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# Self-reported deterrence effects of the Norwegian driver's licence penalty point system

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## Abstract

Norway's penalty point system implies that traffic infractions are penalised with two or three points for full-licence drivers and four or six points for probationary-licence drivers, and when a total of eight points is reached within a three-year period the licence is revoked for a duration of six months. A web-based questionnaire was administered to four different driver samples based on number of acquired penalty points: a) drivers with no points (n=1206), b) full-licence drivers with two or three points (n=190), c) full-licence drivers with four points or more (n=172), and d) probationary-licence drivers with four points or more (n=193). Drivers with penalty points had better knowledge about the penalty points than those without penalty points. Drivers with four points or more, which means that they are close to the disqualification limit, to a greater extent replied that they have become more law-abiding, compared to those with few or no points. Also drivers without points reported that their driving was influenced by fear of penalty points. Thus, the penalty point system seems to have both a specific perceived deterrence effect on drivers who are at a high risk of losing their licence, and a general perceived deterrence effect on drivers without penalty points.

**Keywords:** Penalty point system; Deterrence; Driver behaviour; Driver attitudes; Road safety

## 1 Introduction

Penalty point systems (PS) are now widely used as a measure to deter motor vehicle users from committing traffic law infractions. According to a review by Castillo-Manzano and Castro-Nuno (2012), more than 40 countries have implemented a penalty point system. There are several behavioural mechanisms by which such systems may possibly influence road safety. Castillo-Manzano and Castro-Nuno (2012) have described the following mechanisms, based on previous work by Basili and Nicita (2005), Zambon et al. (2008), and others: 1) *Deterrence*, implying that drivers behave lawfully in traffic from fear of licence revocation; 2) *Selection*, or

incapacitation (Basili and Nicita, 2005), which means that drivers who commit point-related offenses several times lose their licence and are thus removed from the driver population for some time; 3) *Correction*, implying measures for changing dangerous driving behaviours, including driver improvement courses as a precondition for keeping the driving licence; and 4) *Education*, or prevention, that is, informing drivers about dangerous violations possibly resulting in penalty points, by e.g., driver training, thus, preventing drivers from committing dangerous behaviours in the first place. Mechanisms 1) and 4) are applicable to drivers in general, whereas the mechanisms 2) and 3) apply only to drivers that have incurred penalty points.

Several studies have shown increased safety in terms of changes in crash risk and/or other safety indicators after introducing a PS (e.g. Zambon et al., 2008; Novoa et al., 2010; De Paola et al., 2013). However, in some studies it may be difficult to entangle effects of the penalty point system from increased police enforcement or size of fines, which have been introduced at the same time as the penalty point system. For example, Montag (2014) reported a sharp decrease in road fatalities in the Czech Republic the first months after a change the traffic law in 2006. While the author states that the point system was the greatest change, there was also a manifold increase in fines and strengthened enforcement, so it is not possible to ascribe the decrease to the point system alone. In general, in order to draw definite conclusions about aggregated effects of point systems, police enforcement and size of fines should be kept constant.

Furthermore, in a meta-analysis study Castillo-Manzano and Castro-Nuño (2012) concluded that effects of introducing a PS were only temporary, lasting for about 16 months on the average. It could be that some of the four mechanisms mentioned above are temporary, e.g. the “education” effect of information provided in conjunction with introduction of a new system. Individual deterrence effects on the other hand, to the extent that there is a real threat of licence revocation, would be expected to be stable over time. The selection effect of preventing offenders from driving would also be expected to be rather stable, varying only with the number of offenders losing their licence, and with the degree of surveillance and sanctioning of unlicensed driving.

It has been shown rather clearly that drivers reduce their rate of committing traffic violations when they come close to the point limit of losing their licence (Haque, 1990; Broughton, 2008; Basili et al., 2015; Sagberg & Ingebrigtsen, 2018). However, with most penalty point systems, relatively few drivers ever acquire so many points that they will lose their licence at the next violation, and still fewer have their license revoked. This means that the deterrence effect of approaching the limit for license revocation, as well as the selection effect of removing drivers from traffic, affect a rather small proportion of the driver population. Consequently, it may be difficult to detect the effects on aggregated crash risk estimates, although the safety effect may be considerable for the individual repeat offenders.

An interesting question is whether a penalty point system has a deterrence effect on drivers with no or few penalty points, and not only on the rather small group of repeat offenders. Effects of the first instance of incurring penalty points could possibly be investigated with individual register data containing information about

point in time of each penalty point allocated. That there may be such an effect was indicated in an early study by Haque (1990), showing that mean inter-offense time interval was longer between 2<sup>nd</sup> and 3<sup>rd</sup> offenses than between 1<sup>st</sup> and 2<sup>nd</sup> offenses.

Apart from this register study, we have found a few self-report studies of the general deterrence effect of PS. In the UK, Corbett et al. (2008) carried out a postal survey about deterrence effects of penalty points among drivers sampled from a national database run by the DVL (Driver and Vehicle Licensing Agency). The approximately 1100 drivers that responded were divided into different groups based on their recorded history of penalty points or disqualifications, including a group of drivers without penalty points for the latest four years. One of the findings was that drivers who had a recent increase in their recorded number of points reported to have decreased their speed at road sections with speed cameras more than drivers whose latest change was a reduction in recorded points. Based on the survey data in combination with a qualitative interview with drivers, the authors concluded that threat of disqualification, which is the ultimate consequence of accumulating penalty points, is an effective deterrent. Regarding background factors, they found that drivers with points were more likely to be male, middle-aged (35-64 years), drive for work, and drive long annual distances.

