

# Driver acceptance of mandatory intelligent speed adaptation

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*This paper examines driver acceptance of mandatory ISA. This intervening system that prevents the driver from exceeding local limits runs the risk of insufficient support of stakeholders and drivers because behaviour is restrained. At the same time, the expected impact on efficiency and traffic safety might be greater than the effects of permissive systems. Measuring driver acceptance was a major objective of a Dutch field test involving 120 test drivers who used the mandatory ISA system during six weeks. The research design included three different reference groups with varying degree of ISA exposure. The major research question addressed in the paper is the acceptance level of mandatory ISA among drivers who experience the system. The related question whether acquaintance with automatically enforced speed adaptation goes with either a lower or a higher level of acceptance is discussed. The acceptance data show considerable similarities with the Hawthorne effect. It is concluded that the level of acceptance of mandatory ISA is fairly high - higher than expected - and that experience results in a higher acceptance level.*

**Keywords:** Acceptance, Hawthorne effect, mandatory ISA, problem awareness, speeding.

## 1. Introduction

The quality of the urban living environment is served, among others, by a policy capable of reducing the usual negative impacts of the traffic system on citizens. A diversity of traffic calming measures has been developed in the past few decades trying to cope with inevitable side effects of car mobility such as speeding and unsafety. Physical measures like narrowing the roads or road humps, enforcement strategies by the police, educational measures or fining are strategies with varying degrees of success. Reality shows the obstinacy of car drivers. Large-scale speed offences and the necessity of on-going police enforcement actions are illustrative.

In order to enhance traffic safety, the Dutch Ministry of Transport explored the viability of options to prevent drivers from speeding. A study to investigate whether speeding can be reduced by simple in-car feedback was carried out using an instrumented vehicle with twenty-four subjects in the late nineties (Brookhuis and De Waard, 1999). The option to bind all car use to a maximum speed level through Intelligent Speed Adaptation-ISA was studied in a large-scale field test. Cars were prevented from speeding by repressing the fuel supply. However, this policy to drastically cope with speeding could run the risk of failure like some other measures such as road pricing or car pool strip failed in the Netherlands due to the lack of acceptance among the general public and, consequently, politicians. This paper describes the driver acceptance of ISA based on an evaluation study in a real-life trial using mandatory ISA. The trial was initiated and coordinated by the Transport Research Centre of Rijkswaterstaat of the Ministry of Transport. A summary overview of the trial and the results is given by Besseling and Van Boxtel (2001). Acceptance was just one of the evaluation objectives besides evaluation of the technical functioning of the system and identification of the effects on driver behaviour. The acceptance study covered both passenger car drivers and bus drivers (Katteler, 2001; Duynstee et al., 2001). This paper restricts itself to passenger car drivers. Effects on driving behaviour are described by Van Kooten and Martens (2001).

ISA specifically aims to address the vehicle's speed. As such, ISA systems are different from other advanced driver assistance systems that address the position of the vehicle. Various systems support the lateral dimension of the driving task. A pilot focusing on lateral driver support evaluated the acceptance of Lane Departure Warning Assistance systems (LDWA) among truck drivers (Katteler, 2003). Other systems are developed to influence the longitudinal dimension of the driving task, such as Intelligent Cruise Control. The latter received substantial attention in studies (a.o. Törnros et al., 2002).

The purpose of this paper is to investigate to what extent drivers accept mandatory ISA. Acceptance is a prerequisite to achieve the benefits that usually are attributed to ISA and other advanced driver assistance systems. Brookhuis et al. (2001) tribute great potential to advanced driver assistance systems, provided ADAS will be completely accepted and widely introduced. The research design used is described in section 4 followed by the study results in sections 5 and 6. Section 5 focusses on the acceptance of test drivers whereas section 6 involves reference groups for the benefit of correct interpretation of the results. These sections are preceded by information on mandatory ISA (section 2) and ISA acceptance studies (section 3).

## **2. Mandatory ISA as subject of study**

ISA is a system by which the local maximum speed for each (part of the) road is passed to the vehicle. This information can be used in different ways and those ways determine the particular ISA system. As far as the information is used to inform the driver, the driver keeps control over the vehicle and may decide to obey or to neglect the signal. In fact, a continuum of system designs is in place varying from informing the driver, warning him when he is exceeding the speed limit, discouraging him or even preventing him from speeding. The last system is mandatory.

In the relevant literature, different terminology and various categorizations are being used. The categorization open – half open – closed system refers more or less to the technical system whereas other classifications refer more explicitly to the function of the system to the driver. In essence, there is no difference. The triplet advisory system – voluntary system – mandatory system is often used in the context of field trials in the UK. The slightly different triplet informative system – warning system – active accelerator is frequently used in the Swedish context. Both the informative and the warning ISA system are an open system: the driver keeps all freedom and there is any physical resistance. The active accelerator pedal corresponds to the half-open system. The mandatory system is a closed system. Within the divergence of ISA systems, the general principle is held that the system adapts to local speed limits usually based on a GPS-based navigation system and a digital road map, independent of the device that is used for passing the information to the driver.

ISA is an exponent of the current tendency towards creating an automatic vehicle guidance (AVG) environment. Early AVG systems support the driver in one specific task such as distance keeping, lane keeping or speed behaviour. Future AVG systems will support the driver in a more integrated way. Although the complete implementation trajectory will require some decades, serious technical problems are not expected. Future general AGV developments were described by a.o. Marchau and Van der Heijden (2003). Carsten (2000) described an ISA implementation scenario ending up in 2019 as a first possible date for a legal requirement for mandatory usage of ISA.

