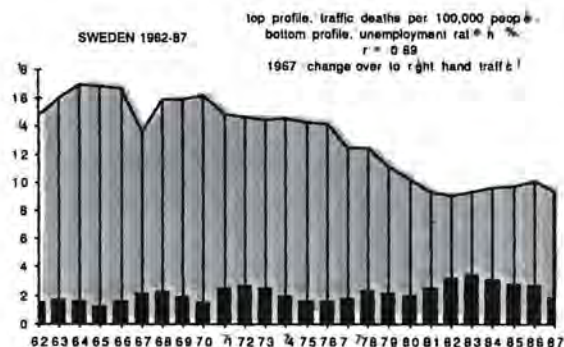
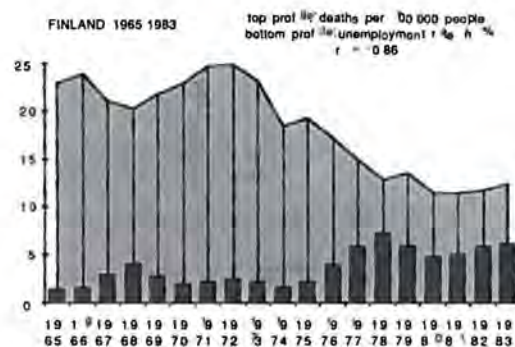


Fig. 6: Unemployment rate and traffic death rate per 100,000 people, Finland 1965-1983.



be assumed to be interchangeable is clearly demonstrated by Fig. 9. This figure spans about two-thirds of the present century in the USA. Over this time period the death rate per 100 million miles driven has declined by a factor of about ten. That would suggest that progress has been made, but also consider the following: the traffic death rate per 100,000 inhabitants towards the end of the last decade was about the same as it was some 60 years earlier! There have been major fluctuations in the per capita death rate and we now realize that the economic juncture has been a prominent causal influence. There has been progress in the sense that we can now drive many more kilometres per person killed than we could before,

Fig. 7: Unemployment rate and traffic death rate per 100,000 people, the Netherlands 1968-1986 (from Wilde, in press b).

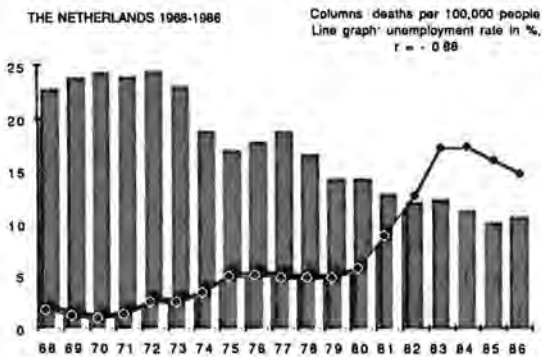


Fig. 8: Annual unemployment rate, traffic death rate per mile and mileage per capita, USA 1948-1987 (from Wilde, in press a).

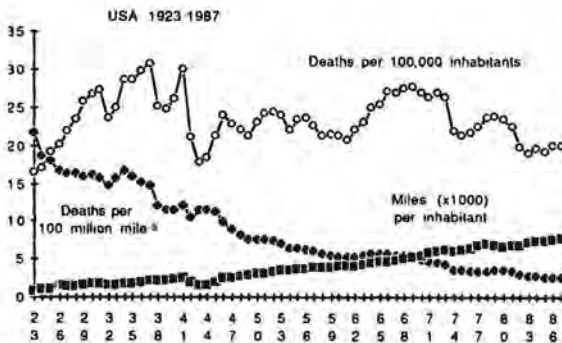
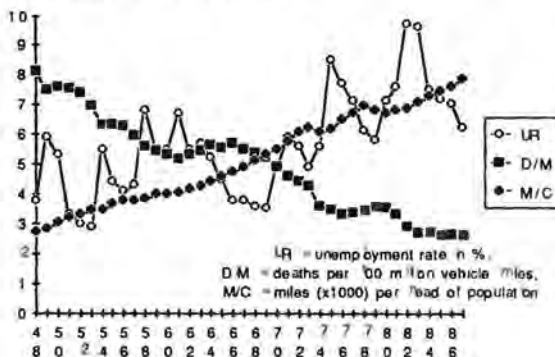


Fig. 9: Traffic death rate per capita and per mile driven, and mileage per capita in the USA, 1923-1987 (from Wilde, in press c).



but we don't have commensurately fewer persons killed. Against the criterion of mobility per road death we can see progress, but against the criterion of public health we would seem to see failure. So, progress towards one safety objective does not necessarily entail progress towards another, and in the design and evaluation of countermeasures this should be clearly borne in mind.

