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The self-reported psychosocial and legal factors contributing to drink and drug driving

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ABSTRACT

Drug driving is recognised as a major road safety problem in many countries. In Australia, the primary response to this problem involved the adoption of roadside drug testing (RDT), which was modelled on the policies and practices used to conduct random breath testing (RBT) for alcohol. However, there remain important differences in the way that RDT and RBT are conducted, which might produce differential effects on drug and drink driving behaviour. In addition, various psychosocial factors are known to influence the two behaviours. Thus, there is a need to investigate the relative influence of legal and psychosocial factors on drug driving and explore how they may be similar or different to drink driving. Accordingly, this study utilised Deterrence Theory and Akers' Social Learning Theory, augmented by measures of dependence and a range of psychosocial factors, to examine the factors associated with self-reported drink and drug driving. An online survey was completed by 1394 licensed drivers from the three most populous states in Australia: Queensland, New South Wales and Victoria. Self-reported drink and drug driving became more likely as level of dependence increased. In relation to legal factors, direct experience of avoiding detection was the strongest predictor of self-reported drink and drug driving. Among the psychosocial factors, a significant positive relationship was found between holding favourable attitudes toward both drink driving and drug driving and self-reported behaviours. The findings suggest that applying legal sanctions in isolation without addressing the psychosocial rewards and punishments for the behaviours is not sufficient to reduce drug or drink driving. Future research should identify countermeasures that integrate deterrence and psychosocial principles in order to reduce these risky driving behaviours.

1. Introduction

Drug driving remains a major road safety problem in many countries, despite continuous attempts to improve in relevant traffic laws and their enforcement (Mills et al., 2021; Myers et al., 2023; Starkey et al., 2017). Drug driving-related crashes often result in serious harm to both the drug driver and other road users (Baldock & Lindsay, 2020; Berning, 2022). Concerningly, this risky behaviour appears to be on the rise, as an increasing trend in drug driving-related crashes and associated fatalities has been observed in

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many jurisdictions. For instance, data from the US showed that the percentage of drug-positive drivers among those who were seriously injured or killed in crashes increased from 18% in 2008 to 59% in 2020 (National Highway Traffic Safety Administration, 2021). As for Canada, from 2000 to 2007, of the fatally-injured drivers tested, 18.5% tested positive for drugs, while 14.2% tested positive for alcohol and drugs (Beasley et al., 2011). The number of drug-related road fatalities in the EU increased by 39% during the period of 2010–2018 (Modijefsky et al., 2022). Similarly, the percentage of drug-related annual fatalities has increased in both the Australian states of South Australia (35% increase between 2010 and 2014) and Queensland (10% increase between 2011 and 2015) (Baldock & Lindsay, 2020; Davey et al., 2020).

Historically, the main approach to reducing drug driving has been based on the concept of deterrence through law enforcement and the application of penalties. Deterrence Theory has guided the development of many road policing countermeasures in Australia, including the Roadside Drug Testing Program (referred to as RDT). The RDT program aimed to detect and punish drug drivers (Davey et al., 2017) and was modelled on Random Breath Testing for alcohol (referred to as RBT), which was progressively introduced across Australia in the 1980s (Homel, 1986; Watson et al., 2005). Although both programs have the same goal of deterring illegal driving, the deterrence-based approach appears to have been more effective in reducing drink driving than drug driving. This may be attributed to some significant differences between the two enforcement approaches. Firstly, the police conduct far more RBT tests per year than is the case for RDT, since performing breath testing for alcohol is faster and cheaper than oral fluid testing for drugs (Cameron, 2013). Secondly, the certainty of being detected for drink driving is greater than for drug driving, due to the emergence of various new drugs that are not detectable in oral fluid, leading to a higher number of false positive drug testing results than for breath testing (Baldock & Woolley, 2013). Thirdly, although RBT is conducted in conjunction with a *per se* blood alcohol concentration (BAC) limit of 0.05, the selection of this limit was based on a strong body of evidence confirming the increased risk of crashing at 0.05 (Watson et al., 2005). In contrast, the *per se* limit applying to RDT is a *zero-tolerance* one (Moxham-Hall & Hughes, 2020), which does not have the same scientific basis, since drivers are deemed to be impaired when there is any presence of the specified drugs in their system. This makes it harder to communicate to the general public the risks associated with driving after taking drugs compared to driving after consuming alcohol, especially in the case of cannabis where varying impairment effects have been found depending on the dose, the frequency of use, and the method of consumption (alone or in combination with alcohol or other substances) (Arkell et al., 2020). Based on these differences between RDT and RBT, it is possible that they have differential effects on drug and drink driving behaviour.

Evaluations have consistently shown the introduction of RBT to be associated with long-term reductions in alcohol-related crashes and related fatalities (Bates et al., 2012; Bureau of Infrastructure Transport Regional Economics (BITRE), 2022a). Nationally, the proportion of drink drivers killed with BAC of 0.05 or more fell from 44% in 1981 to 19% in 2020 (Australian Transport Safety Bureau, 1998; Bureau of Infrastructure Transport Regional Economics (BITRE), 2022b; Watson, 1994). On the other hand, similar evaluations of RDT have shown no long term reductions in drug driving-related crashes, but rather a 68.4% increase in the number of drivers killed due to illegal drugs in their system in 2020 compared to 2010 (Bureau of Infrastructure Transport Regional Economics (BITRE), 2022a).

In the absence of strong research evidence, there has been a tendency to assume that the factors contributing to drug driving are the same as those previously found for drink driving (Hasan et al., 2022). This prompted policymakers to often base their solutions for reducing drug driving on strategies used to deter drink driving. But drug drivers tend to be older, have a higher level of education and report significantly more offences than drink drivers (Hoye, 2020; Karjalainen et al., 2012; Scott-Parker et al., 2014). Recent research from Spain has demonstrated the importance of alcohol and drug use, and the inability to dissociate use from driving, as key contributors to drink and drug driving, respectively (Castro, Doncel, Dinu, & Padilla, 2023). Similarly, an earlier paper by the authors which focused on contributors to drug driving concluded that problematic drug use was the strongest predictor of self-reported drug driving (Hasan et al., 2023). Consequently, enforcement-based countermeasures will be less effective in changing the behaviour of people with drug dependence problems (Mills, Freeman, et al., 2022). However, policy responses to drug driving in Australia have focused largely on policing, with an almost complete absence of other strategies to address the origins of the drug driving problem, such as drug dependence and other psychosocial factors (Castro et al., 2023; Hasan et al., 2022). In this regard, a potential response to the issue of drug dependence is to require drug drivers to participate in rehabilitation programmes similar to those for drink drivers, which have been shown to reduce the likelihood of recidivism (Bartl et al., 2002; Boets et al., 2008). In the United Kingdom, the government has recently called for an evaluation of the feasibility of rehabilitation courses for drug drivers similar to those for drink drivers (Department of Transport, 2022). However, compared to drink driving, the uptake of drug driving rehabilitation in Australia is still relatively low, with the focus being mainly on issues related to problematic drug use in general rather than those related to driving (Australian Institute of Health and Welfare, 2023). As such, more research is needed on the effectiveness of addiction treatment programs in reducing drug driving.

Given that drug driving often occurs alongside drink driving, and to mirror the success achieved in reducing drink driving, it is important to investigate and compare these two behaviours separately and in combination (Baldock, 2023; Hammig et al., 2021). Furthermore, the theoretical basis on which the enforcement strategy is based has some limitations, as Deterrence Theory has limited ability to explain a broader set of factors other than legal sanctions (Akers, 1977, 1990). Previous research suggests that other factors influencing drug driving may include social sanctions and rewards for drug driving (Hasan et al., 2022). Therefore, there is a need to explore how people's behaviours are shaped by potential rewards as well as punishments. To do so, a comprehensive framework is needed to examine the characteristics of drug drivers and the related factors contributing to their behaviour and to contrast them with those contributing to drink driving. Drawing on previous research into risky driving behaviours, including speeding (Fleiter et al., 2010; Fleiter et al., 2006; Watson et al., 2015) and unlicensed driving (Watson, 2004a), the framework utilised in this research combined Deterrence Theory with Akers' Social Learning Theory.

1.1. Deterrence Theory

Classical Deterrence Theory posits that individuals are deterred from engaging in illegal activities if they fear the consequences of the act, and that these consequences (or punishments) are perceived to be certain, severe, and swift (Homel, 1986, 1988). The perceived certainty of detection and subsequent punishment relates to whether offenders perceive a high likelihood of being arrested and punished for their criminal acts. Consistent with the predictions of Classical Deterrence Theory, previous research into drug driving has found that a lower perceived certainty of detection and punishment is associated with a greater likelihood of people reporting drug driving (Davey et al., 2008; Donald et al., 2006; Freeman et al., 2008; Freeman et al., 2010; Matthews et al., 2009; Mills, Truelove, et al., 2022; Watling & Freeman, 2011). Similarly, low levels of certainty of being punished for drug driving have been found to be associated with an increase in this behaviour among illicit drug users (Jones et al., 2006).

