# Intelligent Speed Adaptation

## From Trial Support to Public Support.

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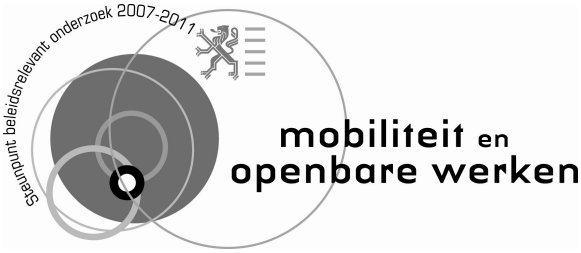


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## Samenvatting

Intelligente Snelheidsaanpassing of ISA is een intelligent transportsysteem dat kan bijdragen tot een betere verkeersveiligheid. In 2002 werd de eerste ISA_trial gehouden met een actief gaspedaal. 34 personenwagens en 3 bussen werden hiermee uitgerust. Hierbij voelde de bestuurder een tegendruk in het gaspedaal wanneer hij/zij sneller reed dan toegestaan. Uit de resultaten bleek dat de adaptatie en acceptatie van het systeem vrij hoog was. Ook had de trial tot doel om meer draagvlak te creëren. Hierbij werd gebruik gemaakt van rolmodellen die participeerden in de trial. De laatste jaren ligt de focus nu ook meer op het bepalen van het draagvlak voor ITS. In dit rapport wordt het concept draagvlak en aanvaarding verder uitgediept en toegepast op ISA.

## English summary

### Intelligent Speed Adaptation

### From Trial Support to Public Support

### Abstract

Intelligent Speed Adaptation (ISA) is a beneficial Intelligent Transport System (ITS) to increase road safety. In 2002, thirty-four cars and three buses were equipped with the "active accelerator pedal." The results showed that the pedal assisted them well in upholding the speed limits and that the system increased driving comfort. Data analysis showed a reduction in the amount of speeding. Besides the research on the effects, the trial was used to gain more support of the general public, decision and opinion makers. Nowadays the focus is shifted to define the acceptability by the public to get a better implementation. A general research framework consisting the social and cultural factors and the device related characteristics that influence acceptability is constructed.

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# 1. INTRODUCTION

Excessive speed is considered as the number one road safety problem in many countries (ECMT, 2006). Inappropriate speed is responsible of one-third of the accidents resulting in vehicle occupant fatalities (ETSC, 1995). Finch et al. (1994) calculated that reducing the speed level with 1 kph leads to a 3% reduction in accidents risk. In 2000, the European Union (2001) has set the ambitious target to reduce the number of fatal accidents by half before 2010. One of the actions is to use and develop intelligent transport systems (ITS) that can improve road safety. Intelligent Speed Adaptation (ISA) is such an ITS device that can help to counter inappropriate speed.

ISA is an intelligent in-vehicle transport system, which warns the driver when speeding, discourages the driver from speeding, or prevents the driver from exceeding the speed limit (Regan et al., 2002). ISA-devices can be categorized into three types (ETSC, 2005) depending on how intervening (or permissive) the devices are. An informative or advisory system will only give the driver feedback through a visual or audio signal. A supportive or warning ISA system will intervene when the speed limit is overruled. For example, the pressure on the accelerator pedal will increase when the driver attempts to drive faster than the speed limit. A mandatory or intervening system will totally prevent the driver from exceeding the limit: in other words, the driver cannot overrule the system.

In the last decades many trials and experiments with ISA were held around the world. From October 2002 until January 2004, an ISA-trial has been held in the city of Ghent (Belgium). In total, 34 cars and 3 buses were equipped with a supportive ISA-system called the "active accelerator pedal". On the basis of driving data analysis and participant surveys, the effect of the ISA-system on speed-change, traffic safety, drivers' attitude, behaviour and drivers' acceptance were studied (Vlassenroot et al., 2007).

The Ghent trial also wanted to achieve a better acceptability of ISA by policy-makers and the public (De Mol and Vlassenroot, 2007). Among the test drivers, there were drivers that could be considered as role models. These drivers had a higher - public function in the council of Ghent, in the university or in a car company and were chosen because they could have influence on the general public, decision and opinion makers.

Public acceptability is an important precondition for a successful measurement introduction. Greater acceptability will result in larger support in political and governmental circles, and in more successful in public behavioural adaptation.

When this trial was held, including the communication and acceptability strategies, the question had arisen which specific factors could influence acceptability and how these could be measured. Therefore the acceptance results of the test-drivers and the 'acceptability' strategy will be described. Throughout these findings the concept of acceptability and how to measure this concept will be approached. This "theoretical concept" will be used in the future to define the different factors that can influence the public acceptability of ISA.

# 2. THE DIFFERENCE IN ACCEPTANCE AND ACCEPTABILITEY RESEARCH

The research setting in the Ghent trial does not differ significantly from most other ISA-trials: the focus is mostly set in defining the effectiveness and acceptance of the system throughout data logging and questioning the test-drivers.

In most of the trials acceptance is considered as the outcome of the behavioral changes, i.e. by comparing the old driving style with the new driving behavior when using the device, in combination with the opinions of the users, which would state the 'willingness to use it' (Jameson, 2006). In other research, the outcome of behavioral change is mentioned as (behavioral) adaptation (Brookhuis et al., 1999). In the PROSPER-project (2004), i.e. a European funded research project in which different countries participated regarding ISA-research, the term acceptance was related to research on opinions, perceptions and attitudes of the test drivers. Van der Laan et al. (1997), however, noted a certain difference between user acceptance and social acceptance. User acceptance is more related to the ergonomic issues of a device, whereas social acceptance will focus more on the (long-term) effects by analyzing indirect attitudes. In this method, standardization for measuring acceptance is made, although it is still focused more on the ergonomic aspects.