Self-reported deterrence was also studied in two different studies in Spain, where a penalty point system was introduced in 2006. Based on telephone interviews with about 2000 drivers, González et al. (2008) found that a large proportion of drivers report to have changed their behaviour after introduction of the point system, especially regarding speeding and mobile phone use. They concluded that the results are consistent with a hypothesis that the point system is the main explanation of an observed decrease in road traffic casualties after 2006. A more recent study (Gras et al., 2014) focused on self-reported behaviour among undergraduate university students and showed that young Spanish drivers reported to have reduced risky driving behaviour and increased their use of safety equipment after introduction of the point system. The change was more notable among female drivers, concerning driving under the influence of alcohol, speeding, and seatbelt wearing.

The main purpose of the present study is to investigate to what extent self-reported deterrence of the Norwegian point system, primarily in terms of driving behaviour, is related to the driver's record of incurring penalty points. Our hypothesis is that deterrence increases as the number of incurred points approaches the limit for disqualification.

A precondition for a deterrence effect is that drivers have knowledge about the PS, and what consequences various types and number of violations may have in terms of licence withdrawal. The mentioned study by Corbett et al. (2008) concluded that general knowledge of the system was good among UK drivers. A purpose of our study is to investigate knowledge about the point system among Norwegian drivers, as well as their attitudes to the system, and whether those variables also vary with the number of incurred points.

A previous study (Sagberg & Ingebrigtsen, 2018) using register data showed a clear deterrence effect on drivers who have incurred four or more points, implying that they would lose their licence with one or two more violations. We do, however, not

know whether the PS affects the behaviour of drivers with fewer penalty points. Therefore, we will investigate self-reported deterrence also among drivers without penalty points.

## **2 Norway's penalty point system**

Norway's penalty point system was introduced in 2004. Penalty points were then given for speeding, priority, overtaking, and red-light violations. The system was modified in 2011, by extending the list of point-resulting violations with too short headways, driving on a painted median barrier, and inadequate securing of child occupants.

In general, a violation entails three penalty points for drivers holding a full licence. An exception is minor speed limit transgressions, which result in two points. After the revision of the system in 2011, drivers with a probationary licence (the two first years of solo driving) incur double points for each violation. Drivers with eight or more points in a three-year period get their licence revoked for six months (and all previous points are deleted).

Acquired points expire three years after the time when the actual violation was committed. This means that all drivers who have not committed any violations during the latest three years will have zero penalty points.

As soon as a driver has incurred four or more points, they receive a warning letter with information about the consequences of further penalty points. For full-licence drivers, having incurred four points means losing the licence after two more violations before the current points expire, and for probationary-licence drivers four points implies licence loss after just one more infraction.

The Police records all instances of incurred penalty points in a national register.

## **3 Main hypotheses**

The main question to be investigated is whether the self-reported effect of PS on driver behaviour increases with number of incurred points, and whether such an effect can be observed already with two or three points compared to zero points. An additional question is whether probationary-licence drivers report larger effects, since they lose their licence already after two violations, due to the doubling of penalty points during the two-year probationary period. Furthermore, the consequences of losing the licence are more serious for probationary-licence drivers, because they are required to pass a new driving test after the suspension period, and the probationary period is prolonged by another two years. This is likely to add to the deterrence for this group.

We will compare self-reported effects of the PS between samples. If PS has an effect, we would expect an effect on behaviour that is proportional to the number of incurred points. In other words, drivers with four points or more are expected to report larger effects than drivers with three points or less. And probationary-licence

drivers with four or more points are expected to report larger effects than full-license drivers with the same number of accumulated points.

## **4 Driver survey**

### **4.1 Survey contents**

A web-based questionnaire was administered to four samples of drivers with category B licences. The survey included questions about number of speeding fines, knowledge about the penalty point system, self-reported effect of the system on driving behaviour, attitudes to the system, and changes in driving behaviour among drivers who had incurred penalty points. In addition, it included personal background information like gender, age, marital status, area of residence, county, education, annual driving distance, car ownership, time holding a driver's licence, and job-related driving. Filling in the questionnaire took between ten and 15 minutes typically – the mean was close to 15 minutes and the median 11 minutes.

### **4.2 Driver samples**

To obtain a group of drivers without penalty points, we used a sample from the national driver's licence register – Group A. Data from the penalty point register show that only 6.4% of drivers have active penalty points, so random sampling from the licence register was expected to give a sample with more than 90% drivers without penalty points. This group consisted of 3170 drivers who had participated in a previous questionnaire, where they had consented to receiving invitation to other studies and had given their email addresses. For the previous survey, a random sample from the licence register had been invited. Invitations with a link to the questionnaire were sent by email to Group A.

