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A One Year Pay-as-You-Speed Trial With Economic Incentives for Not Speeding

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A One Year Pay-as-You-Speed Trial With Economic Incentives for Not Speeding

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Objective: The objective was to identify whether it was possible to change driver behavior by economic incentives and thereby reduce crash risk. Furthermore, the objective was to evaluate the participants’ attitudes toward the pay-as-you-speed (PAYS) concept.

Methods: A one-year PAYS trial with economic incentives for keeping speed limits using intelligent speed assistance (ISA) was conducted in Sweden during 2011–2012. The full incentive was a 30 percent discount off the insurance premium. The participants were private insurance customers and were randomized into a test group (initial n = 152, final n = 128) and a control group (initial n = 98, final n = 68). When driving, the drivers in the test group were informed and warned visually when the speed limit was exceeded. They could also follow their driving results on a personal website. The control group was not given any feedback at all. To reflect the impact of the PAYS concept the proportion of distance driven above the speed limit was compared between the 2 groups.

Results: The introduction of a PAYS concept shows that the test group significantly reduced the proportion of distance driven above the speed limit. The proportion of driving at a speed exceeding 5 km/h over the speed limit was 6 percent for the test group and 14 percent for the control group. It also showed that the effect was higher the higher the violation of speed. The result remained constant over time.

Conclusions: It was shown that a PAYS concept is an effective way to reduce speed violations. Hence, it has the possibility to reduce crash severity and thereby to save lives. This could be an important step toward a safer road transport system. The majority of the participants were in favor of the concept, which indicates the potential of a new insurance product in the future.

Keywords: driver behavior, driver assistance systems, ITS, speeding, speed limits

Introduction

Speed has been identified as a key risk factor for sustaining a serious injury (Elvik 2007; Farmer and Lund 2006; World Health Organization [WHO] 2008). The biggest road safety problem in many countries is that road users exceed the speed limit (WHO 2008). For instance, more than 50 percent of Swedish drivers violate posted speed limits (Swedish Transport Administration 2013). The correlation between speed and crashes or crashes with injuries has been described by power functions (Elvik et al. 2004; Nilsson 2004). Even small changes in average speed have a great effect on crash severity and therefore on risk of injury. These power functions are based on police-reported crashes on rural roads. By comparing the number crashes before and after a change in speed limit, Nilsson (2004) found a relationship between average speed and the number of crashes. A decrease in average speed of 5 percent is associated with a 15 percent reduction in serious injury and a 20 percent reduction in fatalities.

Speeding is sometimes a result of an unintended error; for example, the driver is adapting to a certain traffic situation (Institute for Road Safety Research 2012). There are several technical solutions to help drivers maintain the speed limit. Intelligent speed assistance (ISA) is a summary of systems that provide the driver with support on speed control tasks. In 2013, the European New Car Assessment Programme implemented a test protocol for ISA (Schram et al. 2013). The systems will be rated regarding 3 different factors: communication, warning, and limitation. There are several technical solutions to help drivers maintain the speed limit. Intelligent speed assistance (ISA) is a summary of systems that provide the driver with support on speed control tasks. In 2013, the European New Car Assessment Programme implemented a test protocol for ISA (Schram et al. 2013). The systems will be rated regarding 3 different factors: communication, warning, and limitation. There are several studies indicating that ISA has a positive effect on driver behavior regarding speeding (Almqvist and Nyård 1997; Hjälmdal 2004; Varheley et al. 2004). However, this effect decreases over time because drivers tend to fall back to old driving behaviors (Wallen-Warner and Åberg 2008). Most studies evaluating ISA have been based on a voluntarily participation. Few
studies have involved any rewards or penalties. A previous 3 month trial in Sweden with 114 participants has shown that ISA linked to economic incentives has a greater impact on driver behavior than ISA without economic incentives (Hultkrantz and Lindberg 2011).

