



Attitude-change-based road safety re-education in catalonia: recidivism, severity, and changes in officially recorded sanction profiles

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ABSTRACT

This study examined differences in the frequency, severity, and distribution of officially recorded traffic sanctions before and after attendance at attitude-change-based road safety awareness and re-education courses integrated into the Penalty Point System in Catalonia. A retrospective longitudinal pre-post design was applied to administrative records from the complete 2017 cohort of 14,022 course participants. The main sanction-profile analyses focused on 9,886 drivers with at least one pre-course sanction, accounting for 36,546 pre-course and 23,022 post-course sanctions. Period-by-category differences were examined using Pearson chi-square tests of homogeneity, Cramér's V, and aggregate log-linear Poisson models. During follow-up, 37.1% of drivers with previous sanctions had no further officially recorded sanction, and the total sanction count in this group was 37.0% lower. Alcohol- and drug-related sanctions showed the largest relative decline (−77.9%), followed by safety-device and driver-related sanctions. Mobile phone-related sanctions declined by 62.0%. Speeding showed a smaller reduction (−17.2%) and represented a larger share of the post-course profile. Significant distributional differences were found for the main offence categories, offence severity, driver-related offence subtypes, and serious speeding subtypes (Cramér's V = 0.128–.210). Sanctions recorded in average-speed enforcement sections and urban access areas increased despite declines in other speeding categories. These findings show that a single recidivism indicator would conceal meaningful differences in offence type, severity, and speeding context. Because the study was observational, lacked a comparison group, and relied on detected offences, the patterns cannot be attributed causally to course attendance or interpreted as direct evidence of behavioural or attitudinal change.

1. Introduction

Driver-related factors are among the main contributors to road traffic crashes and remain a central concern in road safety policy (Direcció General de Tràfic, 2025; World Health Organization, 2023; Bucsuházy et al., 2020; Yakupova et al., 2020; Hidalgo-Fuentes & Sospedra-Baeza, 2019; Assemi & Hickman, 2018). As a result, many road safety strategies have focused not only on infrastructure and vehicle safety, but also on reducing traffic offences linked to risky driving practices. Among these strategies, Penalty Point Systems (PPS) have been widely implemented as mechanisms that complement

traditional sanctioning regimes by introducing progressive penalties and, in some contexts, educational or re-education components.

Key traffic offences related to risky driving include alcohol- and drug-impaired driving, speeding, distraction, and the non-use of seat belts, helmets, and other safety devices (Hasan et al., 2025; Somoray et al., 2024; Jazayeri et al., 2021; Rivera Tigre & Vargas López, 2021; Tábora Cruz, 2021). Persistent risky driving and repeated offending have also been associated with psychosocial factors such as risk perception, cognitive biases, impulsivity, and sensation seeking (Cardoso et al., 2024; Amoadu et al., 2023; Song et al., 2021; Baran et al., 2021). These findings support the need to examine traffic

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offending not only through total sanction counts, but also through the types and severity of the offences recorded over time.

In Spain, traffic offences represent a major administrative and road safety issue, with more than 4.5 million administrative sanctions recorded in 2019 (Fernández Benítez et al., 2022). Deterrence-based mechanisms have been widely adopted as preventive strategies, including targeted drug-driving legislation and detection practices (Goel et al., 2024; Armstrong et al., 2018). Within this framework, PPS have become widely used to regulate traffic offending (Alonso et al., 2025). Their theoretical foundation lies in deterrence theory, according to which offending may be influenced by the perceived probability of detection and by the certainty, severity, and swiftness of sanctions (Rebollo-Sanz et al., 2021; Dong et al., 2019). Several studies have suggested that deterrence may increase as drivers approach licence suspension, contributing to reductions in recorded recidivism (Sagberg & Ingebrigtsen, 2018).

However, PPS do not operate solely as sanctioning mechanisms. In several jurisdictions, they are combined with rehabilitation or re-education programmes for drivers who have committed serious traffic offences or who have lost licence points. Following the implementation of the PPS in Spain in 2006, the system was accompanied by a substantial reduction in road fatalities during its initial years (Aparicio Izquierdo et al., 2011), although subsequent evidence suggests that outcomes may vary across regions, implementation contexts, and evaluation designs (Alonso et al., 2025).

Several countries have implemented rehabilitation or re-education programmes for traffic offenders, including the Back on Track programme in Ontario, Canada (Wickens et al., 2025), the National Driver Offender Retraining Scheme in the United Kingdom (UKROED, n.d.), and programmes examined through the European ANDREA and DRUID projects (Bartl et al., 2002; Klipp, 2009). In Australia, administrative studies have also followed recidivism after traffic infringements (McDonald et al., 2020). Across these settings, approaches differ in their theoretical foundations, educational strategies, duration, target populations, and evaluation methods. Some focus mainly on information and risk awareness, whereas others include cognitive-behavioural methods, motivational work, group reflection, or attitude change. Reported findings are likewise mixed, with reductions in recidivism in some studies and limited or inconsistent results in others (Kaur et al., 2023; Escamilla-Robla et al., 2024; Wickens et al., 2025).

The international evidence on the effectiveness of rehabilitation programmes for traffic offenders remains methodologically diverse and difficult to compare directly (Kaur et al., 2023). Administrative-record studies offer objective follow-up over long periods, but their findings are affected by exposure, enforcement, and detection. Psychological assessments and experimental designs can examine attitudes, self-efficacy, behavioural intentions, and substance use more directly, although they often involve narrower samples or shorter follow-up periods (McDonald et al., 2020; Wickens et al., 2025). Recent reviews therefore recommend combining administrative outcomes, including offences and crashes, with psychological and behavioural measures (Kaur et al., 2023).