Drivers with various number of penalty points were recruited by drawing three random samples from the national register of incurred penalty points: B) full-licence drivers with two or three points; C) full-licence drivers with four or more points; D) drivers with a probationary licence, i.e., having held their licences for less than two years, who had incurred four or more points. Each sample from the penalty point register comprised 1000 drivers who received invitations by ordinary mail to participate in the study by using an internet link to the questionnaire website.

The survey was administered to Group A (from the licence register) some weeks before the remaining groups were invited (due to long waiting for address lists from the penalty point register). Based on experiences from Group A, the questionnaire was slightly modified before being administered to the remaining groups. This had implications for some of the analyses, which will be explained in the results section.

To increase response rate, participants in all four samples were given the opportunity to take part in a lottery of a gift voucher with a value of approximately 500 euros, by providing contact information. In order to preserve the anonymity of respondents, contact information was saved in a separate file, and the researchers analysing the

questionnaire data had no possibility to identify individual respondents. The drivers were informed about this procedure in the invitation letter.

### 4.3 Response rate and group characteristics

For the three samples from the penalty point register (Groups B, C, and D), response rates for completed questionnaires varied from 17.2% to 19.3% (Table 1). In addition, 2.5% of the drivers had filled in parts of the questionnaire but had quit before completing; data for those drivers were not included in the analyses.

For the sample from the driver licence register, the response rate was 41.8. There were 1325 respondents in this group. Among these, 119 drivers reported that they had incurred penalty points, and they were therefore excluded from the analyses. The drivers with penalty points make up 9.0% of the respondents, which is not very different from the registered proportion of 6.4% in the general driver population. The remaining 1206 drivers were defined as the “No points” group (Group A). The explanation for the higher response rate in Group A is that the drivers in this sample had previously consented to receiving invitations to further surveys.

About 90% of the drivers provided contact information for the lottery. This high proportion reporting personal identification data may be an indication that most respondents trusted the information regarding confidentiality of their responses. The proportion was highest (98.4%) among the probationary-licence drivers, whereas it varied between 87.2% and 89.5% for the other groups.

Background characteristics of the four driver groups are shown in Table 1. Per definition, the probationary-licence group (Group D) differs considerably from the other groups, particularly regarding age, since they have held a driver's licence only for the latest two years or less. (Seven drivers in this group reported having held a licence for a longer period; this is either a reporting error or drivers who had held a licence previously that had been revoked, and who had been required to undergo a new licensing test.). There is also a lower proportion of drivers living in cities in this group; this is most likely due to the decrease in driver licensing rate among young people in cities during the 1990's. Furthermore, there is also a lower proportion with college or university level education, since they are mostly young people. For the same reason, a lower proportion were married or cohabiting.

Among the full-licence drivers, Group C drivers (i.e., drivers with four or more penalty points) were on average younger, had longer annual driving distances, and more of them were occupational drivers, compared to the two groups with fewer penalty points. Group C also contained fewer married or cohabiting drivers than the other two full-licence driver groups.

Since the groups differ in many background factors, it is relevant to include some of these factors as control variables in the statistical analyses, to check whether univariate differences between drivers group can be explained by their penalty point status as hypothesised, or whether they can be explained by some background factors. We will therefore control for the following variables in the analyses: age, sex, marital status, area of residence, annual driving distance, and occupational driving.

## 4.4 Sample representativeness

Since the response rate is low, the respondents are probably not quite representative for the respective driver populations. However, this is not necessarily a problem for the comparison between groups unless the non-response bias differs between the groups. Concerning the three samples from the penalty point register (Groups B, C and D), which were drawn randomly from the respective driver populations, the response rates are rather similar. This indicates that the non-response bias is not very different across groups, and that these groups are comparable.

For Group A, drawn from the licence register, the two-step sampling procedure must be considered when discussing possible non-response bias. Originally, a random sample of 19 650 drivers was drawn for a different survey, which included a question about consent to receiving invitations for further surveys. The 3170 drivers who consented make up 16.1% of the original sample, and the 1206 that responded in the present survey and had no penalty points make up 6.1%. It is notable that the response rate in the first step is similar to response rates of the other groups. We investigated the possibility of a bias introduced in the second step of the sampling procedure, by comparing background factors between the 1206 Group A respondents with the 3170 invited drivers, for whom we had data from the previous survey. We found the following differences between invited and responding drivers: Among responding drivers there was a slightly lower proportion of females (32.0 vs 34.8%), relatively fewer drivers in the age group below 25 years (15.2 vs. 21.6%) and more between 40 and 69 years (53.7 vs 46.3%), a lower proportion living in urban areas (48.0 vs. 54.2%), a lower proportion with primary and secondary lower school education only (5.4 vs. 9.8%), a lower proportion with an annual driving distance of 35 000 km or more (7.3 vs. 13.3%), and a higher proportion having held a licence for more than 20 years (68.2 vs. 62.5%). Except for gender, these differences are statistically significant by chi square tests ( $p < .001$ ). This means that non-response bias effects on the results cannot be excluded. Although we do not have background data for the invited drivers in the other groups, we assume that there are similar differences between invited and responding drivers in the other groups as well.

However, despite similar response rates and similar background factors, due to different sampling procedures Group A may not be quite comparable to Groups B, C, and D, so results from comparisons with these groups must be interpreted with caution.

Table 1. Drivers responding to the questionnaire, by driver group and background variables. Percent.