1.4 Intermediate versus ultimate safety criteria

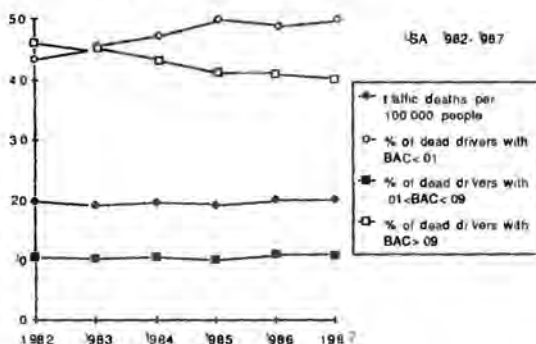
We face an analogous problem when deciding what the aim of an accident countermeasure ought to be: change in a particular specified behaviour, or change in the accident record of the people to whom the countermeasure is addressed (Wilde, 1985)? To put it simply: should we reward people for specific behaviours such as wearing the seatbelt and not speeding, or should we reward people for not having accidents?

What I wish to stress here that the two types of criteria are not equally pertinent, that they are not interchangeable, and that the ultimate criterion (the "end result", i.e. the fact of having or not having an accident) is the preferable focus for accident countermeasures. This is because the relationship between the intermediate and ultimate criteria is uncertain, in some cases maybe even non-existent. To drive at or below the speed limit is no guarantee for safety; sobriety is no guarantee for safety; the potential safety benefit of wearing a seatbelt can only materialize if the wearer does not alter any of his or her other safety-relevant behaviours.

If enforcement discourages a habitual speeder from speeding, he may no longer speed, but incur an accident due to lack of vigilance in a driving situation he now experiences as dull and monotonous. As is indicated by Fig. 10, it may well be that the anti drinking/driving legislation and enforcement in the USA has had some success: the percentage of dead drivers with illegal blood-alcohol concentrations (BAC's) has shown a steady decline from 1982 to 1987. But, there is no decline in the number of traffic deaths per 100,000 people.

There are, of course, several possible explanations for this pattern of findings. The one explanation that should concern us here is that the same kind of people who used to kill themselves when drunk are now killing themselves while sober. Drunk accidents might thus have made room for sober accidents; instead of accident reduction there is accident metamorphosis. Thus, there may be problems when the countermeasure focusses upon specific behaviours to be rewarded or punished, instead of upon the end result. As the authors (McAfee and Winn, 1989, p. 14) of a recent review on the use of

Fig. 10: Traffic deaths per capita and changes in BAC levels in drivers killed, USA 1982-1987 (from Wilde, in press a).



incentives to enhance workplace safety put it: "The risk is here that while the rewarded behaviour may improve, other related safe behaviours may deteriorate". It would seem wise, therefore, to define and measure the effectiveness of accident countermeasures in terms of what this term entails, that is not in terms of changes in specific behaviours, but instead in terms of the end result, that is the accident rate. An effective speeding countermeasure may be exactly that and indeed reduce speeding, but it should not be uncritically be regarded as an accident countermeasure by the same token.

2. THE ROLE OF THE INSURANCE INDUSTRY IN ACCIDENT PREVENTION

This is a highly interesting topic for a number of reasons, and the striking diversity in points of view is just one of them. Consider, for instance, the following quotations. The first is from Mr. Vaaje: "[...] it is obviously of great interest for the insurance companies to cooperate in order to reduce the number of traffic accidents and consequently their cost".

The following statements may be found in the presentation by Mr. Chich:

"[...] l'assurance [...] est au fond neutre et indifférente à l'égard de la survenue de ces événements socialement définis comme des accidents [...]".

"Dès lors, on pourrait à bon se demander si la question même qui inspire cette communication, "l'action préventive de l'assurance", n'est pas stupide quoique bien intentionnée."

In a similar vein, writing about inventors and their safety gadgetry, Michael Grey (1989) noted in Lloyd's List:

"All it needs is the insurance industry to require such equipment to be mandatory, suggest these hopeful people - on the again falling in the age-old trap of assuming that the purpose of insurance is in some way to increase safety, or alter human nature, or dramatically to affect statistics."

It is an argument which apparently has right and justice on its side, until the truth dawns that insurers are not philanthropists or safety agencies, but merely takers of commercial risks - nothing more, nothing less."

Consider the conflict of sentiment which would flash through an underwriter's mind if a wild-eyed inventor burst into his office waving plans for some equipment that would make ships virtually unsinkable."

So, according to the first point of view, the insurance industry is positively interested in accident reduction. According to the second it is not interested in this objective and accordingly, it has been suggested that it is dumb to raise the question of preventative action by the insurance industry. According to another author still (Wilde, 1986, p 398 and 1988b, p 507), the insurance industry may actually be interested in keeping the accident rate at a high level: *"Substantial reductions in the per driver accident rate may not be welcomed by the automobile manufacturing, retail, repair and insurance industries, as such reductions would likely decrease the demand for new cars and car parts, as well as people's willingness to pay current insurance fees against a level of risk that would no longer exist. Profits and employment opportunities in the sectors would thus go down"*.

