INTELLIGENT SPEED ADAPTATION
The Dutch experiment

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If the power of (....) technological control increases,
the question of the ethics of its application
becomes more urgent
(Zygmunt Bauer)
The very act of studying something may change it.
(Earl Babby)

1. Introduction and problem

In The Netherlands, we are confronted daily with 3 traffic deaths, 50 injured people that require hospitalization, and 250 people who suffer lighter injuries. The estimated yearly costs of these traffic accidents amount to 11 and a half billion Dutch guilders (about 5 and a half billion Euros), which amounts to about 400 Euro per person per year. We have a program that sets a goal to reduce traffic fatalities and injuries by 25% in 2000 (as compared to 1985), and by 50% fatalities in 2010 (as compared to 1986). Part of this ambitious Sustainable Safety-program focuses on speed, speeding behaviour, and speed reduction by speedcontrol. Speeding and traffic accidents as a result of it, are a problem in The Netherlands. Statistics show that speeding varies from 32% in cities, to over 52% on freeways. Two years ago the Dutch minister of transport ordered a pilot study to look into the feasibility of forced speed reduction by technical means. This was an important political signal, because it cleared the way for the idea that really effective measures against speeding make it necessary to limit the autonomy of car drivers in choosing any speed they want. From the beginning it was recognized that the individual driver might not agree. New technology and technological developments can help solve some of the problems in our modern, industrial societies. But technological developments sometimes ask people to adjust their daily routines and the way they 'normally' do things. If technology demands too much of people's ability to change, and technology always changes faster than people can, people will resist the change. Sometimes that's for the better, sometimes it's not. Technically we can limit how fast people drive, we need to know if people want us to do that.

The goal of our pilot is to learn more about how people will change in action and thought, when their behaviour is influenced by technological means. An experiment like this, and the ones you've done here in Sweden, offers an excellent opportunity to actually observe how the interaction between new technology and behaviour of people takes place and works out. How technology makes people adapt and how human behaviour forces changes in the technological design. In this presentation I will focus on the research design of the pilot. Mainly because

that's all the far we are in The Netherlands with our experiment, but also in the hope that you, here present, with your experience with this kind of experiment, will find many flaws in it, and by commenting, prevent us from making the same mistakes again.

In paragraph two I will focus on the research questions. In the third paragraph I will take a closer look at the way the pilot in the city of Tilburg has been set up, and the actions that we have undertaken so far. Finally I intend to share some ideas with you about the expected results.

2. The research questions

The pilot in Tilburg is scheduled to start in October of this year, and is set up as a small scale experiment, where 20 passenger cars will be equipped with ISA. Electronic equipment in the car will 'know' when the car enters an area where the speed is limited, and will activate a restriction of the gasoline-inlet, so that the car is forced to reduce its speed to the speedlimit at that particular location. A small section of the city of Tilburg, in the southern part of The Netherlands, called Campenhoef, was chosen as a testside. It is a relatively new and small suburban area, where speedlimits prevail of 80 kms per hour on the road leading to the area, and 50, 30 kms /hr, and walking speed in the test-area itself. The intelligent speed adapter will enforce all of these speeds, so is the intention.

- Central question is: does the enforced version of ISA work in The Netherlands? Does it function technically and does it function in people's views?

The effects we want to measure can be devided in three separate parts:

1. The functioning of the technology
   - How do people experience the working of ISA?
   - What are (indicative) effects on emissions of harmful gases, energy use, and traffic safety?
2. User acceptance and attitudes towards the system
   - How is acceptance influenced by using ISA?
   - How is the public opinion affected?
3. Effects on driving behaviour
   - What are the effects on driving behaviour when driving an ISA car?
   - What are the effects on behaviour of other drivers (of non ISA cars)?

In order to make clear why we don't just use the Swedish results of pilots held and being hold here, let me take a moment, for those not familiar with the Swedish experiments, to give you a quick idea of what we already know. A small scale field try was held in Eslov, Sweden, by the University of Lund (Almqvist et al, 1997). The aim of the project was to study the degree of acceptance of a speed adjuster and its effect upon driving behavior during extended use of it. Here, 25 drivers had their car equipped with an automatic speed adapter (SA) in an urban environment. The adapter consists of a device that increases the resistance of the gaspedal when a speedlimit area of 50 kms/hr is entered. Not just opinions were asked but users of ISA were interviewed before and after driving with ISA for two months and driving behaviour was observed. The results were encouraging:

- subjects experienced SA as providing safety and support, and they did not experience it as either an unwelcome control or a source of irritation. Three-fourth of the subjects thought more positively of the SA function than they had expected they would
- clear differences between subjects' speed patterns were registered with and without the use of SA. Initial measurements, before SA was installed, indicated subjects to often exceed the speed limit. Measurements after subjects had driven with SA for two months showed speeds to have been reduced so as to conform with speed limits
- Besides increase of the acceptance of the SA device, and lower speeds, behavioural observations showed improvement in behaviour in interactions with other road users.