Insurance premiums based on a pay-as-you-speed (PAYS) concept could be one way to stimulate safer driving using ISA. In a previous Danish study with 153 participants, drivers were informed if the speed was exceeded and all speeding above 5 km/h was linked to a penalty (Lahrmann, Agerholm, Tradisauskas, Berthelsen, and Harm 2012; Lahrmann et al. 2007, Lahrmann, Agerholm, Tradisauskas, Naess, et al. 2012). However, few studies have been conducted based on the PAYS concept linked to the speed limit. Some insurance concepts have used PAYS to investigate the speed in case of a crash but not during daily driving (Alka 2013). The objective of the present study was to identify whether it was possible to change driver behaviors using economic incentives in terms of discounted insurance premiums in correlation with real-time feedback on driving speed and thereby reducing crash risk. Furthermore, the aim was to evaluate the participants’ attitudes toward the PAYS concept.

Method

A one-year trial with economic incentives for keeping the speed limit using ISA was conducted in Sweden during 2011–2012. An enquiry regarding the willingness to participate in the trial was sent out either by a mail or by a telephone request to members of a major Swedish motor club, Motorförråns Helnykterhetsförbund. The inclusion criteria were that the members of the motor club were private insurance customers of Folksam Insurance Group and were between 22 and 66 years of age. The participants were randomized into a test group and a control group (Table 1). When driving, the drivers in the test group were informed and warned visually when the speed limit was exceeded. They could also follow their driving results on a personal website. The full incentive was a 30 percent discount off the insurance premium for the participants in the test group. The discount depended on the amount of speeding (6 km/h or more above the speed limit) and participants were informed that the discount would be given after the completion of the trial. The reason for this was that the insurance premium in Sweden is calculated on a yearly basis. However, the participants did not know how the discount was calculated but were aware that the amount of speeding would affect the discount. The aim was that the participants would strive not to speed at all. Detailed feedback on possible reductions were not given at the time of the project. There was a maximum reduction of 30 percent and a stepwise reduction between 0 and 30 percent. It was also part of the project outside the scope of this article to study and develop a relevant stepwise reduction that could be used in future insurance solutions. At the end of the trial the participants who had less than 1 percent of the total distance driven above the speed limit received a 30 percent reduction and the participants who had more than 15 percent speeding were not given any reduction. The other participants were given stepwise reductions between no reduction and up to 30 percent. The control group was not given any feedback at all during the trial and received a 20 percent discount regardless of their driving behavior. The reason for this was to motivate them to participate in the trial and to obtain their permission to use their driving data as well as permission to install the device in their cars. To analyze the effect of the PAYS concept, the proportion of distance driven above the speed limit was compared between the 2 groups. Questionnaires were sent out to the participants before, during, and after the trial asking questions concerning, for instance, acceptance and usability. In addition to general questions regarding age, gender, driving style, and driving attitudes the following questions were asked:

- Is the PAYS concept an effective tool to keep speed limits?
- Would you be interested in an insurance product of this kind?

Possible answers were yes, probably, do not know, probably not, and no. The response rate in the test group was 79 percent (118 of 150) for the questionnaire that was sent out after 6 months and 65 percent (98 of 150) for the questionnaire that was sent out at the end of the trial. One third of the participants followed their driving results on personal website more than 100 times. The others also followed their results but to a lesser degree; all participants used the website. The participants in the control group received questionnaires before and after the trial. The feedback on their driving behavior was the only thing difference between the 2 groups.

Dropouts

Twenty-four participants dropped out of the test group and 30 participants dropped out of the control group. Before the device was mounted in the vehicles, 8 participants (7 in the test group and 1 in the control group) chose to leave the trial. The most common reason for a dropout was that the participant chose to change insurance companies while the trial was running (14 in the test group and 17 in the control group). Another reason was technical malfunction of the system (12 in the control group). When the data were not received in the car the participants in the test group contacted the project leader. Since the drivers in the control group did not see that their

<table>
<thead>
<tr>
<th>Participant characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
</tr>
<tr>
<td>Test group Initial participants</td>
</tr>
<tr>
<td>Test group Participants with measured data month 1 and month 11</td>
</tr>
<tr>
<td>Control group months 1–11</td>
</tr>
</tbody>
</table>

*One participant in the test group did not fulfill the inclusion criteria (age 22–66).
device did not send any data they had no reason to contact the project leader. There was no control system for technical malfunctions and therefore the device malfunctions in the control group were not noticed. Only 3 in the test group had other reasons for leaving the trial. The dropouts were spread out during the whole test period.