"This is another way of saying that the higher the accident rate, the greater the insurance industry's opportunity for absolute profit. Apart from a sudden and short term drop in accidents, the insurance companies cannot rationally be expected to show a positive concern for the reduction of the accident rate".

Some aspects of insurance practice may indeed be construed as having perverse effects upon the accident rate, perverse in the sense that these practices may increase the accident rate and thus increase the risk road users may wish to insure themselves against. The opportunity for profit to the insurance industry would likewise be increased. The very fact that insurance can be bought against certain hazards diminishes the threat of the consequences of these hazards and, therefore, may be expected to increase people's willingness to expose themselves to these hazards with an increase in the number of casualties as a consequence. This has also been noticed by Mr. Chich, just as others have reported that increases in workers' compensation payments for injuries may increase the rate of workplace accidents (Worrall, 1983). Phrased in simple terms: to offer people protection from risky behaviour encourages risky behaviour; to offer people increased protection from risky behaviour encourages riskier behaviour.

In North America it is not uncommon for insurance companies to offer discounts for newly licenced drivers provided they have taken a driver education course offered by high schools. There is no evidence whatsoever that such a course has a beneficial effect upon the the accident rate of the graduates (Brown, Groeger and Biehl, 1987). The fact that they are nonetheless offered an insurance discount could either be explained by the insurers suffering the mistaken belief in the accident-reducing effectiveness of such courses, or to their expectation that the discount will effectively subsidize driving by young people and thus enlarge the market of potential insureds and thus the potential for profit. The marked sensitivity of young people to subsidies that help them obtain a driver's licence and thus the ability to drive has been clearly established (Robertson, 1980). Where such subsidies were eliminated, there was a sharp decline in road fatalities among the relevant age groups.

In Ontario it is common practice for insurance companies to give fee discounts that are greater as the number of claim-free years increases. But this is true only for up to five years of accident-free driving, as if such discounts would have no accident-reducing effect beyond that period (Wilde and Murdoch, 1982). And what may be worse from the point of view of accident prevention is that a driver with five or more fault-free years who has an accident, in which he or she is at fault, is not likely to actually incur an increase in insurance fees. The reason that insurance companies have for this 'forgiveness clause' would seem to be that the driver in question is seen as a relatively 'good risk' whose business would be sadly missed if it went to the competition.

One thing that appears to be clear from these considerations is that the optimal accident rate is different for different people. Years ago this was clearly recognized by an author who, for reasons of social equity, proposed the notion of an 'accident tax' to be levied on companies in order to compensate for the fact that only part of the actual accidents costs are carried by the company in

question and the other part by society in general (Smith, 1973-1974). Because different social factions are interested in different levels of safety (and interested in different means for attaining safety), safety is indeed a bone of contention, a political issue and it would be wise at a conference like ours to be cognizant of that fact.

3. ISSUES IN REWARD VERSUS PUNISHMENT IN DRIVER CONTROL

Have all the important issues in the choice between punitive and rewarding approaches in the design of accident countermeasures been discussed? Of course I would not raise the question if I felt the answer were in the affirmative. It would seem that at this conference we have been able to present a lot of surface, but we seem to have been mostly scratching at it, rather than getting at some of the underlying issues and sources of diverging attitudes toward accident prevention.

During our discussion on the enforcement of punitive laws, we somehow failed to consider the Nashville quasi-experiment and its implications. Increasing the number of charges for traffic violations to 152% of base rate, and subsequently decreasing it to 36% of base rate for periods of about one month each, failed to affect the accident rate. The authors (Carr, Schnelle and Kirchner, 1980) concluded that *"The present retrospective analysis of police traffic enforcement shows that wide variations in the overall levels of enforcement have no immediate measurable impact on the frequency or severity of traffic accidents, even when these interventions are highly publicized"*

We somehow failed to discuss what we have learned from this study, or from other major reports on the effectiveness of the punitive (enforcement) approach to accident prevention (OECD, 1974; Bonnie, 1985)? Are we still inclined to believe that the enforcement of the traffic code has a beneficial effect upon safety? And, if so, why?

We somehow failed to pay sufficient attention to some problems that are associated with the punitive approach? Here is an attempt to summarize these problems as they have been identified in a recent book on sanctions and rewards in the legal system (Arnold, 1989):

1. *The self-fulfilling prophecy*, as a result of labelling people with undesirable characteristics some people may behave as if they had these characteristics. Thus, the very existence of a speed limit may elicit speeding.
2. *The emphasis is on process controls* (instead of the focus being on outcome). Process controls are cumbersome to design and implement. Moreover, process controls can never be totally exhaustive (cover all undesirable behaviour of all people all the time).
3. *Negative side effects of punishment*
 - (a) Punishment creates resentment, uncooperativeness, antagonism, recalcitrance, sabotage.
 - (b) As a result, the very behaviour that was to be prevented is in fact being stimulated.
 - (c) Only what is not desired is spelled out, not what is desired.

