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Profiling and Prevalence of Substance-Related and Addictive Disorders and Behavioural Addictions in Incarcerated Traffic Offenders

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Abstract: A field study was designed to determine if traffic offenders were characterised by substance-related and addictive disorders and behavioural addictions, and to examine their prevalence in this population. A total of 268 regular drivers (weekly or daily use) participated in the study; 132 incarcerated traffic offenders and 136 drivers with no criminal background. Subsamples were matched in age, sex, and time elapsed since their driving test. Participants responded to a measure of impulse control and addictions. The results revealed a more-than-problematic effect regarding drug addiction, alcohol consumption, and compulsive purchasing in the population of traffic offenders. In contrast, a trivial effect (insignificant) was observed in addiction to gambling, internet, videogames, eating, and sex. Comparatively, traffic offenders reported higher addiction to drugs, alcohol, gambling, compulsive purchasing, and sex, but less addiction to internet than controls. As for caseness analysis, a significant prevalence of caseness (>0.05) was observed in traffic offenders in connection to drugs, alcohol, internet, compulsive purchasing, and eating addictions. Moreover, addiction comorbidity or multi-comorbidity was found to be common (=0.50). The implications of the results for interventions with traffic offenders are discussed.

Keywords: traffic crash; caseness; prison traffic inmates; fatalities; serious injuries

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1. Introduction

The World Health Organization [1] has estimated that each year, around 1.3 million people lose their lives in traffic accidents, with 20 to 50% sustaining serious injuries that often lead to serious disability. The European Commission [2] has estimated (preliminary) there were 44 road deaths per million inhabitants in 2021 (with an EU-27 population of 447,007,596 in 2021, the overall fatalities would be 19,668 [data calculated, not reported]), ranging from 18 road deaths per million inhabitants in Sweden to 93 road deaths per million inhabitants in Romania. Thus, the probability of a traffic fatality was 5.17 times higher in Romania than in Sweden, a large effect size for the context. The discriminative variables between both contexts explain this disparity and define the key issues for reducing traffic fatalities. The increase in fatalities was 5% in 2020, while the decrease compared to 2019 (pre-pandemic) was 13%. The coming years will tell if the tendency will eventually rise or fall, or recover from pre-pandemic levels. In terms of victim profiling, 77% were male, representing 45.3% of the total EU population; 28% were elderly (>65 years), corresponding to 21% of the total EU population; and 12% were aged 18 to 24, embodying 7% of the total EU population [3]. In consequence, men were 4.04 (OR = 4.04 [95% CI 3.98, 4.10]) times more likely to sustain a fatal traffic accident; the elderly were 1.46 (OR = 1.46 [95% CI 1.44, 1.48]) more likely to suffer a fatal age-related accident; and young adults were 1.81 (OR = 1.81 [95% CI 1.79, 1.83] more likely to suffer a fatal age-related accident. In the USA, the number of fatal traffic accidents in 2021 was estimated to be around 42,915 fatalities [4], a rate of 129.14 deaths per million inhabitants (332,031,554 inhabitants; Bureau of Census, n.d.), which tripled the rate in the EU-27 (ratio = 2.934). The WHO [1] has estimated that approximately 1.3 million people died yearly in fatal traffic accidents worldwide, with low- to middle-income countries accounting for 93% of fatalities, which is around 9 times greater (a more than large effect), OR = 8.86, than in middle- to high-income countries (only 60% of the world's vehicles). The figures for serious injuries (a score > 3 in MAIS; e.g., incapacitating, chronic injury) are even more alarming given that the EU has estimated that for every life lost, five people suffer serious injuries. Likewise, in the USA, the number of disability-related traffic accidents is around 5 times higher than fatalities [5]. Worldwide, from 20 to 50 million people suffer non-fatal injuries, many of them incapacitating injuries [1]. Additionally, traffic accidents cost countries an average 3% of their gross domestic product [1].