As the effectiveness and acceptance is proven in trials, more steps are considered to come to the implementation of these devices. Creating implementation strategies must be seen in the increased notion that policymaking acts must be considered as a two-way direction wherein interaction, transaction and communication with the public are the key-elements (Nelissen and Bartels, 1998). This leads, in terms of road safety policy, to the precondition that the effectiveness of a measure will increase if there is support. Therefore, measuring public support would be a valuable tool. Measuring public support can be described as a method to predict if there can be a future acceptance, based on the opinions given by potential users. Future acceptance is mostly described as 'acceptability.'

Schlag and Schade (2004) use the term 'acceptability' as the prospective judgment of measures to be introduced in the future. Thus the target group will not have experienced any of these measures, making ''acceptability'' an attitude construct. Acceptance defines respondents' attitudes including their behavioral reactions after the introduction of a measure. Likewise, the term public acceptability is conceptually rather fuzzy as it is unclear what exactly is meant by the "public". Some authors focus on motorists, others on voters, consumers, citizens or inhabitants.

So the difference between acceptance and acceptability is due to having used the device or not. In acceptance research the device related characteristics will have a more central focus while in acceptability research underlying factors in willing to use the system have to be found, although it must be noted that acceptance and acceptability are complementary to each other and certain approaches would be the same.

In the next sections, the project results of the Ghent trial would be described as the future framework to get a better acceptability research approach.

# 3. RESULTS OF THE GHENT TRIAL

## 3.1 The trial set-up

In the Ghent trial, a half-open or supportive ISA-system was used. This system is better known as the 'Active Accelerator Pedal (abbreviated as AAP) or 'Limit Advisor' manufactured by the Swedish company Imita. This system has a force feedback function, which is a mechanical resistance applied to the accelerator pedal as a distinct moveable pressure point.

The test area covered the city of Ghent, within the ring-road R4. All legislated speed limits (30 kph, 50 kph, 70 kph, 90 kph) within this area were put on a digital map. Inside the test-area the system could not be switched off. Outside the test-area, the participants could choose to enter a speed limit manually to activate the system.

In total, 37 vehicles participated in the ISA-trial. 20 vehicles were owned by private test-drivers, 17 vehicles were owned by companies: 6 cars of the City of Ghent (1 of the Social Services), 5 vehicles of the Ghent University, 3 buses of the regional public transport company, 2 vehicles of the Province of East-Flanders and 1 of Volvocars Ghent. The total number of voluntary drivers was 28, spread over the 20 private cars. In the company cars segment it was assumed that there would be more than one driver, for example the bus drivers. The total (restricted) number of test drivers was 62: 42 male and 20 female spread over different ages.

In the group of professional drivers there were test-drivers that could be considered as role models. These drivers are higher educated employees of the council of Ghent, institution or company, and were selected because they have some influence on the general public, decision and opinion makers. The mayor and two aldermen of the city of Ghent, The vice-chancellor and the deputy vice-chancellor of the Ghent University, and the general manager of Volvocars Ghent were driving with the active accelerator pedal.

## 3.2 Research method

As in most ISA-trials, all 37 vehicles were equipped with so-called data-logging facilities and a flash-memory. This made it possible to collect data on speed, speed limit, position, time, date and voluntary use of the system outside the test area. Data was saved at a frequency of 5 Hz whenever the vehicle was inside the test area and at a frequency of 1 Hz whenever the vehicle was outside the test area. Data were logged for 1 month prior to when the active accelerator pedal was activated and then during the entire trial. Logged data were used to analyse changes in speed, driving-behaviour and voluntary use of the ISA-system.

Also, all test-drivers were interviewed three times: before their vehicle was equipped with ISA, after driving with the system for four months, and finally, at the end of the test-period (after driving for 11 months). Most of the questions from the base-line questionnaire were repeated, but there were more specific questions about driving experience and acceptance. The objective of the questionnaire was to study the drivers' attitudes, behaviour, acceptance level and experiences with ISA, and possible changes after using the system for a long period.

### *3.2.1 Main results gathered by data-logging*

a. Aggregated speed

The effect of the active gas pedal on average speed (V) was small. Effects were largest in the 90 km/h zone with a decrease of average travel speed of only 1.1 km/h. Average speed is not influenced in the 30 km/h and 70 km/h zone and even increases in the 50km/h zone. A possible explanation is the fact that cautious drivers who mostly obey the speed limit drive faster with ISA and that this effect evens out the reduction of speeding. A more obvious effect is in the 85 percentile (85P): for all speed zones the 85 percentile decreases.

Table 1. Driving speeds average, standard deviation and 85 percentile of test area

| Speed limit | Km driven | AAP inactive | | | AAP active | | | Change in | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | V | SD | 85P | V | SD | 85P | V | SD | 85P |
| 30 km/h | 5569 | 23,8 | 11,4 | 39,0 | 23,8 | 10,2 | 36,5 | 0,0 | -1,2 | -2,5 |
| 50 km/h | 95509 | 30,9 | 14,9 | 49,9 | 31,6 | 14,6 | 49,6 | 0,7 | -0,2 | -0,4 |
| 70 km/h | 13297 | 47,5 | 19,3 | 71,3 | 47,5 | 19,1 | 68,9 | 0,0 | -0,2 | -2,5 |
| 90 km/h | 17194 | 69,1 | 19,3 | 89,4 | 68,0 | 17,6 | 86,9 | -1,1 | -1,7 | -2,5 |

V = average speed, SD = standard deviation, 85P = 85 percentile

b. Speeding

The amount of speeding was lower when the active gas pedal was operational. Effects were largest in zones with the highest speed limit. Although speeding was reduced, there still remained a large percentage of speeding. Especially in the 30 km/h zone the effect on speeding was minimal, although the amount of speeding was high. The counterforce, exerted by the pedal, was not strong enough to discourage drivers to exceed the speed limit.