We somehow failed to discuss whether the costs, the inefficiencies and the boomerang effects of the punitive system outweigh the safety benefits that are believed by some to accrue from the general and specific deterrence effects of the legal and policing apparatus.

In contrast, the track record of incentives programmes as a means of enhancing safety would seem much more clearly established (Fox, Hopkins and Anger, 1987; Wilde, 1988b; MacAfee and Winn, 1989). Since they were first discussed at an international road safety conference in Cardiff nine years ago (Wilde and Murdoch, 1982), incentives have been found to be effective: accident reductions per head down to between 50% and 20% of base are not uncommon in industry. They have been found to be cost-effective: the ratios between benefits (savings on accidents prevented) and programme costs are usually greater than 2 to 1, meaning that companies can make money on these accident prevention efforts (largely due to reduced fees payable to insurance). They meet with approval among the people to whom they are addressed and in this respect they compare favourably with the much less popular action of the law and of the police. To put it popularly: a small carrot is not only much better liked, but also much more effective than a big stick.

Programme characteristics that make some incentive programmes more effective than others have been tentatively identified, and the only negative side effect that has been noticed so far is the tendency of people to under-report accidents when incentive programmes are in effect. Fortunately, however, such underreporting has been found to occur with respect to minor accidents only (Wilde, 1988b; MacFee and Winn, 1989).

Now then, if the differences between the rewarding and the traditional penalizing approach are indeed as much in favour of the former as they seem to be, what is holding us back from using the reward approach more often?

4. "HAUER'S DISEASE" AND A POSSIBLE REMEDY

One possible explanation is that this is due to the malady that has been diagnosed by Mr. Hauer and that may be described as follows:

"The current road safety delivery system is driven by political motives and fuelled by ignorance"

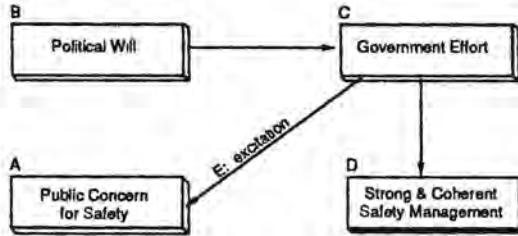
It is my experience that some politicians and civil servants in high places are quite willing to admit that governments launch road safety programmes primarily in order to be seen to be doing something about the accident problem (rather than really doing something about it; Wilde, 1986), but when they are asked why they don't ask for expert opinion, they are quick to add that if you ask 12 experts you get 13 different opinions. This, of course, is just another symptom of Hauer's disease.

Let me first add an optimistic note: there is hope for the future. In many countries health delivery systems are currently delivered by governments, but that does not mean that the treatment for diabetes or cancer is also decided on by the cabinet or an act of parliament. The question, therefore, is: how can we create a similar situation for road safety delivery?

What can we learn from political history? How did the separation between State and Church, that Mr. Hauer mentioned, actually come about (as far as it did)? By what processes were legislative and executive bodies separated?

In connection with this issue, there is an intriguing statement in the presentation by Mr. Wegman. He said that, in order to get a particular safety programme accepted by parliament in the Netherlands, the Dutch minister of transport had to consent to the programme being empirically

Fig. 11: Firm safety management by government cannot occur without strong public concern for safety (from Wilde, 1981).



evaluated on its effects! From whom came this unexpected pressure towards evaluation, how was it motivated and how was it presented to parliament? And, no less important, how will the political bodies react to the evidence? Generally speaking, it would seem that, in democracies at least, any government's effort towards road safety depends upon its perception of public concern for safety (see Fig. 11). Actual effort depends upon political will, and political will in turn depends on public concern. Public concern for road safety will be higher to the extent that demand for safety exceeds the level of safety perceived (see Fig. 12).

Fig. 12: Public concern for safety equals demand for safety minus perceived safety (from Wilde, 1981).

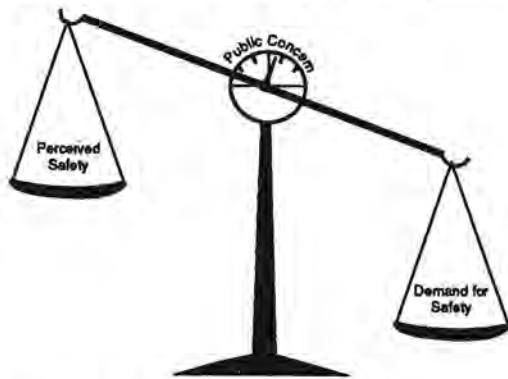


Table 1: Comparative strengths of private and public insurance in terms of requirements for effective incentive programming (from Wilde, 1988b).