	Driver group				Total
	A 'No points'	B '2-3 points'	C '4+ points'	D Probationary	
No. of drivers	1206	190	172	193	1761
Response rate	41.8	19.0	17.2	19.3	30.5
Proportion females	32.0	22.1	21.5	33.7	30.2
Age groups					
18-24	15.2	5.8	27.3	92.2	23.3
25-39	13.6	23.2	20.9	4.7	14.3
40-54	27.3	43.7	28.5	1.6	26.4
55-69	26.4	23.7	18.0	1.6	22.8
70+	17.5	3.7	5.2	0.0	13.2
Married or cohabiting	69.1	77.9	60.5	19.2	64.1
Area of residence					
- City	48.0	47.9	45.9	35.8	46.6
- Built-up area	32.3	32.6	31.4	44.6	33.5
- Rural area	19.7	19.5	22.7	19.7	19.9
Education					
- Compulsory	5.4	4.2	4.1	4.1	5.0
- High school	44.9	32.1	43.6	81.9	47.3
- College/university	49.8	63.7	52.3	14.0	47.7
Annual driving distance					
- <10,000 km	20.6	13.2	12.2	38.9	20.9
- 10,000-15,000 km	27.5	23.7	18.6	22.8	25.8
- 15,000-20,000 km	21.9	30.0	20.3	16.1	22.0
- 20,000-25,000 km	10.1	8.9	12.8	2.6	9.5
- 25,000-30,000 km	8.5	7.4	10.5	7.8	8.5
- 30,000-35,000 km	4.1	5.8	4.7	4.7	4.4
- >35,000 km	7.3	11.1	20.9	7.3	8.9
Owning a car	85.0	92.6	84.3	64.8	83.6
Years of holding a driver's licence					
- <2 yrs	9.9	0.5	1.7	79.3	15.3
- 2-4 yrs	7.6	2.1	25.0	17.4	9.6
- 5-10 yrs	7.5	14.2	9.3	0.0	7.6
- 11-20 yrs	6.7	13.2	14.0	0.5	7.4
- >20 yrs	68.2	70.0	50.0	3.1	60.0
Occupational driver	15.2	13.2	23.8	14.5	15.7

## 4.5 Statistical analyses

The main purpose of the statistical analyses is to compare questionnaire responses between the four driver groups. Since the groups differ in some of the background factors shown in Table 1, the statistical significance of group differences is tested by multivariate analyses, using background factors specified in Section 4.3 as control variables. For dichotomous dependent variables we use logistic regression with driver group and background factors as independent variables. For continuous and ordinal dependent variables, we use analysis of variance, with driver group and background factors as between-subject independent variables.

## 5 Results

### 5.1 Drivers' knowledge about the penalty point system

Drivers were asked (in an open-ended question) how many points they could incur in a three-year period before their driver's licence would be withdrawn. In addition to this single knowledge question, the questionnaire contained two different blocks of knowledge questions. Results for the knowledge questions – one single question (item I) and two blocks of questions (items II and III) are presented in Table 2.

Table 2. Drivers' knowledge about the point system.

Question/block		Driver group					
Number	Content	Data unit/range	Chance expectation	A: No points	B: 2-3 points	C: 4+ points	D: Probationary
I	'How many points in a three-year period will lead to disqualification?'	Percent of drivers giving the correct answer (=8 points)	n/a	43.0	52.1	70.3	79.3
II	Knowledge of number of points for each of 25 violations	Mean no. of correct answers (1-25). Standard deviation in parenthesis	3.57	n/a	4.9 (5,0)	6.5 (5,2)	n/a
III	'True' vs. 'false' judgments of 16 factual statements about point system	Mean no. of correct answers (1-16). Standard deviation in parenthesis.	5.33	n/a	6.7 (2.7)	8.3 (2.7)	8.4 (2.2)

#### 5.1.1 Limit for licence withdrawal

As shown in Table 2 (item I), the highest proportion of correct answers (the correct answer was '8 points') was found for Group C and Group D, which were the two groups with four points or more, whereas the lowest proportion was found for

Group A (drivers without points). This indicates that knowledge about the PS was better among drivers who had incurred four or more points than those without points. Compared to Group A (zero points), odds ratios (OR) for a correct answer was shown by a logistic regression analysis (controlling for age, sex, marital status, education, area of residence, annual driving distance, car ownership, years of driving, and professional driving) to be significantly higher for both Group C (OR = 2.65;  $p < .001$ ) and Group D (OR = 3.08;  $p < .001$ ). Also with Group B as a reference, the odds ratios were significant for both Group C (OR = 1.95;  $p = .004$ ) and Group D (OR = 2.28;  $p = .03$ ).

### 5.1.2 Number of points incurred for specific violations

The questionnaire contained a list of 25 specific violations, for each of which the drivers were required to indicate on a forced-choice scale the number of points given (item II in Table 2). The list also included some violations that are not part of the PS in Norway, e.g. seatbelt use or wrong-way driving. Therefore, 'zero' was one of the response options. The number of correct responses for each driver was computed. For this block of knowledge questions, the mean number of correct responses was significantly higher for Group C than for Group B ( $t = 2.96$ ;  $df = 360$ ;  $p = .003$ ). However, when controlling for background factors, the difference between the two driver groups was not significant. Group D and Group A were not included in this analysis. For Group D – probationary-licence drivers – the correct answers were different because of their incurring double points, and due to an error in the questionnaire, the correct answer for most violations was not a possible response alternative for this group. For Group A, the 'Don't know' response alternative was missing (adding this alternative was one of the changes made after administering the survey to Group A), and consequently, due to fewer non-correct response alternatives, chance expectancy for a correct answer would be higher for this group, and the knowledge score would not be comparable to the scores of the other groups.