Table 2. Amount of speeding in different speed limit zones

| Speed limit | Km driven | AAP inactive | AAP active. |
|---|---|---|---|
| 30 km/h | 5569 | 45,9% | 42,8% |
| 50 km/h | 95509 | 14,7% | 13,1% |
| 70 km/h | 13297 | 17,6% | 12,6% |
| 90 km/h | 17194 | 13,5% | 3,8% |
| Total | 131569 | 16,3% | 13,1% |

c. Evolution of speeding

An important issue in making use of an active accelerator pedal is the applied counterforce. Speed offences can again become more frequent as drivers get used to the counterforce exerted by the pedal. To test this effect, loggings were compared on a monthly basis. Deactivation of the pedal took place for all cars during month 10 and month 11. In these periods both loggings with and without the AAP-system activated were logged. After these months only loggings without the system are recorded.

In all speed zones, speed offences have increased in month 9, just before the start of the deactivation period, compared with the first month. In low speed zones speed offences increase rapidly the first three months and then stay more or less at the same level until deactivation. In high-speed zones the increase is more gradually.

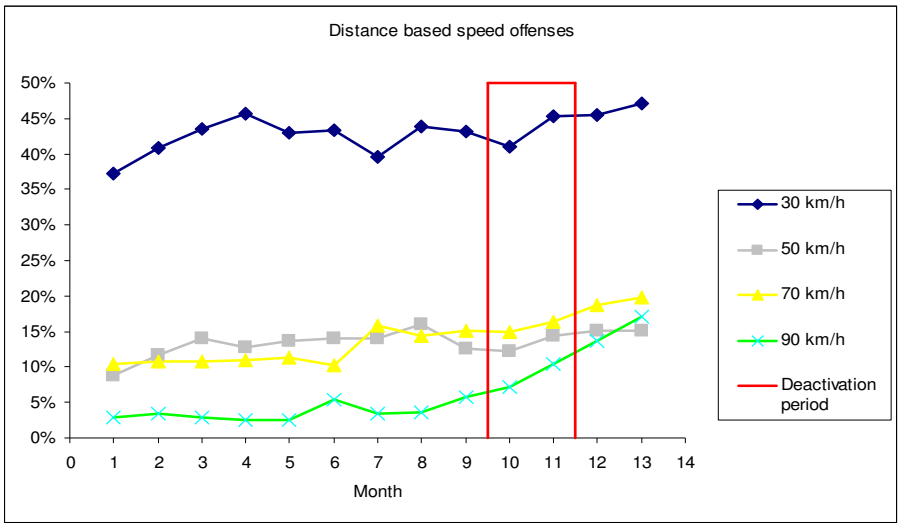


Figure 1. Percentage of distance speeding on monthly basis for different speed zones

### *3.2.2 Results based on questionnaires*

Table 3. Main results on basic attitudes, attitudes about speeding and speed limits

| | Before | | | During | | | After | | |
|---|---|---|---|---|---|---|---|---|---|
| **Basic Attitudes** | **Not agree** | **Neutral** | **Agree** | **Not agree** | **Neutral** | **Agree** | **Not agree** | **Neutral** | **Agree** |
| Driving fast is fun | 76,9 | 7,7 | 15,4 | 71,8 | 12,8 | 15,4 | 71,8 | 12,8 | 15,4 |
| A car is only for use of transportation | 25,6 | 5,1 | 69,2 | 10,3 | 17,9 | 71,8 | 17,9 | 12,8 | 69,2 |
| Driving fast, saves time | 53,8 | 28,2 | 17,9 | 64,1 | 30,8 | 5,1 | 61,5 | 28,2 | 10,3 |
| Speeding is exciting | 61,5 | 28,2 | 10,3 | 53,8 | 12,8 | 28,2 | 61,5 | 12,8 | 23,1 |
| Driving is only satisfying with a nice car | 35,9 | 25,6 | 38,5 | 28,2 | 43,6 | 28,2 | 41,0 | 30,8 | 28,2 |
| People should be stimulated to use the car less | 5,1 | 10,3 | 84,6 | 10,3 | 7,7 | 82,1 | 10,3 | 2,6 | 87,2 |
| Driving fast is liberating | 69,2 | 12,8 | 18,0 | 79,5 | 12,8 | 7,7 | 71,8 | 10,3 | 17,9 |
| If I drive, I live up | 82,1 | 10,3 | 7,7 | 84,6 | 12,8 | 2,6 | 74,4 | 15,4 | 10,3 |
| Drivers have got to be to much aware of other road users | 38,5 | 15,4 | 43,6 | 35,9 | 12,8 | 48,7 | 41,0 | 12,8 | 46,2 |
| **Attitudes about Speeding** | **Not agree** | **Neutral** | **Agree** | **Not agree** | **Neutral** | **Agree** | **Not agree** | **Neutral** | **Agree** |
| Speeding is dangerous | 12,8 | 10,3 | 76,9 | 10,3 | 7,7 | 82,1 | 18,0 | 10,3 | 71,8 |
| Speeding is sportive | 71,8 | 7,7 | 18,0 | 71,8 | 15,4 | 12,8 | 71,8 | 15,4 | 12,8 |
| Speeding is reckless | 12,8 | 7,7 | 79,5 | 18,0 | 5,1 | 76,9 | 15,4 | 10,3 | 74,4 |
| Speeding causes the most traffic accidents | 7,7 | 15,4 | 74,4 | 7,7 | 23,1 | 69,2 | 20,5 | 23,1 | 56,4 |
| **Attitudes about Speed limits** | **To low** | **Good** | **To High** | **To low** | **Good** | **To High** | **To low** | **Good** | **To High** |
| Highway (120 kph) | 35,9 | 64,1 | 0,0 | 28,2 | 71,8 | 0,0 | 28,2 | 69,2 | 2,6 |
| Outside urban area (90 kph) | 15,4 | 71,8 | 12,8 | 5,1 | 87,2 | 7,7 | 5,1 | 82,1 | 12,8 |
| Inside urban area (50 kph) | 10,3 | 84,6 | 5,1 | 5,1 | 94,9 | 0,0 | 7,7 | 89,7 | 2,6 |
| In 30-area (30 kph) | 23,1 | 74,4 | 2,6 | 35,9 | 61,5 | 2,6 | 41,0 | 59,0 | 0,0 |
| In pedestrian area (15 kph) | 18,0 | 82,1 | 0,0 | 38,5 | 61,5 | 0,0 | 48,7 | 51,0 | 0,0 |