REQUIREMENT	INSURANCE	
	PRIVATE	PUBLIC
1 Widening of the utility gap	-	+
2 Managerial vigour and commitment	-	+
3 Perceived equity of incentives	-	+
4 Consultation with the driving public	-	+
5 Perceived attainability of bonuses	=	-
6 Enhancement of peer pressure towards safety	-	+
7 Short incubation periods for incentives	=	-
8 Continued accumulation of safety credits	-	-
9 Simplicity of rules and fee structure	+	-
10 Low cost of administration	-	+
11 Handling the underreporting problem	-	+
12 Research and development effort	-	+

*) - means weaker, + means stronger, = means no difference

It should be noticed too that, apart from occasional outbreaks for greater safety from some advocacy group or other, there is no major and persistent pressure from the general public on government to enhance safety. In fact, if it existed, people would not

be patient and wait for government to act, but take action on their own accord and thus adopt a more prudent driving style (Wilde, 1986). What then can be suggested by the community of road safety researchers and practitioners to governments in order for governments to raise public interest in safety and thus stimulate governments themselves out of their inaction? What bootstraps can we offer a government so that they may develop not only the desire but also the ability to pull themselves up, as Baron von Münchhausen did by his own bootstraps?

The key answer, according to Fig. 11, is that we offer governments the means to increase public concern for safety as symbolized by arrow E.

What can we suggest to government to make it increase the level of traffic safety demanded by its citizens?

Well, we have noticed that incentives for accident-free driving have a strong motivating effect upon the driver population: their desire for safety is enhanced and they act accordingly. We have also noticed that some incentive programmes are more successful than others. The characteristics of the programmes having the greatest effect on safety have been tentatively identified and they are listed in Table 1. This is not the appropriate moment for discussing each of these characteristics, but it is of interest to note that an earlier review has come to the conclusion that government-run insurance offers a better opportunity for effective incentive programming than private insurance (Wilde, 1988a).

So, the treatment for Hauer's disease that I suggest is simply this: nationalize the automobile insurance industry. (Two weeks ago the government of Ontario announced that it would do exactly that, but for reasons already mentioned it is unlikely that this decision had anything to do with my suggestion). There is another argument for the safety-enhancing effect of insurance run by government. When claim costs rise as a result of inflation, a government would seem to have three options of coping with this. First, it might impose higher insurance fees on the electorate; second, it might absorb the increased costs through other tax revenues; third, it might attempt to reduce the accident rate. As the third option seems to be most appealing to a government that wishes to stay in power, a stronger government effort in the pursuit of road safety will likely be the result (Wilde, 1988b).

5. A NAGGING QUESTION OF COSTS AND BENEFITS

As noted above, there would seem ample evidence to indicate that the reward approach is much more effective than the punitive policy in reducing the accident rate. What then is holding us back from using the reward approach? One explanation is that it is due to Hauer's disease, that is ignorance and lack of interest, but there is another.

We have noted that governments are not all that interested in accident reduction and that some economic sectors may profit from a high accident rate. We have noticed too that, apart from occasional protests by some advocacy groups, the general road-using public does not exactly cry out for greater safety. Could it possibly be true that the inaction of both governments and the general public is justified on perfectly rational grounds?

At other occasions I have committed the heresy of hypothesizing that any nation's accident rate is the rate of accidents accepted by its population in return for the benefits accruing from the amount and style

of mobility enjoyed by the road users in that nation (Wilde, 1988a). The questions I am asking here I dare only whisper, because at a conference involved with accident prevention they would seem even more heretical.

Can we be sure that the current accident rate is higher than the optimal accident rate when all benefits and costs - economic, psychological or whatever - of prudent and risky behaviour are considered? And if so, by how much should it be reduced so that net benefit will be maximized? Are we - that is the members of the safety research and implementation community - saying that the people are wrong and that we are right?

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CONCLUSIONS ET RECOMMANDATIONS DES RAPPORTEURS DE SÉANCE 3

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1. Introduction

Pour augmenter la sécurité des usagers de la route, il est possible d'influencer directement ou indirectement la population, cela à l'aide de différentes méthodes et approches, en fixant un objectif et en visant un groupe cible adéquat, etc.

Campbell a déterminé les principaux aspects qui doivent être pris en compte pour influencer le public :

- Le groupe cible doit être bien défini.
- Le changement souhaité du comportement doit être précis.
- L'approche doit être adaptée à l'objectif et au comportement souhaité.
- L'approche peut être adaptée au niveau étatique.
- La récompense peut être liée à une certaine pression.

En outre, le développement scientifique et l'évaluation des mesures sont des éléments importants de la stratégie de prévention des accidents. Les résultats d'évaluations ne devraient pas servir (uniquement) à la critique de programmes mais stimuler le processus des travaux de prévention au niveau des pouvoirs publics.

2. Exemples nationaux

Plusieurs pays ont mis sur pied des opérations que l'on peut discuter et juger d'après les critères susmentionnés :

– France (Stenhardt).

