Effects of an active accelerator pedal on driver behaviour and traffic safety after long-term use in urban areas
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Abstract
The long-term effects of the active accelerator pedal (AAP) were evaluated in the city of Lund in 2000 and 2001. The system, installed in 284 vehicles, produced a counterforce in the accelerator pedal at the speed limit. It could, however, be overridden by pressing the accelerator pedal harder. The results showed that test drivers’ compliance with the speed limits improved considerably. Reduction in average speeds and less speed variation by the test vehicles indicate a great traffic-safety potential. Travel times were unaffected, while emission volumes decreased significantly.

Keywords: Active accelerator pedal; Long-term effects; Driver behaviour; Speed; Emissions

1. Background
Speed adaptation via in-car devices as a tool for increasing traffic safety has been studied for more than 15 years. Estimates of the safety effects of a fully implemented automatic speed management system in Sweden and the UK vary from a 10% reduction in injury accidents with an advisory system, to a reduction in the range of 20–40% with a system that enforces current speed limits and also limits the speed in critical conditions, such as slippery road, poor visibility (Várhelyi, 1996; Carsten and Comte, 1997, Carsten and Fowkes, 2001).

Earlier field trials (Saad and Malaterre, 1982; Schulman, 1985; Persson et al., 1993; Almqvist and Nygård, 1997; Várhelyi and Mäkinen, 2001) and simulator experiments (Godthelp and Schumann, 1991; Comte, 1996, 1998a,b) have demonstrated the positive effects of the “intelligent” gas pedal. However, it was concluded that some aspects of negative behavioural adaptations and the long-term effects on compliance and acceptance in real traffic needed more research. Based on the promising results from these experiments, the Swedish Road Administration started large-scale trials with vehicle-based speed management systems in order to evaluate their effects and driver acceptance in four Swedish cities (Vägverket, 2002). One of the sites was the city of Lund. The system tested in Lund is also known as the Active Accelerator Pedal (AAP). It is based on a GPS receiver, continuously identifying the position of the vehicle, and a digital map, containing all the current speed limits within the test area. The interface with the driver consists of a display, showing the current speed limit, and an active accelerator pedal, which exerts a counterforce at speeds over the speed limit. In order to exceed the speed limit the pedal must be pressed approximately three to five times harder than normally. The vehicles were also equipped with a data-logger, recording, among other things, time, position and speed.

The test area consisted of the entire city of Lund (100,000 inhabitants) and included 30, 50 and 70 km/h speed limits. The system was activated automatically when the vehicle was within the test area and could not be turned off. Outside the test area the driver could activate the system manually and set it to a desired speed limit.

The installation of the AAP in the 284 test vehicles was carried out from November 2000 till May 2001. After data collection for evaluation, the scheduled dismantling of the AAPs started in November 2001 and went on until January 2002.

2. Purpose and hypotheses
The purpose of the study was to evaluate the effects of the AAP on traffic safety, speeds, driver behaviour, travel times and emissions during and after long-term use of the system.

The hypotheses to be tested in the trial were based on the
results from previous studies. The main hypotheses were as follows: (1) the level and variance of speed decrease after long-term use of the AAP; (2) compensatory behaviour can occur in the form of higher speeds at intersections when driving with the AAP; (3a) compensatory behaviour can occur outside the test area in the form of higher speeds, (3b) behavioural transfer from the test area to roads outside the test area can occur in the form of lower speeds; (4) behaviour towards other road users becomes more considerate when driving with the AAP; (5) time consumption increases when driving with the AAP; (6) emission volumes decrease in vehicles equipped with the AAP.

3. Method

3.1. Test driver selection

The recruiting of test drivers in 2000 was based on letters to a randomised sample of 3863 vehicle owners in Lund and a request to companies to allow their vehicles to be included in the trial. In the recruitment letter the contacted drivers were asked about their opinion of the active accelerator pedal. Answers were received from 1607 private car owners, of which 625 were interested in participating in the trial. Besides private car owners, 38 drivers of company cars were recruited. Of the 373 cars that showed up at the garage, the system was installed in 284 (including 38 company cars), but due to technical difficulties could not be installed in the remaining 89 cars. The drivers were assigned to groups with regard to gender, age and initial attitude towards the AAP, and by filling all the cells in Table 1 equally, could not be reached, despite the large number of people contacted from the start. It was difficult to recruit female drivers over 65 years of age (due to the fact that, in this age group, cars are mainly registered to the male member of the household) and young drivers (due to the fact that people below 25 years of age do not usually possess cars of recent model, suitable for being equipped with the AAP). A few drivers did not reveal their initial attitude to the system, which is why the sum of the numbers in Table 1 is <284, i.e. the total number of test drivers. During the trial, 78 drivers (including 11 company car drivers) dropped out before the scheduled de-installation of the system mainly because of technical problems.