Since there were seven response alternatives and 25 items the expected number of correct answers by chance would be  $25/7=3.57$ . The mean scores for both groups are significantly higher than the chance expectancy. For Group B, we get a  $z$  value of 3.6 ( $p < .001$ ) – based on  $n = 190$  and  $sd = 4.98$ . For the Group C we get  $z = 7.3$  ( $p < .001$ ) – based on  $n = 172$  and  $sd = 5.21$ .

### 5.1.3 Judgment of factual statements

The last block of knowledge items comprised 16 factual statements about the penalty point system, for each of which the drivers were to state whether the statement was true or false (item III in Table 2); for example, "The main rule is 3 penalty point for a violation" (true), "The PS entails a risk of losing the driver's licence for 6 months" (true), or "After incurring a certain number of points, a driver is required to take an improvement course" (false).

Analyses of variance with background factors as independent variables in addition to point groups showed that the mean number of correct answers was significantly lower for Group B than for both Group C ( $F = 7.08$ ;  $df = 1/332$ ;  $p = .008$ ) and Group D

( $F = 5.21$ ;  $df = 1/361$ ;  $p = .023$ ). (Group A was not included in this analysis, because of the missing ‘Don’t know’ response alternative.)

Since there were three response alternatives (True/False/Don’t know), the expected chance score would be 5.33 correct answers. Even the lowest score (6.7 for Group B) was significantly above chance level, with  $z=7.1$  ( $p < .001$ ) – based on  $n = 190$  and  $sd = 2.72$ .

## 5.2 Attitudes, intentions and perceived control

The questionnaire contained a list of 14 positive statements about the PS, where drivers were asked to indicate their degree of agreement with each statement, on a 5-point scale from ‘strongly disagree’ to ‘strongly agree’. The mean scores across all 14 statements are shown in Figure 1. Coefficient alpha for the total score was 0.82, indicating that the score is a reliable estimate of this composite behavioural measure. This coefficient is a measure of the reliability of a scale consisting of several items, in terms of internal consistency of the scale (Cronbach, 1951). It increases as a function of the number of items (in our case the 14 statements) and the average correlation between the items, and the size of the coefficient varies between 0 and 1. According to Tavakol and Denmick (2011) there are different views on what is the lowest acceptable value of alpha, ranging from 0.70 to 0.95.

There is a clear relationship between the number of incurred points and driver attitudes. An ANOVA with background factors and point groups as independent variables showed the overall difference across groups for the composite score shown in Figure 1 to be clearly significant ( $F = 11.55$ ;  $df=3/1702$ ;  $p<.001$ ). Pairwise comparisons showed significant contrasts between Group C and both Group A ( $F = 34.68$ ;  $df = 1/1348$ ;  $p < .001$ ) and Group B ( $F = 6.08$ ;  $df = 1/332$ ;  $p = .014$ ).

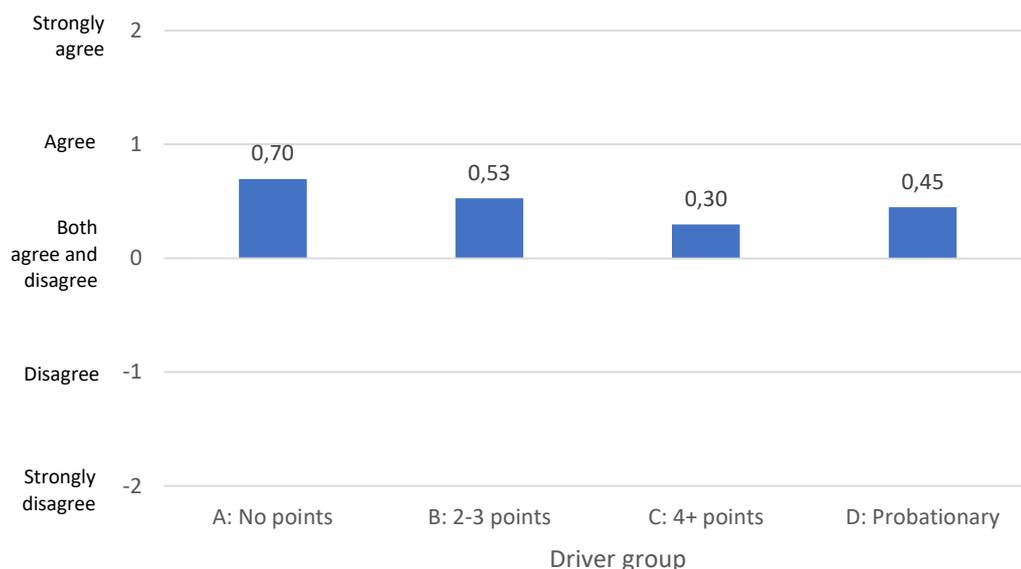


Figure 1. Mean agreement scores for the 13 statements shown in Table 2, by driver group.