En France on a mis au point des actions visant à permettre une décentralisation du travail de prévention routière, sous forme de contrats entre l'Etat et les autorités publiques départementales et locales. Partant d'un groupe cible très large (usagers de la route), l'objectif est la réduction des accidents de 10% par année, sans préciser les initiatives par rapport aux causes d'accidents. L'approche est très générale, puisqu'il s'agit de mobiliser toute la population. Le niveau de l'approche est hiérarchisé car l'intervention de l'Etat aboutit finalement au niveau régional et individuel. Une récompense est attribuée sous forme de prime.

L'évaluation démontre que, jusqu'à présent, l'opération "10%" n'a pas posé de problèmes sur le plan financier mais a manqué de concertation. En outre, il s'est avéré que les spécialistes en matière de prévention des accidents ont fait défaut au niveau communal. Par ailleurs, les résultats positifs de

l'évaluation doivent être relativisés, étant donné que celle-ci n'a pas été effectuée systématiquement. Malheureusement, les municipalités n'ayant pas participé à l'action, elles n'ont pas été intégrées dans l'analyse.

– Pays-Bas (Wegman)

Aux Pays-Bas, une opération similaire à celle des Français est en train d'être mise en œuvre. Comme en France, le groupe cible, à savoir tous les usagers de la route, est défini très largement. Il en est de même pour l'opération visant à réduire de 25% le taux des personnes tuées sur la route, sur une période de plusieurs années. La méthode consiste à sensibiliser les municipalités en leur accordant des récompenses sous forme de primes.

L'évaluation ne porte que sur la première période de la campagne innovatrice. Bien que l'on enregistre plus d'activités et que le transfert de connaissances relatives aux méthodes de prévention ait débuté, il se pose la question de savoir jusqu'où ira l'efficacité. À première vue, il s'avère que la formation des spécialistes dans les municipalités devra être modifiée et développée.

– Grande Bretagne (Jolin)

En Grande Bretagne, depuis quelques années, les campagnes sont mieux coordonnées sur l'ensemble du territoire et mieux basées sur la recherche des causes d'accidents. Les objectifs et les méthodes ont évolué, si bien que le système de récompense s'est développé et le rôle de la punition a diminué. Actuellement la police s'engage à influencer les attitudes et le comportement des usagers de la route pour les sécuriser.

3. Assurances et entreprises

Les assurances peuvent avoir des effets positifs sur la sécurité routière :

- indirectement par le truchement de la législation et des normes y relatives ;
 - directement en fonction du coût de la prime qui peut apporter des modifications du comportement par rapport aux risques.
- Cette constatation (Chich) peut être relativisée en tenant compte du fait que d'une part, la motivation des assureurs n'est pas liée à la réduction des accidents... (Wilde) et que d'autre part, leur trop forte mise à contribution peut diminuer l'effet positif des assurances.

Néanmoins, il semble être possible d'influencer le comportement – particulièrement des jeunes conducteurs – par un système de primes assurancières et de récompenses. Vaaje a démontré que le système bonus/malus peut mettre en évidence les deux aspects "récompense" et "punition" au niveau individuel, non seulement pour améliorer la relation coût/bénéfice de l'assurance, mais aussi pour augmenter la sécurité des conducteurs.

Quant aux entreprises, l'exemple concernant le camionnage français (Hamelin) démontre que les

questions de sécurité liées au trafic routier professionnel représentent des problèmes d'ajustement du système de travail, de logique de production, d'emploi et de circulation. Il est évident qu'il faudra prouver aux entreprises qu'il est possible d'augmenter leur revenu en accroissant la sécurité des employés.

4. Conclusions

Les communications présentées et des discussions permettent de faire les remarques générales suivantes:

4.1. Généralités

Les discussions au sujet des mesures de sécurité prises par les pouvoirs publics font ressortir à la base des problèmes, une grande complexité. Il est évident qu'il faut relativiser les possibilités de prévention des accidents. Bien qu'il semble être utile d'intervenir au niveau d'un gouvernement, d'un district, d'une grande entreprise etc., il s'avère nécessaire de clarifier les objectifs, de développer des méthodes adéquates et d'évaluer les activités. Cela d'autant plus qu'il existe une interdépendance entre les efforts pour la sécurité et le système de base: Plus le système "trafic routier" sera sûr, moins on cherchera à le modifier!

Quant aux mesures prises pour assurer la sécurité dudit système, on peut émettre deux critiques: D'une part des doutes subsistent si on dispose des bases nécessaires pour prendre les mesures adéquates, d'autre part la question se pose de savoir si les mesures prises sont bien basées sur les connaissances acquises dans ce domaine (cf. Hauer).

4.2. Aspects politiques

Le problème primordial consiste à motiver le politicien pour qu'il puisse promouvoir la sécurité dans la région dont il est responsable. Les hommes politiques disposés à lutter contre les accidents ne reçoivent pas toujours de la population, le soutien moral dont ils ont besoin. La population n'exige pas ou pas assez de mesures pour assurer la sécurité routière.