The authors of the end-report of the Lund-test conclude: "These results provide clear objective support for the usefulness of the SA device in increasing traffic safety and in improving driving effectiveness through producing a steadier flow of traffic" (pg II).

As a result a large scale field try in 4 different cities in Sweden, with a total budget of 75 million Swedish Krones, is presently being prepared and partly underway. The test will involve over 5000 vehicles during 1999-2001. I'm sure you will hear more from those field tries while you're here. For the 4 cities four different forms of speed adaptation were chosen, from intelligent speed bumps in Umea, to driver warning systems based on GPS in Borlange. None of the four, however, is (at least as far as I know) testing the enforced version. What we have to keep in mind, therefore, is that in the Eslov experiment as in the other Swedish experiments, we are dealing with a different form of speed adaptation, than in the pilotstudy in The Netherlands. The driver, in the Swedish tests can, if he so choses, still exceed the speed limit. In the Dutch experiment, he (or she) can not. This is a rather fundamental difference.

A second reason why still further tests are required is formed by the cross- cultural differences. The Netherlands is not Sweden. But a clearer example of how culture can influence implementation can be found in the US, the land of the free. Enforced speed limitation is no longer an issue there. After the recent abandoning of the Automated Highway-concept, Intelligent Transportation Systems (ITS) now concentrate on just Intelligent cruise controls to avoid rear ending and side-swiping and is limited to warning signals to the driver. Apparently, user acceptance for devices that limit the options of drivers, is considered too low. The price to pay for increased safety, being a lesser degree of freedom to choose, is apparently considered too high.

I'd like to make two more observations on the subject, if I may. First of all: in the Lund experiment the focus was on the driver. Successful implementation of new technology, however, very seldomly depends on user support alone. Irritation by non ISA drivers in the same suburb where the system is tested can easily set a negative tone about ISA, especially when such opinions are supported by local newspapers or other media. We will therefore keep a close eye on the media, and hired professional people to interact with the press.

Secondly, with regard to the intelligent speed adapter as an instrument, acceptance is related to people's feelings, besides knowledge about it and attitudes towards restrictions. On top of that people have preconceived ideas, not based on experience, about the effects of systems such as speed adaptors. We have learned a lot from the questionnaires in your experiment in Eslov and will integrate this knowledge into our survey. But even more to the point: open communication with the city of Tilburg, its public officials, its citizens and other actors and parties involved, is

prerequisite. Also, it goes without saying that we hired professionals to handle the communication and selection of participants.

3. The research design

Next let me focus on the three research areas mentioned earlier: technological functioning, user acceptance, and driving behaviour. First, briefly, the technology.

The analyses of the technical functioning of the system will be based on two sources: data-logging on the one hand, and questionnaires that will be put to the drivers. The data-logging will mainly consist of the logging of speed driven at known moments and locations. In the questionnaires some attention will be payed to the ergonomics of the system. Here is an overview of the research questions and the way the effects will be measured.

research questions:	to be measured through:
1. How does the system perform in actual use?	• data logging • note book by driver • questionnaire (survey)
2. How can the system be optimalised ergonomically?	• note book by driver • questionnaire
3. What are the effects on emissions, energy-use and traffic safety? (indications)	• data logging • questionnaire

Figure 3.1 Technical functioning of the system

Next: user acceptance and attitudes. Measuring user-acceptance of ISA is not limited to acceptation in terms of somebody's attitude. Actual behaviour in accordance with the objectives and the idea behind ISA is also part of that acceptation. This can show up in the behaviour within the limits set by the pilot, but also in the behaviour after the test car has been returned. The survey therefore takes an important place, and self-reporting playes an important role in the whole.

Finally, what is the effect of ISA on people's behaviour? The central question here is: "What is the influence of ISA on the driver's behaviour? The way we want to measure that is as follows.

research question:	to be measured through:
What is the influence of ISA on the driver's behaviour?	• data-logging • speedmeasurements on pre-determined locations • survey-questions • special gathering of test-drivers (workshop) • in-use observations within the car

Figure 3.2 Influence on driving behaviour

The research design is relatively simple:
1. The experimental group consists of 120 people, who will all drive a car equipped with ISA for a period of 8 weeks each. Within one year 6 groups of 20 people will drive an ISA car that is much like their own family car on their regular day to day routine. Before, during and after the two month testperiod they will be interviewed. It is a panel study. That means: the same set of people is studied each time.
2. There will be control groups at three levels: People in the same suburb, not using ISA, but familiar with the experiment on a daily basis (through interaction with ISA vehicles), a group of people from a neighbouring section in Tilburg, familiar with ISA (from press releases), but not in daily interaction, and a controlgroup at random elsewhere in The Netherlands. The four groups will have varying degrees of exposure to the phenomenon ISA, as follows.