The perceived severity of punishment relates to the degree to which individuals believe that the penalty is relatively severe. Lower perceptions of punishment severity (such as the extent of applied fines) have been found to be associated with stronger intentions to drug drive in the future (Watling et al., 2014). The perceived swiftness of punishment is defined as how quickly people believe that the penalty will be administered. A study by Davey et al. (2008) reported that drug driving offenders perceive the time between apprehension and conviction to be swift. However, when future drug driving intentions were studied by Armstrong et al. (2018), none of these three constructs of Classical Deterrence Theory were found to be significant.

Some researchers have utilised an expanded version of Classical Deterrence Theory to provide a broader perspective on the influence of legal sanctions on illegal behaviours. Homel (1986, 1988) developed a model of deterrence to explain the introduction of RBT in Australia which incorporated both legal sanctions and informal sanctions, such as peer pressure, physical loss, internal loss and material loss. He suggested that the decision to drive after drinking alcohol is based on the individual's evaluation and balancing of the various outcomes with relation to the potential losses involved. In the area of drug driving research, drivers who felt ashamed and embarrassed if they were caught drug driving have been found to be less inclined to drug drive again (Watling & Freeman, 2011). Conversely, research has demonstrated that concerns about social sanctions (e.g., losing friends' respect), internal loss and physical loss by self-injury or vehicle damage have not been shown to be predictive of future intentions to offend (Freeman et al., 2008).

Classical Deterrence Theory was further extended by Stafford and Warr (1993) to incorporate the concept of punishment avoidance in addition to experiencing punishment, as well as vicarious exposure to these two outcomes (i.e., knowing others who have either been punished for illegal behaviour or have successfully avoided punishment). Evidence from the road safety field suggests that punishment avoidance, in particular, is strongly associated with illegal behaviours such as speeding (Fleiter & Watson, 2005; Truelove et al., 2021) and unlicensed driving (Watson, 2004a). In relation to drug driving, punishment avoidance and vicarious punishment avoidance experiences were found to be significant predictors of the intentions to drug drive in the future (Armstrong et al., 2018), but vicarious exposure to punishment was found to be poorly associated with drug driving (Armstrong et al., 2005).

1.2. Akers' Social Learning Theory

Akers (1977, 1990) argued that Deterrence Theory is conceptually limited in scope because it only considers the influence of legal sanctions on criminal behaviour and ignores a range of other factors known to encourage or discourage that behaviour. Drawing on the work of Skinner (1971), Sutherland et al. (1992) and Bandura (1977), Akers proposed a form of Social Learning Theory that he argued provides a more comprehensive framework for integrating a wide range of personal and social factors associated with illegal behaviour (Akers, 1977, 1990). The theory postulates that an individual's behaviour is primarily learned through *differential association* with significant others (such as family and friends); *imitating* their behaviours, which leads to forming one's own *definitions* (attitudes, beliefs or orientations), and having their behaviour *differentially reinforced* through social and non-social rewards or punishments. Based on the latter concept, a decision to engage in illegal behaviour represents a process of balancing the various anticipated outcomes.

Akers' Social Learning Theory (SLT) has been used to investigate a wide range of illegal driving behaviours including non-compliance with road laws (Bates et al., 2016), speeding (Fleiter et al., 2010; Scott-Parker et al., 2013), hooning (Gee Kee et al., 2007), unlicensed driving (Watson, 2004a), and drink driving (Chen, Grube, Nygaard, & Miller, 2008; Watling, Hooijer, Armstrong, & Watling, 2018).

While SLT has had little application to drug driving, there is evidence confirming the relevance of the constructs within SLT to understanding the influences on drug driving. In terms of social rewards and punishments for drug driving, peer influence has emerged as one of the most important social factors, as the greater one's peers acceptance of drug driving, the more likely an individual is to engage in this behaviour (Jones et al., 2007; McCarthy et al., 2007). In this regard, having friends who usually drug drive has been found to influence individuals so that they are more likely to engage in this illegal behaviour (Benotsch et al., 2015). Previous research has also demonstrated that drug users, who had family members or friends who drove following cannabis use, were more likely to drug drive themselves (Berg et al., 2018; Jones et al., 2007). A study by Otto et al. (2016) found that those who drive after using cannabis thought that drug driving was acceptable to their friends and most people in their community. On the other hand, other individuals have been found to refrain from engaging in drug driving because they believe that people who are important to them would be disappointed if they did so because the behaviour was inappropriate (Salmon et al., 2019; Ward et al., 2018).

Other research has shown that some groups of drug drivers have favourable attitudes (i.e., definitions) towards the behaviour. For instance, favourable attitudes to drug driving have been found among students and club attendees (Davey et al., 2005; Duff & Rowland, 2006). Another key construct within Akers' theory is differential reinforcement, which reflects the balance between the anticipated rewards and punishments for a particular behaviour. Previous research has shown that perceived social punishments are negatively

correlated with drug driving, while anticipated social rewards are positively associated with willingness to drug drive (Armstrong et al., 2005).

1.3. The present study

Drug driving has a wide range of adverse outcomes. While enforcement approaches to drug driving have been modelled on drink driving, the two behaviours are complex as there are different types and patterns of drinking and driving and many more different types and patterns of drug use and driving. This study aims to compare the sociodemographic, legal and psychosocial factors contributing to drink and drug driving. To guide the research, Deterrence Theory (in its classical and expanded forms) and Akers' Social Learning Theory were used to operationalise the key legal and psychosocial variables of interest. To explore the influence of the various factors on drink and drug driving, self-reported drink driving and drug driving over the last three months were chosen as the key outcome variables of interest. Drink driving was defined in terms of consuming alcoholic drinks then driving, rather than a specific blood alcohol concentration (BAC level), for comparability with drug driving which has no concentration limit for enforcement purposes. In addition, self-reported drug driving in combination with drink driving was also investigated since the two behaviours are known to often co-occur (Hammig et al., 2021; Li et al., 2020). Participants who self-reported driving after having consumed both alcohol and at least one other drug on the same occasion are referred to throughout the paper as 'self-reported combined drug and drink drivers'. The current study uses some items from a larger survey described in (Hasan et al., 2023), but unlike that paper, the focus here is on theoretical underpinnings of self-reported behaviour, rather than the broad range of contributing factors.

2. Methods

2.1. Participants

The online survey yielded a pool of 2,322 participants. Participants were free to skip questions in accordance with the approved ethical protocol for the study. Accordingly, the sample used in this study consisted of those participants who completed all the items relevant to the analyses undertaken, which eliminated the need to replace missing data. This resulted in a sample of 1,394 participants, aged 18–81 years (M = 37.3; SD = 16.4; 56.8% male) who all resided in Queensland, New South Wales or Victoria. The recruitment was carried out through a Facebook advertisement; Queensland University of Technology (QUT) mailing lists and the psychology participant pool designated for the first-year psychology students. The criteria for inclusion in the study were that participants needed to be 18 years or older; have consumed alcohol and/or drugs during the last 12 months and held a current driver's licence (Australian or international).

The ages of male and female participants differed significantly ($p < .01$), with females being younger. On average, participants reported driving 12 hours (SD = 12.8) per week and 76% had an unrestricted licence (including Open/ Full/ Foreign driver's licences). Given the graduated licensing systems in the three states, only 30% of the participants aged 24 or younger held an unrestricted licence, compared with 98% of the participants aged 25 and older. Most participants were either full-time (36.7%) or part-time employees (30.9%). Table 1 summarises the demographic characteristics of the drivers. The comparison of the sample with the official driver

Table 1
Demographic and driving characteristics of the total sample.

Total (N = 1,394)	N	%
Age		
Young adult (18–24 years)	437	31.3
Adult (25 years or older)	957	68.7
Gender		
Male	792	56.8
Female	587	42.1
Other	15	1.1
Marital status		
Single	506	36.3
Married/ have a partner	797	57.2
Divorced/ Widowed	91	6.5
Level of education		
Primary & secondary	471	33.8
Tertiary	923	66.2
Employment status		
Unemployed	392	28.1
Employed	1,002	71.9
Licence type		
Provisional licence (including Provisional/ Probationary licences)	321	23.0
Unrestricted licence (including Open/ Full/ Foreign driver's licences)	1,073	77.0
Average hours of driving per week		
Below 12 h	912	65.4
Over than 12 h	482	34.6

licensing data in the three states showed that the participants were more likely to be male (57% vs. 51%), younger (31% vs. 12% aged 24 or younger) and less likely to hold an unrestricted licence (77% vs. 88%) (Bureau of Infrastructure Transport and Regional Economics (BITRE), 2021). All first-year psychology students received partial course credit for their participation and other participants were entered into a draw to win one of six AUD $200 online vouchers. The study was approved by the Human Research Ethics Committee at Queensland University of Technology (QUT) (approval number 2000001069).

2.2. Materials

The outcome/dependent variables were self-reported drink driving, drug driving or combined drug and drink driving. Unlike alcohol, the current legal limit applying to drug driving reflects a *zero-tolerance* law approach. As a result, most jurisdictions consider any presence of drugs in the system while driving to represent drug driving. Consistent with this, self-reported drug driving was operationalised in this study as having driven within an hour of consuming drugs. To maintain comparability with this approach, self-reported drink driving was operationalised as having driven within an hour of consuming alcohol. In this regard, across Australia a 0.05 alcohol limit applies to general drivers and 0.02 to professional drivers, while a zero limit applies to Learner and Provisional (called Probationary in some states) driver's licence holders. As a consequence, it is possible that some of the participants who reported drink driving may not have been over the limit at the time and thus their behaviour may not have been illegal. The survey collected items assessing the following variables.