En outre, on constate que l'Etat ne tient pas compte de l'effet d'intervention de la police, du point de vue coût/efficacité. Etant donné que le comportement des usagers de la route serait mieux adapté aux circonstances si la police était plus souvent présente, on peut en déduire que les pouvoirs publics devraient augmenter les contrôles afin de sanctionner les comportements inadaptés. Par conséquent, les contrôles routiers devraient être plus fréquents qu'ils ne le sont actuellement.

4.3. Sanctions et récompenses

Il existe une interdépendance entre la législation, les sanctions qui en découlent et la transgression des règles. A la limite, d'après Wilde, les restrictions engendrent même des comportements qui vont à l'encontre de la sécurité. De plus, la répression n'exclut pas la récompense. L'une peut être liée à l'autre (p.ex. primes pour conducteurs respectant les limites de vitesse).

En ce qui concerne les récompenses, le problème est de savoir ce que l'on veut récompenser. Pour augmenter la sécurité par le truchement des pouvoirs publics, il faut déterminer au sein des municipalités les mesures et les activités que l'on veut développer ou réduire.

4.4. Assurances

Mis à part le fait que l'existence des assurances encourage l'emploi d'un véhicule, on ne sait pas jusqu'à quel point les assurances ont un effet favorable sur la sécurité (voir divergence entre Vaaje et Chich à ce sujet). Dans certaines circonstances les assureurs profitent d'un taux d'accidents élevé, dans d'autres il représente une perte. Quoiqu'il en soit, les mesures prises par les assurances pour réduire le nombre des victimes devraient porter davantage sur les jeunes conducteurs.

4.5. Evaluation des mesures

L'évaluation des mesures prises au niveau des pouvoirs publics s'avère très difficile - mais néanmoins importante. Bien qu'il faille admettre que le processus d'évaluation a aussi une fonction d'apprentissage, sa valeur primordiale consiste à connaître l'effet des mesures introduites. Vu la complexité des données à contrôler (voir p.ex. campagnes "1006"), il faut

- établir des groupes de contrôle adéquats,
- tenir compte des effets statistiques, tels que "regression to mean", et de la base de référence choisie,
- différencier les organisateurs des campagnes des spécialistes en matière d'évaluation, afin que celle-ci ne soit pas influencée par des intérêts personnels ou conservateurs,
- déterminer les effets des facteurs modérateurs prédominants sur les mesures évaluées (p.ex. situation économique du pays ayant une influence primordiale sur la sécurité; voir Wilde).

Les résultats d'études d'évaluation ne sont pas à l'heure actuelle, suffisamment encourageants; mobiliser la population sans pouvoir apprécier les effets des mesures dans le groupe visé ne suffit pas! Les connaissances des spécialistes de la sécurité routière doivent être transférées au niveau local où elles seront appliquées.

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I am not sure whether I should consider it a privilege to be able to address you right at the end of our symposium after we have just heard such stimulating and highly instructive contributions. I am certainly even less sure that it is a privilege for you to be obliged to stay in this conference room a few minutes longer to hear me. But since the symposium has been organised in this way, I shall make the most of this opportunity to convey to you some of the views of the Organisation that I am representing here, the European Conference of Ministers of Transport, usually abbreviated to ECMT: first on the subject that has been brought us together in Copenhagen over the past three days and then as to ways in which ECMT, acting in partnership with OECD, can further the work that you have just completed.

I should therefore first like to say how grateful we are to the OECD's Road Transport Research Co-operation Programme and its Steering Committee for having organised this symposium on the topic 'Enforcement and Rewarding'. I underline this despite some doubts or even irritation expressed by several participants about the formulation of the topic. And of course, I wish to thank the Danish and Netherlands authorities, more particularly Mr. Christensen and Mr. Koornstra and their team, for having managed the operation so efficiently.

Our interest in the selected topic – and therefore in the findings of the Symposium – is very closely bound up with a number of major difficulties now being experienced by Ministers when they endeavour to implement a more effective road safety policy.

While it is not my intention to repeat what was said at our opening session, I must emphasize that it is the 'enforcing' aspect linked to the behavioral component that we consider at present to be one, if not the crucial element of such a policy.

As everyone knows, the past two decades have been a period of considerable progress in the sphere of technology – whether it be in motor vehicle manufacturing, concept of road environment or, more recently, the use of advanced computer and telecommunication techniques – a process of development that has made its contribution to road safety and is continuing to do so.