Meanwhile, several field trials have been carried out across Europe. Some countries focussed on one of the available systems whereas other countries wanted to test a set of different systems. The Dutch field test that is subject of discussion in this paper illustrates the former choice focusing on the drastic mandatory system. The United Kingdom focussed on an advisory system in the External Vehicle Speed Control study (Carsten and Fowkes, 2000). Sweden provides a clear example of the choice to test a range of ISA systems. The Swedish field tests were carried out in different cities and testing different ISA systems (Vägverket, 2002a). Special attention is given to the system warning the driver through the active accelerator pedal (Várhelyi et al., 2002).

Field trials and, accordingly, evaluation studies differ in scale, both in terms of time span and number of test drivers. Table 1 gives a summary overview of field trials in Europe. Seen against the background of the field trials carried out across European countries, the Dutch pilot has several characteristics that are common to field trials in other countries. The length of the period of exposure to ISA (six weeks) and the number of test vehicles (twenty) fit into the usual range. Also the scale of the field trial in terms of number of test persons is more or less similar to the scale used in the UK and France but somewhat larger than in other countries except Sweden that had a substantially higher number of test drivers. One element makes the Dutch field test particular. The Dutch field trial was particular in the exclusive focus on the mandatory ISA system. The French trial was particular in that all test drivers experienced all three modes. The Dutch field test did not suffer from serious technical problems. In general, imperfections in the technology used may disturb the acceptance level and therefore the validity of the results. Várhelyi et al. (2002) require faultless functioning of the test system in trials as a prerequisite for acceptance studies as a result of the problems with technology in the Lund trial with active accelerator pedal.

**Table 1. Indicative overview of scale of ITS field trials in Europe**

Country	Nr. of vehicles	Nr. of test drivers	ISA system	Test duration per test person	Remark
Belgium	34	37	active accelerator		primarily show character
Denmark	24	24	warning	6 weeks	auditory + visual warning
France	100	100	informing + voluntary + mandatory	8 weeks	each driver each system
<i>Netherlands</i>	<i>20</i>	<i>120</i>	<i>mandatory</i>	<i>6 weeks<sup>2</sup></i>	<i>test duration one year</i>
Sweden	840 <sup>1</sup> 4,000	10,000	informative; warning; active accelerator	several months, e.g. Lund 6 m	
Un. Kingdom	20	80	advisory; voluntary; mandatory	6 months	4 trials, 2 areas

<sup>1</sup> Borlänge + Lund + Lidköping 840, Umeå 4.000 (Umeå using transmitters rather than digital map/GPS).

<sup>2</sup> These weeks followed on a week of habituation to the test car with the system still off.

The ISA system in the Dutch field trial was operating during twelve months. Twenty passenger cars were equipped with an ISA system and were available to randomly selected households. Six successive groups of twenty test drivers were involved in the experiment. Each of them had the test car available during a 6 week period, leaving time for learning effects. In total, 120 test drivers participated in the test. The Campenhoef district was chosen as test area in the city of Tilburg (150,000 inhabitants). The test included roads with speed limits of 30 km/h, 50 km/h and 80 km/h. A differential Global Positioning System (dGPS) determined to two metres accurate in which speed zone the car is situated. The speed limiting mechanism was activated by restricting the fuel inlet as soon as the vehicle exceeded the speed limit. The system had an emergency button that enabled the driver to overrule the system when necessary.

### 3. ISA acceptance studies

#### 3.1 Types of studies

The emphasis of published study results varies strongly. Results are different in terms of evaluation objective such as driving behaviour, driver acceptance, acceptance by stakeholders or accident-reducing potential. Results are also different in the basis of the outcomes varying from behavioural responses based on measurements, via reported driver responses and driver opinions to expert judgements. Expert opinions can be subject of study in a particular country or in a set of countries (Marchau and Van der Heyden, 2003). These latter results usually cover a set of advanced driver assistance systems of which ISA is one. Quite a different criterion for distinguishing between study results is the source of the information gathered. Several studies used interviewees that had any experience with and knowledge-beforehand of intelligent speed adaptation. A large-scale study in Belgium included 2.500 interviewees who were surveyed on both warning and mandatory ISA systems (De Mol et al., 2001). Field trials

provide the opportunity to measure driver responses and acceptance directly related to personal experiences. Usually, field trials are designed for that purpose (UK; Sweden; The Netherlands; France). Another typical type of ISA studies is the simulator study. That type of study was used in the Dutch project 'Automation of the driving task' and in the first phase of the EVSC project in the UK. Recently, a network simulation study in four European countries was carried out in the context of the Prosper project. The aim was to assess the efficiency of ISA dependent on factors such as degree of penetration and type of ISA system (voluntary; mandatory).

### 3.2 Available insights

It goes beyond the scope of this paper to give a broad overview of ISA related acceptance studies or to summarize the insights gained so far. Examples of studies among drivers without and studies among drivers with ISA experience are given. In general, studies on ISA acceptance are less numerous than studies on behavioural effects. An overview of results of behavioural adaptation and ISA is given by Saad et al. (2004).