Three underlying factors account for traffic accidents, i.e., driver (e.g., distracting, drowsy driving, speeding, driving under the influence of alcohol and other psychoactive substances), vehicle (e.g., unsafe vehicles, tires, brake), and environmental factors (e.g., unsafe road infrastructure, slick roads). As these critical factors can be controlled, most traffic accidents can be prevented. Driver error was the main cause (94 ± 2.2%) of traffic accidents [6] and alcohol was the leading cause, followed by distractions, speeding, and driving under the influence of substances (i.e., illegal drugs, medications impacting the ability to drive; [1]). In Europe, 25% of fatalities were related to alcohol consumption [7]; 29% in the USA [8] and 35% worldwide [9]. Succinctly, approximately 1/4 to 1/3 of fatalities were alcohol-related, and this figure rises to 70.2% (94.5% for sentenced to withdrawal of driving license) in traffic offenders [10]. Furthermore, the lower probability of recidivism (the real probability being larger as most relapses do not lead to arrest) was, as measured in re-arrest rates during a 7-year period, 30% [11]. Drunk driving has been strongly correlated to speeding and drug impairment, i.e., medicinal drugs and illegal drugs [12,13]. However, prescription drugs had a marginal effect, OR = 1.20, on the number of road accidents [14], but they increased the probability of impairment by 6.8% [15]. Drug/alcohol-impaired drivers had a 4.65 greater probability of speeding (a large effect) than sober drivers [16], and drug use doubled the probability of being involved in a traffic accident [17].

Driver distraction at the wheel was another leading cause of traffic accidents, mainly due to drowsiness (initially) or the use of mobile phones (recently). A meta-analysis [18] estimated that drowsiness increased the likelihood of a traffic accident by 1.34 times, a marginal effect (OR < 1.47). The use of mobile phones was strongly correlated to physical (e.g., use of hands), visual (i.e., attention is not on the road), auditory (i.e., driver is not focused on driving sounds), and cognitive (i.e., divided attention implies a lower cognitive load while driving) distractions leading to traffic accidents [19,20].

The administrative strategy to cope with these contingencies was curbing these behaviours through law enforcement. Nevertheless, the data on the effects of sanctions and sentencing in decreasing these behaviours and in diminishing relapses is scarce [11,21].

In short, addiction was the main psychological factor accounting for most driver-related accidents. Addiction is a clinical issue classified in DSM-5 as "substance-related and addictive disorders" encompassing 10 types of drugs as well as gambling disorder, which is a non-substance-related addictive disorder [22]. However, other behavioural addictions (repetitive behaviours) such as sex addiction, eating addiction, or compulsive purchasing were not included in the DSM-5 as there is no clinical evidence of their diagnostic criteria and the development of these disorders, though they entail addiction. The distinctive characteristic of substance-related and addictive disorders and behavioural addictions is that individuals continue the behaviour or use the substance despite significant behavioural addiction or substance-related problems (in the present study, problems related to driving under the effects of substances or behavioural addictions). Thus, if there is no clinical intervention, a final remission is not expected (recidivism in traffic offences). Hence, a field study was designed to determine if incarcerated traffic offenders were characterised by substance-related and addictive disorders, and to assess their prevalence in this subsample.

2. Method

2.1. Participants

A total of 268 regular drivers (weekly or daily use) with more than 1 year of experience (not learner drivers) participated in the study, of which 132 (112 males and 20 females) were drivers sentenced to prison under the Spanish legislation for traffic offences, and 136 (115 males and 21 females) were drivers from a community sample (the same as sentenced drivers) with no previous convictions. All participants were adults (>18 years old) ranging from 20 to 70 years (M = 35.44, SD = 10.59), 84.7% males, who had a driving license for a mean of 21.01 years (SD = 9.25). Both subsamples were matched in age (Ms = 36.61 and 34.32 years old for incarcerated traffic offenders and community sample, respectively), $t(266) = 1.78$, *ns*, sex, $\chi^2(N = 268) = 0.00$, *ns*, and time elapsed since their driving test (Ms = 20.90 and 21.12 years for incarcerated traffic offenders and community sample, respectively), $t(266) = 0.20$, *ns*.

2.2. Measurement Instruments

Participants completed an ad hoc sociodemographic questionnaire measuring sex, age (measured in years), previous convictions (yes vs. no), driving license (yes vs. no), and year of driving test.