2.2.1. Sociodemographic variables

The sociodemographic variables collected were age, gender, type of driver's licence, level of income and hours of driving per week.

2.2.2. Substance use and dependence

Participants were asked to indicate whether they had used one or more of the following substances over the past 3 months: alcohol, cannabis, MDMA, amphetamine, methamphetamine, cocaine, opioids, hallucinogens, GHB and other drugs. If participants had not used any substances within the past 3 months, they were asked to select the response option: "None of the above".

The Alcohol, Smoking and Substance Involvement Screening Test (ASSIST, version 3.1) developed for the World Health Organization (WHO) was used to assess and identify problematic substance use (Humeniuk et al., 2010; Humeniuk & Holmwood, 2011). Participants were asked six items about: frequency of use; urge to use, drug-induced life problems (i.e., financial, legal, etc.), failure to perform usual tasks, others' expressed concerns about the participant's drug use and unsuccessful attempts to cut down on use. Possible overall scores on the ASSIST scale range from 0 to 39, with three levels of risk of drug use: 0–3 indicating low risk, 4–26 indicating medium risk and 27 or more indicating a high risk. The corresponding values for alcohol consumption are: 0–10 (low-risk), 11–26 (medium-risk) and +27 (high-risk). Participant's scores were calculated, with problematic substance use defined as a score of 4 or greater for drugs and 11 or greater for alcohol (i.e., medium- or high-risk) (Humeniuk et al., 2008).

2.2.3. Legal variables

The legal variables measured in the questionnaire were based on both Classical Deterrence Theory and Stafford and Warr (1993) reconceptualisation of the theory, and drew on previous studies in the road safety domain, such as Watson (2004a). The perceived certainty of detection was assessed using three items (e.g., *"It is very likely that I would be caught by the police if I were to drive within an hour of taking illegal drugs"*) ($\alpha = 0.68$) (α refers to Cronbach's alpha coefficient, which is used to measure the internal consistency, or reliability, of a set of survey items). The perceived certainty of punishment was assessed using two items (e.g., *"If I was caught driving in this way by the police, I'm sure that I'd receive a penalty"*) ($r = 0.17$) (r is the Pearson's correlation coefficient that measures the strength of the relationship between two variables). The perceived severity of punishment was assessed using two items (e.g., *"The penalty I'd receive if caught by the police driving in this way would be severe"*) ($r = 0.60$). The perceived swiftness of punishment was also assessed using two items (e.g., *"I'm likely to be punished quickly if I get caught driving in this way"*) ($r = 0.49$).

Direct experience of punishment was assessed by asking the participants if they *"Have ever been convicted of drug driving in the past?"*, with two outcomes (Yes, No). Indirect experience of punishment was assessed using two items (e.g., *"I am aware of people that have been caught and punished by the police for driving in this way"*) ($r = 0.44$). Similarly, indirect experience of punishment avoidance was assessed using two items (e.g., *"I am aware of people who have avoided being punished after being caught driving in this way"*) ($r = 0.64$). Direct experience of detection avoidance was assessed by asking the participants if they *"have regularly driven within an hour of having taken illegal drugs without being caught"*, with answers ranging from 1 "Never" to 5 "Always". Indirect experience of detection avoidance was assessed using two items (e.g., *"I am aware of people who have driven in this way and not been caught"*) ($r = 0.63$).

A similar set of questions was used to measure the deterrence-related perceptions and experiences relating to driving after consuming alcohol. A table of Cronbach's alpha and Pearson correlations for items measuring the variables is provided in the appendix (Table A1). Unless otherwise stated, all response choices were on a five-point Likert scale (1 = "Strongly disagree" to 5 = "Strongly agree"). Participants were asked to answer the questions even if they had never driven within an hour of consuming alcohol and/or drugs during the past three months.

2.2.4. Psychosocial variables

The psychosocial variables operationalised in the questionnaire were based on the theoretical model developed by Akers (1977, 1990, 1994), and drew on previous studies adopting the theory to road user behaviour, including Watson (2004b) and Fleiter et al. (2010). The behavioural dimension of differential association was measured using four items asking the participants how many of *"the*

people they consider to be the most important to them regularly drive within an hour of taking illegal drugs" (α = 0.89), with answers ranged from 1 "None" to 5 "All". The normative dimension of differential association was also measured with four items (e.g., *"Many of my friends think there is nothing wrong with driving in this way"*) (α = 0.89), with a scale of answers ranging from 1 "Strongly disagree" to 5 "Strongly agree" for this construct and the following ones.

Definitions refer to the attitudes, beliefs or orientations that individuals hold toward different behaviours. Given that the term "definitions" is not widely used in the road safety and traffic psychology fields, it was decided to refer to this construct as "attitudes" throughout the remainder of the paper. However, the construct retains Akers' original meaning, encompassing attitudes, beliefs and orientations. Consistent with this approach, attitudes (definitions) were measured in three categories: favourable (e.g., *"I think it is okay to drive in this way"*); neutral (e.g., *"I think that as long as I'm careful it is ok to drive in this way"*), and unfavourable (e.g., *"I think it is morally wrong to drive in this way"*). Each of the three forms of attitudes (definitions) was measured with two items. The two items measuring unfavourable attitudes (definitions) were reverse coded to enable a composite mean to be calculated using the six items (α = 0.90).

Two items each were used to measure anticipated instrumental (e.g., *"It makes life easier to drive in this way than to make alternative plans"*) ($r = 0.79$), social (e.g., *"My friends/partner would look up to me if I drove in this way"*) ($r = 0.92$), and non-social rewards (e.g., *"I feel more relaxed when I drive this way"*) ($r = 0.57$). Anticipated lack of punishment (e.g., *"It is no big deal to get caught driving in this way"*) ($r = 0.69$), instrumental (e.g., *"Because I don't want to lose the freedom of having my licence, I won't drive in this way"*) ($r = 0.77$), and non-social punishments (e.g., *"I'd feel guilty if I was to drive in this way"*) ($r = 0.86$) were measured with two items each. Anticipated social (informal) punishments were measured with four items (e.g., *"My family members would think I was stupid to drive in this way"*) (α = 0.92). These items were asked in relation to both drug driving and drink driving, resulting in two sets of variables as shown in Table A1 of the Appendix.

2.2.5. Drink and drug driving frequency

The frequency of drug driving was assessed by asking, "*Over the past 3 months, have you driven your vehicle within one hour of taking (selected drug/drugs)?*" with response options being: (1) Never, (2) Rarely, (3) Sometimes, (4) Often and (5) Always (Jones et al., 2005; Richer & Bergeron, 2009). Response choices were dichotomised into "no" if the respondents answered "never" and "yes" if they chose any of the remaining options (Jones et al., 2007).

Similarly, drink driving was assessed with the question: "*Over the past 3 months, have you ever driven within one hour after consuming alcoholic drinks (beer, wine, spirits, etc.)?*". Similar to drug driving, responses on a five-point Likert scale of choices were later dichotomised into "yes" and "no" and used for drink driving responses. The term "self-reported combined drug and drink driving" refers to the act of driving after having consumed both alcohol and at least one other drug on the same occasion. This variable was measured by asking participants who had already indicated driving after consuming one of the listed drugs "*on how many of these occasions '**of drug driving**' did you also consume alcohol?*", with answers ranging from "Never" to "Always".

2.2.6. Data analysis

Data were analysed using the IBM Statistical Package for the Social Sciences (Version 28). All analyses were evaluated at a significance level of α = 0.05. Descriptive analyses on the behaviours of interest and the key independent variables were conducted. Regression-based techniques were utilised to analyse the data.

The independent variables included in the analysis (see list in Table A2 of the Appendix) were selected based on background knowledge from the literature review and the aforementioned theories. Although the selection of independent variables was guided by theory, the primary goal was not to test these theories but to identify the key influences on drink and drug driving and how they may be similar and/or different. Therefore, a statistical approach was chosen to identify the most important predictors rather than a theoretically driven approach such as hierarchical regression. More particularly, logistic regression was used to examine the factors predicting drug driving, drink driving and combined drug and drink driving. Since the number of variables is smaller than the sample size, a backward elimination approach was used. Furthermore, compared to other elimination methods, the backward stepwise regression approach is useful because it has the advantage of considering the effects of all variables simultaneously by starting with the full model (i.e., all variables are under consideration), reduces the number of predictors, reduces the multicollinearity problem and resolves the overfitting of the models (Chowdhury & Turin, 2020). The variables were chosen to be excluded at each step according to a *p*-value greater than 0.05, and the procedure stopped when there were no variables left in the model that satisfy the elimination criterion (i.e., all variables in the model have a *p*-value less than 0.05).