3.2. Evaluation methods

The evaluation was designed as a before/after study with control, and partly as a with/without study. The effects on test driver behaviour were studied with the help of data logging in their own vehicles. All 284 vehicles were equipped with data-logging facilities in the form of a flash-memory, which made it possible to register and analyse driving data of the test cars on any stretch within the test area. The data included speed limit, speed, position, time, and voluntary use of the system outside the test area, and was saved five times per second when the vehicle was within the test area and once a second outside the test area. The driving data was logged for 1 month before the system was activated and then during the entire trial. The comparative analyses of the studied variables were carried out for one before-period and two after-periods: short-term use, up to 1 month, and long-term use, 5–11 months after activating the system in the individual vehicles. Weather and road conditions were monitored during the trial so that days with extreme conditions could be left out of the analyses.

The analyses on changes in emissions were based on the logged speed and acceleration data with the help of an emission calculating program, VETO, developed by Hammarström och Karlsson (1987). The VETO model was validated with exhaust emission data for a petrol-driven passenger car model Volvo 940 (Hammarström, 1999).

In order to see whether the test drivers’ initial speed level differed from that of other drivers, measurements of speeds in the field were carried out before the system was activated in the test cars. Speeds were measured with pneumatic tubes on mid-block sections, 12 sections (two directions each). The speed of all passing vehicles was measured during 24 h on working days at each section in both the before and after periods. After-observations were carried out in Lund to ascertain whether the presence of the equipped vehicles influenced the speed level in the city, as were comparative observations for control in another city of the same size, Helsingborg at six sections (two directions each).

Interaction studies in the field were carried out to study possible indirect effects of the system in situations where the prevailing speed was lower than the speed limit, and where test drivers had to negotiate priority with other road

<table>
<thead>
<tr>
<th>Age group</th>
<th>18–24</th>
<th>25–44</th>
<th>45–64</th>
<th>65+</th>
</tr>
</thead>
<tbody>
<tr>
<td>pos</td>
<td>neg</td>
<td>pos</td>
<td>neg</td>
<td>pos</td>
</tr>
<tr>
<td>Male</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>41</td>
</tr>
<tr>
<td>Female</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>26</td>
</tr>
</tbody>
</table>
users. The situation type selected to analyse unobtrusive video-recordings from the road side was “pedestrians on zebra crossings when meeting test cars and other cars”. The equipped vehicles were provided with labels to identify them as test vehicles. Sixty observations, where drivers of equipped vehicles interacted with pedestrians, were compared with 60 observations where drivers of non-equipped vehicles interacted with pedestrians.

Accidents were analysed to find out whether test drivers’ accident history differed from that of the average driver in Lund, follow up any accident involving a test car, and find out whether that accident could have any relation to the use of the equipment. The test drivers’ possible involvement in accidents was monitored via self reporting in questionnaires and with the help of police statistics, and those involved in accidents were contacted by phone and interviewed about the accident.

4. Results

The mean speed of the test cars (logged speed of all participants who passed the measurement section in question) was compared with that of all cars on the road (measured in the field with pneumatic tubes) at 21 sections before the system was activated in the test cars. At nine sections, the test cars’ speed was significantly lower ($P < 0.05$) than the general speed, while at seven sections it was significantly higher ($P < 0.05$); at the rest of the sections no difference was found. The mean speed (unweighted) of the test vehicles at the 21 measurement sections was 0.97 km/h lower than the general speed. This indicates that the test drivers’ initial speed level did not differ much from other drivers’ speed level.

Another result was that no general changes in average speeds of other (non-test) drivers could be found between the before and after measurements. At five sections the mean speed decreased and at four sections it increased statistically significantly ($P < 0.05$), while for the rest of the sections no statistically significant changes could be shown. The average (unweighted) change was >0.1 km/h. Similar results were found in the control city, Helsingborg: the mean speed decreased statistically significantly ($P < 0.05$) at four sections and it increased at three sections. At the same time, the mean speeds of the test vehicles in the long-term measurement were statistically significantly ($P < 0.05$) lower than those of other vehicles at 13 sections, and higher at five sections, while for the rest of the sections no statistically significant changes could be shown. The long-term measurement showed that the mean speed (unweighted) of the test vehicles was 2.4 km/h lower than that of other drivers.