According to attitudinal studies in the UK and in Belgium among people without any ISA experience, a majority of people are in favour of ISA, even the mandatory version. In the UK, 53% of driving license holders favoured fitment of mandatory ISA (Carsten, 2002), whereas 59% of the 2.500 respondents in Belgium supported that idea (De Mol et al, 2001). Even 88% of these respondents claimed to accept a voluntary ISA system that gives signals when speeding. Van der Heijden and Molin (1999) observed an acceptance level of 55% in an earlier ISA study that was mainly related to advisory ISA. Marchau and Van der Heijden (2003) found that, general, informing and warning devices are preferred to control systems.

Study results based on real experiences with test drivers are more informative. Early results based on testing electronic speed control (ESC) are available from Sweden involving 65 private drivers and 27 professional drivers (Marell and Westin, 1997). The positive belief in ESC was strengthened after having tested the equipment for nine months. The equipment warned when exceeding the speed limit on 30 km/h road segments near schools and care-centres. An acceptability scale was used in the EVSC project in the UK (Carsten & Fowkes, 2000). This allowed drivers to express opinions about two ISA variants. Subjects rated the mandatory system as more useful after experiencing it compared with their prior conception, and they also rated it less negative in terms of satisfaction, although they were still quite negative about it in this respect. However, the results of a simulator study and a real road study did not provide identical results. In general, the scores tended to improve with familiarity. More positive attitudes after using ISA were found. An on-road experiment in Finland tested three types of ISA in a so-called within-subjects design (Paätalo et al, 2001). The systems did not result in dramatic differences in acceptance. The following proportions of the 24 test drivers claimed that they could take the system to their own car: informing system 62%; recording system 64%; compulsory system: 48%. One of the field experiments in Sweden (Lidköping, 220 cars) compared the ISA information system with the active accelerator pedal that activates a resistance as soon as the driver attempts to exceed the speed limit. Significant differences in acceptance could not be found (Vägverket 2002b). This study showed a high general acceptance level of the open and the half-open ISA system. It might be concluded that previous studies show a tendency towards a higher degree of acceptance of informative/warning devices compared to mandatory systems. Actual experience with ISA

seems to soften negative attitudes. Insight into the acceptance of mandatory ISA is limited. The Dutch field trial was set up to get better insight into this intervening system.

### **3.3 Expectancy**

The choice for the closed ISA system in the Tilburg field trial implied the choice for a system that would take the driver out of the loop and deprive him of his freedom to cope with the traffic situation in terms of speeding. This mandatory system was thought by the authorities the most effective one but with the risk that the acceptance level among drivers would be relatively or even absolutely low. In general, compelling measures appeared to include political risk as they invade drivers' freedom. Acceptance of the mandatory system, therefore, was a significant part of the evaluation objectives. In literature, driver attitudes are considered main obstacles to mandatory ISA. Almost two-thirds of a broadly composed mainly Scandinavian expert panel claimed that driver attitudes would be an important obstacle to compulsory ISA scoring 4 or 5 on a scale of 1 to 5 whereas informing or warning ISA were expected to meet this type of resistance by only 19 respectively 29 percent of the 78 experts (Tapio et al., n.d.). Goldenbeld (2004) studied the political support for ISA by means of interviews with representatives of political parties. The interviewed politicians had clear reservations that particularly applied to an obligatory introduction of ISA associated with a general limitation of personal freedom of choice of the motorist.

In the knowledge that mandatory imposed measures general are far from popular and that a closed ISA system would reduce drivers' freedom, the general attitude in the professional research scene towards the compulsory ISA system was reserved. The expectations in terms of driver acceptance were definitely lower than the expectations in terms of effect on driving behaviour. In addition, there were no consistent expectations among the project participants in the Dutch field trial. Although the study had an explorative rather than an explanatory nature, the study team held a concise poll among 17 stakeholders prior to the field test in order to make explicit the expectancies about the acceptance level of drivers. Half of the stakeholders (9 out of the 17) expressed as their view that at the very most 35 percent of the drivers would accept the mandatory ISA system. Six of the stakeholders held the view that more than half of the drivers would accept the system. It was also felt that informative ISA would appeal strongest to the drivers: the majority of the stakeholders (10 out of 17) ascribed this ISA system the largest support whereas the advisory ISA (active gas) and mandatory ISA system each received only 3 followers with one stakeholder undecided. Section 6.1 will relate these expectations to the acceptance level actually observed. The moderate expectations with regard to mandatory ISA fit close to the expectations informally expressed by researchers involved in field trial initiatives elsewhere in Europe. Intermediate study results in Sweden seemed to support this expectation and were reported in the final report: "Warning and informative systems were preferred in advance by most people among the general public and among those recruited. Only around half as many considered active gas to seem suitable." (Vägverket, 2002a).

## 4. Research design

### 4.1 Acceptance as a layered concept

The Dutch acceptance study took on board the notion of problem awareness. An attitude that is grown in the notion that speeding is a real problem was assumed to be different from an attitude that does not include that notion. The latter type can be said to be more opportunistic and more easily influenced. An adequate acceptance measurement would not suffice by relying on a superficial measurement and not discriminating a superficial positive attitude from a deeper, more fundamental attitude. The premise has also a political relevancy. The acceptance of any policy measure is presumably stronger and lasting when going together with the sense the proposed measure will address a real problem. Measures that combat phenomena that are not really felt as problematic by drivers can be expected to fail evoking internalised behaviour. Measures that link up with problems that are really felt will probably have a higher chance of gaining enduring support. Therefore, the perspective of policy measures to influence social behaviour or traffic behaviour is better when solving a well-recognised problem. Also a study in Belgium took this notion on board in a nation-wide study about ISA acceptance (De Mol et al., 2001). ISA is introduced to discourage speeding. Given the pattern described, the acceptance level will presumably be lower among those drivers who do not feel speeding as a real problem. The Dutch ISA evaluation study identified the degree in which speeding in the urban area is felt as a real problem.