Within this international context, the Catalan road safety awareness and re-education programme represents a structured regional intervention integrated into the Spanish PPS and delivered through a standardised curriculum. The programme is grounded in the Attitude Change Model, which integrates cognitive, emotional, and behavioural components (Montané et al., 2007). Recent longitudinal evidence from Catalonia, although obtained in the training of road safety instructors rather than offending drivers, found sustained improvements over a 48-month period in risk anticipation, emotional engagement, and professional commitment following training based on the same attitude-change approach (Tello-Sánchez et al., 2026). The present study examines this large-scale, institutionally embedded programme through the frequency, severity, and composition of officially recorded sanctions before and after course attendance in the complete 2017 regional

cohort.

Official sanction records do not measure driving behaviour directly. They contain only offences that were detected, processed, and recorded by the enforcement system. Differences between periods may therefore reflect several factors, including offending, driving exposure, enforcement intensity, detection probability, and recording practices. The study was not designed to estimate the causal effectiveness of the programme or to determine whether participation produced behavioural change. Instead, it examines differences in the frequency, severity, and distribution of officially recorded traffic offences between the pre-course and post-course observation periods.

The present study aimed to analyse pre-course and post-course differences in officially recorded traffic offences among participants in the Catalan road safety awareness and re-education programme. Specifically, the study sought to: (1) describe the profile of officially recorded traffic offences prior to course attendance; (2) analyse the occurrence of new officially recorded traffic offences in the post-course period; (3) examine differences in the severity of recorded offences between the pre-course and post-course periods; and (4) explore changes in the distribution and relative contribution of different types of officially recorded traffic offences between the two observation periods.

2. Methods

2.1. Study design

This study used a retrospective, non-experimental longitudinal pre-post design based on population-level administrative data.

Driver-level records were followed across two observation periods, without an external control group. Sanction-profile analyses compared aggregated offence records from the same group of drivers before and after course attendance. Similar pre-post approaches have been used in evaluations of Penalty Point Systems (Sagberg & Ingebrigtsen, 2018).

The observation window was symmetrical: 24 months before and 24 months after each participant's 2017 course. Taken together, the records covered the period from 2015 to 2019.

The observational design does not allow the causal effect of the programme to be estimated. Throughout the manuscript, reductions, increases, and changes refer to differences in officially detected and recorded traffic sanctions, not to directly observed changes in driving behaviour.

The 2017 course was treated as the index educational event. Recidivism was defined, among drivers with at least one pre-course sanction, as the occurrence of one or more new officially recorded sanctions during the post-course period. The database did not indicate whether participants attended further road safety awareness and re-education courses during follow-up. Possible repeated participation could therefore not be assessed.

2.2. Data Source

Data were obtained from the administrative records of the Servei Català de Trànsit, the Catalan Traffic Service of the Department of the Interior, Government of Catalonia.

Three administrative data matrices were integrated for analysis:

- participating drivers and course characteristics;
- traffic offences recorded during the 24 months prior to course participation;
- traffic offences recorded during the 24 months following course participation.

The course data came from the official register of road safety awareness and re-education courses. The sanction data came from the administrative traffic sanctioning system and included information on officially detected and processed traffic offences committed in

Catalonia.

Official administrative records avoid the recall and social desirability biases associated with self-reported offending and provide complete coverage of the sanctions recorded for this cohort in Catalonia. Their scope is nevertheless limited to offences that were detected, processed, and entered into the sanctioning system. The records were therefore treated as administrative outcomes rather than as a direct measure of driving behaviour.

From an analytical perspective, the data allowed the examination of three complementary dimensions:

- the occurrence of new officially recorded traffic sanctions after course participation;
- changes in the number of officially recorded sanctions;
- changes in the distribution of recorded sanctions by offence type, severity, licence points deducted, and speeding subtype.

2.3. Study population

The analysis included the full population of drivers enrolled in road safety awareness and re-education courses in Catalonia in 2017, based on complete administrative records from the Catalan Traffic Service.

The study population comprised 14,022 drivers. Of these, 9,886 had at least one pre-course sanction and formed the analytical group used for the main pre-post sanction-profile comparisons. They accounted for 36,546 pre-course sanctions and 23,022 post-course sanctions. In the full cohort, 26,563 post-course sanctions were recorded. The difference of 3,541 sanctions came from 1,553 drivers who had no pre-course sanctions but received at least one sanction during follow-up; these records were not included in the main pre-post profile comparisons.

Among drivers with pre-course sanctions, 27,296 pre-course and 17,584 post-course records were classified as traffic offences related to risky driving practices. The five main categories used in the distributional analysis accounted for 26,404 and 17,002 of these records, respectively.

Of the 14,022 participants:

- 5,423 drivers attended partial point-recovery courses;
- 8,599 drivers attended full licence-recovery courses.

Within the full licence-recovery group:

- 3,702 followed the administrative route;
- 4,464 followed the criminal route without prolonged judicial licence withdrawal;
- 433 followed the criminal route with prolonged judicial licence withdrawal.

The sample was predominantly male (91.8%), with a mean age of 40.5 years (SD = 12.48). Professional drivers represented 2.1% of the population, and 88.1% of participants were Spanish nationals. Most lived in the province of Barcelona (68.8%), followed by Tarragona (11.4%), Girona (10.8%), and Lleida (7.4%). A small proportion lived outside Catalonia (0.9%) or could not be geographically classified (0.8%).