The speed reductions of test drivers with the AAP active were largest on stretches where their speed levels with the AAP inactive had been highest, often above the speed limit. However, the AAP also had effects on stretches with lower speeds (see an example of the profiles of mean speeds of the test cars when driving with the AAP active, respectively, inactive in Fig. 1). The mean speed of the test vehicles in

![Fig. 1. Profiles of mean speeds on a main street before, 1 month after and 5–11 months after activating the AAP in the individual vehicles (CI = 95% confidence interval of mean speed with the AAP inactive).](image-url)
Table 2

Changes in mean speeds, standard deviations and 85% speeds at mid-block sections when driving with the AAP inactive, respectively active (after long-term use) on different street types

<table>
<thead>
<tr>
<th>Street type, speed limit (km/h)</th>
<th>No. of stretches</th>
<th>AAP inactive</th>
<th>AAP active</th>
<th>Change in NV 1 S 85P N V 2 S 85P V S 85P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial street, 70 Dual carriageway</td>
<td>8</td>
<td>5017 74.5 11.9</td>
<td>83.9 3336 70.8 6.9</td>
<td>76.3</td>
</tr>
<tr>
<td>Arterial street, 50 Dual carriageway</td>
<td>10</td>
<td>5265 52.1 7.9</td>
<td>59.0 3839 48.6 6.2</td>
<td>52.9</td>
</tr>
<tr>
<td>Arterial street, 50 Single carriageway</td>
<td>19</td>
<td>6462 50.4 8.8</td>
<td>54.0 4370 47.7 6.4</td>
<td>52.2</td>
</tr>
<tr>
<td>Main street, 50</td>
<td>12</td>
<td>3381 44.8 9.3</td>
<td>52.2 2570 44.4 7.9</td>
<td>50.0</td>
</tr>
<tr>
<td>Main street, mixed traffic, 50</td>
<td>10</td>
<td>2373 36.5 8.3</td>
<td>44.6 1407 35.6 7.6</td>
<td>43.6</td>
</tr>
<tr>
<td>Central street, 30</td>
<td>8</td>
<td>1235 24.0 10.3</td>
<td>31.7 857 24.1 7.1</td>
<td>30.3</td>
</tr>
</tbody>
</table>

N: The total number of vehicle passages for all stretches; V: Mean speed at mid-block (unweighted average for all stretches), km/h; S: standard deviation of mean speed (unweighted average for all stretches), km/h. 85P: 85 percentile speed at mid-block (unweighted average for all stretches), km/h.

a Statistically significant difference according to t-test (P < 0.05).

mid-block sections, where the speed level was highest with the AAP inactive, decreased statistically significantly (P < 0.05) on arterial streets and on main streets with mixed traffic (see Table 2). On streets where the speed level was already below the speed limit, the reductions were much more moderate with the AAP active.

The initial decrease in speeds was greater than the decrease after long-term usage of the system (see Fig. 2). The increase of the speed level between the short-term measurement and long-term usage was 5–50% of the decrease from the before period to the short-term measurements on the different street types.

Reduction in speed variance could also be shown. The standard deviation of mean speeds at mid-block sections decreased considerably in all types of streets, on average from 9.4 to 7.0 km/h, i.e. by 25% (see Table 2). The reduction was mainly due to a decrease of the highest speeds. This is indicated by the reductions in 85% speeds which are double the reductions in mean speeds (see Table 2). However, there is an effect of a slight increase of the lower speeds as well (see Fig. 3).

The profiles of mean speeds of the test vehicles over a distance of 80 m before the yield line were analysed to study approach speeds. In this speed profile the maximum and minimum speed values were compared for both the before and long-term after-measurements, respectively. The results revealed that, compared to the before situation (AAP inactive), the maximum arrival speed was statistically significantly decreased.