Dummy coding was applied to the categorical variables, namely age (18 to 24 years: young adult [reference]; 25 and older: adult), income (did not state [reference]; "less than $10,000 - $29,999": low income; "$30,000 - more than $150,000" middle & high income) and hours of driving per week (0 to 11 h: below median [reference]; 12 h and more: over median). "Male" was chosen as the reference category for gender, while "Provisional/ Probationary licence" was selected as the reference group for the driver's licence type. Dependency was classified into three levels: non-consumers/low dependence, medium dependence and high dependence using the cut-offs described in Section 2.2.2. The Nagelkerke R^2 was used to measure the strength of association for each model of the logistic regressions.

3. Results

3.1. Descriptive analysis

Overall, 266 (19.1%) participants self-reported driving after using at least one of the listed drugs. Most drug driving was reported after using cannabis (n = 192), opioids (n = 66) and cocaine (n = 26). In total, 556 respondents indicated drink driving (with or without drugs) during the past three months, and 110 self-reported combined drug and drink driving.

In total, 723 participants (51.9% of the whole sample) met the threshold for problematic substance use (i.e., medium- or high-risk), of which 199 had a score indicative of problematic use of drugs-only; 329 for problematic use of alcohol-only and 195 for problematic alcohol and drug use. Cannabis was the most common drug of problematic use (n = 345, 24.8%), followed by cocaine (n = 59, 4.3%). Furthermore, 227 participants with problematic substance use (i.e., medium- or high-risk) self-reported drug driving (with or without alcohol), 204 drink driving (with or without drugs), and 100 combined drug and drink driving within the past three months.

3.2. Intercorrelations of variables

Bivariate correlations for the independent variables and dependent variables of self-reported drug driving, drink driving and combined drug and drink driving are presented in Tables A3, A4 and A5 of the Appendix. Anticipated non-social punishments, for both drug driving and drink driving, were strongly and positively correlated with anticipated social (informal) punishments, and negatively correlated with attitudes to drug driving. Of the sociodemographic variables, age was strongly and positively correlated with driver licence type.

3.3. Factors predicting self-reported drug and drink driving

A logistic regression was used to identify possible predictors of drink and drug driving from among the various sociodemographic, legal and psychosocial variables. The final model for each behaviour was reached by using a backward stepwise method. The final models are shown in Tables 2, 3 and 4.

3.3.1. Logistic regression analysis of factors predicting self-reported drug driving

The final model predicted 61% of the variance in drug driving (Nagelkerke R^2) (Table 2). Age was significantly associated with self-reported drug driving, with drivers aged 25 or older being less likely to report drug driving than younger drivers. The greater the level of drug dependence, the higher was the likelihood of self-reported drug driving (medium dependence: OR = 4.106, high dependence: OR = 11.062). Drivers who reported engaging in drink driving were more likely to report drug driving.

In terms of legal factors, direct experience of detection avoidance was significantly associated with self-reported drug driving, with those who regularly drove after taking drugs without being caught being more likely to report drug driving in the last three months. Among the psychosocial factors, attitudes and anticipated instrumental rewards were significantly associated with self-reported drug driving, with participants who agreed that nothing was wrong with drug driving along with those who considered it more convenient than using other forms of transport being more likely to drug drive. Experience of direct detection avoidance (OR = 2.325) and attitudes (OR = 2.116) also had strong associations with self-reported drug driving.

3.3.2. Logistic regression analysis of factors predicting self-reported drink driving

For drink driving, the final model predicted 60% of the variance in the outcome variable (Nagelkerke R^2) (Table 3). Male drivers

Table 2
Logistic regression analysis of self-reported drug driving [1] (N = 1,394).

Variables	*B*	Std. error	Wald test	Odds Ratio	95% CI for Odds ratio	
					Upper	Lower
Constant	−5.656	0.337	281.654***	0.003	–	–
Age [2]	−0.485	0.234	4.297*	0.616	0.389	0.974
Drug dependence [3]						
Medium dependence	1.412	0.219	41.729***	4.106	2.675	6.303
High dependence	2.404	0.547	19.316***	11.062	3.787	32.312
Self-reported drink driving	0.468	0.207	5.101*	1.597	1.064	2.398
Direct experience of detection avoidance	0.844	0.101	69.875***	2.325	1.908	2.834
Attitudes to drug driving	0.750	0.126	35.553***	2.116	1.654	2.708
Anticipated instrumental rewards	0.173	0.087	3.982*	1.189	1.003	1.410

Full model vs. constant-only model: χ^2 (7, 1,394) = 676.015, p <.001; Nagelkerke R^2 = 0.617.
[1] . Reference category is self-reported non-drug driving in last 3 months.
[2] . Reference category is young age group (i.e., 18 – 24 years).
[3] . Reference category is "Non-consumer/Low dependence".
* p <.05.
*** p <.001.

Table 3
Logistic regression analysis for self-reported drink driving[1] (N = 1,394).

Variables	*B*	Std. error	Wald test	Odds Ratio	95% CI for Odds ratio	
					Upper	Lower
Constant	−2.963	0.589	25.296***	0.052	–	–
Age [2]	−0.944	0.246	14.679***	0.389	0.240	0.631
Gender [3]	−0.354	0.162	4.804*	0.702	0.511	0.963
Driver's licence type [4]	1.161	0.289	16.150***	3.194	1.813	5.628
Alcohol dependence [5]						
Medium dependence	0.837	0.167	25.123***	2.310	1.665	3.205
High dependence	1.401	0.409	11.743***	4.059	1.822	9.045
Self-reported drug driving	0.609	0.197	9.537**	1.838	1.249	2.705
Perceived certainty of punishment	−0.305	0.092	11.107***	0.737	0.616	0.882
Direct experience of detection avoidance	1.527	0.109	197.016***	4.606	3.722	5.701
Attitudes to drink driving	0.379	0.101	14.011***	1.461	1.198	1.782

Full model vs. constant-only model: χ^2 (11, 1,394) = 809.680, p <.001; Nagelkerke R^2 = 0.596.
[1] . Reference category is self-reported non-drink driving in last 3 months.
[2] . Reference category is young age group (i.e., 18 – 24 years).
[3] . Reference category is "Male".
[4] . Reference category is Provisional licence (including Provisional/ Probationary licences).
[5] . Reference category is "Non-consumer/Low dependence".
* p <.05.
** p <.01.
*** p <.001.

Table 4
Logistic regression analysis for self-reported combined drug and drink driving [1] (N = 1,394).

Variables	*B*	Std. error	Wald test	Odds Ratio	95% CI for Odds ratio	
					Upper	Lower
Constant	−7.901	0.953	68.771***	0.000	–	–
Drug dependence [2]						
Medium dependence	1.809	0.333	29.454***	6.102	3.175	11.725
High dependence	1.857	0.531	12.249***	6.407	2.264	18.131
Direct experience of detection avoidance for ***drug*** driving	0.332	0.111	8.969**	1.394	1.122	1.733
Direct experience of detection avoidance for *drink* driving	0.709	0.111	40.812***	2.033	1.635	2.527
Attitudes to ***drug*** driving	0.464	0.152	9.356**	1.591	1.182	2.143
Behavioural dimension of differential association for *drink* driving	0.376	0.139	7.308**	1.457	1.109	1.914
Anticipated non-social punishments for *drink* driving	−0.287	0.113	6.472*	0.750	0.601	0.936

Full model vs. constant-only model: χ^2 (8, 1,394) = 330.779, p <.001; Nagelkerke R^2 = 0.498.
[1] Reference category is self-reported non-combined drug and drink driving in last 3 months.
[2] Reference category is "Non-consumer/Low dependence".
* p <.05.
** p <.01.
*** p <.001.

were significantly more likely to self-report drink driving than others (49.7% vs. 26.9%). Drink driving was significantly more common among drivers with unrestricted licences than those with provisional licences (47.3% vs. 15.0%). Overall, 26% of the drivers aged 18 to 24 reported drink driving, while 46% of drivers aged 25 and over reported drink driving. Given that unrestricted licences were more common amongst the older participants, this led to spurious results for the effects of age on drink driving, as the model shows that the drivers aged 25 or more were less likely to drink drive.

The greater the level of alcohol dependence, the higher was the likelihood of self-reported drink driving (medium dependence: OR = 2.310, high dependence: OR = 4.059). The regression shows that drivers engaging in drug driving were almost twice as likely to self-report drink driving.

Of the legal factors, perceived certainty of punishment was significantly associated with drink driving, with those believing that punishment is more certain being less likely to drive after consuming alcohol. On the other hand, direct experience of detection avoidance was significantly associated with self-reported drink driving, with those who regularly drove within an hour of consuming alcohol without being caught being more likely to report drink driving in the last three months. Of the psychosocial factors, attitudes were significantly associated with self-reported drink driving, with participants who indicated that nothing was wrong with driving after consuming alcohol being more likely to drink drive. The odds ratios indicate that having had direct experience of detection avoidance (OR = 4.606) and licence type (OR = 3.194) had strong associations with self-reported drink driving.

3.3.3. Logistic regression analysis of factors predicting self-reported combined drug and drink driving

For combined drug and drink driving, the final model predicted 50% of the variance in the outcome variable (Nagelkerke R^2) (Table 4). Medium and high levels of drug dependence were associated with a higher likelihood of self-reported combined drug and drink driving compared to low drug dependence or non-consumption. Of the legal factors, direct experiences of detection avoidance for drug driving and drink driving were significantly associated with self-reported combined drug and drink driving. More specifically, participants who did not get caught for driving after consuming either drugs or alcohol were more likely to self-report combined drug and drink driving.