N= 62 respondents

ISA had a certain effect on the drivers' opinion on basic attitudes. Basically, most of the drivers did not think that driving fast is fun (average, more than 70%) or exciting (average, more than 53%). Their opinions about these issues did not change dramatically during or after the trial. More people agreed on 'driving fast is liberating' during (79%) than before (69%) or after (71%). More than 75% did not agree with the attitude 'if I drive, I live it up', although this opinion increased (84%) during the trial and decreased (74%) after the trial. Before the trial 1 out of 5 drivers thought that 'driving fast saves time', during the trial only 5% agreed and after the trial, only 1 out 10 thought that 'driving fast saves time'. Before (84%), during (82%) and after (86%), a huge majority agreed that 'people should be stimulated to use the car less' and that 'a car is only a way of transportation' (around 70%). Before the trial, 38% thought that 'driving is only satisfying in a nice car'. During the test most of them (43%) were neutral, while after the trial most did not agree.

The attitudes on speed and speeding were analysed before, during and after the trial. Although their opinions changed during and after the trial, the most drivers thought that speeding is 'dangerous', 'reckless' and 'not sportive'. The most remarkable changes were about their opinion of 'speeding causes the most traffic accidents': 74% agreed before, 69% during, and 56% after the trial.

The test-drivers were asked to express their views with respect to the different speed limits in different areas. On average, more than 60% of the drivers declared before, during and after that the speed limits are adequate in all areas. During and after the trial, more and more drivers claimed that speed limits in 30-areas (23% before, 36% during, 41% after) and pedestrian areas (82% before, 61% during, 51% after) are too low. Main reason was that with the AAP they were forced to comply to the speed limits in these area. Most drivers said that 'driving 30 or 15 is slow', although they did not want to declare that '30 areas and pedestrian areas are not useful for road-safety'.

Table 4. Speeding behaviour of the test-drivers

| | Highway (120 kph) | | | Outside urban area (90 kph) | | | Inside urban area (50 kph) | | | In 30-area (30 kph) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Before | During | After | Before | During | After | Before | During | After | Before | During | After |
| Not known | 12,8 | 12,8 | 12,8 | | | | | | | | | |
| Never | 12,8 | 51,3 | 28,2 | 38,5 | 64,1 | 56,4 | 35,9 | 51,3 | 51,3 | 38,5 | 43,1 | 43,6 |
| Sometimes | 59,0 | 28,2 | 46,2 | 41,0 | 28,2 | 28,2 | 48,7 | 41,0 | 35,9 | 38,5 | 46,2 | 38,5 |
| Regularly | 10,3 | 2,6 | 10,3 | 20,5 | 7,7 | 2,6 | 15,4 | 7,7 | 7,7 | 17,9 | 7,7 | 12,8 |
| Mostly | 5,1 | 5,1 | 2,6 | | | | | | 5,1 | 5,1 | 5,1 | 5,1 |

N=62 respondents

In table 4 the results – based on the questionnaires - are described on how the test-drivers perceived speeding with and without ISA. Compared with their speeding behaviour before ISA (see table 4), the test-drivers declared that they were driving slower during the project. On highways, the answer on 'never speeding' increased during the project with 49%, outside urban areas with 26%, in urban areas with 16%, in 30 km/h zones with 7%. The answers on 'regularly speeding and mostly speeding' decreased on most categories during the trial. The answers given after the trial on 'never speeding' stayed level for outside urban areas, in urban areas and 30 km/h zones.