Fig. 2. Speed levels of test cars on the different types of streets during the three observation periods.
lower ($P < 0.05$) in the long-term after-measurement (AAP active) at four sections and higher at one section out of the 17 observed sections. The average difference between the long-term and before measurements was $−0.7 \text{km/h}$ (unweighted mean), and the difference was not statistically significant according to the sign test. The minimum values, defined as turning speeds, of the above described speed profiles were compared for the before and after periods. The results revealed that, compared to the before situation, the turning speeds were statistically significantly lower ($P < 0.05$) in the long-term after measurement at one section and unchanged at the others. The average difference between the long-term and before measurements was $−0.9 \text{km/h}$ (unweighted mean). The conclusion is that no differences could be shown in approach speeds before intersections and turning speeds at intersections.

Possible speed changes outside the test area, where the AAP was not automatically activated, were studied by analysing spot speeds for eight sections in both directions on roads with different speed limits. The mean speeds of individual test vehicles were compared between the before period (AAP inactive inside the test area) and the long-term use period (AAP active inside the test area). The number of vehicles that passed the selected sections during the two periods, the number of passages of each vehicle, the mean speeds for all passing test vehicles (unweighted) and the number of vehicles with statistically significant differences in mean speeds between the two periods are shown in Table 3. The results did not show statistically significant differences ($P < 0.05$) in speeds of the test vehicles outside the test area between the two observation periods on rural roads with speed limits of 70 or 90 km/h or on motorways.

![Speed distribution on an arterial street with 70 km/h speed limit](image)

**Fig. 3.** Speed distribution on an arterial street with 70 km/h speed limit.

### Table 3

<table>
<thead>
<tr>
<th>Speed limit (km/h)</th>
<th>No. of cars</th>
<th>No. of speed observations</th>
<th>Mean speed (unweighted) (km/h)</th>
<th>Change in mean speed (km/h)</th>
<th>No. of cars with stat. sign. increase</th>
<th>No. of cars with stat. sign. decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>8</td>
<td>29</td>
<td>39.2</td>
<td>$−2.1$</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>50</td>
<td>30</td>
<td>89</td>
<td>52.7</td>
<td>$−0.4$</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>70</td>
<td>71</td>
<td>265</td>
<td>68.8</td>
<td>$+1.8$</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>90</td>
<td>66</td>
<td>341</td>
<td>90.9</td>
<td>$+0.3$</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>110</td>
<td>51</td>
<td>225</td>
<td>107.8</td>
<td>$+1.7$</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>
Fig. 4: Profiles of mean speeds of all passing test vehicles when leaving the test area on a rural road with a 70 km/h speed limit before, 1 month after and 5–11 months after activating the AAP in the individual vehicles (CI = 0.95, confidence interval of mean speed with the AAP inactive).

with a speed limit of 110 km/h or on through roads in villages with speed limits of 50 and 30 km/h. An example with the profiles of mean speeds when leaving the test area on a rural road during the before period and after short-term and long-term use of the AAP is shown in Fig. 4.

The log-data analyses revealed that voluntary use of the AAP outside the test area varied among the test drivers from 0 to 88% of the driven distance, with a mean of 11%. Women and old drivers used the AAP voluntarily to a larger extent than men and young drivers. Those test drivers who were initially positive to the system used the system voluntarily to a larger extent than the initially negative test drivers. Test drivers with lower annual mileage used the system voluntarily to a larger extent than those with a high annual mileage.

Travel times, totally for all test vehicles, changed marginally (decreased by 0.6%). On streets with a speed limit of 30 km/h travel times decreased by 5.4% while they increased by 0.9% on streets with a speed limit of 50 km/h and by 1.2% on streets with a speed limit of 70 km/h. These results may be attributed to the fact that on streets with a speed limit of 30 km/h and mixed traffic, speeds had to be adapted to the prevailing conditions (physical speed-reducing measures and frequent presence of pedestrians) and speeds were already on a low level. The speed distribution changed; the highest speeds decreased, but those driving slowest increased their speed, thereby reducing their travel time. On the other hand, in streets with speed limits of 50 and 70 km/h, where the AAP had the largest speed-reducing effect, it seems natural that travel times did not decrease.

The emission volumes decreased statistically significantly (P < 0.05) on 29 stretches for CO, on 27 stretches for NOx and on 21 stretches for HC (of the studied 67 stretches). The reduction for CO volumes was on average 11% (unweighted mean), for NOx 7% and for HC 8% (see Table 4). For CO volumes, the largest reductions occurred on arterial streets with dual carriage ways and 50 km/h speed limits. On the rest of the street types the changes were not statistically significant, but there was a suggestion of reductions, except on arterial streets with 70 km/h speed limits, where there was the opposite indication. For NOx volumes, the largest reductions were recorded on arterial streets with dual carriage ways and 50 km/h speed limits. On the rest of the street types the changes were not statistically significant, but there was an indication of reductions. For HC volumes, the changes on all the different street types were not statistically significant, but there was an indication of reductions on most of the street types.