At the same time we began to see the introduction – and subsequent gradual extension – of a whole series of regulatory measures in European countries and elsewhere which were designed to ensure that

the number of risk factors were significantly reduced. These measures which still need to be completed in greater detail and further improved, of course, were discussed at some length mainly during our first session. I am thinking more particularly of speed limits both in and outside built up areas, the laws on drinking and driving, compulsory wearing of seat belts and helmets, to mention but a few. And, within the framework of the United Nations Economic Commission for Europe, a project has now been completed whereby further progress has been made in the international harmonization of regulations relating to road traffic, signs and signals, regulations that are to be both updated and incorporated in a body of legislation which is equivalent to what may now be called the 'European highway code'. This code is, incidentally, to be presented to the general public early in October 1990 at the opening of the 'European Road Safety Week', at the same time as the Ministers of Transport of 26 countries of Eastern and Western Europe will meet in Stockholm at the invitation of the Chairman-in-Office of ECMT.

A great deal has therefore been done at the political level both to improve and harmonize regulations at international level, but we have not had the same degree of success – indeed, far from it – in ensuring that such regulations are complied with satisfactorily.

This situation is all the more a matter of concern in view of the fact that, after a long and virtually uninterrupted downward trend in numbers of road accident casualties in Western Europe taken as a whole, there have again been sharp fluctuations in the pattern of development over the last years. This must be taken as a warning signal indicating that the overall situation remains fragile and, accordingly, that nothing can be regarded as definitively achieved.

It has been established that the role of the human factor is predominant in the large majority of road accidents. We therefore believe at ECMT that, if any further significant progress is to be made, it is essential to define the most appropriate strategies for influencing and in fact modifying road users' behaviour. I leave it open as to what extent this should be achieved directly or – as strongly suggested by our keynote speaker, Professor B. W. B. – in a more indirect way, including for instance automatic monitoring systems (the famous Big Brother). What we actually need, is the implementation of a credible and consistent policy concept, providing a judicious mix of all the means of a given capability of influencing behaviour, starting of course with training and information, but by no means overlooking the areas discussed at our symposium. I think Mr. L'Hoste was perfectly right when he said in his evaluation speech that the influence upon behaviours has become the true paradigm of action aimed at increased road safety.

The second point I should now like to make concerns further action that ECMT might take as regards the findings of your work, that is to say, the practical way in which our organization can

collaborate with OECD on such an undertaking.

For those of you who may not be all that familiar with our Conference, I should simply like to underline that, as the name indicates, it brings together the ministers in charge of the transport sector of 19 European member countries. The geographical area covered, is near enough the same as the European zone of the OECD, whose major non-European countries, such as Australia, Canada, the United States and Japan – all represented here – are, however closely associated with the Conference's activities.

Like OECD, moreover, we are currently pursuing an open policy vis-à-vis the East European countries, some of which already have observer status at ECMT. All these countries are, also, as it happens, experiencing very serious problems as regards road accidents.

But the point I really have to make here relates to the essentially policy-making nature of our work which is submitted directly to Ministers at the two Council meetings held by the Conference each year.

It is that policy making factor, together with the institutional advantage that the two organisations largely cover the same geographical area, which gives weight to the kind of collaboration planned between us for the present symposium.

What could in fact be more natural, when the research community that you represent seeks to co-operate internationally to determine the state of the various arts, than to take steps to give practical effect to your findings in the framing of policy? It would seem to me that this type of co-operation between intergovernmental bodies is particularly apt, not only because it is based on the principle of complementarity but also because it caters for a need and a mutual interest, namely that of the research community, which sees its work turned to advantage in practice and that of the policy-makers, who, in a highly complex sphere such as road safety today, are increasingly finding it necessary to base their decisions on established scientific facts and not only on opinions or pure assumptions as has frequently been insinuated during our discussions.

As indicated by Mr. Christensen at the opening session, the OECD will not confine itself to publishing a comprehensive state-of-the-art report after the symposium – the proceedings being edited separately – but intends, in addition, to draw up a special policy report setting out the most essential conclusions and recommendations – may be together with the main questions remaining open – both for individual Governments and the international institutions bearing responsibility in this field. This is in my opinion an excellent formula which deserves to be kept in mind as an innovative and hopefully successful example for similar occasions in the future. Anyhow, the ECMT is looking forward to receiving this paper with the greatest interest since it will undoubtedly provide a major stimulus for its own multilateral decision-making process, a process whereby it is first up to a committee of government specialists to assess the recommendations before them, not from the standpoint of their scientific or practical relevance – for which the OECD can vouch – but more in terms of their feasibility in the policy sphere and the potential they offer for concerted action at international level. (This is just to avoid the matter ending up in a collective political suicide. f l

may be permitted to pick out certain thoughts which have recurred during our discussions.) Submitted then for approval by the Council of Ministers, the measures in question do not automatically have force of law in every country – and in this respect our system differs from that of the European Communities – but they are applied with a certain flexibility by each member country individually, according to their specific situation, legal system and socio-cultural tradition.

I really do hope that, in combining their efforts in this specific field of their respective activities, the OECD and ECMT can take a further step forward together, a step that will open up a new phase of even greater co-operation to serve the common cause for which they are, after all, both working, that of reducing the unacceptable price paid by our motorised societies as a result of road accidents.

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