The population-based nature of the dataset reduces concerns about sampling bias within the 2017 course cohort and allows for a comprehensive characterisation of officially recorded sanction patterns before and after course participation.

2.4. The Catalan road safety awareness and re-education programme

Participants included in this study completed the official Catalan road safety awareness and re-education programme for drivers who had lost licence points or had their driving licence withdrawn as a result of serious or very serious traffic offences. The programme is integrated into

the Spanish Penalty Point System and is delivered in Catalonia through a standardised curriculum.

The programme is based on the Attitude Change Model (Montané et al., 2007; Arnau-Sabatés & Montané-Capdevila, 2010), which treats safe mobility as involving cognitive, emotional, and behavioural components. The approach goes beyond the transmission of traffic rules and includes reflection on risk, review of unsafe driving habits, emotional work around the consequences of road crashes, and personal commitments to safer driving.

Courses are delivered in small groups, with a maximum of 18 participants. Partial point-recovery courses last 12 h, whereas full licence-recovery courses last 24 h. The programme follows a structured sequence that includes:

- an initial assessment using the QAR-C questionnaire, covering speed, risk awareness, responsibility, and distraction or vulnerability (Montané et al., 2023);
- activities aimed at improving knowledge of road safety risks and preventive measures;
- review of unsafe driving habits and discussion of safer alternatives;
- work on emotions, values, and personal responsibility, including testimonies related to road crash consequences;
- final reflection on intentions and commitments to change.

The QAR-C assessment was used to identify risk areas for individual reflection and group work. Although participation in the programme may be triggered by a specific offence or by the accumulation of point losses, the course does not focus only on the offence that led to participation. The curriculum addresses the main risk factors associated with traffic offending and road crashes, including speeding, alcohol- and drug-impaired driving, distraction and mobile phone use, non-use of seat belts or helmets, risky interactions with vulnerable road users, and other unsafe driving practices.

The study did not assess psychological change during the course or measure individual learning outcomes, attitudes, intentions, or risk perception before and after participation.

2.5. Study variables

Study variables were defined based on administrative records of traffic offences and were structured to assess differences between the pre-course and post-course observation periods.

The primary outcomes were the number and distribution of officially recorded traffic sanctions during the pre-course and post-course periods. The main distributional analysis focused on five offence categories used throughout the study:

- speeding;
- driving under the influence of alcohol or other substances;
- non-use of safety devices, including seat belts, helmets, or other protective systems;
- traffic signalling offences;
- driver-related traffic offences, including mobile phone use, reckless driving, and negligent driving.

Speeding offences were analysed both in aggregate and in disaggregated form, distinguishing five modalities:

- exceeding the posted speed limit indicated by fixed signage;
- exceeding the general speed limit on interurban roads;
- speeding in average-speed enforcement sections;
- speeding in urban access areas;
- other speeding offences.

This disaggregation allowed the analysis to distinguish speeding offences according to road context and type of enforcement.

Driver-related traffic offences were also examined at both general and specific levels. Three main subcategories were analysed:

- mobile phone use while driving;
- reckless driving;
- negligent driving.

Other driver-related offences were grouped in a residual category when they did not correspond to these three subtypes.

The severity of traffic offences was defined according to the classification established in Spanish traffic legislation, which categorises offences as minor, serious, or very serious. Licence penalty points deducted were also analysed as an administrative indicator of offence severity, using the categories recorded in the sanction files: 0, 2, 3, 4, or 6 points.

Remaining administrative categories were retained in the overall sanction totals but were not included in the main category comparison because they combined heterogeneous legal and behavioural classifications.

2.6. Data analysis

The observation period was symmetrical, comprising 24 months before and 24 months after course participation.

The analysis was conducted at three levels:

- driver-level analysis;
- sanction-level analysis;
- distributional analysis of sanction profiles.

2.6.1. Driver-level analysis

Driver-level analysis assessed recidivism among the 9,886 drivers with at least one pre-course sanction. The Net Change among Drivers (NCD) was calculated as the ratio between the number of these drivers with at least one post-course sanction and the number with a pre-course sanction:

$$NCD = \frac{N \text{ drivers sanctioned post}}{N \text{ drivers sanctioned pre}}$$

An $NCD < 1$ indicates that fewer drivers had an officially recorded sanction in the post-course period, $NCD = 1$ indicates no difference, and $NCD > 1$ indicates that more drivers had a recorded sanction.

The associated reduction rate was calculated as:

$$\text{Driver reduction rate} = 1 - NCD$$

This rate represents the proportional difference in the number of drivers with officially recorded sanctions between the two periods.

2.6.2. Sanction-level analysis

Sanction-level analysis estimated the Net Change in Sanctions (NCS), defined as the post/pre ratio for the total number of sanctions recorded among drivers with pre-course sanctions:

$$NCS = \frac{N \text{ sanctions post}}{N \text{ sanctions pre}}$$

The reduction rate in sanctions was calculated as:

$$\text{Sanction reduction rate} = 1 - NCS$$

These indicators were calculated for the overall sanction volume and for the offence categories and severity classifications examined.

2.6.3. Distributional analysis

To assess whether the composition of officially recorded sanctions

differed between the pre-course and post-course periods, formal distributional analyses were conducted.

Pearson chi-square tests of homogeneity were used as the primary omnibus tests of whether the distribution across categories differed between the pre-course and post-course periods. Comparisons were conducted for the main offence categories, offence severity, driver-related offence subtypes, and serious speeding offence subtypes. Cramér's V was calculated to describe the magnitude of each association. Given the size of the administrative dataset, statistical significance was interpreted together with effect size and the pattern observed across categories.