Field observations of interactions with pedestrians showed that test-car drivers’ behaviour when meeting pedestrians at a pedestrian crossing generally did not differ from other car drivers’ behaviour. In interactions with equipped vehicles the pedestrian passed first in 50% of the cases, while in interactions with non-equipped vehicles the pedestrian passed first in 48% of the cases, i.e. no significant differences could be observed. According to these observations, the drivers of test cars did not give priority to pedestrians more often. It also implies, however, that they did not compensate in these situations for assumed time losses. The drivers of city buses equipped with the system did not give priority to
pedestrians at a pedestrian crossing as frequently as drivers of non-equipped buses. The difference was not significant, only a tendency, but may indicate that bus drivers, who have to keep to a time table, try to compensate for not being able to exceed the speed limit, by higher speeds in low speed situations.

The test drivers’ self-reported accident rate (number of accidents per person and year) during a 3-year period before the trial is double the self-reported accident rate of other drivers in Lund (see Table 5). The difference is statistically significant (P < 0.01). This difference might be due to that the fact that being selected for the trial made the test drivers more conscious and more eager to report their accident involvement. At the same time, a comparison based on police-reported accidents during a 6-year period before the trial (for those 185 test drivers who gave their permission to look at their accident history during the last 6-year period before the trial) could not identify any negative effects of the AAP on accidents. No change could be shown either for the other drivers’ accident rate during these periods (see Table 5).

5. Discussion

5.1. Test of hypotheses

The hypothesis (1): “the level and variance of speed decrease after long-term use of AAP” can be verified. The test drivers drove at lower and more even speeds when they used the AAP. Compliance with the speed limits improved. The findings concerning the changes in the speed level are in line with other studies in Sweden (Persson et al., 1993;
Almqvist and Nygård, 1997) and in Finland (Päätalo et al., 2001). However, these studies did not draw any conclusions regarding speed variance. Other studies in the UK (Carsten and Fowkes, 2000), in Sweden, The Netherlands and Spain (Várhegyi and Mäkinen, 2001) and in The Netherlands (Ministry of Transport, 2001; Örj and Polak, 2002) have shown positive results, both with regard to general speed reductions and reduction in speed variance.

The hypothesis (2): “compensatory behaviour can occur, when driving with the AAP, in the form of higher speeds at intersections” cannot be verified. No statistically significant changes \( P < 0.05 \) could be shown in approach speeds and turning speeds at intersections. The earlier experiments that studied speeds at intersections reached somewhat conflicting results. Persson et al. (1993) found that turning speeds increased when driving with a speed limiter, while Várhegyi and Mäkinen (2000) found that speeds were smoother with the speed limiter. In these two studies the test drivers drove along a specified test route, once without the speed limiter and once with it. Clearly, this was not sufficient for the test drivers to get used to the system and adapt their driver behaviour accordingly. In another study, where the test drivers drove with the system in their own cars for 2 months (Almqvist and Nygård, 1997), no difference in turning speeds at intersections could be detected. This suggests that a speed adaptation system takes some time to get used to, and in the initial phase the test drivers might behave in a way that differs from their normal driving.

The hypothesis (3a) “compensatory behaviour can occur outside the test area in the form of higher speeds”, and the counter-hypothesis (3b) “behavioural transfer from the test area to roads outside the test area can occur in the form of lower speeds” cannot be verified. No signs of spill-over effects in the form of lower speeds or compensatory effects in the form of higher speeds outside the test area could be found. This is a clear indication that the AAP did not change the driving preconditions in a dramatic way. Interviews with the test drivers strongly support this (Várhegyi et al., 2002).

The hypothesis (4) “behaviour towards other road users becomes more considerate when driving with the AAP” cannot be verified. The studies of interactions in the field did not show a general difference in the behaviour of drivers of AAP-equipped vehicles towards pedestrians compared to other drivers. Earlier studies of interactions with other road users are partly in accordance with the findings in this study. Persson et al. (1993) found that driver behaviour deteriorated, while Várhegyi and Mäkinen (2000) could not detect any difference and Almqvist and Nygård (1997) found that, after driving with a speed limiter in their own cars for 2 months, test drivers showed improved behaviour towards other road users. Again, there is a difference between the studies over time and the “without/with the system”, as was the case for speeds at intersections above.