Also the following experiences when driving with ISA were given:

- 3 out of 5 drivers declared that they drove more comfortably and relaxed than without ISA.
- 1 out of 3 drivers said that they had more consideration for other road-users.
- The drivers looked less often at the speedometer and they let their foot 'rest' relatively often on the counterforce of the accelerator pedal, even as some of them tried to drive in such way that the pedal would not be activated.
- Most drivers did not notice any difference while driving with or without the active accelerator pedal regarding looking at speed signs, recognition of and involvement in certain traffic situations or keeping distance with other cars. If they experienced some changes it was more in favour of driving with ISA.
- 1 out of 2 test-drivers declared that they overtook less while driving with ISA.
- 1 out of 2 drivers found it easier to keep a constant speed with ISA.
- The ISA-system assisted them well to maintain the right speed, most notably for the 30 km/h limit of which they noted that it was not an easy speed to drive at without assistance.

### *3.2.3 The drivers' acceptance of ISA*

Besides the changes in driving behavior noted in the logged data and the opinions given by the drivers, some other methods and indications can describe the acceptance of ISA:

A method that was used to measure the acceptance was the procedure of Van Der Laan, et al. (1997). Acceptance is measured by direct attitudes towards a system and provides research with a system evaluation in two dimensions. The technique consists of nine rating-scale items. These items are mapped on two scales, a scale denoting the usefulness of the system, and a scale designating satisfaction.

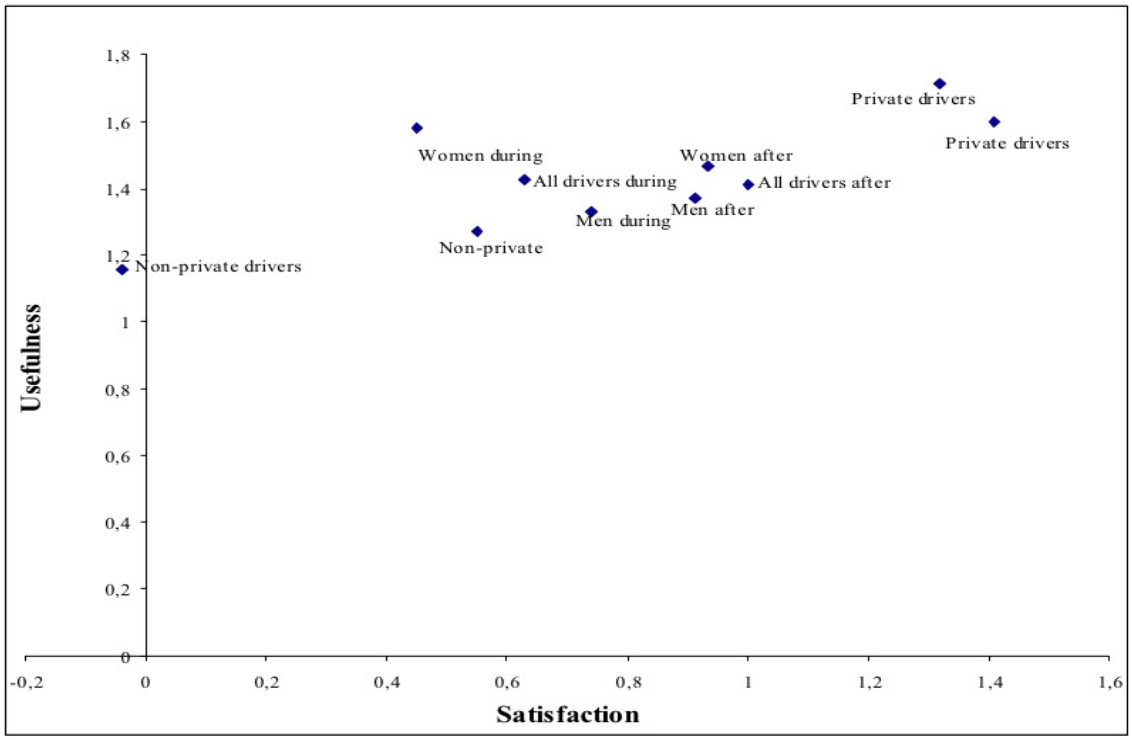


Figure 2. Acceptance of ISA, scaled on Usefulness and Satisfaction

All drivers (total) accepted the active accelerator pedal. After the trial they experienced the pedal as being even more satisfying. The most pleased with the active accelerator pedal were the private drivers. During the project they found it more useful but less satisfying than after the project. The most remarkable change is seen by the non-private drivers: while during the project they experienced it was not satisfying, although useful, they declared it was more satisfying and useful after the trial.

When drivers were outside the ISA-zone, no speed limits were available and the gas pedal was not activated. Drivers did however have the possibility to manually insert the speed limit into the system. This manual mode caused the active gas pedal to be operational. Whether the system was activated or not, all data was logged during the trial. The percentage of loggings with the ISA system manually activated is however still a good indication of the willingness of people to use the system.

Results in figure 3 show that in some 30% of the time a speed limit was manually inserted into the system. This percentage tends to increase as the trial continues. The percentage in month 7 is much lower than in other months, but the holiday period and festivities in the city centre could explain why. After deactivation of the AAP, the speed limit was naturally not implemented as no benefit could be gained from this insertion.