The same contingency tables were also represented through aggregate log-linear Poisson models. For each classification, a model containing period and category as main effects was compared with a model that also included the period-by-category interaction. Likelihood-ratio tests assessed whether inclusion of the interaction improved model fit. These models provide a count-model formulation of the same distributional comparison and were not treated as independent confirmation of the Pearson tests.

These analyses were based on aggregated sanction counts. They were used to examine differences in the composition of officially recorded sanction profiles, not to estimate individual-level causal effects, behavioural mechanisms, or predictors of recidivism.

Data analysis included univariate, bivariate, and aggregate-count procedures. Results were summarised using frequencies, proportions, means, standard deviations, reduction rates, Pearson chi-square statistics, Cramér's V, and likelihood-ratio tests from log-linear Poisson models.

Descriptive analyses and contingency-table procedures were performed using IBM SPSS Statistics version 29. Aggregate log-linear Poisson models and complementary checks of the distributional analyses were conducted in Python 3.13 using SciPy 1.17.0 and statsmodels 0.14.6.

2.7. Traffic enforcement context

To examine whether broad changes in traffic enforcement might have contributed to the recorded patterns, annual indicators from the Catalan Traffic Service were reviewed for 2015–2019 (Table 1). These included breath alcohol tests, roadside drug tests, and the published number of fixed speed cameras. Because only five annual observations were available, and the camera counts for 2015 and 2016 were approximate, simple ordinary least-squares lines were fitted only to summarise the direction and approximate magnitude of change. No formal inferential claims were based on these fits. Roadside drug tests were not modelled because the police forces included in the published totals differed in 2015 and 2019. The annual indicators were used to describe the enforcement context and were not included as adjustment variables in the main analyses. They do not capture local deployment, operating time, or offence-level detection conditions.

Table 1
Traffic enforcement indicators during the study period.

Traffic enforcement indicators	2015	2016	2017	2018	2019
Breath alcohol tests	400,373	355,451	306,064	395,772	348,651
Roadside drug tests	4,500*	14,282	13,347	13,518	6,891**
Number of fixed speed cameras	~246	~252	260	260	267

Note: *2015 data include only the Mossos d'Esquadra, the Catalan regional police force. **2019 data include only local police forces. *Source:* Authors' calculations based on annual statistics published by the *Servei Català de Trànsit (2015–2019)* and the annual reports of local police forces (*Direcció General d'Administració de Seguretat. 2015–2019*).

2.8. Ethical considerations

This study was conducted using anonymised administrative data provided by the Catalan Traffic Service. No direct contact with participants occurred. The research team worked with anonymised identifiers and did not have access to information that allowed individual drivers to be directly identified. According to national regulations and institutional guidelines, the use of anonymised administrative records for research purposes does not require formal ethical approval.

3. Results

3.1. Pre-course profile of officially recorded traffic offences

Before course attendance, 36,546 sanctions were recorded. Speeding was by far the most frequent category, followed by alcohol- and drug-related offences and driver-related traffic offences. Traffic signalling and non-use of safety devices were less frequent. Together, these five categories accounted for 72.2% of all pre-course sanctions (Table 2).

Serious offences predominated, whereas minor offences represented only a small proportion of the total. The pre-course and post-course severity distributions are compared in Section 3.5.

Among serious speeding offences, most sanctions involved exceeding a posted speed limit or the general speed limit on interurban roads. Offences recorded in average-speed enforcement sections and urban access areas were less frequent (Table 3).

Among driver-related traffic offences, mobile phone use while driving clearly predominated. Reckless and negligent driving were much less frequent, while the remaining category included several offences with low individual frequencies (Table 4).

3.2. Licence point deductions

Licence point deductions varied markedly across offence categories (Table 5). Alcohol- and drug-related offences had the highest proportion of sanctions involving point deduction and the highest mean number of points deducted. Driver-related traffic offences and offences involving the non-use of safety devices also frequently resulted in point deduction.

Speeding followed a different pattern. A smaller proportion of speeding sanctions involved point deduction, but their high frequency meant that they still accounted for a substantial share of all points deducted.

3.3. Overall post-course records: Recidivism and sanction volume

Among the 9,886 drivers with at least one pre-course sanction, 6,219 had one or more officially recorded sanctions during the two-year post-course period (NCD = 0.629). The remaining 3,667 drivers (37.1%) had no post-course sanction in the administrative records. This does not establish that they committed no traffic offences.

In the same group, the post/pre sanction ratio was 0.630 (NCS), corresponding to 37.0% fewer officially recorded sanctions in the post-

course period (Table 6).

3.4. Changes in the distribution of the main offence categories

All five main offence categories showed lower absolute counts in the post-course period, although the size of the difference varied considerably across categories. Alcohol- and drug-related offences showed the largest relative decline. Offences involving safety devices, driver-related traffic offences, and traffic signalling offences also declined markedly. Speeding showed a smaller reduction and consequently represented a larger share of the selected offence profile in the post-course period (Table 7).

The distribution of these offence categories differed significantly between the two observation periods. The corresponding Pearson and likelihood-ratio statistics are reported in Table 9.

3.5. Changes in offence severity

The number of officially recorded sanctions was lower in all three severity categories in the post-course period. The largest relative differences were observed for minor and very serious offences, while serious offences showed a smaller decline and consequently represented a larger proportion of the post-course total (Table 8).

The distribution of sanctions by severity differed significantly between the two observation periods. The results of the formal distributional comparison are presented in Section 3.6.