The hypothesis (5) “time consumption increases when driving with the AAP” cannot be verified. Changes in time consumption were not significant and the indication was rather a decrease than an increase. This result is not in line with earlier findings (Persson et al., 1993; Almqvist and Nygård, 1997; Várhegyi and Mäkinen, 2001) where an increase in travel time by between 2 and 7% was found. It should be noted though, that the analysis of time consumption in this study is based on all the logged data of everyday driving in the entire city of Lund, which should be compared to the previous studies where time consumption was calculated with and without a speed limiter over a predetermined test route for 20–75 drivers. A simulation study on travel times in a system where all vehicles were equipped with speed limiters in a built-up area showed travel time savings due to smoother driving (Davidsson, 1995).

The hypothesis (6) “emission volumes decrease in vehicles equipped with the AAP” can be verified. The average amount of CO and NO\(_x\) emissions per car decreased statistically significantly. These findings are in line with the two previous studies that calculated the changes in emissions (Persson et al., 1993; Almqvist and Nygård, 1997).

5.2. Other findings

After the initial decrease, speeds increased somewhat after long-term usage of the system. This increase in speed after the initial reduction has been found in another study of the speed-reducing effect of large scale implementation of roundabouts in the city of Vaxjo, Sweden. The speed measurements after long-term use—4 years after the construction—revealed a similar increase compared to the short-time after measurements (Hydén and Várhegyi, 2000).

The conclusion of this comparison is that the test drivers’ speed level can be regarded as being stabilised.

Given the relationship between the speed level and accidents established in earlier studies (see e.g. Salusjärvi, 1981; Finch et al., 1994; Elvik et al., 1997; Nilsson, 2000) and speed variance and accidents (Salusjärvi, 1981; Finch et al., 1994), the AAP has great potential in terms of lowering accident risks and the consequences of accidents. The reductions in the high percentile speeds are much greater than the reductions in mean speeds. This fact reinforces the system’s effect by reducing the speed of the fastest drivers most, which is the speed that really needs to be addressed.

The results of time consumption studies indicate something that can be of great importance for the further development of the concept of vehicle-based speed adaptation: the total change in time consumption for test drivers was positive, i.e. time consumption was not higher with the AAP. If this result is sustainable and general, it may reveal interesting aspects connected to the way people drive their cars with and without a system like the AAP. The results may imply that car drivers, when not being able to speed, start driving in a more strategic way, i.e. they will use more information of what is going on further on along their route. This can e.g. result in a lower speed along a stretch when the driver finds out at an early stage that there is no use...
driving fast because the traffic signal will be red anyway once the car arrives at the next intersection. Our knowledge to-day is limited, and further research in this area is highly needed, as it might produce a new paradigm when looking at vehicle speeds in built-up areas, namely that high speeds on stretches of (primarily) main roads may not lead to shorter travel times than a system where speeds are generally low.

6. Conclusions

No system effects could be found on speeds, traffic volumes or accidents of the fact that 284 vehicles, equipped with AAPs, were circulating in Lund for a period of 5–11 months. The number of equipped vehicles was so small that the possibility of any “contagion” effect was low. Test vehicles accounted for, at most, only about 1% of the total number of vehicles in Lund. The results show that this implementation rate and the way the vehicles were driven had little influence on the traffic system.

Most of the results of the evaluation studies are positive, as they revealed that the test drivers’ speed behaviour improved. The system has great traffic safety potential. The test drivers generally think that the AAP is efficient for improved. The system has great traffic safety potential. The test drivers generally think that the AAP is efficient for in-creasing traffic safety and experience it as a support in car driving. Driver-acceptance of such a system is high within built-up areas (Falk et al., 2002).

Further research on in-vehicle systems for speed management is needed in order to investigate: (a) possible behavioural adaptation effects when the system is inactive, for example, on non-equipped roads; (b) driver reactions and acceptance in different European regions; (c) the various human-machine interfaces for in-vehicle speed adaptation; (d) driver reactions to a weather-related dynamic speed adaptation system, and the potential for such a system; (e) driver reactions to a combination of the AAP with other vehicle based safety systems, e.g. intelligent cruise control, and the potential for such systems; (f) system safety issues; (g) liability issues and (h) implementation strategies.

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