Table 3. Degree of agreement with statements about the penalty point system, by driver group. Mean scores on 5-point scale from -2='strongly disagree' to 2='strongly agree'. Statistical significant differences between groups.

Attitude statement	Driver group				Statistical significant differences between groups
	A: No points	B: 2-3 points	C: 4+ points	D: Probationary	
I like the penalty point system	0.46	0.28	-0.20	0.00	A vs C*** B vs C***
I think the system is interesting	0.43	0.19	-0.15	0.02	A vs C*** B vs C**
I'm in favour of controlling driver behaviour	1.01	0.96	0.66	0.48	A vs C*** B vs C***
Introducing the penalty point system is a positive measure	0.70	0.46	0.15	0.36	A vs C*** B vs C**
I like the challenge of avoiding points, to see if can make it	-0.05	-0.23	-0.30	0.40	
The point system is irrelevant to me, because I generally drive lawfully	0.48	0.22	-0.26	0.02	A vs C***
It is unlikely that I will incur 8 points in three years	1.24	1.27	0.64	0.42	A vs C** B vs C*
The point system makes me feel safer in traffic	-0.11	-0.42	-0.47	-0.15	A vs C*
Increased risk of apprehension for traffic violation is a positive thing	0.71	0.53	0.24	0.19	
I can behave in a way that makes me avoid incurring points	1.15	1.08	0.97	1.01	
If I try hard, I shall get no points	1.18	1.16	0.94	1.15	A vs C**
The point system is so easy to comply with that I will not get any points from now on	0.14	-0.26	-0.28	0.01	A vs C**
I intend to drive lawfully the next six months	1.24	1.15	1.13	1.17	
My aim is to avoid incurring points	1.16	0.95	1.07	1.20	A vs B*

\*  $p < .02$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$

The mean group scores for each statement are shown in Table 3. The statements were a mix of attitudes (e.g. 'I like the penalty system'), intentions (e.g. 'I intend to drive lawfully the next six months') and perceived behaviour control ('I can behave in a way that makes me avoid incurring points'). Most of the single statements show the same pattern of differences between the groups as the total score shown in Figure 1.

It is notable that Group C drivers have more negative attitudes than Group A and/or Group B drivers on most of the items, whereas Group D does not differ from other groups on any of the statements.

### 5.3 Behaviour change

Drivers were asked to what extent fear of incurring penalty points had an influence on specific aspects of their driving behaviour. For each of 11 behaviour items they had to indicate the degree of influence on a four-point scale from “not at all” to “to a great extent”. A total score for all 11 items was computed, and Figure 2 shows the mean total score for each driver group. Coefficient alpha for the total score was 0.97, indicating that the total score is a reliable estimate of the perceived influence of PS on the drivers’ own behaviour.

There is a clear relationship between the number of previously incurred points and the degree to which drivers feel influenced by fear of additional points. The probationary-licence drivers (Group D) report the highest degree of influence, followed by Group C. Those two groups, and mostly Group D, are closest to losing their licence with additional points. The drivers with no points are the ones who are least afraid of getting points.

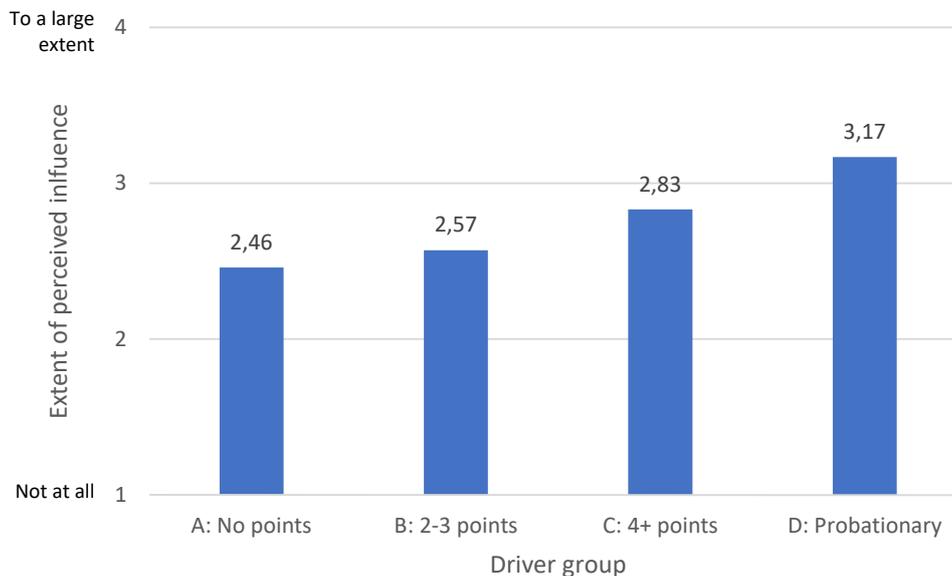


Figure 2. Mean score for perceived influence of PS on own driving behaviour, by driver group. Means for items shown in Table 4.