The ISA System

The ISA system was based on a Global Positioning System receiver that continuously identified the position of the vehicle. The ISA system was also linked to a digital map in the National Road Database including speed limits for the Swedish national road network. The speed measured by the Global Positioning System was compared to the posted speed limits according to the digital map and speeding could be detected and recorded. Logged driving data were transferred through a GSM (Global System for Mobile Communications) technique to a database. A display containing the whole system was mounted on the dashboard in all cars. When driving, the drivers in the test group were informed of their speed in relation to current speed limit. The current speed limit was continuously shown as well as a colored circle that changed color depending on whether the driver was speeding or not (Figure 1). If the driver exceeded the speed limit it turned from green to yellow and if the driver exceeded the speed limit by more than 5 km/h the circle turned red. The system was automatically activated when the engine was started. The proportion of speeding was calculated by accumulating all driving data during a trip. This information was also provided as a circle diagram showing the proportion of green, yellow, and red when the trip was completed. A maximum 30 percent reduction in the insurance premium was given to drivers with less than 1 percent of the distance driven over the speed limit. The control group had no display and therefore no feedback on driving behavior during real-time or on the website was given, but all of their driving data were logged.

Analysis of Vehicle Data

The onboard ISA system recorded data at 1 Hz. The variables measured during driving were distance driven, speed, speed limit, acceleration, and time. Data used for analysis were distance based and the variables used in the present study were distance driven, average speed, and distance driven above the speed limit. The data were split into 4 categories; 1–5 km/h above the speed limit, 6–10 km/h above, 11–20 km/h above, and 21 km/h above or higher. The data were also divided into different categories depending on speed limits.

Statistical Analysis

To reflect the effect of this PAYS concept, the total proportion of distance driven 6 km/h or more above the speed limit was compared between the 2 groups and used to describe the change in speeding behavior. Within-group differences as well as differences at the individual level were studied. Differences over time were studied by comparing the results for each month with the results from the first month. In this analysis, only participants with measured driving data for month 1 to month 11 were used (Table 1). Furthermore, distributions of speeding as well as differences in average speed between the 2 groups were studied for different speed limits. Differences in travel time were calculated based on average speed and average mileage driven (13,000 km/year). In the analysis regarding average speed, a weighted mean speed was used. For comparison purposes, mileage, age, and gender distribution were checked.

To investigate the difference between those in the test group and those in control group who drove the fastest, the 85th percentile was used. Nonparametric confidence intervals were used for the percentiles and the software Scientific Workplace 5.5 was used for the calculation. In all other analyses, 95 percent confidence intervals were used, and P values from t tests was calculated using SPSS software (IBM SPSS Software [CT500], IBM Corporation).

Results

Evaluation of the PAYS concept showed that the test group significantly reduced the proportion of distance driven above the speed limit (Table 2). The proportion of “red” driving (6 km/h or more above the speed limit) was 6 percent for the test group and 14 percent for the control group. Regardless of the speed limit, the control group had a larger proportion of distance driven 6 km/h or more above the speed limit (Figure 2). The distribution of speeding was also analyzed, and the effect was higher for higher speeds. The reduced speeding in the test group did not have a large effect on the average speed compared to the control group (Table 3). However, all differences in average speed between the 2 groups on roads with different speed limits were significant. On average, the test group had less than 1.5-min longer travel times per hour traveled.

The speed distributions differed between the 2 groups (Figures 3–6). The impact of the PAYS concept could be studied by looking at the shape of the speed distribution. Figures 3–6 show the most common speed limits in Sweden but the same pattern was seen at all speed limits. A high proportion is below the speed limit, which also was reflected in the average speed. The difference between the 2 groups was less on roads with a speed limit of 70 km/h.

The present study shows that the effect of this PAYS concept is constant after 11 months, at both the group level.
Table 2. Total distance (km) and distance driven above the speed limit for both the test group and the control group

<table>
<thead>
<tr>
<th>Distance (km)</th>
<th>Test group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total distance over speed limit (km)</td>
<td>1,767,150</td>
<td>1,015,284</td>
</tr>
<tr>
<td>0–5 km/h</td>
<td>162,688 (9.2%)</td>
<td>120,394 (11.9%)</td>
</tr>
<tr>
<td>6–10 km/h</td>
<td>52,144 (3.0%)</td>
<td>67,448 (6.6%)</td>
</tr>
<tr>
<td>11–20 km/h</td>
<td>44,057 (2.5%)</td>
<td>55,999 (5.5%)</td>
</tr>
<tr>
<td>above 20 km/h</td>
<td>14,180 (0.8%)</td>
<td>20,315 (2.0%)</td>
</tr>
</tbody>
</table>

Fig. 2. Total proportion of distance driven 6 km/h or more above the speed limit.