Of the psychosocial factors, attitudes towards drug driving; the behavioural dimension of differential association for drink driving and anticipated non-social punishments for drink driving were significantly associated with self-reported combined drug and drink driving. More specifically, participants who agreed that nothing was wrong with drug driving were more likely to drug and drink drive. Similarly, participants who indicated that most people they know or mix with drive after consuming alcohol were more likely to drug and drink drive. In contrast, those who reported feeling guilty or worried about hurting themselves or other road users if they drove after consuming alcohol (i.e., anticipated non-social punishments) were less likely to self-report combined drug and drink driving. High (OR = 6.407) and medium (OR = 4.106) drug dependence and direct experience of detection avoidance for drink driving (OR = 2.033) had the strongest associations with self-reported combined drug and drink driving.

3.4. Summary of results

Table 5 summarises the factors that predict the driving behaviours. A (-) sign indicates that the factor is associated with a decrease in the likelihood of engaging in the behaviour; the (+) sign indicates an increase in this likelihood, while non-significant associations are left blank.

4. Discussion

The current study explored how drink and drug driving are associated with various personal characteristics and the potential rewards and punishments for engaging in these behaviours. The influence of sociodemographic, legal and psychosocial factors on self-reported drink and drug driving was investigated. The similarities and differences between the findings for these two behaviours and the implications for designing more effective countermeasures are discussed below.

4.1. Factors associated with both drink and drug driving

Most of the theoretical factors examined in this study were not found to be significantly associated with self-reported drink or drug driving. However, some theoretical factors contributed to both behaviours. Among the legal factors, direct (personal) experience of detection avoidance was a significant predictor of both behaviours. Similar to previous research (Armstrong et al., 2018; Szogi et al., 2017; Truelove et al., 2022), successful evasion of detection was associated with both self-reported drink driving and drug driving. This suggests that successful evasion might both encourage more frequent drink and drug driving, and similarly, that frequent drink and drug driving might enable faster and better learning of how to evade detection. This implies that the effectiveness of enforcement is undermined by drivers applying strategies to evade detection and thus avoid punishment. Previous research has shown that such strategies were either police-oriented (e.g., staying alert to police vehicles and locating operations by using GPS) or driving-oriented (e.g., drive home through back streets, camouflaging impaired driving performance) (Love et al., 2022; Mills, Truelove, et al., 2022; Oviedo-Trespalacios & Watson, 2021). For instance, drug drivers have reported seeing RDT tests being conducted repeatedly at the exact same location and setup, which may undermine police enforcement by encouraging them to memorise these locations and thus avoid them (Love et al., 2022).

Of the psychosocial factors, attitudes were the only shared factor associated with self-reported drink and drug driving. Although

Table 5
Summary of variables predicting engagement in self-reported drug, drink and combined drug and drink driving.

Variable	Prediction status		
	Drug driving	Drink driving	Combined drug and drink driving
Age (being 25 years or older)	–	–	
Gender (being male)		+	
Driver's licence type (holding an unrestricted licence)		+	
Substance dependence (medium to high dependence)	+	+	+
Self-reported drug driving		+	
Self-reported drink driving	+		
Perceived certainty of punishment		–	
Direct experience of punishment/ detection avoidance	+	+	+
Behavioural dimension of differential association			+
Attitudes	+	+	+
Anticipated instrumental rewards	+		
Anticipated non-social punishments			–

driving after taking alcohol or drugs is illegal (except for low levels of alcohol), some participants still had favourable attitudes toward drink and drug driving, believing that nothing was wrong with driving in this way. A central trait of SLT is that a personal preference for engaging in illegal behaviour is influenced by being exposed (i.e., through differential association) to others who also engage in the behaviour and who they thus imitate (Akers, 2017). Interestingly, the correlation analysis in this study showed a significantly positive association between attitudes and both the behavioural and normative dimensions of differential associations (see Table A5). That is, individuals interacting with important others who usually drink or drug drive and evaluate these behaviours as normal will reinforce their favourable attitudes toward drink driving and drug driving. Noteworthy, and similar to previous research (Armstrong et al., 2005), attitudes were positively associated with anticipated rewards for engaging in drink or drug driving and negatively with anticipated punishments (see Table A5).

Consistent with previous research (Castro et al., 2023; Hasan et al., 2023), there was solid evidence in this study that medium and high levels of alcohol or drug dependence are significant predictors of both drink or drug driving. In the current study, a dose response relationship was observed, with both drink and drug driving increasing as level of dependence increased. This reflects that decision-making regarding whether to drive after consuming alcohol or drugs is just one of the aspects affected by addiction. As outlined below, other factors influenced either drink or drug driving but not both.

4.2. Factors specific to drug driving

The rewards associated with drug driving have received little research attention (Hasan et al., 2022). While attitudes influenced both drink and drug driving, instrumental rewards were significantly associated with self-reported drug driving only. Specifically, the convenience of driving after taking drugs compared with using available but less convenient modes of transport was a motivation for drivers to engage in drug driving. The finding is consistent with previous research in Australia showing that limited access to alternative transport options was a leading factor contributing to the decision to drug drive (Gavin et al., 2008). Coordinating road safety strategies with better public transport access decisions is a prudent approach towards enhancing road safety in Australia.

None of the legal factors were found to be a significant predictor of drug driving, except direct experience of detection avoidance. Moreover, similar to previous research, whether or not a driver perceived the punishment to be certain, severe or swift did not appear to influence the tendency to drug drive (Armstrong et al., 2018; Freeman et al., 2008; Watling & Freeman, 2011; Watling et al., 2010). This questions whether relying solely on enforcement is sufficient to curb drug driving.

4.3. Factors specific to drink driving

In terms of the legal factors, greater perceived certainty of punishment was associated with a lower likelihood of drink driving. This is consistent with the general body of research (Freeman et al., 2006; Freeman & Watson, 2006; Szogi et al., 2017). The influence of perceived certainty of punishment suggests that current enforcement efforts to deter drink drivers are being successfully implemented. In particular, evaluations of RBT suggest it has had a long-term deterrent effect in Australia (Bates et al., 2012; Truelove et al., 2022; Watson et al., 2005). While several studies have shown that the severity and swiftness of punishment are significant deterrents for drink driving (Freeman et al., 2006; Freeman & Watson, 2006; Szogi et al., 2017), they did not appear as predictors in the current drink driving model.

Some sociodemographic factors were significantly associated with self-reported drink driving but not drug driving. Drink driving was significantly more common among drivers with unrestricted licences than those with provisional licences (47.3% versus 15.0%). As noted earlier, drink driving was defined in this study as driving after consuming alcohol, regardless of what the blood alcohol concentration may have been. The participants were from Australian states where any concentration of alcohol in the blood is illegal for provisional licence holders, but fully licensed drivers are subject to a 0.05% BAC limit. Thus, the drink driving measure in this study related to an illegal behaviour for the provisionally-licensed drivers but it may not necessarily have been an illegal behaviour for the fully-licensed drivers. Therefore, the study findings that provisional licence holders were less likely to report drink driving (as defined in the study) are consistent with their being deterred by the potential legal consequences of that behaviour.

None of the psychosocial factors were found to be significant predictors of drink driving, except for attitudes, which are discussed in more detail later in this paper.

4.4. Factors specific to combined drug and drink driving

To the best of the authors' knowledge, this is the first study to examine legal and psychosocial factors contributing to self-reported combined drug and drink driving. Among the legal factors examined, direct experience of detection avoidance was the only factor associated with self-reported combined drug and drink driving. This factor emerged as an important predictor of the two risky driving behaviours when considered separately, thus, it is expected that driving after drug and alcohol consumption together would be affected by perceptions relating to the possibility of evading detection. Indeed, it is possible that the likelihood of evading detection will seem greater due to the cognitive impairment resulting from the combination of drugs and alcohol, and if addiction is present, these perceptions may be exacerbated. Alternatively, since the direct experience of detection avoidance was correlated with lower perceptions of certainty of detection, this might serve to motivate more participation in risky driving (see Table A4). This should be a point of concern for road safety stakeholders and road authorities given the increasing popularity and accessibility of applications to locate

police enforcement operations (Truelove, Nicolls, Stefanidis, & Oviedo-Trespalacios, 2023; Oviedo-Trespalacios and Watson, 2021).