3.6. Inferential comparison of sanction distributions

Formal comparisons showed that the composition of recorded sanctions differed between the pre-course and post-course periods across all four classifications examined (Table 9). The largest differences were found for serious speeding subtypes and the five main risk-related offence categories. The effect sizes were modest, ranging from 0.128 to 0.210.

Likelihood-ratio tests from the log-linear models led to the same substantive conclusion, as expected because both analyses were based on the same contingency tables. In each classification, inclusion of the period-by-category interaction improved model fit, indicating that the relative distribution of sanction counts differed between periods.

These analyses assess differences in sanction composition at the aggregate level. They do not estimate individual-level programme effects or account for the clustering of repeated sanctions within drivers.

3.7. Driver-related traffic offences

All four categories of driver-related traffic offences showed lower counts in the post-course period, although the magnitude of the difference was not uniform (Table 10). Mobile phone use remained the most frequent offence in this group, but represented a smaller proportion of the post-course total. Reckless driving also showed a marked decline. Negligent driving and the residual category showed smaller relative differences.

As a result, the internal distribution of driver-related traffic offences changed between the two periods, as confirmed by the inferential analyses reported in Table 9.

3.8. Speeding offences

Serious speeding sanctions followed different patterns across offence subtypes (Table 11). Sanctions for exceeding posted speed limits and general speed limits on interurban roads were lower in the post-course period. By contrast, sanctions recorded in average-speed enforcement sections and urban access areas were higher in both absolute and relative terms. Other serious speeding offences declined.

These differences produced a clear change in the internal

Table 2

Main categories of officially recorded traffic offences before course attendance.

Traffic offence category	n	%
Speeding	16,686	45.7
Alcohol- and drug-related offences	3,898	10.7
Driver-related traffic offences	2,826	7.7
Traffic signalling offences	1,698	4.6
Seat belt, helmet, and child restraint offences	1,296	3.5
Other sanctions	10,142	27.8
Total	36,546	100.0

Note: "Other sanctions" includes all administrative offence categories not shown separately in the table. Authors' calculations based on administrative records from the Catalan Traffic Service.

Table 3

Distribution of serious speeding offences before course attendance, by licence points deducted.

Type of speeding offence	Total <i>n</i> (%)	No penalty points deducted <i>n</i> (%)	Penalty points deducted <i>n</i> (%)	2 points <i>n</i> (%)	4 points <i>n</i> (%)	6 points <i>n</i> (%)
Exceeding the posted speed limit	7,755 (46.8)	5,767 (34.8)	1,988 (12.0)	1,603 (39.9)	276 (6.9)	109 (2.7)
Exceeding the general speed limit on interurban roads	6,191 (37.4)	4,641 (28.0)	1,550 (9.4)	1,277 (31.9)	176 (4.4)	97 (2.4)
Exceeding the average speed limit in a section control zone	1,708 (10.3)	1,269 (7.7)	439 (2.6)	380 (9.5)	43 (1.1)	16 (0.4)
Exceeding the posted speed limit at urban access roads	583 (3.5)	545 (3.3)	38 (0.2)	38 (0.9)	0 (0.0)	0 (0.0)
Other speeding offences	336 (2.0)	336 (2.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Total	16,573 (100.0)	12,558 (75.8)	4,015 (24.2)	3,298 (82.2)	495 (12.3)	222 (5.5)

Note: Percentages for total offences and offences with or without point deduction are calculated over all serious speeding offences. Percentages for 2-, 4-, and 6-point sanctions are calculated over serious speeding offences involving point deduction. Authors' calculations based on administrative records from the Catalan Traffic Service.

Table 4

Driver-related traffic offences before course attendance: selected categories.

Driver-related traffic offence	Totals N	%	Legal classification	Licence points deducted
Mobile phone use while driving	2,101	74.3	Serious	3 points
Reckless driving	201	7.1	Very serious	6 points
Negligent driving	178	6.3	Serious	No point deduction
Other driver-related offences	346	12.2	Heterogeneous	Not disaggregated
Total	2,826	100		

Note: The category 'Other driver-related offences' includes heterogeneous offences, each accounting for less than 3% of the category. Aggregate point-deduction indicators for driver-related traffic offences are presented in Table 5. Authors' calculations based on administrative sanction records from the Catalan Traffic Service.

distribution of serious speeding sanctions, which was also supported by the inferential analyses reported in Table 9.

The pattern also differed according to whether the sanction involved licence point deduction. Sanctions involving point deduction declined in each of the four main speeding contexts. Sanctions without point deduction also declined for posted speed limits and interurban roads, but increased in average-speed enforcement sections and urban access areas (Table 12).

3.9. Traffic enforcement indicators during the study period

The annual number of breath alcohol tests fluctuated during the study period, with a fitted slope of $-6,312$ tests per year. Published fixed-camera counts rose from approximately 246 in 2015 to 267 in 2019, corresponding to a fitted increase of about five devices per year. Roadside drug tests were not modelled because the published totals did

not cover the same police forces in every year. Given the five annual observations and the approximate nature of the earlier camera counts, these slopes are descriptive summaries rather than formal evidence of stable or changing enforcement.

4. Discussion

This study found fewer officially recorded sanctions during the 24 months after course attendance among drivers with previous sanctions, but the pattern varied across offence types, severity levels, and speeding contexts. The clearest distributional differences concerned the five main risk-related categories and the serious speeding subtypes, although effect sizes were modest. The results therefore describe an uneven change in the administrative sanction profile. Without a comparison group, this pattern cannot be attributed to course attendance alone.