An ANOVA with background factors and point groups as independent variables showed a significant overall effect ( $F = 5.71$ ;  $df = 3/1702$ ,  $p = 0.001$ ). Pairwise

comparisons showed that the score for Group A was significantly lower than for both Group C ( $F = 9.56$ ;  $df = 1/1348$ ;  $p = 0.002$ ) and Group D ( $F = 11.03$ ;  $df = 1/1370$ ;  $p = .001$ ). Furthermore, the higher score of Group D compared to Group B was marginally significant ( $F = 4.02$ ;  $df = 1/354$ ;  $p = .046$ ). Mean responses for single items are shown in Table 4. The same pattern as for the total score in Figure 2 is shown for almost all single statements. Group C and/or Group D report higher effects particularly compared to Group A, but for some items also when compared to group B. It is noticeable that there is a significant difference also for seatbelt use, which is a behaviour that is not enforced by penalty points. For driving through a red traffic light, the differences are in the same direction as for the other items, although not statistically significant.

Table 4. Self-reported effect of the penalty point system on driving behaviour, by driver group. Mean scores on a four-point scale from 1='not at all' to 4='to a large extent'.

	Driver group				Statistical significance of group differences
	A: No points	B: 2-3 points	C: 4+ points	D: Probationary	
To what extent does fear of incurring penalty points influence you to:					
behave lawfully in traffic generally?	2.58	2.77	3.16	3.18	A vs C*** A vs B*
keep lower speeds generally?	2.39	2.65	2.97	3.12	A vs C*** A vs D**
avoid overtaking?	2.21	2.25	2.48	2.71	A vs C** A vs D*** B vs D**
avoid driving through red traffic light?	2.61	2.68	2.93	3.44	
keep long headway to lead vehicles?	2.35	2.40	2.60	3.00	A vs D*** B vs D*
use seatbelt?	2.43	2.49	2.58	3.16	A vs D**
be conscious about obeying priority rules?	2.47	2.42	2.65	3.26	A vs D**
keep the speed limit in 30, 40, and 50 km/h zones?	2.62	2.88	3.19	3.53	A vs C*** A vs D***
keep the speed limit in 60 and 70 km/h zones?	2.54	2.77	3.09	3.31	A vs C*** A vs D**
keep the speed limit in 80, 90, and 100 km/h zones?	2.45	2.56	2.92	3.05	A vs C*** A vs D**
give way more frequently to pedestrians and cyclists?	2.42	2.42	2.58	3.10	A vs D**

\*  $p < .02$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$

## 5.4 Correlations between knowledge, attitudes, and influence on behaviour

To the extent that incurring penalty points results in changed behaviour, it is reasonable to assume that such effects are moderated or mediated by drivers' knowledge about the point system as well as their attitudes and intentions related to the system. Therefore, to see whether self-reported behavioural effects of the penalty point system could possibly be predicted from the knowledge and attitude items, we computed correlations between the total scores for knowledge and attitudes (composite measure) on the one hand and the total score for influence on behaviour on the other. We did this analysis separately for each driver group, because otherwise the relationship between number of points and reported influence on behaviour, as shown in Section 5.3, would unduly influence correlation coefficients. The coefficients are shown in Table 5. Correlation with specific knowledge was not computed for Group D, for the reason specified in Section 5.1.2 regarding Table 2.

*Table 5. Correlation between driving safety attitudes and knowledge of point system on one hand and behavioural effect of point system on the other hand. Pearson's r.*

	Driver group			
	A: No points (n=1206)	B: 2-3 points (n=190)	C: 4+ points (n=172)	D: Proba- tionary (n=193)
Knowledge and attitudes				
Specific knowledge (Item II in Table 2)	-0.037	0.101	0.051	n/a
General knowledge (Item III in Table 2)	-0.028	0.177**	0.140*	0.016
Attitudes (composite score)	0.257***	0.308***	0.384***	0.480***

\* p < .10; \*\* p < .02; \*\*\* p < .001

The composite attitude score correlates positively and significantly with reported effect on driving behaviour for all groups. There seems to be a tendency in the direction of a stronger relationship between attitudes and behaviour for the groups with the largest number of accumulated points (Groups C and D). It is further notable that there is a lower, but positive and significant, correlation also with general knowledge about the PS for Group B and an almost significant tendency in the same direction for Group C. Those are the samples consisting of drivers in general who had incurred penalty points. For specific knowledge about number of points (first row in Table 5), all correlations with behavioural influence were insignificant and close to zero.

## 6 Discussion and conclusions

The results show that drivers with penalty points have significantly better knowledge about the PS than drivers without points, and among drivers that have incurred

points, those with more than four points tend to have better knowledge than those with two or three points. (Three points and less means only one violation.) This is not a surprising finding, and there are at least three possible explanations. First, the fact of incurring penalty points for a given violation provides knowledge to the driver about the consequence of that violation. Second, some drivers may want to drive as fast or as offensively as possible, but without being punished, and they may therefore seek specific knowledge about the PS, in order to adapt their driving behaviour when they approach the point limit for disqualification. Third, the warning letter received after reaching four points may also result in increased knowledge about the system. The letter contains an advice that the driver has to change their driving behaviour to avoid losing their licence.