It was decided in the design stage of the Dutch study to combine an attitudinal question and problem consciousness with respect to speeding. This would presumably provide a potentially powerful acceptance concept. Two elements were distinguished when identifying people's concern: a) to what extent do residents in the urban area experience speeding and b) as far as they experience so, is this speeding felt as inconvenient rather than problematic or does it really affect them as a problem. Only those who personally experience speeding and, additionally, feel it as problematic got the 'problem awareness' score. This was done separately for three types of roads: streets in the built-up area, urban traffic routes and secondary roads that usually have a maximum speed limit of 80 km/h.

Drivers' attitude towards ISA was measured as follows: 'What is your position concerning Intelligent Speed Adaptation as applied in the pilot?' (against - neutral - in favour of it, on a 5-point scale). In the measurement prior to the field test and among the reference groups a verbal description of the ISA system was given. The final acceptance concept combined the persons' problem awareness and his negative or positive attitude towards ISA. This yielded four categories of drivers with different levels of acceptance as shown in figure 1.

	Negative attitude towards ISA	Positive attitude towards ISA
Low degree of problem awareness	— — Indifferent, Opposed to ISA	+ — Opportunistic acceptance
High degree of problem awareness	— + ISA the wrong means to a serious problem	+ + Well-founded, firm acceptance

Figure 1. Types of acceptance in a multi-layered approach

This approach that takes into account the stability of the acceptance distinguishes itself from usual approaches that focus just on the attitudinal element. It distinguishes itself also from those approaches that address acceptance by using rating scales assessing the usefulness and comfort of the system in question (for example Hoedemaeker, 1999). The layered approach allows distinguishing between a rejection of ISA claiming that there definitely is a problem but ISA is the wrong means to solve it and a more systematic rejection. This latter attitude both denies the problem and rejects the solution. Even more relevant is the distinction among those who have a positive attitude towards ISA. An opportunistic acceptance can be considered less stable and more sensitive to change than a well-founded acceptance.

#### 4.2 Test group and three reference groups

The study design included four different groups of residents with a divergent degree of exposure to ISA. The target number of persons for each group was 120. The following groups were distinguished:

- Test drivers from the residential area Campenhoef: car drivers experiencing ISA in the car they drive daily.
- A first reference group: inhabitants of the same residential area Campenhoef in Tilburg., These inhabitants interact on the roads in their residential area with speed limited cars while not having a speed limited car by themselves. They have a similar level of information on ISA based on communications and information in the residential area.
- A second reference group: inhabitants of the city of Tilburg addressed with ISA-information to a low extent and with hardly any interaction with ISA cars on the road.
- A third reference group: inhabitants of other cities of the province of North Brabant, not specifically supplied with ISA-information and without any interaction with ISA cars on the road.

Table 2. Reference groups and exposure to ISA

	Information; communication	Interaction with ISA vehicles	Driving ISA car
Inhabitants of other cities	-	-	-
Inhabitants of pilot city	+	-	-
Residents of pilot area	+	+	-
Test drivers from pilot area	+	+	+

The design was experimental. There was a random allocation of households to the test group and to the first reference group, both consisting of residents of the test area. This procedure avoided the risk of self-selection. A further relevant feature of the test group – reference group design is the decreasing degree of exposure to ISA. Whereas test drivers received the broad spectrum of stimuli including practise with the instrumented car, the reference cases show a decreasing level of ISA involvement as shown in table 2. This allows the acceptance study identifying effects on a firm basis.

A further relevant principle was the acceptance measurement at different moments in time. The attitude towards the mandatory ISA system among test drivers was measured at a series of four moments. This allowed observing the development of ISA acceptance over time: (1) before start of the field test, (2) at a moment shortly before the driver got the test car for a period of two months (it should be noted that the selected test drivers had to wait several months for their turn except the first group of 20 drivers); (3) during the test period; (4) two months after the test period. The reference groups were approached twice: a first time prior to the start of the field test and a second time during the field test but spread across six periods parallel to the six groups of test drivers.

## 5. Test group results

### 5.1 Acceptance level and development over time

Figure 2 shows the development in the attitude towards ISA of test drivers who experienced the mandatory ISA system themselves after the first two measurements. The ‘in-between measurement’ was held one week prior to the actual test period after a period of waiting for the availability of the ISA car (6 successive groups of 20 test drivers got the 20 ISA cars for a period of two months).

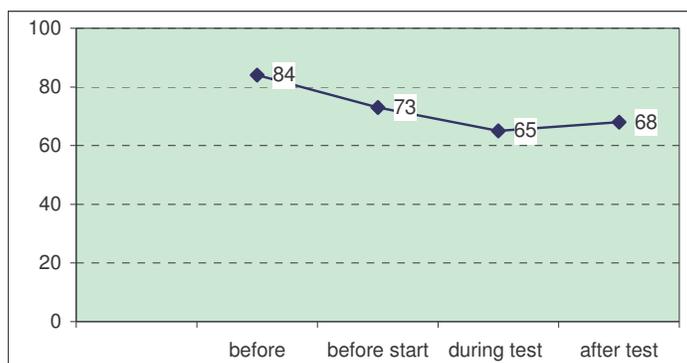


Figure 2. Development in ISA acceptance in % of test drivers (n=120)

The following observations can be made based on figure 2. The reader should be aware that some of these observations will have to be substantially amended after comparing the test group results with the reference group results.