A group of psychosocial factors emerged as predictors of self-reported combined drug and drink driving. Firstly, attitudes were the main predictor of combined drug and drink driving. Some participants believed that nothing was wrong with combined drug and drink driving. Akers' SLT proposes that the social environment in which a particular behaviour occurs plays a vital role in shaping favourable personal attitudes toward the behaviour. A person exposed to such attitudes tends to behave in a way congruent with the behaviour of those with whom they associate. Indeed, this study showed that the behavioural dimension of differential association for drink driving appeared as a predictor of self-reported combined drug and drink driving, with participants who indicated that most people they mixed with drove after consuming alcohol being more likely to report combined drug and drink driving. The social influence of those known to the driver can be detrimental, and it is therefore essential to educate people about the risks associated with behaviour such as drink and drug driving and to encourage them to be responsible role models to others. On the other hand, drivers who were concerned about the risk of hurting themselves or someone else and felt guilty about drink driving (i.e., non-social punishments) were less likely to self-report combined drug and drink driving. A possible explanation for the effect of the anticipated non-social punishments is that some drivers believed that alcohol consumption impairs the ability to drive and increases the crash risk (Ward et al., 2017). A further explanation could be attributed to community anti-drink driving campaigns that emphasise negative feelings and social disapprovals for the behaviour. Finally, none of the sociodemographic factors were found to predict combined drug and drink driving.

4.5. Implications for road safety

The findings have important implications for road safety, both in relation to existing countermeasures and the need for new approaches. In terms of drink and drug driving enforcement, a key implication is the need to reduce drivers' experience of avoiding detection. A number of researchers have argued that successful deterrence requires that enforcement should be as unavoidable as possible (Homel, 1986; Watson, 1994). In this regard, ongoing innovation is required to enhance RDT and RBT operations to minimise the likelihood of punishment avoidance and maximise the exposure to direct and indirect punishment experiences. In order to increase the awareness of detection risks, previous research has suggested increasing the variability in RDT and RBT operations to optimise their visibility while maintaining their unpredictability in time and location (Haworth & Lenné, 2007; Homel, 1993). However, much of the previous research was conducted before technology made it easy to identify police enforcement locations. Today, ubiquitous tools like GPS and social media can be used by offenders to avoid police. Therefore, it is unclear whether RDT and RBT operations have reached a point where further uncertainty regarding testing times and locations can be generated. This highlights the need for further research into the strategies being used by drivers to evade detection and potential approaches to counter them.

Furthermore, as RBT has been operating for longer than RDT, more people have been exposed to the threat of alcohol testing, thus enhancing its deterrent effect (Homel, 1986). This suggests that the deterrent effect of RDT may grow over time. However, deterrence is an unstable process that requires ongoing resources and innovation (Homel, 1993). A good example is the temporary suspension of RBT during COVID-19, which was associated with decreased perceptions of apprehension and continued drink driving (Watson-Brown et al., 2021). Furthermore, it remains unclear whether the current level of RDT testing in Australia is likely to be sufficient to match the deterrent effect of RBT, even if it operates for much longer. Previous research recommended providing additional resources to increase the number of RDT tests performed annually (Newstead et al., 2020). The current results suggest that enhancements to enforcement should be part of a more comprehensive approach that addresses drug use as a public health concern.

A further suggestion is to refine existing enforcement to be more holistic in deterring combined drug and drink driving by testing and applying penalties for combined drink and drug driving offences. Additionally, this can present challenges due to the additional resources required and the difficulty in maintaining drivers' perceptions of such penalties as just and thus enhancing their compliance with the law (Watling & Freeman, 2011). Noteworthy, research on perceptions of policing and procedural justice to enhance the integrity of drink and drug driving enforcement is scarce.

Information campaigns and educational programs can bring about slow but significant changes in the attitudes prevalent in society and need to be considered (Fleiter et al., 2014). These campaigns should stress that engaging in these risky driving behaviours is socially undesirable, in the long-term, strengthening the anticipated social punishments for the behaviour. However, changing entrenched community acceptance for drink driving, drug driving and combined drug and drink driving can be a challenging task. Previous research has shown that changing attitudes to risky behaviours, such as speeding, does not necessarily lead to behaviour change (Fleiter & Watson, 2005), particularly if there are rewards anticipated for engaging in these behaviours. These rewards may be linked to personal characteristics such as risk-taking and sensation-seeking propensity (Armstrong et al., 2005), as previous research has indicated that consuming alcohol and drugs together leads to increased risk-taking (Dever et al., 2012).

Since favourable attitudes to drug driving were positively associated with anticipated instrumental rewards, another approach to reducing drug driving could focus on minimising these rewards. For example, the convenience of driving home after drug taking compared with other transport alternatives was identified as an important reward for drug driving. Increasing the frequency and reducing the costs of using buses or taxis at night in entertainment precincts where drug taking is more common could minimise the anticipated reward of driving home (Gavin et al., 2008).

While some of the sociodemographic factors identified in this study are not modifiable (i.e., age), or are difficult to do so (i.e., licence status, hours driven), identifying them can assist in tailoring specific interventions to different groups of drivers. Moreover, drink and drug dependence emerged as significant predictors for each of the counterpart driving behaviours. Accordingly, specific addiction treatment programs may be more useful than enforcement in reducing drug and drink driving among alcohol and drug

addicts. Research has shown that drink driving-related crashes were reduced by 50% in the ten-year period following the introduction of adequate health programs to treat alcohol addiction, which suggests that a similar approach for drug addiction may be successful in reducing drug driving (Salmon et al., 2020). In Australia, these programs are mainly designed around rehabilitation, behavioural change, withdrawal management and pharmacotherapy. More specifically, drivers convicted of drink driving offences are required to follow either a behaviour change program (e.g., The Behaviour Change Program, Victoria), complete a short online course that encourages separating drinking from driving (e.g., Drink driving short course, Queensland), or group therapy (e.g., The Sober Driver Program, New South Wales). There is no evidence that these alcohol rehabilitation programs would be suitable for drug driving. Therefore, similar but tailored programs are needed for drug driving as they are currently only available in Victoria.

4.6. Strengths and limitations

This study has some key strengths. Firstly, an integrated approach was undertaken to examining and comparing the legal and psychosocial factors contributing to self-reported drink driving and drug driving. A review of the relevant literature indicated that there were no studies specifically comparing these two behaviours alongside combined drug and drink driving through a framework that integrates legal and psychosocial factors. Therefore, the findings of this study may assist policymakers to identify strategies that are more specific to drug driving rather than rely on approaches traditionally used to address drink driving. A second strength of the present work was the utilisation of a robust theoretical framework combining Deterrence Theory and Akers' Social Learning Theory. However, it should be noted that the study used these theories to identify the variables and then analyse them from a statistical point of view rather than specifically test the adequacy of these theories.

It is also important to acknowledge the limitations of this study. First, self-reported drink driving behaviour was measured in a way to make it comparable with self-reported drug driving, but therefore did not necessarily equate to illegal drink driving (at least for fully-licensed drivers). Second, the two items used to measure perceived certainty of punishment (for both drink driving and drug driving) were only weakly correlated. This could be due to some level of measurement error or limitations with the scale that may have diminished the relationship between the two items. Third, backwards elimination was used in the regression analyses. Other algorithms could result in different models, and different variables might emerge as significant. Fourth, participants were recruited through Facebook advertising, which has been shown to be a low-cost and efficient method for reaching different groups of the general population (Kamp et al., 2019; Whitaker et al., 2017). However, since not all people use Facebook and the sample included many psychology students, care should be taken when generalising the findings. Lastly, as the study utilised an online survey for collecting self-reported data over different time periods, a range of recall biases may have been introduced. Furthermore, there may be the problem of socially desirable responding, which may lead to a potential bias.

5. Conclusions

This research has demonstrated that there are both similarities and differences in the sociodemographic, psychosocial and legal factors which appear to influence drug and drink driving. Among the legal factors examined, direct experience of avoiding detection was a strong motivator for both drink and drug driving. Furthermore, the certainty of punishment was significant in explaining self-reported drink driving, but not drug driving. This may in part be due to the way drug driving enforcement is carried out, as not all drugs can be detected by oral fluid devices and they produce relatively high false positive results, especially for cannabis (Arkell et al., 2019). The findings imply that the deterrent effect of RDT is not as strong as RBT. Identifying innovative mechanisms to make police enforcement more unavoidable and unpredictable in time and location would likely enhance the deterrent effect of both RBT and RDT.

Furthermore, relying on enforcement and associated legal sanctions in isolation without considering psychosocial rewards and punishments does not appear sufficient to reduce drink or drug driving. The significance of psychosocial factors was evident, as attitudes appeared to be significantly associated with both driving behaviours. In addition, rewards encouraging the behaviour, such as anticipated instrumental rewards, were found to be associated with self-reported drug driving. Future research should focus on examining countermeasures that integrate deterrence and psychosocial principles in order to change these risky driving behaviours.

Overall, this highlights the importance of recognising drug driving as a public health issue, not just a road safety issue. Cooperation among government agencies is not just desirable, it is imperative. Effective strategies to combat drug-impaired driving must address the root causes of drug use, such as addiction and lack of access to treatment, and involve a multi-disciplinary approach that includes law enforcement, healthcare professionals, and the wider community. With a comprehensive approach, safer roads can be created for everyone, and the devastating effects of drug-impaired driving can be reduced.

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CRediT authorship contribution statement

Razi Hasan: Methodology, Conceptualization, Data curation, Formal analysis, Investigation, Writing - original draft. **Barry Watson:** Supervision, Conceptualization, Methodology, Validation, Writing - review & editing. **Narelle Haworth:** Supervision, Conceptualization, Methodology, Validation, Writing - review & editing. **Oscar Oviedo-Trespalacios:** Supervision, Conceptualization, Methodology, Validation, Writing - review & editing.