Before course attendance, speeding was the dominant offence category, followed by alcohol- and drug-related offences and driver-related traffic offences. Serious offences accounted for most sanctions, while alcohol- and drug-related offences contributed disproportionately to the

Table 6

Overall number of officially recorded sanctions in the pre-course and post-course periods.

Indicator	Value
Pre-course sanctions	36,546
Post-course sanctions	23,022
Absolute difference	-13,524
Post/pre sanction ratio (NCS)	0.630
Relative change	-37.0%

Note: The post-course count refers to sanctions recorded among drivers with pre-course sanctions. Authors' calculations based on administrative records from the Catalan Traffic Service.

Table 5

Main pre-course traffic offence categories by licence points deducted.

Sanctioned infringement	Point deduction (%)		Mean points deducted	SD	Sanctions with point deduction <i>n</i>	% of point-deduction sanctions	Total points deducted	% of points
	Without	With deduction						
Driver-related offences	14.1	85.9	3.25	0.828	2,428	19.1	7,894	16.5
Alcohol/drug offences	0.3	99.7	5.51	0.862	3,886	30.6	21,400	44.8
Speeding	74.1	25.9	2.61	1.206	4,327	34.1	11,294	23.7
Safety-device offences	17.4	82.6	3.00	0.000	1,071	8.4	3,213	6.7
Signalling offences	78.7	21.3	4.00	0.000	361	2.8	1,444	3.0
Driver documentation	88.6	11.4	4.00	0.000	452	3.6	1,808	3.8

Note: SD = standard deviation. Percentages may not sum to 100 because only the main offence categories involving licence point deduction are shown. Authors' calculations based on administrative records from the Catalan Traffic Service.

Table 7

Distribution of the five main risk-related traffic offence categories in the pre-course and post-course periods.

Traffic offence category	Pre-course n (%)	Post-course n (%)	Absolute difference	Relative change (%)
Speeding	16,686 (63.2)	13,813 (81.2)	−2,873	−17.2
Alcohol- and drug-related offences	3,898 (14.8)	863 (5.1)	−3,035	−77.9
Driver-related traffic offences	2,826 (10.7)	1,195 (7.0)	−1,631	−57.7
Traffic signalling offences	1,698 (6.4)	713 (4.2)	−985	−58.0
Seat belt, helmet, and child restraint offences	1,296 (4.9)	418 (2.5)	−878	−67.7
Total selected categories	26,404 (100.0)	17,002 (100.0)	−9,402	−35.6

Note: Percentages were calculated within the five categories shown. Together, these categories accounted for 96.7% of the traffic offences classified as related to risky driving practices in both observation periods. Relative change was calculated using the pre-course count as the denominator. Authors' calculations based on administrative records from the Catalan Traffic Service.

Table 8

Distribution of officially recorded sanctions by offence severity in the pre-course and post-course periods.

Severity	Pre-course n (%)	Post-course n (%)	Absolute difference	Relative change (%)
Minor	2,389 (6.5)	870 (3.8)	−1,519	−63.6
Serious	25,811 (70.9)	18,883 (82.0)	−6,928	−26.8
Very serious	8,346 (22.6)	3,269 (14.2)	−5,077	−60.8
Total	36,546 (100.0)	23,022 (100.0)	−13,524	−37.0

Note: Relative change was calculated using the pre-course count as the denominator. Authors' calculations based on administrative records from the Catalan Traffic Service.

number of licence points deducted. This profile is broadly consistent with previous research on drivers entering penalty-point and rehabilitation systems, where speeding, substance use, and persistent risky driving practices are recurrent concerns (González Iglesias & Gómez Fraguera, 2010; Montoro González et al., 2010; Escamilla et al., 2023; Cardoso et al., 2024).

Among the 9,886 drivers analysed, 37.1% had no officially recorded sanction during the post-course observation period, and the overall sanction count in this group was 37.0% lower. These figures describe what appeared in the administrative database. They do not show that the same proportion of drivers stopped committing offences. Some may have driven less, had fewer opportunities to offend, or committed offences that were not detected.

The differences were greatest for alcohol- and drug-related offences,

Table 9

Inferential comparison of officially recorded sanction distributions between the pre-course and post-course periods.

Classification	Pearson χ^2	df	p	Cramér's V	LRT χ^2	df	p
Five main risk-related offence categories	1,765.40	4	< 0.001	0.202	1,878.90	4	< 0.001
Offence severity	981.26	2	< 0.001	0.128	1,012.95	2	< 0.001
Driver-related traffic offence subtypes	69.20	3	< 0.001	0.131	67.41	3	< 0.001
Serious speeding offence subtypes	1,333.89	4	< 0.001	0.210	1,339.57	4	< 0.001

Note: LRT = likelihood-ratio test from the aggregate log-linear Poisson model comparing a model with period and category main effects with a model that also included the period-by-category interaction. Cramér's V was calculated from the corresponding contingency table. The analyses are based on aggregated sanction counts and assess differences in recorded sanction composition, not individual-level programme effects. Pearson and likelihood-ratio statistics are alternative tests of the same period-by-category association and should not be interpreted as independent evidence.

safety-device offences, and driver-related traffic offences. Previous research has reported reductions in recidivism in some rehabilitation and psychoeducational programmes, although results differ according to the programme, population, design, and outcome examined (Kaur et al., 2023; Escamilla-Robla et al., 2024). The present findings are compatible with that broader literature, but they cannot identify the contribution of the Catalan programme. Sanctions, enforcement, public awareness, driving exposure, and the probability of detection may all have influenced the recorded pattern.