Addictive behaviours (with or without substances) were measured with the MULTICAGE CAD-4 [23]. The MULTICAGE CAD-4 consists of 32 items structured in 8 subscales (4 items each): drugs (internal consistency: Cronbach's $\alpha = 0.88$), alcohol (Cronbach's $\alpha = 0.84$), pathological gambling (Cronbach's $\alpha = 0.73$), internet (Cronbach's $\alpha = 0.82$), videogames (Cronbach's $\alpha = 0.79$), compulsive purchase (Cronbach's $\alpha = 0.79$), eating (Cronbach's $\alpha = 0.70$), and sex (Cronbach's $\alpha = 0.73$) addiction. The diagnostic sensitivity was over 90% with a $\geq$2 raw cut-off score.

2.3. Procedure

Participants who were serving prison sentences for traffic offences were assessed in the "A Lama" prison (Pontevedra, Spain). Prison authorities approved the data collection. Drivers with no convictions for traffic offences were randomly selected from the general population from the community as convicted drivers. Participants completed the sociodemographic questionnaire and endorsed the MULTICAGE CAD-4 individually and voluntary. Informed consent for data collection and use for scientific purposes was signed by each participant, data were processed and stored in accordance with the Spanish Data Protection Law (Ley Orgánica 3/2018, de 5 de diciembre, de Protección de Datos Personales y Garantía de los Derechos Digitales), and data were processed in accordance with the Spanish Penitentiary Law (Ley Orgánica 1/1979, de 26 de septiembre, General Penitenciaria). Moreover, the study was approved by the Ethics Committee of the University of Vigo (Spain).

2.4. Data Analysis

The study of the differences in the addictions of incarcerated traffic offenders was assessed by contrasting the overlapping of the 95% confidence interval: if confidence intervals overlapped, they were statistically equal, whereas if they did not overlap, they were significantly different. Likewise, if the 95% confidence interval was above 0.25, it was deemed a trivial effect, i.e., insignificant (*ns*) in addiction [24]. The coefficient of variation (CV) was computed for the distribution of the measures of the addictive behaviours of incarcerated traffic offenders: a high variation indicated significant dispersion related to caseness [25]. The observed mean in the population of incarcerated traffic offenders was compared (one-sample t-test) with 0.25 (trivial effect) as a test value in order to determine if the level of addiction of the population in each measure was significant; and with 1 (moderate effect, problematic effect; [25]) as a test value to determine if the level of addiction was problematic. The effect size was estimated as a standardised mean difference, i.e., Cohen's d (dividing mean for standard deviation in one-sample t-test, and dividing mean differences by weighted and pooled standard deviation in two-sample *t*-test), and interpreting the magnitude quantitatively as the Probability of Superiority of the Effect Size (PS_{ES}; [26]) consisting in the transformation and interpretation as a percentile.

Between the populations (incarcerated traffic offenders vs. general population), mean comparisons in addiction were performed with a MANOVA (dependent variables comprise a theoretical construct, addiction behaviour, $\bar{r} = 0.250$, $p < 0.001$). As multivariate heterogeneity was observed, Box's M = 322.18, $p < 0.001$, multivariate test Pillai-Bartlett trace (Wilk's λ, Hotelling–Lawley trace, and Roy's maximum root provided equal results in terms of the rejection of the null hypothesis) was employed as it is more robust to heterogeneous variances [27]. In univariate effects when heterogeneity of variance was exhibited by the Levene's test, three criteria were applied to validate the correct rejection of the null hypothesis [28]: (a) that the empirical *F* (3.84) was greater than the theoretical *F*; (b) that the effect size, Cohen's *d*, was significant (95% CI has no 0) and the magnitude was $\geq$0.20; and (c) that the ratio between β/α (probability of false acceptance of the null hypothesis/probability of false acceptance of the alternative hypothesis) was $\geq$1. All three criteria were met for significant univariate *F* values. The error of the empirical models, i.e., the misclassification of individuals with the application of the statistical model, was evaluated with the Probability of an Inferiority Score (PIS; [29]).

The case study was analysed estimating the probability of caseness, and the 95% CI for the prevalence of substance-related and addictive disorders and behavioural addictions among incarcerated traffic offenders was computed: if the 95% CIs overlapped, the prevalence was equal between the two compared behavioural addictions, whereas if they did not overlap, the observed prevalence was significantly different. The observed probability of caseness was contrasted with a constant (trivial prevalence, 0.05; [24], the effect size in Odds Ratio (*OR*) was computed, and the magnitude of the effect as the Effect Incremental Index (incremental effect over the constant) was quantified (EII; [30]).