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

Data will be made available on request.

Appendix A

Table A1, Table A2, Tables A3, A4 and A5.

Table A1
Means, standard deviations, Cronbach and Pearson's reliability coefficients of scales (N = 1,394).

Construct (variable)	*Number of items measuring the construct*	*Cronbach's α/ Pearson r* **	*Mean (M)*	*Standard deviations (SD)*
Drug driving related constructs				
Perceived certainty of detection	3	$\alpha = 0.681$	3.111	0.969
Perceived certainty of punishment	2	$r = 0.173$	4.272	0.791
Perceived severity of punishment	2	$r = 0.598$	4.203	0.970
Perceived swiftness of punishment	2	$r = 0.492$	3.615	1.020
Direct experience of punishment	1	–	–	–
Direct experience of punishment/ detection avoidance	1	–	1.55	1.081
Indirect experience of punishment	2	$r = 0.439$	2.873	1.191
Indirect experience of *detection* avoidance	2	$r = 0.629$	3.417	1.211
Indirect experience of *punishment* avoidance	2	$r = 0.644$	2.359	1.125
Behavioural dimension of differential association	4	$\alpha = 0.888$	1.533	0.757
Normative dimension of differential association	4	$\alpha = 0.889$	1.773	0.911
Attitudes	6	$\alpha = 0.904$	1.76	0.942
Anticipated instrumental rewards	2	$r = 0.793$	2.430	1.342
Anticipated non-social rewards	2	$r = 0.574$	1.523	0.846
Anticipated social rewards	2	$r = 0.923$	1.282	0.689
Anticipated lack of punishments	2	$r = 0.693$	1.402	0.781
Anticipated instrumental punishments	2	$r = 0.766$	3.887	1.288
Anticipated non-social punishments	2	$r = 0.864$	4.142	1.219
Anticipated social (informal) punishments	4	$\alpha = 0.915$	4.428	0.891
Drink driving related constructs				
Perceived certainty of detection	3	$\alpha = 0.624$	3.149	0.921
Perceived certainty of punishment	2	$r = 0.201$	4.038	0.925
Perceived severity of punishment	2	$r = 0.660$	4.039	1.052
Perceived swiftness of punishment	2	$r = 0.498$	3.640	0.997
Direct experience of punishment	1	–	–	–
Direct experience of punishment/ detection avoidance	1	–	1.93	1.129
Indirect experience of punishment	2	$r = 0.477$	3.458	1.167
Indirect experience of *detection* avoidance	2	$r = 0.610$	3.672	1.117
Indirect experience of *punishment* avoidance	2	$r = 0.650$	2.518	1.185
Behavioural dimension of differential association	4	$\alpha = 0.905$	1.902	0.869
Normative dimension of differential association	4	$\alpha = 0.888$	1.874	0.920
Attitudes	6	$\alpha = 0.886$	1.832	0.903
Anticipated instrumental rewards	2	$r = 0.794$	2.459	1.317
Anticipated non-social rewards	2	$r = 0.648$	1.476	0.778
Anticipated social rewards	2	$r = 0.910$	1.288	0.654
Anticipated lack of punishments	2	$r = 0.671$	1.447	0.795
Anticipated instrumental punishments	2	$r = 0.778$	3.911	1.267
Anticipated non-social punishments	2	$r = 0.856$	4.211	1.083
Anticipated social (informal) punishments	4	$\alpha = 0.914$	4.395	0.862

** Correlation is significant at the 0.01 level (2-tailed).

Table A2
Independent variables included in the logistic regressions.

Variable	Measurement type	Scale Response categories
Age	Dichotomous	(1) Young adult (18 – 24 years) (Ref) (2) Adult (25 years or older)
Gender	Dichotomous	(1) Male (Ref) (2) Female + Other
Income per year	Nominal	(1) Did not state (Ref) (2) Low income (3) Middle & High income
Driver's licence type	Dichotomous	(1) Provisional/ Probationary licence (Ref) (2) Open/ Full/ Foreign driver's licence
Hours of driving per week	Dichotomous	(1) Below median (Ref) (2) Over median
Drug dependence	Nominal	(1) Non-consumer/ Low (Ref) (2) Medium (3) High
Alcohol dependence	Nominal	(1) Non-consumer/ Low (Ref) (2) Medium (3) High
Self-reported drink driving (when the DV is drug driving vs. non-drug driving)	Dichotomous	(1) No (Ref) (2) Yes
Self-reported drug driving (when the DV is drink driving vs. non-drink driving)	Dichotomous	(1) No (Ref) (2) Yes
Legal and psychosocial variables	Various (see Table A1)	Various (see Table A1)

Table A3
Correlation matrix of dependent and independent variables (Page 1).

Variable		1	2	3	4	5	6	7	8	9	10
Drug driving	1	1.00	0.212**	0.603**	0.064*	−0.140**	0.075**	0.055*	0.088**	0.493**	0.028
Drink driving	2		1.00	0.359**	0.194**	−0.231**	0.278**	0.162**	0.122**	0.201**	0.378**
Combined drug and drink driving	3			1.00	0.066*	−0.121**	0.091**	0.062*	0.101**	0.328**	0.173**
Age	4				1.00	−0.216**	0.747**	0.274**	0.121**	−0.079**	−0.043
Gender	5					1.00	−0.201**	−0.183**	−0.137**	−0.114**	−0.071**
Driver's licence	6						1.00	0.265**	0.111**	−0.045	−0.015
Income per year	7							1.00	0.078**	0.038	0.069*
Hours of driving per week	8								1.00	0.019	−0.022
Drugs dependence	9									1.00	0.170**
Alcohol dependence	10										1.00
Certainty of detection	11										
Certainty of punishment	12										
Severity of punishment	13										
Swiftness of punishment	14										
Indirect punishment	15										
Indirect detection avoidance	16										
Indirect punishment avoidance	17										
Direct punishment	18										
Direct punishment/ detection avoidance	19										
Behavioural dimension of differential association	20										
Normative dimension of differential association	21										
Attitudes	22										
Instrumental rewards	23										
Non-social rewards	24										
Social rewards	25										
Lack of punishments	26										
Instrumental punishments	27										
Non-social punishments	28										
Informal social punishments	29										

** Correlation is significant at the 0.01 level.
* Correlation is significant at the 0.05 level.

Table A4
Correlation matrix of dependent and independent variables (Page 2).

Variable			11	12	13	14	15	16	17	18	19
Drug driving	1		−0.151**	−0.154**	−0.061*	−0.052	0.114**	0.228**	0.102**	−0.201**	0.659**
Drink driving	2		−0.163**	−0.237**	−0.146**	−0.052	0.133**	0.172**	0.066*	−0.131**	0.646**
Combined drug and drink driving	3	DD[1]	−0.114**	−0.107**	−0.037	−0.029	0.075**	0.137**	0.092**	−0.112**	0.449**
		AD[2]	−0.060*	−0.064*	−0.036	0.002	0.090**	0.075**	0.043	−0.107**	0.348**
Age	4	DD	−0.138**	−0.135**	−0.203**	−0.122**	−0.011	0.042	0.032	−0.065*	0.157**
		AD	−0.135**	−0.185**	−0.228**	−0.116**	0.069*	0.028	0.050	−0.190**	0.288**
Gender	5	DD	0.189**	0.074**	0.069*	0.039	−0.027	−0.089**	−0.024	0.069**	−0.198**
		AD	0.137**	0.101**	0.060*	0.008	−0.100**	−0.065*	−0.028	0.139**	−0.249**
Driver's licence	6	DD	−0.164**	−0.119**	−0.173**	−0.116**	−0.028	0.072**	0.022	−0.029	0.137**
		AD	−0.169**	−0.228**	−0.243**	−0.125**	0.051	0.049	0.060*	−0.138**	0.324**
Income per year	7	DD	−0.137**	−0.010	−0.046	−0.032	0.057*	0.134**	0.031	−0.033	0.098**
		AD	−0.143**	−0.057*	−0.063*	−0.033	0.082**	0.109**	0.047	−0.064*	0.186**
Hours of driving per week	8	DD	−0.015	−0.070**	−0.035	−0.084**	0.076**	0.040	0.049	−0.065*	0.098**
		AD	−0.001	−0.066*	−0.042	−0.060*	0.073**	−0.009	0.073**	−0.031	0.129**
Drugs dependence	9	DD	−0.114**	−0.061*	0.042	0.016	0.153**	0.283**	0.070**	−0.198**	0.540**
		AD	−0.016	−0.032	−0.004	0.051	0.126**	0.073**	−0.005	−0.122**	0.152**
Alcohol dependence	10	DD	−0.044	0.031	0.078**	0.025	0.068*	0.110**	0.002	0.029	0.048
		AD	−0.051	0.035	0.062*	0.041	0.116**	0.160**	0.026	−0.173**	0.324**
Certainty of detection	11	DD	1.00	0.277**	0.312**	0.192**	0.101**	−0.191**	−0.094**	0.015	−0.230**
		AD	1.00	0.278**	0.297**	0.211**	0.063**	−0.143**	−0.097**	−0.001	−0.238**
Certainty of punishment	12	DD		1.00	0.441**	0.262**	0.055*	−0.052	−0.275**	0.050	−0.172**
		AD		1.00	0.498**	0.233**	0.026	−0.019	−0.258**	−0.033	−0.217**
Severity of punishment	13	DD			1.00	0.405**	0.150**	0.005	−0.136**	0.025	−0.080**
		AD			1.00	0.364**	0.106**	0.006	−0.191**	0.022	−0.170**
Swiftness of punishment	14	DD				1.00	0.158**	−0.002	−0.101**	0.043	−0.056*
		AD				1.00	0.175**	0.024	−0.089**	0.020	−0.054*
Indirect punishment	15	DD					1.00	0.401**	0.260**	−0.139**	0.170**
		AD					1.00	0.397**	0.209**	−0.089**	0.151**
Indirect detection avoidance	16	DD						1.00	0.405**	−0.100**	0.292**
		AD						1.00	0.337**	−0.062*	0.238**
Indirect punishment avoidance	17	DD							1.00	−0.024	0.146**
		AD							1.00	−0.006	0.084**
Direct punishment	18	DD								1.00	−0.296**
		AD								1.00	−0.201**
Direct punishment/ detection avoidance	19	DD									1.00
		AD									1.00

[1] DD: questions asked with regard to drug driving.
[2] AD: questions asked with regard to drink driving.
** Correlation is significant at the 0.01 level.
* Correlation is significant at the 0.05 level.