1. The acceptance degree was at a very high level at the initial stage before start of the field test.
2. The acceptance level decreased from over 80% to a level of about 60%. This result suggests a negative influence of experiencing mandatory ISA on driver acceptance.
3. The acceptance level did not diminish after a period of two months after test participation. There is no evidence of decreasing enthusiasm when falling back in the usual pattern of driving in a not speed-limited passenger car.

The percentage of opponents (not shown in figure 2) amounts to 10-15 percent of the test drivers in the field test stage. The number of ISA opponents that hold a strong negative view can be neglected.

In a way, the observed development is opposite to the development that could have been expected. Particularly, the acceptance level during the field test is lower than it was before. This tendency was not in harmony with results of other field tests that showed more positive attitudes after using ISA. The tendency deviated also from signals from test drivers that generally indicated a positive appreciation of ISA or from reported advantages of the system although also some disadvantages were reported. The most severe side-effect was the irritation among not-speed limited cars that behaved as bumper shadow behind the speed-limited cars. In turn, this hurried the test driver who was not in the situation to give way. Closer inspection of the research results revealed a strange difference between the test group on the one hand and the second and third reference group on the other hand. The acceptance level of about 80 percent among test drivers at the first measurement was substantially higher than the acceptance level among reference groups outside the test area (55%). The inspection further taught that the 'behaviour' of the first reference group (in terms of attitude towards ISA) was quite similar to that of the test group. Those observations were strong indications that a particular phenomenon was in place. What was thought to be a before-measurement was actually a measurement that was biased by other influences, both for the test drivers and for the other residents of the test area.

Closer reflection did assume that the measurement preceding the field test were not a real zero-measurement: Campenhoef residents had already been informed on the principles of ISA and the initiative to have the trial in their residential area. By consequence, their attitude at the start of the trial seemed apparently influenced by the mere fact of alerting residents to the ISA principle and informing them on the forthcoming ISA test. The study team realised that the well-known Hawthorne-effect could have occurred. Since this phenomenon would have major implications for the analyses and the interpretation of the data, additional analyses were carried out before proceeding with the main analysis.

The Hawthorne effect owes the name to experiments that were conducted at the Western Electric Hawthorne plant outside Chicago starting 1927 and running through 1936. Mayo (1933) examined productivity and work conditions. Particularly, the effects of lighting conditions on productivity were studied. Strange enough, each change in working conditions (especially light levels) resulted on average over time in productivity rising, including eventually a return to the original conditions. A discussion of the Hawthorne effect is given by Draper (2005). The essence was the occurrence of an experimental effect in the direction expected (higher productivity under changed working condition) but not for the reason

expected. Essentially, it was the feeling of the workers that they were being closely attended that was the cause of the improvements in performance.

In the Dutch ISA study, effects presumably occurred due to causal factors other than the simple physical ones the experiments had originally been designed to study. These factors caused an improved 'performance', that is a more positive attitude towards ISA, even before the central ISA stimulus was given. In the Hawthorne plant, the causal factor was the attention given to the workers. In the ISA field test in Tilburg, the causal factor most probably was the attention given in the shape of communication and information to the inhabitants of the test area. Irrespective whether it was the attention itself or the contents of the communication, drivers had already adjusted their attitude prior to their practise with ISA and even prior to the first measurement that was held several months before the period of practise.

## **5.2 Characteristics of respondents in reference groups**

Since there were strong indications that the Hawthorne-like effect had influenced the first measurement among inhabitants of the test area, it was acknowledged that the acceptance data in the before-measurement most probably were not real zero-measurement data. A real zero-measurement could only have been realised prior to any information stimulus in the test area. Actually, the first measurement was made four months before the start of the field trial when an information process was already on-going. In view of the information process towards inhabitants, the first measurement should have been carried out more than six months prior to the field trial.

The information and communication process towards the inhabitants of the test area had influenced the attitude of both the future test drivers and members of the first reference group. As a consequence, the research team considered the necessity of attributing the zero values of the other reference groups to these inhabitants (test drivers and 1<sup>st</sup> reference group). However, this would be justified only in case the respondent characteristics are equal among the four groups. In case of differences, it will be useful to check whether or not those differences are associated with the attitude towards ISA. Therefore, the distribution of characteristics across the groups is discussed here. Additionally, it is shown to what extent the variables not equally distributed across the groups correlate with the ISA attitude. The test drivers and the three reference groups were analysed in terms of differences in demographics, driving style and risky behaviour. Table 3 gives a summary overview of these characteristics. The main question is to what extent residents of the test area (both test drivers and members of the first reference group) are different from the members of the second and third reference group. Therefore, all residents of the Campenhoef test area on the one hand and the members of the second and third reference group on the other hand are taken together.

**Table 3. Characteristics of test area drivers and drivers from outside the test area**

	Residents test area Campenhoef (n=251 test drivers; other drivers)	Drivers in 2 <sup>nd</sup> and 3 <sup>rd</sup> reference group (n=291)	Probability
<i>Demographics</i>			
- gender: men	50%	69%	p<.01
- educational level: high	30%	32%	n.s.
- age	40.5	44.5	p<.01
<i>Driving style</i>			
- punchy (self-report)	18%	18%	n.s.
- usually keeping great distance to car ahead (self-report)	40%	43%	n.s.
<i>Risky behaviour</i>			
- tendency to take priority even if not justified	27%	26%	n.s.
- fail to stop after the light changed to red	40%	36%	n.s.
<i>Speeding<sup>1</sup></i>			
- on roads with 30 km/h limit	14%	4%	p<.01
- on roads with 50 km/h limit	23%	16%	p<.10
- on roads with 80 km/h limit	31%	30%	n.s.
- on motorways	37%	40%	n.s.