The large decline in recorded alcohol- and drug-related offences should therefore be interpreted with particular caution. These offences carry severe legal consequences and are the focus of specific testing and enforcement activities. Their lower post-course count may reflect fewer offences, differences in exposure or testing, changes in detection, or

Table 10

Driver-related traffic offences in the pre-course and post-course periods.

Driver-related traffic offence	Pre-course n (%)	Post-course n (%)	Absolute difference	Relative change (%)
Mobile phone use while driving	2,101 (74.3)	798 (66.8)	−1,303	−62.0
Reckless driving	201 (7.1)	48 (4.0)	−153	−76.1
Negligent driving	178 (6.3)	94 (7.9)	−84	−47.2
Other driver-related offences	346 (12.2)	255 (21.3)	−91	−26.3
Total	2,826 (100.0)	1,195 (100.0)	−1,631	−57.7

Note: Percentages were calculated within the driver-related traffic offence category for each observation period. The residual category includes offences with low individual frequencies. Relative change was calculated using the pre-course count as the denominator. Authors' calculations based on administrative records from the Catalan Traffic Service.

Table 11

Serious speeding sanctions in the pre-course and post-course periods.

Speeding offence category	Pre-course n (%)	Post-course n (%)	Absolute difference	Relative change (%)
Exceeding the posted speed limit	7,755 (46.8)	4,896 (35.5)	−2,859	−36.9
Exceeding the general speed limit on interurban roads	6,191 (37.4)	4,446 (32.2)	−1,745	−28.2
Exceeding the average speed limit in a section control zone	1,708 (10.3)	3,109 (22.6)	+1,401	+82.0
Exceeding the posted speed limit at urban access roads	583 (3.5)	1,158 (8.4)	+575	+98.6
Other speeding offences	336 (2.0)	178 (1.3)	−158	−47.0
Total	16,573 (100.0)	13,787 (100.0)	−2,786	−16.8

Note: The table includes serious speeding sanctions. Relative change was calculated using the pre-course count as the denominator. Authors' calculations based on administrative records from the Catalan Traffic Service.

Table 12

Changes in serious speeding sanctions by licence point deduction and enforcement context.

Licence point category	Posted speed limit, Δn (%)	Interurban road, Δn (%)	Section control, Δn (%)	Urban access, Δn (%)
No point deduction	−1,704 (−29.5)	−830 (−17.9)	+1,710 (+134.8)	+606 (+111.2)
With point deduction	−1,155 (−58.1)	−915 (−59.0)	−309 (−70.4)	−31 (−81.6)
2 points	−863 (−53.8)	−713 (−55.8)	−256 (−67.4)	−31 (−81.6)
4 points	−203 (−73.6)	−123 (−69.9)	−37 (−86.0)	0 (nc)
6 points	−89 (−81.7)	−79 (−81.4)	−16 (−100.0)	0 (nc)
Total	−2,859 (−36.9)	−1,745 (−28.2)	+1,401 (+82.0)	+575 (+98.6)

Note: Values represent the absolute and relative change between the pre-course and post-course periods. nc = not calculable because the pre-course count was zero. The four main serious speeding categories are shown; “other speeding offences” are not included. Authors’ calculations based on administrative records from the Catalan Traffic Service.

several of these factors acting together. The database cannot distinguish between these explanations. Nor can it determine whether the pattern was more than a temporal fluctuation among drivers selected because they had already accumulated sanctions.

Recorded mobile phone-related offences were also substantially lower in the post-course period. Experimental evidence shows that mobile phone use can increase workload and impair vehicle control, while European monitoring continues to identify distraction as an important road safety concern (Ortega et al., 2021; European Commission, 2023). Even so, this study did not measure actual phone use, attitudes towards distraction, perceived risk, or exposure to enforcement. The decline in recorded sanctions cannot therefore be taken as evidence that participants became more aware of the danger or changed their behaviour because of the course.

Speeding followed a different and more complex pattern. Its recorded count declined less than those of the other main offence categories, and it consequently represented a larger share of the post-course sanction profile. Moreover, the direction of change varied across speeding subtypes. Sanctions for exceeding posted limits and general limits on interurban roads were lower, whereas sanctions recorded in average-speed enforcement sections and at urban access points increased. Most of the increase in these two settings involved sanctions without licence point deduction.

The speeding results also show why this offence should not be treated as a single, uniform category. Road environment, the type and visibility of enforcement, and the threshold for licence-point deduction may all shape the sanction records. Recent research comparing police and camera-based speed enforcement found differences in perceived detection, deterrence, legitimacy, and procedural fairness (Anderson & Truelove, 2026). Those findings provide useful context, but the Catalan data cannot determine whether enforcement differences produced the patterns observed here.

The enforcement indicators reinforce the need for caution. Breath alcohol testing fluctuated across the five years, while published fixed-camera counts rose from approximately 246 to 267. This contextual increase cannot by itself explain why sanctions rose in average-speed sections and urban access areas, but changes in automated detection cannot be excluded. The enforcement data were annual aggregates and could not be linked to particular drivers, roads, dates, or sanctions.

The persistence of speeding is also consistent with research showing that speeding decisions arise from several interacting factors. A recent literature review identified moral norms and previous behaviour as relevant additions to the usual Theory of Planned Behaviour variables

(Rachad et al., 2024). Liu et al. (2025) highlighted attitudes, perceived behavioural control, and perceived time-saving benefits, while Budak et al. (2025) showed that the relationship between risk perception and driving practices varies according to traffic locus of control. These studies help explain why speeding may be difficult to address through one educational or enforcement measure. None of these psychological variables, however, was available in the present study.