Fig. 3. Speed distribution on roads with a speed limit of 30 km/h.

and an individual level. However, within the test group there was a tendency to increase their proportion of speeding on an individual level. The proportion of speeding increased by 2 percentage points (95% confidence interval [CI], 0.4–3.7; Table 4). There was no difference in average mileage driven between the 2 groups.

Table 3. Differences in average speed between the test group and the control group on roads with different speed limits

<table>
<thead>
<tr>
<th>Speed limit (km/h)</th>
<th>Test</th>
<th>Control</th>
<th>Diff. CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 km/h</td>
<td>18.15 ± 0.058</td>
<td>19.99 ± 0.050</td>
<td>-0.84 ± 0.050</td>
</tr>
<tr>
<td>40 km/h</td>
<td>26.90 ± 0.050</td>
<td>26.50 ± 0.050</td>
<td>-0.40 ± 0.050</td>
</tr>
<tr>
<td>50 km/h</td>
<td>29.81 ± 0.050</td>
<td>31.27 ± 0.050</td>
<td>-1.46 ± 0.050</td>
</tr>
<tr>
<td>60 km/h</td>
<td>48.44 ± 0.050</td>
<td>49.59 ± 0.050</td>
<td>-1.15 ± 0.050</td>
</tr>
<tr>
<td>70 km/h</td>
<td>52.10 ± 0.050</td>
<td>53.06 ± 0.050</td>
<td>-0.96 ± 0.010</td>
</tr>
<tr>
<td>80 km/h</td>
<td>73.65 ± 0.050</td>
<td>74.92 ± 0.050</td>
<td>-1.27 ± 0.030</td>
</tr>
<tr>
<td>90 km/h</td>
<td>81.52 ± 0.050</td>
<td>82.43 ± 0.050</td>
<td>-1.91 ± 0.015</td>
</tr>
<tr>
<td>100 km/h</td>
<td>88.59 ± 0.050</td>
<td>89.55 ± 0.050</td>
<td>-0.96 ± 0.028</td>
</tr>
<tr>
<td>110 km/h</td>
<td>101.07 ± 0.050</td>
<td>101.74 ± 0.050</td>
<td>-0.67 ± 0.013</td>
</tr>
<tr>
<td>120 km/h</td>
<td>111.43 ± 0.050</td>
<td>111.25 ± 0.050</td>
<td>-0.18 ± 0.013</td>
</tr>
</tbody>
</table>

Fig. 4. Speed distribution on roads with a speed limit of 50 km/h.

Fig. 5. Speed distribution on roads with a speed limit of 70 km/h.

Fig. 6. Speed distribution on roads with a speed limit of 90 km/h.

Individual Level of Speeding

The test group had a lower proportion of speeding on an individual level than the control group. By studying the proportion of distance driven 6 km/h or more above the speed limit on an individual level it was found that more than 40 percent of the drivers in the test group drove less than 1 percent of the total
Based on the questionnaires, 9 out of 10 thought that the tested PAYS concept was an effective tool to help maintain speed limits. Few saw it as an integrity threat. Eight percent thought that their “freedom” was narrowed. In total 75 percent of the participants in the test group found it beneficial to give continuous feedback. Lahrmann, Agerholm, Tradisauskas, Berthelsen, and Harms (2012) studied a system with a penalty and audible warnings. However, the PAYS concept had a positive effect on speeding, because the effect was constant during the 1-year test period.

An ISA system with an active gas pedal has shown to be effective (Varhelyi et al. 2004). However, the acceptance of this system is lower (Pääatalo et al. 2001). To be fitted into private insurance customers’ cars on a large scale, the ISA system needs to have high acceptance among the customers. The authors’ opinion is that it has to be an informative and advisory ISA system. In the present study, the acceptance was high. Nine out of 10 participants in the test group found it easier to comply with the speed limit and 75 percent had positive attitudes regarding an insurance product of this kind. The concept was built around rewards, not penalties. This could affect the participants’ attitudes toward the concept.