<sup>1</sup> Based on self-reports. Figures represent the percentage of drivers claiming to speed frequently

Most variables do not show substantial differences between the Campenhoef residents and the other driver groups. The gender distribution is different. However, further analysis showed that the proportion of men that hold a positive attitude towards ISA is almost similar to that of women (65% versus 68%). Therefore, the observed difference in ISA attitude in the first measurement can not be explained by or (partly) attributed to the observed difference between groups in gender distribution. As far as differences in frequent speeding on 30 km/h streets were observed, the differences are fairly small. In addition, these unequally distributed characteristics do not correlate with ISA attitude. Residents of the test area show a somewhat lower average age. However, younger people are slightly less positive on ISA. Only in case young people would be more positive, the age distribution could have been an explanatory factor. In view of the equal distribution of most characteristics and the absence of correlation of unequally distributed characteristics with ISA attitude, the zero values of the second and third reference groups were attributed to the Campenhoef residents.

### 5.3 Revised analysis

Since the first measurement could not be considered a real zero measurement, the attitude value of those other citizens in the second and third reference group (54%) was given to the Campenhoef residents as initial attitude value (see figure 3). This step was justified given the fact that relevant respondent characteristics appeared to be equally distributed across the several groups.

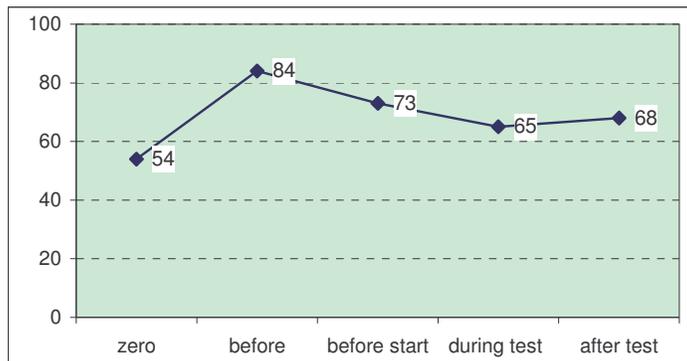


Figure 3. Development of ISA acceptance in % of test drivers (n=120)

Figure 3 gives cause for observations that are different from those based on figure 2. In particular, the conclusion that the results suggest a negative influence of experiencing mandatory ISA on driver acceptance was not justified. The acceptance level after experiencing an automatically enforced speed limitation is definitely not lower than the initial level. There even is a tendency of the opposite. The acceptance level of more than 60 percent is slightly higher than the initial acceptance level of 55 percent.

A further observation from figure 3 is that the decrease in acceptance from over 80 percent to a level of about 60-65 percent already occurred in the period of waiting for participation prior to the actual ISA driving experience in the field test (in-between measurement). This decrease will be discussed in section 6.1 using also the data of the reference groups.

## 6. Test group and reference group results compared

### 6.1 Development of acceptance over time

Each of the three reference groups had a different degree of exposure to intelligent speed adaptation. The exposure varied from 'intensive' for those who are living in the test area (communication and interaction with speed limited cars) to 'zero' for those who live in another city without information on ISA ('Brabanders'), see also table 2. Figure 4 shows the development pattern for all four groups. Test drivers from the Campenhoef area show a pattern that is very similar to the pattern of other residents in the test area Campenhoef. A conclusion that can be drawn from figure 4, comparing test drivers and other Campenhoef residents, is that driving experience with ISA does not bring about a higher acceptance level than only communication about ISA and interaction with ISA vehicles. At the end of the day, both groups have a similar level of acceptance of ISA (more than 60 percent).

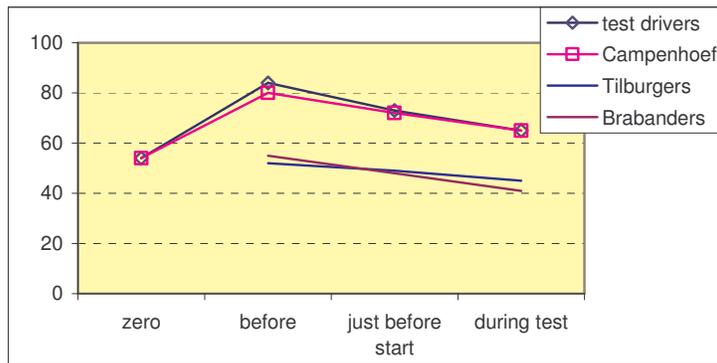


Figure 4. Development of ISA acceptance in test group and reference groups (n=120 each)