3. Results

The descriptive results (see Table 1) revealed a significantly higher level of addiction (95% confidence intervals for mean do not overlap with higher mean scores) in drugs, alcohol, and compulsive purchasing than in gambling, internet, videogames, eating, and sex addiction. Moreover, the effect of sex addiction was trivial (the 95% confidence interval was 0.25, a trivial effect). Nevertheless, the variation (see CV in Table 1) was clinically high (>164.5%; [25]), i.e., the probability of caseness is high.

Table 1. Descriptive and magnitude of the effects.

Addiction	M_{SCRT} [95% CI]	CV	t^{+}	*p*	*d*	t^{++}	*p*	*d*
Drugs	1.63 [1.38, 1.88]	88.96	10.90	0.000	0.95	4.97	0.000	0.43
Alcohol	1.07 [0.84, 1.30]	123.36	7.12	0.000	0.62	0.59	0.554	0.05
Gambling	0.34 [0.19, 0.49]	250.00	1.24	0.219	0.11	−8.96	0.000	−0.78
Internet	0.35 [0.21, 0.49]	231.43	1.40	0.165	0.12	−9.24	0.000	−0.80
Videogames	0.27 [0.15, 0.39]	255.56	0.38	0.705	0.03	−12.23	0.000	−1.06
Compulsive purchase	1.05 [0.82, 1.28]	129.52	6.73	0.000	0.59	0.38	0.701	0.04
Eating	0.33 [0.20, 0.46]	227.27	1.28	0.203	0.11	−10.24	0.000	−0.89
Sex	0.31 [0.19, 0.43]	232.26	0.97	0.337	0.08	−10.97	0.000	−0.96

Note. M_{SCRT} [95% CI]: mean of the group of drivers sentenced for crimes against road safety [95% mean confidence interval], CV: coefficient of variation; *df* (131); t^{+}: test value = 0.25 (trivial effect); t^{++}: test value = 1 (problematic effect); *d*: Cohen's *d* (effect size).

In relation to the effects for drivers incarcerated for traffic offences, the results (see t^{++} in Table 1) showed a problematic (non-significant differences with the problematic test value) level of addiction (mean equal or higher than 1, i.e., a problematic effect) to alcohol and compulsive purchase, and more than problematic (a significant higher mean in comparison with the problematic test value) level of drug addiction. Conversely, a trivial effect (a mean equal to 0.25, i.e., a trivial effect) was observed in addiction to gambling, internet, videogames, eating, and sex (see t^+ in Table 1).

The results of the MANOVA showed a significant multivariate effect, $F(8, 259) = 15.95$, $p < 0.001$, in addictions for the population factor (incarcerated traffic offenders vs. general population), accounting for 33.0% of the variance, $\eta_p^2 = 0.330$, an effect size above 83.84%($PS_{ES} = 0.8384$). Additionally, the total power, i.e., the probability of a type II error, was 0, $1 - \beta = 1.00$. In short, the population factor mediated, with a total probability, differences in addictions with an extraordinary large magnitude of the effect.

As for the univariate effects (see Table 2), the results revealed significant differences for the population factor in drugs, alcohol, gambling, internet, compulsive purchasing, and sex addiction. Succinctly, drivers incarcerated for traffic offences exhibited higher levels of addiction, of a magnitude of the effect (PS_{ES}) above 82.38% in drugs, 87.29% in alcohol, 62.93% in gambling, 65.91% in compulsive purchasing, and 59.48% in sex. Nevertheless, the statistical model error (the misclassification of individuals with the application of the statistical model) was 9.3%, 5.4%, 31.9%, 28.1%, and 36.7% in drugs, alcohol, gambling, compulsive purchasing, and sex addiction, respectively. In contrast, a significantly higher level of internet addiction was observed in unconvicted drivers with a magnitude of the effect above 63.68%, and with a probability of misclassification of the model (PS_{ES}) of 31.2%.

Table 2. Univariate effects on the behavioural addiction measures for population factor. Effects between-subjects.