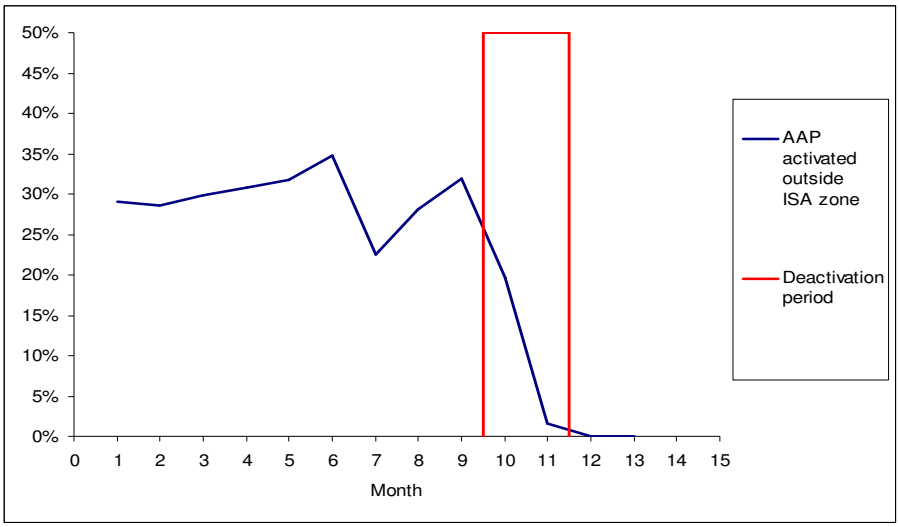


Figure 3. Percentage of loggings outside ISA zone with AAP manually activated

At the end of the trial, the private test-drivers could choose to keep the ISA-system in their car. 15 private car holders chose to keep the system in the vehicle after the test-period which is a significant indication that there is an acceptance of the active accelerator pedal. The main reasons given for keeping the system was that it was assisting, comfortable and relaxed driving.

## 3.3 A first conclusion

We can conclude that ISA had an effect on the drivers' behavior. Most of the drivers were making less speed offences with ISA, although the speeding was still more frequent in lower speed area. Nearly all the drivers declared that ISA supported them well and changed their "percept" behavior. They used the system on a voluntary base outside the test area and they experienced the pedal as satisfying and useful. Throughout these findings it can be noticed that the test drivers accepted the pedal well.

The outcome on policy level can indicate that there is some political and policy acceptability of ISA. Although it has to be considered that these are few and small indications. The question arises if there are indications that there is a public acceptability which can lead to a greater political and governmental willingness to create implementation opportunities for ISA.

The methods used in the trial can be helpful to be integrated in the acceptability concept. Throughout these findings and other research, a first framework will be constructed.

# 4. CONSTRUCTION OF A CONCEPTUAL MODEL IN ACCEPTABILITY RESEARCH

Which individual factors will influence people's acceptability? Goldenbeld (2003) noted that most acceptability research is based on opinion and attitude research. These opinions, which are given by respondents, are influenced by the acts of individuals in society, especially in our case, the acting and behavior in traffic situations. In Figure 4 the acting of individuals in traffic is based on the three main components within road transport systems: the driver (individual), the vehicle (different types…) and the road (the environment). These components mutual interact with each other.

The individual's opinions, attitudes and behavior is based on his or her ethic, social, psychological and physic characteristics. The environmental influence on the driver is based on the physical environment (roads, infrastructure,...) and the psychological environment (social values, policy,…). These influences can be direct (where the person is driving) and indirect (social "general" opinions about road safety).

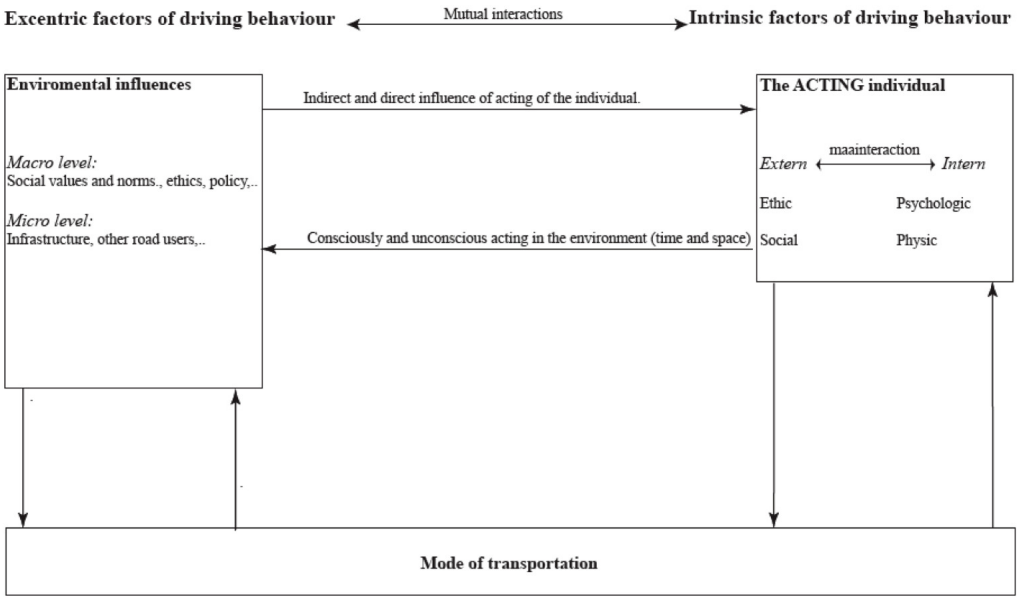


Figure 4. The Individual concept in Travel Behaviour

These individual components will influence peoples' opinion on ISA. We will define this as the individual context. The individual context is determined by the personal components (intrinsic), the environmental aspects (extrinsic) and the mode a person uses to travel and the vehicle use.

Acceptability is also defined by the recognition of a problem in society or problem perception (Schlag and Teubel, 1997; Goldenbeld, 2002; De Mol et al., 2001). This can be subdivided into the personal consciousness (is it an individual problem) and social consciousness (is it a social problem) of the problem. This problem recognition can be found on a general level (e.g. road unsafety versus other social problems, speeding versus alcohol use) and on a specific level (e. g. speeding as a problem).