The results show that this PAYS concept is an effective way to reduce speed violations. Hence, it has the possibility to reduce crash severity and thereby reduce the risk of injuries and fatalities. Reducing speed will have a positive impact on both vehicle occupants and vulnerable road users. By applying established correlations such as the power model (Elvik et al. 2004; Vadeby and Forsman 2012), the reduced speeding in the test group could be correlated to a reduced fatality risk by 20 percent and a reduced risk of serious injury by 5–10 percent if all drivers in Sweden were using the system. This is in line with the result of a study conducted by Lai et al. (2012) that predicted that ISA would reduce fatal accidents by 30 percent and serious accidents by 25 percent of over a 60-year period. This shows that the PAYS concepts could be an important step toward a safer road transport system. The majority of the participants were in favor of the concept (9 out of 10), which indicates the potential of a new insurance product in the future.

Road users exceeding the speed limit is a major road safety problem (WHO 2008). It is known that ISA has a positive impact on driver behavior regarding speeding (Almqvist and Nyård 1997; Hjälmdal 2004; Varhelyi et al. 2004). However, Wallén-Warner and Åberg (2008) have shown that the effect of ISA decreases over time because drivers tend to fall back to old driving behaviors after a couple of months. Previous studies have mainly been based on a system without any benefits for the driver. The present study, as well a previous study of Hultkrantz and Lindberg (2011), shows that the effect of ISA is greater if it involves some kind reward or penalty. Furthermore, it indicates that the rewards in the present study encourage the participants to maintain a low proportion of speeding, because the effect was constant during the 1-year test period.

![Fig. 7. Proportion of drivers in groups of amount of red driving (distance driven 6 km/h or more above the speed limit) for the test and control groups.](image)

The average premium discount for the test group was 21 percent, corresponding to €100 per driver per year in Sweden. Based on the questionnaires, 9 out of 10 thought that the tested PAYS concept was an effective tool to help maintain speed limits. Few saw it as an integrity threat. Eight percent thought that their “freedom” was narrowed. In total 75 percent of the participants in the test group would be interested in an insurance product of this kind.

### Discussion

The results show that this PAYS concept is an effective way to reduce speed violations. Hence, it has the possibility to reduce crash severity and thereby reduce the risk of injuries and fatalities. Reducing speed will have a positive impact on both vehicle occupants and vulnerable road users. By applying established correlations such as the power model (Elvik et al. 2004; Vadeby and Forsman 2012), the reduced speeding in the test group could be correlated to a reduced fatality risk by 20 percent and a reduced risk of serious injury by 5–10 percent if all drivers in Sweden were using the system. This is in line with the result of a study conducted by Lai et al. (2012) that predicted that ISA would reduce fatal accidents by 30 percent and serious accidents by 25 percent of over a 60-year period. This shows that the PAYS concepts could be an important step toward a safer road transport system. The majority of the participants were in favor of the concept (9 out of 10), which indicates the potential of a new insurance product in the future.

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The in-vehicle device used in the present study had a simple construction that was easy for the driver to understand. Only visual feedback was given because it is known from previous studies that audible warning systems can be annoying such that the driver will turn the system off (Bräitman et al. 2010). The present study therefore differs from a similar study conducted in Denmark (Lahrman, Agerholm, Tradisauskas, Berthelsen, and Harms 2012) that used a penalty and audible warnings. However, the PAYS concept had a positive effect on speeding. The best solution would be if the system was integrated into the vehicle. Furthermore, to increase drivers’ motivation to change their driving behavior it is probably not beneficial to give continuous feedback. Lahrman, Agerholm, Tradisauskas, Berthelsen, and Harms (2012) studied how different concepts (only incentives, informative ISA, and informative ISA linked to incentives) affect driving behavior during 135 days. All 3 concepts reduced the amount of speeding. However, the test period was too short to draw any specific conclusions regarding changes in driving behavior. Systems that are just based on logged data would probably not have such a great impact as systems with logged data and continuous feedback in the long run. This should be further