A further relevant observation is that the acceptance level among residents of the test area decreases after a while. There is a drop in the initial acceptance level from about 82 percent to 65 percent. This drop asks for an explanation. It is useful to include the development in ISA acceptance in the second and third reference group in the interpretation. More precisely, a drop in the acceptance level can be seen irrespective of being under or outside test conditions, be it that the decrease is stronger among the Campenhoef residents including test drivers (from 84% to 65%) than among Tilburgers and Brabanders (from around 54% to 43%). It should be kept in mind that half of the decrease for the test drivers already occurred before the start of the test. This means that a substantial part of the decrease can not be attributed to the ISA experience. Two factors may have caused this drop in acceptance level. The first explanation could be the halo effect. The halo effect refers to the effect of novelty: subjects perform differently at first because of the novelty of the 'treatment' which may cause them to be more alert or positive or otherwise perform differently (Draper, 2005). In this sense, a first acquaintance with the ISA principle has evoked a positive view among a relatively large number of people inevitably followed by a decline after elapse of time. This halo effect might completely explain a decrease in acceptance level among the second and third reference groups and may also have caused the decrease in acceptance rate for the Campenhoef residents. The second factor could be the fading away of the Hawthorne-like effect. After the initial quick increase under the influence of communication attention this more or less artificial, relatively high acceptance level dropped to a more natural level. Most probably, both the halo effect and the fading away of the Hawthorne-like effect contributed to the drop in acceptance level of Campenhoef residents.

A third factor could have been the ISA driving experience. Part of the decrease in acceptance occurred during the test period. Therefore, it is useful to check whether there are indications that support the theory that experience with ISA decreases ISA acceptance. The residents who did not experience ISA in their car but who had interaction with speed limited cars also showed this drop in acceptance. Those ISA cars were as such not recognisable to them, but the residents could know what car types were involved in the test. Test drivers and Campenhoef residents were asked whether their attitude towards mandatory ISA was changed as a consequence of ISA experiences in a more positive or more negative direction if their attitude had changed at all. The data show a clear tendency to a positive development of the attitudes (table 4). Indeed, there is a sub-group of test drivers who claim that their attitude

worsened under the influence of ISA experience (15%). However, a much larger group (58%) claimed a positive influence of the ISA experience. A negative influence of ISA experience can hardly be observed among Campenhoef residents in the first reference group whereas many of them also claimed to have changed their attitude in a more positive way. Therefore, there are insufficient indications to support the theory that ISA experience has caused a drop in the acceptance level. Rather the opposite is true.

**Table 4. Development of attitude towards ISA after ISA experience (% of drivers)**

	Test drivers Campenhoef	Campenhoef residents, 1 <sup>st</sup> reference group	All
Came to appreciate ISA much less	3	-	2
Came to appreciate ISA less	12	1	6
Unchanged: similar to before	25	50	38
Came to appreciate IS more	44	43	43
Came to appreciate ISA much more	14	5	9
Don't know	2	2	2
All (100%)	(n=111)	(n=125)	(n=236)

Finally, a particular relevant observation from figure 4 is that, at the end of the day, the level of acceptance among residents of the test area is at a considerably higher level (65 percent) than the acceptance level among others (41-45 percent). The difference of 20 percent points is substantial. These figures would make the possible explanation that driving experience would have lead to a drop in acceptance even less plausible than it already appeared to be. Therefore, the following major conclusions can be drawn:

- Acquaintance with the principle of automatically enforced speed adaptation results in a higher level of acceptance in the order of magnitude of 20 percent points (the first two groups compared to the last two groups, figure 4).
- It does not make a real difference whether the acquaintance is in the form of ISA driving experience or in the form of information and interaction (compare the first and second group). Limited communication (third group), however, does not effectuate an increase in acceptance level neither does the absence of any information (compared with the pattern shown by the fourth group).
- More than 60 percent of the test drivers had a positive attitude towards the mandatory ISA system after they had had practise with it.

The last observation can be compared to the expectancy of stakeholders (see section 3.3). The observed acceptance level can be said to be unexpectedly high. According to the measurement preceding the field test, half of them expressed the view that no more than 35 percent of the drivers would accept mandatory ISA. In fact, the observed acceptance level of 65 percent among test drivers is clearly higher. Even the acceptance rate among reference groups is higher. Also the expectations about the preferred ISA system differed widely from the observed data. The majority (10) of the 17 stakeholders expected the drivers to prefer informative ISA (flashing or by sound signal). However, almost half of all drivers said to prefer the mandatory system to the other systems. The informative system was preferred by one-third of the drivers and the active gas pedal by one-fifth.

## 6.2 Acceptance degrees

Problem consciousness with respect to speeding was introduced as a potentially relevant dimension to combine with the attitude towards ISA (section 4.1). The measurement prior to the field test showed that the problem of speeding is experienced differently per type of road. Whereas speeding in residential streets is a real problem to a majority of people (62%), speeding on secondary roads keeps a minority of people (29%) concerned (figure 5). This is remarkable given the fact that most accidents occur on secondary roads. The differential problem awareness runs parallel to the necessity felt to apply speed limit enforcement in the various types of streets. Marchau et al. (2005) found that more than 90 percent of respondents claimed the necessity of speed limit enforcement in neighbourhoods with a speed limit of 30 km/h as opposed to motorways for which the perceived necessity dropped under 45 percent.

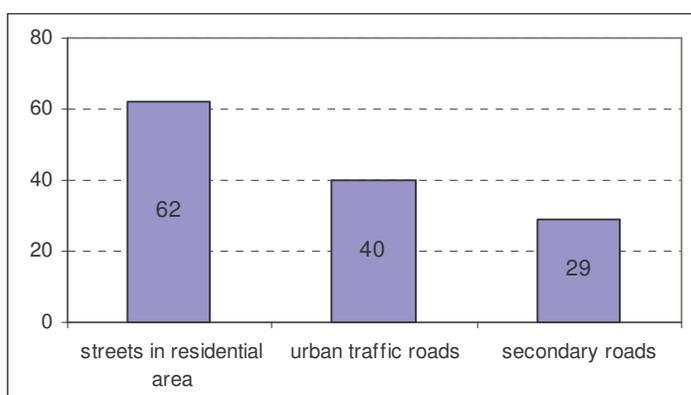


Figure 5. Problem awareness of speeding, per type of road (N=550, % of drivers)

It is interesting to analyse to what extent the support for ISA is embedded in the feeling that the ISA measure serves to solve a real problem. Figure 1 gave the acceptance categories as distinguished in the multi-layered approach. Focus here is on the magnitude of the two categories that include people who show a positive ISA attitude but with different intensity. Opportunistic acceptance represents low speeding problem awareness whereas firm acceptance can be assumed to be more robust by combining the positive attitude with a high speeding problem awareness.