Behavioral Addiction	*F*	*p*	$1 - \beta$	*d*[95% CI]	M_{SD}	$M_{N\text{-}OD}$	PS_{ES}	PIS
Drugs	55.55	0.000	1.00	1.32[1.36, 1.28]	1.63	0.57	0.8238	0.093
Alcohol	50.28	0.000	1.00	1.61[1.57, 1.65]	1.07	0.20	0.8729	0.054
Gambling	6.39	0.012	0.712	0.47[0.43, 0.51]	0.34	0.13	0.6293	0.319
Internet	22.38	0.000	0.997	−0.49[0.45, 0.53]	0.35	0.95	0.6368	0.312
Videogames	0.01	0.874	0.053	−0.03[−0.01, 0.07]	0.27	0.29	0.5080	0.488
Compulsive purchase	20.47	0.000	0.970	0.58[0.54, 0.62]	1.05	0.49	0.6591	0.281
Eating	1.78	0.184	0.264	−0.16[−0.20, −0.12]	0.33	0.46	0.5438	0.436
Sex	4.44	0.036	0.555	0.34[0.30, 0.38]	0.31	0.15	0.5948	0.367

Note. $df(1, 266)$; $1 - \beta$: achieved power; d = Cohen's d; M_{SD}: mean of the group of drivers sentenced for crimes against road safety; $M_{N\text{-}OD}$: mean of the group of non-offender drivers; PS_{ES}: Probability of Superiority of the Effect Size; PIS: Probability of an Inferiority Score.

The case study revealed caseness in all clinical measures (see Table 3), and a significant rate (>0.05; clinical significance) of caseness in drug- and alcohol-related disorders, and in compulsive purchasing, internet, and eating behavioural addictions for drivers incarcerated for traffic offences. Though the results are free ($\beta = 0$) of a type II error (false rejection of the null hypothesis) in drug, alcohol, and compulsive purchasing, for internet and eating addiction, the probability of a false rejection of the null hypothesis was 0.349 ($\beta = 0.349$), i.e., 34.9% in both groups. Likewise, the magnitude of the effect was more than large for drugs, alcohol, and compulsive purchasing, and small for internet and eating addictions. Comparatively, the prevalence of caseness was equal for drug and alcohol addictions (CIs overlap); higher (CIs do not overlap and the observed probability is higher) for alcohol than for compulsive purchasing, internet, and eating addictions; and lower (CIs do not overlap and the observed probability is lower) for eating and internet addictions than for compulsive purchasing. Moreover, a large incremental effect of 85.6%, 90.0%, and 81.7% (EII; the net effect) in drugs, alcohol, and compulsive purchasing addiction caseness was observed in drivers incarcerated for traffic offences; but moderate, 49.0%, for internet and eating addiction.

Table 3. Caseness in substance-related and addictive disorders and behavioural addictions.

Addiction	f(p)[95%CI$_p$]	Z	$1-\beta$	OR	EII
Drugs	46(0.348)[0.267, 0.429])	15.71 ***	1.00	10.14	0.856
Alcohol	66(0.500)[0.415, 0.585])	23.72 ***	1.00	19.00	0.900
Gambling	11(0.083)[0.039, 0.135])	1.74	0.415	1.72	0.398
Internet	13(0.098)[0.047, 0.149])	2.53 *	0.651	2.06	0.490
Videogames	11(0.083)[0.039, 0.135])	1.74	0.415	1.72	0.398
Compulsive purchase	36(0.273)[0.197, 0.349])	11.76 ***	1.00	7.13	0.817
Eating	13(0.098)[0.047, 0.149])	2.53 *	0.651	2.06	0.490
Sex	11(0.083)[0.039, 0.135])	1.74	0.415	1.72	0.398

Note. Diagnostic criterion: raw score ≥ 2 [23]; f(p) [95%CI$_p$]: frequency (proportion) [95% confidence interval]; Z: zeta score for the comparison of the observed probability in the drivers sentenced for crimes against the road security population with a constant (0.05; trivial effect); 1-β: achieved power; OR: Odds Ratio; * $p < 0.05$; *** $p < 0.001$.

Comorbidity (29, 21.9%) or multi-comorbidity (29, 21.9%) was observed in 58 subjects, meaning the prevalence of addictive comorbidity was a clinical characteristic (contrast with the clinical significance criterion, 0.05) of incarcerated traffic offenders, $Z = 20.51$, $p < 0.001$, $1 - \beta = 1.00$, $OR = 14.87$, EII = 0.886.