### Table 4. Changes in proportion of speeding on an individual level by comparing the results for each month with the results from the first month

<table>
<thead>
<tr>
<th>Month</th>
<th>Average (percentage points)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>June–July</td>
<td>−0.37</td>
<td>−1.21 to 0.46</td>
</tr>
<tr>
<td>June–August</td>
<td>−0.86</td>
<td>−1.67 to −0.05*</td>
</tr>
<tr>
<td>June–September</td>
<td>−1.18</td>
<td>−2.30 to −0.07*</td>
</tr>
<tr>
<td>June–October</td>
<td>−0.59</td>
<td>−1.53 to 0.34</td>
</tr>
<tr>
<td>June–November</td>
<td>−0.75</td>
<td>−2.04 to 0.54</td>
</tr>
<tr>
<td>June–December</td>
<td>0.09</td>
<td>−0.78 to 0.95</td>
</tr>
<tr>
<td>June–January</td>
<td>0.58</td>
<td>−0.49 to 1.65</td>
</tr>
<tr>
<td>June–February</td>
<td>−0.09</td>
<td>−1.20 to 1.03</td>
</tr>
<tr>
<td>June–March</td>
<td>−1.12</td>
<td>−2.46 to 0.22</td>
</tr>
<tr>
<td>June–April</td>
<td>−2.03</td>
<td>−3.66 to −0.40*</td>
</tr>
</tbody>
</table>

*Significant difference.
Economic Incentives for Not Speeding

Evaluate. Whether other parameters that affect driving behavior should be added to the model—for example, acceleration and hard braking—should be determined. To increase the acceptance and usefulness of the concept, other functions that could be controlled by the driver or the owner of the vehicle could be added. For instance, the insurance company AA allows their customers to modify the settings (AA 2013). These settings include, for example, the possibility to use texting during driving and to set a maximum speed.

There are mainly benefits associated with the PAYS concept such as increased safety and lower emissions. The purpose of PAYS concept is to prevent drivers from speeding rather than reducing speed in general. The average speed was fairly similar between the 2 groups. The fact that there was statistically significant but little practical difference regarding average speed will increase customer acceptance. On average the premium discount was 21 percent, which corresponds to approximately €100 annually. In addition, the participants in the present study noted in the questionnaires that they reduced their fuel costs. Based on general average fuel consumption, the participants saved around €200 in fuel costs annually. A PAYS concept must make economic sense to consumers; otherwise, they will not sign up for this type of insurance concept. Both insurance companies and society gain with a PAYS concepts because customers change behaviors that directly relate to crashes and injury risks. Therefore, there is a high potential benefit to save lives and costs.

Redefining Insurance Through Dynamic Risk

Today car insurance customers only have limited possibilities to influence their premiums. Traditionally it is common to differentiate insurance premiums based on gender, age, and residential address, which have no direct relationship to individual driving behavior. The Court of Justice of the European Communities has, since late 2012, prohibited differentiation of insurance premiums for gender (European Commission 2012). It is therefore important to create a premium setting that includes gender equality. The PAYS concept, proposed and evaluated in the present study, could be one way to create a more efficient and equitable vehicle insurance product. Factors involving driving behavior are a better way to predict risk than historical rating variables. Furthermore, this type of driving data can be integrated with traditional vehicle insurance rating factors to provide a more comprehensive individual customer profile to predict the risk of accidents. Considering the high effectiveness found and the positive customer responses, it is recommended that insurance companies further introduce the PAYS concept.

Car insurance premiums based on actual driving behavior have become both technologically and economically feasible in recent years. Today most of the products on the market are mainly based on pay-as-you-drive, which can, for example, include mileage, acceleration, and time of day, possibility to track the vehicle (e.g., Unipol Gruppo Finanziario and The Cooperative Insurance). However, these are mainly to prevent theft and fraud and to lower the mileage driven. Some of these variables could also have a positive effect on speeding; however, one main aim for many insurance companies is to prevent theft and fraud because these are substantial problems in many countries. Only a few pay-as-you-drive concepts are based on speeding even if speed has been identified as a key risk factor that has a powerful impact on the risk of crashes/crashes with injuries. The fact that Euro NCAP will, during 2013, implement a test protocol for ISA (Schram et al. 2013) means that the basic platform for PAYS techniques will be available in most vehicles within a short time frame. This will also improve the development of this kind of system and decrease the cost of producing and running such devices.