	Information, instruction	interaction with ISA car	selection proces, contacts	driving an ISA car
Experimental group	X	X	X	X
Pseudo experimental gp	X	X	X	-
Semi-experimental gp	X	X/-	-	-
'Outsiders'	-	-	-	-

Figure 3.3 Exposure to ISA

Important to keep in mind when measuring acceptance and in designing the questionnaire, is what the opinions are towards speedcontrol and -restriction in general, and why. One can imagine, for instance, that a person is positive towards speed-restrictions, but with different means and measures, other than ISA. In that instance ISA can count on a lesser degree of acceptance, while at the same time the person has a positive attitude towards the objectives of the pilot. One can distinguish, therefore, between several degrees of acceptance, as in the following figure, where, acceptance of ISA is at the top of the tabel.

Acceptation of ISA specifically	ISA is a legitimate instrument
Acceptation of speedreduction through infrastructural changes	influence only through infrastructure
Government measures to increase traffic safety are legitimate	accepting Government interference
Realisation of the speeding problem as a cause of accidents	accepts (only) the problemdefinition

Figure 3.4 Degrees of acceptance of ISA

Thus, we can expect and imagine partial acceptance of ISA. It is possible for a person to be positive about measures against speeding, but not through ISA. This approach results in the

following type-casting of possible attitudes people can have (the last two degrees of acceptation from figure 3.4 have been taken together)

	Type I	Type II	Type III	Type IV
A. Accepts ISA	-	-	-	+
B. Accepts infrastructural measures	-	-	+	+
C. Accepts regulation	-	+	+	+

Figure 3.5 The relation between 'Ideal'-types and acceptance

That raises the question whether and how results can be generalized. That is always a problem with a small scale experiment. How 'typical' are the people we interview and test? We have the relatively unique situation here, that we can exclude, at least in part, the bias of selfselecting, by randomly selecting from the people in Campenhoef both the testgroup and the controlgroup. That means to say: from the people who want to participate, of course. By the way the other control groups are selected we are relatively confident that results, at least in some way, can be generalized. Projection of results (in attitudal change and acceptance) to other situations we deem possible and acceptable.

A far bigger problem will be formed by the generalization of the 'objective' data, that is gathered by data-logging. That seems odd, but there is a three-fold reason for that: the pilot experiments ONLY with the *enforced* variety, so that we cannot say much about other forms of speed adaptation in comparison. Secondly, registration of objective data is limited prodimantly to registration of speed. We can only offer indicative results of how ISA will effect traffic safety, emissions, energy-use and (speeding) behaviour. And thirdly: the test area is limited in variation of different speedrestrictions and traffic density. Fortunately, in this pilot-study, the focus of the research is on the user acceptance and attitudal changes of people. In addition I would like to point out, that apart from the normal research-demand to be able to generalize the results, the pilot has the important objective to start a discussion on the use of ISA as a legitimate instrument to reduce traffic accidents, injuries and loss of life.

4. Expected results

The main argument of opponents to the ISA system lies in the believe that self chosen speed is a safety valve for aggression. A psychological reaction to reducing the freedom to chose one's own speed could possibly be to compensate for the repression of these emotions outside the ISA area. We would like to check if:

- people, driving an ISA-car, stop watching the speedometer, and just floor the gaspedal (in other words: will they be driving 50 when they can, instead of 40 where they should?)
- people will be less attentive in general, because of the feeling that 'the system has taken over'
- people without ISA will overtake ISA cars more often than not

And, outside the ISA-zone, if:

- people will accelerate when they approach a zone, in order to maintain a high speed as long as possible
- people will compensate for the frustration they encounter in the ISA zone, by speeding and driving more aggressively once they've left the ISA zone.

From the above it will be clear that we are not so naieve as to believe that people will behave like model-citizens, like docile civilians. People will adjust their behaviour in response to new technology. But they won't always adjust it into the direction we would like them to. We are fairly optimistic, however, about the influence on public opinion of the pilot. Based on the Eslov experiment and other research results we expect an increase in support of ISA systems, both by users and by the public in general.

The big question remains, in my opinion, whether *enforced* speed limitations at all speeds from 80 kms on down, will be so readily accepted. Possibly, there will be a preference for 'softer', less total restriction, in the form of an intelligent acceleration pedal, or in the form of a simple warning signal. Predicting human behaviour is a tricky business to say the least. If the concept of ISA will be a success, and in what form exactly and in what place: not all the reseach in the world will allow for that prediction to be made. We can only make a feeble attempt through research like this pilotstudy, to predict what won't work. What actually will work, only time will tell. We do have to keep trying, though, to at least give concepts like ISA a chance, in the interest of all those involved in traffic accidents.

Thank you for your kind attention.

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