A third aspect in acceptability research is the given opinions on general solutions to solve a problem- like effectiveness, justice and proportionality of the solution - and the concrete solutions of the safety problem. Within the opinions on the concrete solutions, we can distinguish solutions that will affect the own behavior and solutions that will affect the behavior of others.

The last component deals with how the new proposed measure or device will affect the own driving behavior and that of others. The social environmental effects as the measure or device specific characteristics will influence the degree of acceptance.

In figure 5 these aspects are brought into one framework. In our approach of public acceptability of ISA, the precondition is made that individuals must view the use of ISA as a helpful concept in road safety and also recognise the device-related benefits of a certain ISA-device. This indicates that defining the acceptability of ISA depends upon the personalities, attitudes and social context of individuals that determine their (safe) traffic behaviour as well as defining the motivational aspects like individual performance and efforts when using the device.

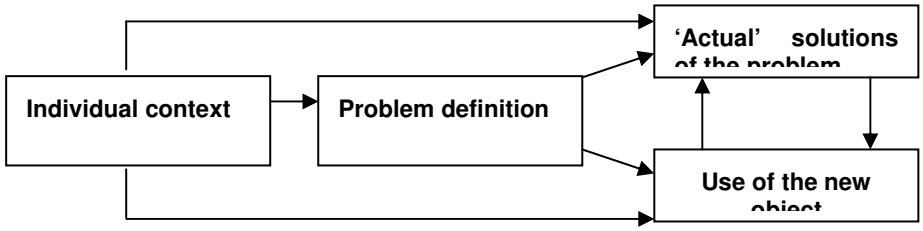


Figure 5. The mutual framework within acceptability measuring methods

The individual context is determined by the personal components (intrinsic), the environmental aspects (extrinsic) and the mode a person uses to travel and the vehicle use. Within the problem definition it is possible to distinguish two aspects: the personal consciousness of the problem and the social consciousness of the problem. The 'actual' solutions of the problem refer to the evaluation and opinions of the individuals about the 'degree' of effectiveness of the current solution to counter the problem. The use of the new object refers to the degree of the 'usefulness' and the willingness to comply with the new measure or device.

In the next sections our approach will be further described. Different components of researches on defining speed and speeding behaviour and the technical aspects of ISA are brought into relation with the described framework. More detailed research on each aspect is still in progress as well as constructing a more operational concept and model.

## 4.1 The individual context

Gender and age are noted as relevant determinants in the performance of speeding behaviour. Speed is more associated with young drivers (Parker et al., 1992; Stradling et al., 2000; Ingram et al., 2001; Shinar et al., 2001), more specifically with young male drivers. Although male drivers (Stradling et al., 2003) are more likely to speed, some studies show that a difference between the sexes cannot be found.

Travel behaviour and the choice of vehicle are also brought into relation with speeding behaviour. Silcock et al. (2000) noted that people admitted they drive faster in more powerful and comfortable cars. Moreover, Steg et al. (2001) did a study to clarify the importance of symbolic-affective motives – the evaluation of car uses especially as an attractive means of transport because of its flexibility, independence, availability, speed, reliability, safety, carrying capacity, and comfort - as opposed to instrumental-reasoned motives for car us. These motives for car use can have an impact on why they are (not)

speeding or why they would (not) like ISA. People who drive more may also speed more. Related to acceptability of ISA, it is therefore hypothesized that travel behaviour and the vehicle choice can be influencing factors.

It is assumed that peers, co-workers or specifically other road users, will influence the attitudes and behaviour of individuals. Silcock et al. (2000) noted that drivers admitted to driving differently when they had passengers in their cars. These findings suggest that immediate peer pressure is an important factor in speeding for some groups. In the Ghent ISA-trial it was noted that drivers ignore ISA, when other drivers (without using ISA) 'forced' them to speed (e.g. tailgating) (Vlassenroot et al., 2007). Silcock et al. (2000) also recognised the influence of other drivers in speeding. On the other hand, when using ISA, image and other people's opinions are seemed to be a relevant determinant to accept or not accept ISA.

## 4.2 The problem definition

How people see the social consequences of speeding can be established in finding the relation between road unsafety and other 'criminal' issues in society. Particularly the question arises if people view speeding, listed with other social unsafety issues, as a conditional problem. It can be assumed that the higher people rank speeding, the higher the acceptance of road safety measures regarding decreasing speed would be. On the other hand, it may be that traffic offences are perceived to be different to non-traffic offences. According to Corbett (2001), speeding is not seen as a 'real' crime by most drivers, which indicates that attempts to dissuade drivers from excessive speeding will be a difficult process.

How do people view speeding in the context of other road unsafety issues? To define this issue, the basis can be found in the SARTRE research. In this European questionnaire, the respondents were asked to rank the importance of different crash causal factors, such as speed, alcohol, distance, fatigue, weather, traffic jams, drugs, medicine, mobile phone use, lights, roads, steering mechanism, and tires. It can be assumed that the higher speeding is ranked, the more people will view speeding as a social problem in society. Alcohol and speeding were indicated by the respondents as the most probable cause of accidents in Belgium (as in most other countries).

Speeding is generally associated with negative consequences in the form of physical injury and fatal road accidents. Based on the previous topics, the awareness of speeding as an individual problem should be defined. People's driving styles, or more related (past) speeding motivations, are key factors in the acceptance of road safety measures. In this case, individuals' attitudes about speed and speeding are relevant determinants. According to Silcock et al. (2000), drivers' view of speed limits, the driver's self-image and the perceived risk-taking (speeding) behaviour could be considered as relevant attitudes towards the shown behaviour.