Differences were also observed in offence severity. Minor and very serious sanctions showed the largest relative declines, whereas serious sanctions represented a larger proportion of the post-course total. This does not demonstrate that individual drivers moved from more dangerous to safer behaviour. It describes the severity distribution of the offences detected in each period, which may also have been affected by the types of offences recorded, legal classifications, exposure, and enforcement practices.

Offence severity in this study refers to the legal classification of sanctions and should not be confused with crash injury severity. The database contained no information on crashes or injuries, so it cannot show whether the observed sanction patterns were accompanied by changes in crash involvement or harm.

The Attitude Change Model provides the educational rationale for the Catalan programme. It emphasises knowledge, reflection on unsafe habits, emotional engagement, and personal commitment (Montané et al., 2007; Arnau-Sabatés & Montané-Capdevila, 2010). Related reflective processes have also been described in European driver rehabilitation programmes (Klipp, 2009). These mechanisms were not measured here, so the study cannot determine whether changes in knowledge, attitudes, emotions, or commitment contributed to the sanction patterns.

The main contribution is not the 37.0% difference in total sanction counts alone. By separating offence type, severity, and speeding context, the analysis shows that the post-course pattern was uneven and that speeding remained the dominant recorded category. This provides a more informative empirical basis for future evaluation of the Catalan programme than a single recidivism measure, while leaving causal explanation to studies with comparison groups and individual-level models.

4.1. Strengths and limitations

A main strength of this study is that it included the complete regional cohort of drivers who attended road safety awareness and re-education courses in Catalonia in 2017. The observation window was symmetrical, and administrative records avoided the recall and social desirability biases associated with self-reported offending. The analysis also considered offence type, severity, licence point deduction, and speeding context. Finally, the revised statistical approach moved beyond descriptive percentages by formally comparing distributions and testing period-by-category interactions.

Several limitations remain. First, the study did not include an external comparison group. Regression to the mean, temporal changes, driving exposure, enforcement, and other contextual factors may therefore have contributed to the observed differences. The inferential tests and aggregate Poisson models show that the distributions differed between periods, but they do not identify the cause of those differences.

Second, administrative records include only offences that were detected, processed, and recorded. They do not provide a direct measure of all offences committed. A driver with no recorded post-course sanction may have committed no offence, may have driven less, or may have committed offences that were not detected. The available data cannot distinguish between these possibilities.

Third, individual driving exposure was not available. The database did not include kilometres driven, frequency of vehicle use, occupational exposure, periods without an active licence, or time spent driving during follow-up. Differences in exposure could therefore not be taken into account.

Fourth, enforcement indicators were available only as annual aggregate data. They were not linked to individual participants or specific sanctions. The gradual increase in fixed speed cameras and the limited comparability of roadside drug-testing data mean that changes in detection probability cannot be excluded.

Fifth, the administrative database did not indicate whether participants attended additional road safety awareness and re-education courses during follow-up. It was therefore not possible to determine whether any driver received more than one educational intervention.

Sixth, the study did not include data on road traffic crashes. It was not possible to determine whether the differences in sanction records were accompanied by changes in crash involvement, injuries, or fatalities. Future studies linking course, sanction, exposure, and crash records would provide a more complete assessment of subsequent road safety outcomes.

Finally, the inferential analyses were based on aggregated sanction counts. They were appropriate for assessing changes in the composition of the recorded sanction profile, but they did not model individual trajectories or account directly for repeated sanctions clustered within drivers. Future research should combine administrative data with sociodemographic, exposure, psychological, and course-process variables and apply individual-level longitudinal models. Risk-assessment information collected during the courses may help identify different post-course trajectories (Montané et al., 2023).

5. Conclusions

Among the 9,886 drivers analysed, the total number of sanctions recorded after course attendance was 37.0% lower, but the pattern was not uniform. Alcohol- and drug-related, safety-device, and driver-related sanctions showed the largest declines. Speeding changed less, remained the dominant category, and represented a larger share of the post-course profile.

The main contribution of this study lies in showing what is missed when programme evaluation relies only on a total sanction count or a single recidivism indicator. Although the distributional effect sizes were modest, disaggregating the records by offence type, severity, and speeding context revealed a distinct pattern: sanctions related to posted and interurban speed limits were lower, whereas those detected in average-speed sections and urban access areas were higher, mainly without licence-point deduction. This population-level analysis, based on the complete 2017 regional cohort and focused on all drivers with pre-course sanctions, provides a more precise account of where recorded changes were concentrated and where sanctions remained prominent.

The design does not allow these patterns to be attributed to the course alone, and administrative records are not a direct measure of driving behaviour. Even so, the findings have practical value for the Catalan programme grounded in the Attitude Change Model because they identify speeding—particularly its variation across detection contexts—as a priority for further evaluation and possible programme refinement. Future studies should link sanction records with driving exposure, enforcement, repeated course attendance, psychological measures, and crash outcomes, using comparison groups and individual-level longitudinal designs.

CRedit authorship contribution statement

Mercè Jariot-Garcia: Writing – review & editing, Writing – original draft, Supervision, Methodology, Formal analysis, Conceptualization. **Montserrat Rodríguez-Parrón:** Writing – review & editing, Methodology, Conceptualization. **Jose Tello-Sánchez:** Conceptualization, Methodology, Formal analysis, Data curation, Visualization, Validation, Project administration, Supervision, Writing – original draft, Writing – review & editing.

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Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this work, the authors used ChatGPT (OpenAI) to improve linguistic clarity and expression. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that support the findings of this study are not publicly available due to restrictions related to participant confidentiality and institutional data protection policies. The authors are not authorised to share the underlying administrative data provided by the Catalan Traffic Service.

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