Table A5
Correlation matrix of dependent and independent variables (Page 3).

Variable			20	21	22	23	24	25	26	27	28	29
Drug driving	1		0.375**	0.405**	0.582**	0.328**	0.384**	0.281**	0.282**	−0.349**	−0.483**	−0.401**
Drink driving	2		0.298**	0.237**	0.438**	0.271**	0.220**	0.192**	0.153**	−0.218**	−0.367**	−0.293**
Combined drug and drink driving	3	DD	0.263**	0.259**	0.379**	0.213**	0.272**	0.153**	0.149**	−0.255**	−0.314**	−0.248**
		AD	0.200**	0.152**	0.222**	0.148**	0.185**	0.124**	0.115**	−0.208**	−0.251**	−0.184**
Age	4	DD	0.047	0.146**	0.146**	0.056*	0.017	0.040	0.080**	−0.086**	−0.130**	−0.101**
		AD	0.134**	0.156**	0.179**	0.089**	0.032	0.067*	0.094**	−0.070**	−0.129**	−0.108**
Gender	5	DD	−0.153**	−0.198**	−0.233**	−0.170**	−0.211**	−0.139**	−0.128**	0.148**	0.254**	0.197**
		AD	−0.120**	−0.138**	−0.206**	−0.146**	−0.176**	−0.118**	−0.143**	0.132**	0.240**	0.174**
Driver's licence	6	DD	0.061*	0.138**	0.114**	0.083**	0.036	0.059*	0.071**	−0.079**	−0.107**	−0.082**
		AD	0.157**	0.171**	0.195**	0.113**	0.059*	0.093**	0.107**	−0.082**	−0.134**	−0.120**
Income per year	7	DD	0.059*	0.062*	0.089**	0.060*	0.052	0.038	0.030	−0.055*	−0.108**	−0.082**
		AD	0.087**	0.047	0.117**	0.066*	0.030	0.029	0.026	−0.032	−0.108**	−0.068*
Hours of driving per week	8	DD	0.071**	0.136**	0.115**	0.049	0.074**	0.062*	0.053*	−0.107**	−0.099**	−0.095**
		AD	0.043	0.083**	0.062*	0.005	0.076**	0.074**	0.064*	−0.067*	−0.055*	−0.038
Drugs dependence	9	DD	0.345**	0.320**	0.499**	0.278**	0.340**	0.225**	0.187**	−0.297**	−0.433**	−0.343**
		AD	0.128**	0.082**	0.137**	0.121**	0.194**	0.117**	0.128**	−0.153**	−0.146**	−0.127**
Alcohol dependence	10	DD	0.112**	0.002	0.058*	0.110**	0.079**	0.006	−0.009	−0.020	−0.038	0.015
		AD	0.190**	0.103**	0.209**	0.161**	0.140**	0.058*	0.016	−0.079**	−0.158**	−0.092**
Certainty of detection	11	DD	−0.124**	−0.166**	−0.243**	−0.214**	−0.150**	−0.108**	−0.127**	0.189**	0.271**	0.227**
		AD	−0.114**	−0.150**	−0.286**	−0.230**	−0.111**	−0.108**	−0.113**	0.178**	0.280**	0.223**

(*continued on next page*)

Table A5 (*continued*)

Variable			20	21	22	23	24	25	26	27	28	29
Certainty of punishment	12	DD	−0.147**	−0.250**	−0.253**	−0.109**	−0.194**	−0.240**	−0.270**	0.224**	0.206**	0.252**
		AD	−0.205**	−0.280**	−0.354**	−0.175**	−0.179**	−0.242**	−0.248**	0.239**	0.272**	0.282**
Severity of punishment	13	DD	−0.078**	−0.196**	−0.179**	−0.088**	−0.110**	−0.206**	−0.308**	0.177**	0.178**	0.252**
		AD	−0.148**	−0.230**	−0.296**	−0.148**	−0.150**	−0.238**	−0.302**	0.203**	0.265**	0.328**
Swiftness of punishment	14	DD	−0.085**	−0.135**	−0.137**	−0.065*	−0.076**	−0.087**	−0.148**	0.143**	0.144**	0.176**
		AD	−0.093**	−0.137**	−0.168**	−0.073**	−0.078**	−0.135**	−0.137**	0.142**	0.157**	0.190**
Indirect punishment	15	DD	0.219**	0.180**	0.119**	0.101**	0.099**	0.085**	0.058*	−0.060*	−0.085**	−0.073**
		AD	0.204**	0.102**	0.027	0.108**	0.040	−0.012	0.002	0.000	−0.016	0.020
Indirect detection avoidance	16	DD	0.282**	0.271**	0.222**	0.276**	0.198**	0.087**	0.093**	−0.131**	−0.217**	−0.146**
		AD	0.260**	0.169**	0.107**	0.199**	0.046	−0.002	0.001	−0.025	−0.059*	−0.030
Indirect punishment avoidance	17	DD	0.185**	0.230**	0.162**	0.151**	0.170**	0.175**	0.162**	−0.109**	−0.088**	−0.122**
		AD	0.150**	0.178**	0.141**	0.138**	0.126**	0.137**	0.141**	−0.091**	−0.031	−0.067*
Direct punishment	18	DD	−0.154**	−0.197**	−0.245**	−0.161**	−0.144**	−0.125**	−0.134**	0.160**	0.229**	0.189**
		AD	−0.106**	−0.101**	−0.100**	−0.038	−0.097**	−0.109**	−0.089**	0.054*	0.104**	0.096**
Direct punishment/ detection avoidance	19	DD	0.421**	0.457**	0.636**	0.356**	0.416**	0.299**	0.302**	−0.410**	−0.580**	−0.465**
		AD	0.365**	0.309**	0.497**	0.314**	0.248**	0.181**	0.174**	−0.253**	−0.427**	−0.341**
Behavioural dimension of differential association	20	DD	1.00	0.519**	0.446**	0.301**	0.400**	0.400**	0.325**	−0.230**	−0.335**	−0.332**
		AD	1.00	0.511**	0.313**	0.295**	0.274**	0.286**	0.247**	−0.166**	−0.258**	−0.273**
Normative dimension of differential association	21	DD		1.00	0.576**	0.341**	0.431**	0.458**	0.413**	−0.322**	−0.467**	−0.483**
		AD		1.00	0.462**	0.287**	0.335**	0.385**	0.375**	−0.230**	−0.338**	−0.386**
Attitudes	22	DD			1.00	0.391**	0.531**	0.480**	0.448**	−0.493**	−0.719**	−0.630**
		AD			1.00	0.361**	0.412**	0.427**	0.378**	−0.382**	−0.635**	−0.587**
Instrumental rewards	23	DD				1.00	0.367**	0.254**	0.225**	−0.263**	−0.357**	−0.268**
		AD				1.00	0.279**	0.216**	0.209**	−0.231**	−0.328**	−0.272**
Non−social rewards	24	DD					1.00	0.661**	0.394**	−0.219**	−0.439**	−0.372**
		AD					1.00	0.641**	0.403**	−0.173**	−0.337**	−0.322**
Social rewards	25	DD						1.00	0.497**	−0.213**	−0.329**	−0.404**
		AD						1.00	0.491**	−0.197**	−0.310**	−0.387**
Lack of punishments	26	DD							1.00	−0.190**	−0.330**	−0.414**
		AD							1.00	−0.160**	−0.326**	−0.367**
Instrumental punishments	27	DD								1.00	0.526**	0.470**
		AD								1.00	0.433**	0.402**
Non-social punishments	28	DD									1.00	0.790**
		AD									1.00	0.792**
Informal social punishments	29	DD										1.00
		AD										1.00

[1] DD: questions asked with regard to drug driving.
[2] AD: questions asked with regard to drink driving.
** Correlation is significant at the 0.01 level.
* Correlation is significant at the 0.05 level.

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