4. Discussion

The results of this field study revealed that incarcerated traffic offenders were not characterised by a common addiction, but by specific addictions. Thus, incarcerated traffic offenders had a trivial (insignificant) addiction to gambling, an addictive disorder, and to internet, videogames, eating, and sex behavioural addictions. Nevertheless, this trivial level of addiction was not generalisable to behavioural addictions in all incarcerated traffic offenders, as a problematic addiction to compulsive purchasing was observed. Moreover, the extremely high variability (>200%) indicated a degree of individualism (caseness). In comparison, substance-related disorders, i.e., to drugs and alcohol, did characterise the population of incarcerated traffic offenders: a problematic abuse of alcohol and drugs. Thus, the results showed a changing trend [8,10,31,32]), where drug addiction was higher than alcohol addiction.

Furthermore, the addictions (multivariate effect) differentiated incarcerated traffic offenders from the general population. In terms of specific addictions, drugs and alcohol addictions were greater in incarcerated traffic offenders with a large effect in comparison to the general population of unconvicted drivers. Likewise, compulsive purchasing also characterised the population of incarcerated traffic offenders in contrast to unconvicted drivers. Though higher levels of addiction to sex were observed in the population of incarcerated traffic offenders, it was not clinically relevant as the effect was trivial (see Table 1).

The case study underscored the prevalence of caseness in all of the addictions in the sample of incarcerated traffic offenders, with significant levels in alcohol- and drug-related disorders. Nevertheless, the tendency in this population was higher in drugs, and the prevalence of cases was similar in alcohol- and drug-related disorders. The prevalence of caseness in compulsive purchasing was also significant, although significantly lower than in alcohol-related disorders. Similarly, a significant prevalence of cases in internet and eating behavioural addictions was observed, but significantly lower in alcohol, drug, and compulsive purchasing disorders. Finally, a high addictive comorbidity was found in the sample of incarcerated traffic offenders. Drugs and alcohol comorbidity with other clinical disorders should be added to this comorbidity, i.e., multi-comorbidity [22].

4.1. Implications for Professional Practice

The following implications for professional practice may be drawn from the results. The effects of substance addiction and behavioural addictions were associated with traffic offenders; the evaluation of incarcerated traffic offenders should encompass these addictions in order to adjust psychosocial interventions (occasional abuse/intoxication or problematic consumption without developing a disorder) to the criminogenic [33,34] and non-criminogenic specific needs (e.g., comorbid psychological problems and disorders) of each individual [35]. Given the high prevalence of addictive disorders in incarcerated traffic offenders and that addictive problems and disorders persist in non-treatment offenders [36], prison interventions should include clinical evaluations to determine clinical treatment in a controlled environment [22]. Moreover, primary prevention programs should include content designed to raise awareness concerning the effects of addiction on driving, road safety, and training strategies to cope with addictions [37–39]. Additionally, the treatment of clinical cases should also entail relapse prevention programs to progress from controlled remission environments to uncontrolled ones [22,40]. As for occasional abusers, additionally to awareness of the effects of addictions on driving, tools such as alcohol ignition interlocks should be implemented based on their efficacy [32].

4.2. Limitations and Future Research

The present study is subject to several limitations that should be borne in mind in when generalising the results. First, the study design (quasi-experimental) did not control the effect of strange variables, and assumed a similar distribution in both samples that limited the causal association between dependent and independent variables. Second, the samples of traffic offenders and the general population were matched in sex, age, and time elapsed since their driving test, but other uncontrolled variables (strange variables) may have mediated the results. Third, the results should be generalised with caution to occasional or minor offenders. Fourth, the ground truth for classifying incarcerated traffic offenders is restricted to Spanish legislation and cannot be fully applied to other samples of incarcerated traffic offenders convicted under other legislations. Fifth, the response of offenders in the treatment phase may be subject to biased defensiveness, and the effect may be greater than observed. Sixth, the psychometric evaluation provided diagnostic impressions, not clinical diagnoses, meaning the results were based on impressions that require clinical validation.

Finally, future lines of research should be focused on the effects of interventions on offenders with addictive behaviours and disorders, and on the effects of occasional or problematic consumption on other populations of traffic offenders or banned drivers.

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