Table 5. Depth of the ISA acceptance

Type of (non) acceptance	Test drivers after ISA practise (n=113)	Reference group without ISA exposure (Brabanders, n=115)
- - Indifferent, opposed to ISA	23	36
- + ISA the wrong means to a real speeding problem	12	20
+ - Opportunistic acceptance	41	22
+ + Well-founded, firm acceptance	24	22
Total	100%	100%

Table 5 clearly shows a tendency among test drivers to opportunistic ISA acceptance. The majority of those who have a positive attitude towards ISA do not clearly recognise speeding

as a problem. In total, 41 percent of the test drivers belong to this category. Their acceptance can be said to be less robust than the acceptance of other test drivers whose positive attitude goes with speeding problem awareness (24%). The higher level acceptance of about 20 percent points as a consequence of ISA exposure, as established in section 6.1, has apparently entered fully in opportunistic acceptance. This can be seen when comparing test drivers' 'depth' of acceptance with that of reference group drivers who did receive any ISA information. The gain in acceptance comes both from previously indifferent drivers or ISA opponents and from drivers whose assessment is that ISA is not the right means for the solution of the speeding problem. The high proportion of opportunistic acceptance should sensitize policy makers and advocates of ISA to the delicate basis of the high ISA acceptance level. The support for ISA is not always associated with meeting a strong need or solving a really felt problem. The large support includes both stable and unstable followers.

The stability of ISA acceptance clearly differs per type of road (see figure 6). The support for ISA in residential areas goes together with a high degree of problem consciousness (47% out of 63% drivers accepting ISA). The large majority among those who are in favour of ISA for that type of roads holds the view that a serious problem is addressed by this measure. However, as far as urban traffic roads are concerned, the support is as frequently opportune as robust (25%-25%). The majority of those who support ISA for secondary roads (30% out of 47%) have a low degree of problem consciousness. Therefore, as far as resistance would arise against ISA, this could be expected for this type of roads outside the built up area. The degree of acceptance is highest for ISA in residential streets, both in 'absolute' terms and considered the depth of the acceptance.

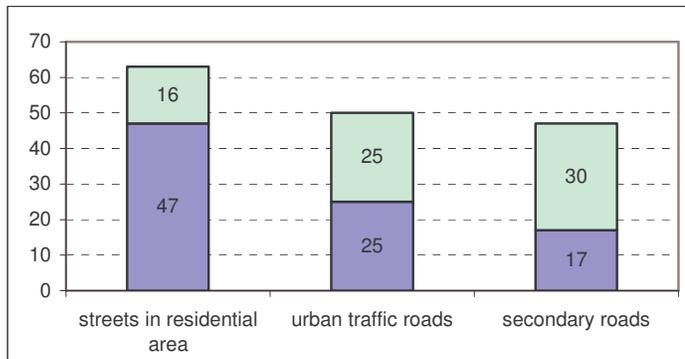


Figure 6. Firm (dark) or opportunistic ISA acceptance, per type of road (% of drivers)

## 7. Conclusions

This article provided driver acceptance data in the context of a field test in which drivers could use a speed limited passenger car in their residential area. The ISA variant used was the mandatory system that prevented the driver from speeding irrespective of the local limits. The study results are based both on the experiences of 120 test drivers during a six week period and on three reference groups with varying degrees of ISA exposure. More than 60 percent of the test drivers had a positive attitude towards mandatory ISA when they had practise with

the system. The acceptance was still at that level a few months after the field test. This acceptance level can be considered fairly high in view of the frequently held opinion that mandatory systems run the risk of lack of support. The observed acceptance level exceeded the expectations of most stakeholders involved in the field test. The study showed that acquaintance with the principle of automatically enforced speed adaptation results in a higher level of acceptance. This is true both for self-experience with the ISA system and for informed people driving in traffic situation mixed up of with cars with and without speed limiters. The difference in acceptance level with drivers outside those traffic conditions was 20 percent points. The data included strong indications for the incidence of the Hawthorne effect. The initially observed relatively high acceptance level among test drivers could not be caused by test driving as the effect appeared already prior to the field test. The availability of three reference groups helped in the process of interpreting data. Two major developments that were to be explained were the initial high acceptance level compared to that of reference groups and the drop in acceptance thereafter.

The depth of acceptance was a useful concept. The distinction of types of acceptance according to the degree of being conscious of a speeding problem enabled to deepen the interpretation. The increase in acceptance turned out to be mainly an increase of opportunistic acceptance that does not acknowledge the problem of speeding. Additionally, the concept could make visible a differential pattern of ISA acceptance for different types of roads. The broad support to mandatory ISA in streets in residential areas appears to be more fundamental whereas the support to ISA on secondary roads – that is relatively limited anyhow – mainly includes opportunistic rather than fundamental support.

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