## 4.3 The actual solutions of the speeding problem

The 'actual' solutions of the problem refer to the evaluation and opinions of the individuals about the 'degree' of effectiveness of the current solution to counter the problem.

Some of the abstract norms and values people have about speed and speeding as a problem will be brought into relation with the actual measures taken to stop speeding. Implemented speed limits, infrastructural changes, enforcement, education and information could be considered as the most relevant actual measures taken to reduce speeding.

Implemented speed limits should be logical for drivers. Vlassenroot et al. (2007) noted that although drivers were using ISA in 30 km/h areas, they were still driving too fast. In general, the acceptance of ISA by the test drivers was high, so other factors probably influenced the drivers. It was noted that in some areas the 30 km/h-policy was not accepted, because the necessary infrastructural measures were not taken. Silcock et al. (2000) also noted that the bad or wrong positioning of speed limits can be a reason to speed.

Holland and Conner (1996) studied the effects of police intervention on exceeding the posted speed limit and on intentions to speed in one UK location. They found that an anti-speeding campaign of enhanced enforcement was effective in reducing the number of drivers breaking the speed limits, with a small effect still evident nine weeks after three weeks of police presence.

Hooke et al. (1996) looked at the effectiveness of speed camera areas and found the installation of fixed-site speed cameras reduced accidents by 28%.

In the view of policymakers, the above-mentioned can be regarded as effective. Our interest goes to the evaluation and acknowledgement of drivers whether they found these measures effective and would accept them. Therefore the perform expectancy, effort expectancy and the facilitating conditions must be translated in the model. Also, these actual solutions must be brought into relation with ISA.

## 4.4 The potential use of the new object

The use of the new object refers to the degree of 'usefulness' and the willingness to comply with the new measure or device.

As noted earlier, ISA (acceptance) is related to drivers' attitudes and behaviour about speed and speeding. Therefore, the previous concepts must be taken into consideration to define the acceptability of ISA. However, ISA also has particular characteristics and ISA-devices exist in different forms: ISA has got a certain degree of interference with driving or the vehicle. These characteristics have to be translated within the perform expectancy, effort expectancy and the facilitating conditions. For example, a warning ISA could be regarded by individuals as effective, but could still not be immediately accepted due to social influence or because it is not consistent with their feelings about driving.

Also other aspects related with ISA will define the degree of acceptance, such as technical possibilities. In the Ghent ISA-trial, some drivers rejected it more, due to technical failure (such as wrong speed limits in the speed map), rather than by the 'concept of ISA.' Questions like costs, incentives, etc. are noted in most trials as a possible reason for non-acceptance of ISA. Therefore, the gains and losses for individuals when choosing a device have to be included in the framework.

# 5. CONCLUSIONS

Comparison of logged speed data during the activation period and speed data after this period shows ISA had an effect on speeding. Effects were highest in the 90 km/h zone where speeding decreases by almost 10%. At lower speed limits effects were smaller although speeding was more frequent. In the 30 km/h zone distance speeding decreased from 45.9% to 42.8%, which means that the counter pressure was overridden in a vast amount of distance. Comparing effects on a monthly basis shows a higher amount of speeding at the end of the activation period than at the beginning. Especially in low speed zones speeding increased during the first months.

Regarding the basic attitudes in the results of the questionnaire, most of the drivers did not think that driving fast is fun, liberating or exciting, prior, during or after the experiment. Most drivers stated that speeding is dangerous, reckless and not sportive. Driving with ISA changed their behaviour on speeding: during the project, most of the drivers declared that they strictly upheld all speed limits (at highways, outside urban areas, in urban areas and 30-zones). The drivers used the system voluntary on highways and outside urban areas, which gave a first indication of their acceptance of the active accelerator pedal. They also experienced the pedal as satisfying and useful. After the trial, the private test-drivers could choose to keep the ISA-system in their car. 15 private car holders chose to keep the system in the vehicle after the test-period. The drivers noticed that the system assisted them well in upholding the speed limits and provided for comfortable and relaxed driving, although certain technical issues could be better.

As acceptance was noted in the trial, communication strategies were conducted to gain a better acceptability.

Acceptance and acceptability are defined in different ways. We will use the term "acceptance" as the respondents attitudes including their responses after the ITS device was introduced. Acceptability will be used as the prospective judgement to be introduced in the future. Besides the discussion about the definition of acceptance and acceptability our main goal was to describe what can or will influence the level of acceptance or acceptability.

A central notion is that policymakers do not have a clear picture of the ITS conditions, goals and concepts contributing to road safety or mobility. Although, some technological efforts (e.g. speed limit databases) are made by governments, policymakers do not have a clear picture of the ITS conditions, goals and concepts contributing to road safety or mobility. A certain risk-avoiding attitude towards ITS among policymakers can be noted.'One of the key-concerning issues is how the public will react if ITS were to be implemented. The understanding of the defined concept that will influence acceptability and acceptance can help to provide policymakers a better-carried implementation strategy. Through the construction of this framework, we want to provide policymakers and other actors a method and procedure that is easy to use and understand based on socio-psychological models. The concept of the Van der laan scale (Van der Laan et al., 1997) could be used in the development of a simple procedure to define acceptance and or acceptability, while the socio-psychological theories, like UTAUT-model (Venkatesh et al. 2003) or theory of planned behaviour will be used to validate the model. This will be done in the next step of our research.

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