The pay-as-you-drive concept will be attractive to those customers who want more control over their insurance costs, have environmental concerns, and desire real-time feedback in the vehicle. However, private insurance customers are not the only target group. This concept might even have greater benefits for organizations and private companies with large vehicle fleets, which should be further evaluated. They could use this concept to control the fleet and their expenses. Organizations and companies could also use this concept to implement ISO 39001 Road Traffic Safety (RTS) Management Systems—Requirements With Guidance for Use (International Organisation for Standardisation 2012). Furthermore, this system could be used to track and provide information about traffic congestion.

Limitations

The participants in the test and control groups voluntarily accepted installation of speed alert devices. The mean age in the present study was 50 for the test group and 58 for the control group. This indicates that they are more inclined toward safe driving than the general population. However, the difference between the test and control groups should not be influenced by this. The impact of the system might be even higher for other segments of the population—for instance, younger drivers—if there is acceptance of the system. Young drivers have a higher crash risk and have higher insurance premiums and would therefore benefit more from a PAYS concept. However, Lahrmann, Agerholm, Tradisauskas, Berthelsen, and Harms (2012) have shown that young drivers in general had a higher proportion of speeding during the baseline than more experienced drivers but during the ISA periods they were similar. Furthermore, the data were based on logged driving data from private insurance customers. It would be of interest to study other target groups such as organizations or private companies with large vehicle fleets.

The study group consisted of over 200 private insurance customers who all shared their driving data during a 1-year trial. In many households, there may be multiple drivers for a single car. The results in this study will therefore be based on multiple drivers. This is a confounding factor. However, the insurance premium is based on a single car, not an individual driver. It was therefore assumed that the policy holder would try to convince other users of the car to reduce their speeding. The primary hypothesis was that the PAYS concept would impact driving behavior. Furthermore, the objective was also to study whether the impact was constant over time because a large majority of studies conducted to evaluate ISA have been limited in time. The present study is based on a 1-year trial and the proportion of speeding was significantly lower in the test group over time. However, on an individual level
the participants tended to increase the proportion of speeding by 2 percentage points. It is known that drivers tend to fall back to old driving behaviors (Lahrmann, Agerholm, Tradisauskas, Berthelsen, and Harms 2012; Wallen-Warner and Åberg 2008). It is therefore important to study driver behavior after long-term use of the PAYS concept to evaluate whether the impact of this type of system might change over time.

The present study is in some ways unique. Few countries have a digital road map that includes the speed limits of the whole national road network. This makes it difficult to run a large-scale trial to evaluate this type of system. Previous studies have therefore only included small parts of the road network and some selected roads with different speed limits. However, the technology in new cars can recognize and read speed limit signs to provide information about local speed limits. This opens up new technological solutions and the possibility for large-scale trials and implementation. To the authors’ knowledge, Citroën is the first manufacturer that has fitted a car with an insurance “black box” as standard in their vehicles. This pay-as-you-drive system, which is now running in the UK, will open up the market for similar products.

Digital maps will always have some problems regarding accuracy of the position of the speed signs and the speed limit itself, although continuous improvements will take place as the PAYS insurance product develops and is running. In this study, drivers detecting errors could report this via the PAYS device directly to the responsible body for the digital maps. The error that the drivers were most critical of was changes from one speed limit to another. To reduce the influence of such errors, certain buffer distances or time periods could be introduced. In order to create an insurance solution it is important to further discuss the question of responsibility regarding the accuracy of the digital maps.

The results show that this PAYS concept is an effective way to reduce speed violations. By comparing the test group to the control group, a more than 50 percent reduction in speeding (6 km/h or more above the speed limit) was discovered. Furthermore, the greater the speed, the greater the difference between the 2 groups. This means that the concept has the greatest impact on excessive speeding. Hence, it has the possibility to reduce crashes and crash severity and thereby to save lives, which is an important step toward a safer road transport system. The majority of the participants were in favor of the concept, which suggests great potential for an insurance product of this kind.

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References