Although knowledge scores are highest among drivers with four or more penalty points, also among drivers without points a large share seem to have some general knowledge about the points system. For example, almost half of the no-points drivers know that incurring eight points within a three-year period results in licence withdrawal. Thus, knowledge as a basic prerequisite for a deterrence effect is present among a large proportion of drivers, a finding that is consistent with previous results, e.g., the study by Corbett et al. (2008) of drivers in the UK.

When it comes to more specific knowledge about number of points for various violations, and about other aspects of the PS, drivers' knowledge is not very precise. The mean number of correct answers on factual questions is only slightly higher than chance expectancy, although statistically significant for all driver groups. However, also for the specific questions, the number of correct answers increases with the number of incurred points.

The most important purpose of a penalty point system is to motivate safe driving behaviour. For this purpose, detailed knowledge about the point system may not be very important. Maybe general knowledge, e.g. that there is a point system implying possible licence withdrawal after repeated violations, is the most important deterrent. This is supported by the finding of positive (although weak) correlations between general knowledge and reported effect on behaviour, whereas there were no correlations with specific knowledge. Most drivers are probably cognisant about traffic rules, and general knowledge about the point system may deter them from any kind of illegal driving behaviour. This may explain why many drivers report that the PS has influenced not only behaviour leading to incurring penalty points, but also certain behaviours that would not result in penalty points, such as non-use of seatbelts.

A most important finding is that the groups that are at risk of losing their license after one or two more violations, report the largest deterrence effect in terms of influence on behaviour. This is consistent with previous results using register data showing that the likelihood of violations decreases among drivers that are close to the disqualification limit (Broughthon, 2008; Sagberg and Ingebrigtsen, 2018). Drivers with a probationary license report the highest degree of influence on behaviour. Although not significantly higher than the other group with four points (Group C), this result is consistent with the hypothesis that incurring double penalty points adds to the deterrence effect for probationary-license drivers.

It is notable that drivers' attitudes to the PS is significantly and positively correlated with influence of the PS on behaviour. This finding may indicate that drivers who have positive attitudes to the PS, to a higher extent than drivers with negative attitudes drive in a way that reduces the risk of incurring penalty points. There is, however, an apparent inconsistency in the results regarding relationships between attitudes and behaviour. Although the correlation between attitudes and behaviour is positive and significant, we find that the groups with four or more points (Groups C and D) have the most negative attitudes to the point system (Figure 1), at the same time as they have the highest scores for influence on behaviour (Figure 2). A plausible interpretation is that a reported positive influence of the penalty point system on behaviour is a function of both positive attitudes toward the point system and having incurred a high number of points, and that these two predictors are partly independent. In other words, approaching the point limit of disqualification may change behaviour without changing the underlying attitudes, at least not in the short term.

Another notable finding is that a large proportion of drivers without points report that fear of incurring penalty points influences their driving behaviour. Detailed inspection of the data presented in Table 2 shows that between 37% and 57% of the 'No point' drivers reported to be influenced "to some extent" or "to a large extent". This is an indication that the point system has some deterrent effect also for drivers in general.

A possible limitation of the study is the low response rate, which may have introduced non-response bias. A possible bias could be that those who respond to such surveys, are more law-abiding, and that consequently, drivers with several penalty points are more likely to refrain from responding to the survey. The slightly lower response rate in the full-license driver group with four or more points may indicate such an effect. The difference in response rates is small, however, indicating that there is no strong relationship between responding and number of points. Thus, since the response rates are rather similar across samples, we have no particular reason to expect that observed differences between samples are explainable by non-response bias. In other words, we can expect that the observed differences between groups would have been in the same direction also for non-responders, although the absolute effect sizes might have been different.

Socially desirable responding or a wish to satisfy investigator expectations are also commonly reported sources of error in surveys (see e.g. Paulhus, 2002). However, in this study drivers with incurred penalty points (Groups B, C and D) received exactly the same information before responding, including a statement that they had been selected because of having incurred penalty points. Number of points was not mentioned, and we do therefore not think that there should be differences between the groups regarding tendencies to socially desirable responding. The letter to the 'No points' group was slightly different, pointing out that the recipients were a random sample of drivers. We do, however, not have any reason to suspect that this group should differ from the others regarding socially desirable responding. Consequently, we conclude that the results most likely reflect real differences in knowledge, attitudes, and behaviour between the groups, especially since differences in background factors are controlled for.

Although the results provide rather clear evidence for a deterrence effect of the PS on driving behaviour, it may be difficult to observe the effects in crash statistics. First, the proportion of drivers receiving more than four points in a three-year period is rather low, and therefore a crash risk reduction for this group may be too small to be detectable in aggregated crash data. However, the effect of the PS may be important for this small group of drivers, and future research should focus on more detailed studies of those who accumulate points, including those who lose their licence, in order to see if they change their risk of traffic violations when they get their licence back. Second, the preventive effect of the PS on drivers with no or few points may imply small behaviour changes that contribute to the general improvement of road safety but may be difficult to disentangle from other sources of safety improvement.

In summary, the present findings are consistent with previous results showing that deterrence effects of a penalty point system increase as drivers are approaching the point limit for licence revocation. Furthermore, drivers with no or few penalty points also tend to report some deterrence. Consequently, introducing a penalty point system with licence revocation as the ultimate consequence seems to reduce the propensity of traffic rule offenders to repeat violations, as well as the risk among drivers in general to commit violations in the first place.

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