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Driving under the influence of cannabis: The problem and potential countermeasures

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This bulletin assessed (a) whether recent drug-drivers were more likely to self-report accidents than non-intoxicated drivers; (b) the likely deterrent effect of roadside drug testing (RDT), increasing the severity of sanctions for drug-driving and providing factual information about accident risk associated with drug-driving; and (c) what factors were predictive of driving under the influence of cannabis (DUIC). Face-to-face structured interviews were conducted with 320 cannabis users in NSW. The results provided only limited support for a relationship between DUIC and accident risk, although replication with a larger sample size is recommended. RDT appears to act as a more effective deterrent against drug-driving than either increasing the severity of sanctions or providing factual information about the risks associated with the behaviour. Males, dependent users, early onset cannabis users, frequent drivers, cannabis users who had used more classes of other drugs and cannabis users who believed that their risk of accident would not change following cannabis use were all more likely to report DUIC.

INTRODUCTION

THE PREVALENCE OF DRUG DRIVING

More than 60,000 Australians aged 14 years and over reported driving a motor vehicle in 2004 while "under the influence" of drugs other than alcohol (4.8% of males and 2% of females, Australian Institute of Health and Welfare 2005). This is likely to be an underestimate because the household survey from which these data were derived cannot measure drug-driving among hard-to-reach populations who are potentially at-risk of drug-driving. The prevalence of drug-driving in New South Wales (NSW) appears very similar to the national estimate. Recent survey data collected by the NSW Roads and Transport Authority (RTA) estimated the past year prevalence of driving after any illicit drug use to be four per cent. Four-fifths of recent drug-drivers reported using cannabis on the last occasion on which they drove under the influence of drugs (Hawkins, Bryant & Zipparo 2004).

While quite low among the general population, the prevalence of drug-driving is more common among certain subgroups. Offender populations (Poyser et al. 2002; Turner 2004) and young drivers (AAMI 2004; Jones, Freeman & Weatherburn 2003; McLeod et al. 1998), for example, are more likely than non-offenders and older drivers to report drug-driving. As we might expect, the likelihood of drug-driving is also much higher among recent drug users. Secondary analyses of the 2001 National Drug Strategy Household Survey data revealed that 30 per cent of past-year cannabis users had driven under the influence of drugs other than alcohol in the past 12 months (personal communication, Mark Cooper-Stanbury, Australian Institute of Health and Welfare). Hawkins and colleagues (2004) estimated that 43 per cent of recent drug users (i.e. those who had used in the past 3 months) were also recent drug-drivers (i.e. had driven after using illicit drugs in the past 12 months).

Among past-year cannabis users residing on the North Coast of NSW, Jones, Freeman and Weatherburn (2003) found that 43 per cent had driven within an hour of using cannabis in their lifetime and 29 per cent had done so in the past year. Forty-one per cent of participants who had used weekly or more frequently in the 12 months prior to being interviewed reported driving under the influence of cannabis (DUIC) at least once in the same year. Prevalence estimates are even more stark among populations of long-term cannabis users and injecting drug users (IDU). Among 268 long-term cannabis users interviewed on the far North Coast of NSW, Reilly et al. (1998) found that 90 per cent drove at least occasionally soon after using cannabis. Among a sample of

300 IDU interviewed in NSW, Darke, Kelly and Ross (2004) found that 74 per cent had ever driven after using cannabis, 57 per cent of drivers had driven under the influence of cannabis in the previous year, and 21 per cent had done so weekly or more frequently.

Much less is known about the prevalence of driving under the influence of cannabis and alcohol together (DUICA) among populations of primary cannabis users, and almost nothing is known about driving after using cannabis and other illicit drugs together (DUICO). It appears that drug users sometimes DUICA, although it is much less common than driving after having used cannabis alone (Aitken, Kerger & Crofts 2000; Lenne et al. 2001). Jones et al. (2003), for example, found that only two per cent of their sample reported DUICA in the prior 12 months. This figure rose to seven per cent among participants who had used cannabis in the previous year. While power was a problem due to a small sample size, about one in four cannabis users who reported DUIC in the past year also reported DUICA.

THE RISKS ASSOCIATED WITH CANNABIS USE AND DRIVING

An increased risk of road trauma associated with DUIC may be one of the most serious acute risks posed by the use of cannabis. Yet, at present, the nature of the relationship between cannabis use and accident risk is not entirely clear. Most researchers agree that cannabis intoxication impairs performance on laboratory-based psychomotor tasks, simulated driving and actual on-road driving (e.g. European Monitoring Centre for Drugs and Drug Addiction 1999; Kelly, Darke & Ross 2004; Lenne, Triggs & Regan 2001; Moskowitz 1985; Smiley 1999; Walsh et al. 2004). However driving impairment provides necessary, but not sufficient, evidence that cannabis use increases accident risk. Studies commonly find, for example, that cannabis users are aware of these performance decrements and adjust their driving behaviour accordingly (e.g. by driving more slowly, see Smiley 1999 for a review).

Delta-9-tetrahydrocannabinol (or THC, the psychoactive ingredient found in cannabis) has been found in the blood of between three and 14 per cent of fatally injured drivers (Drummer et al. 2003; Longo et al. 2000a; Ramaekers et al. 2004; Walsh et al. 2004). Prevalence estimates at the higher end of this range might suggest that cannabis-intoxicated drivers are over-represented in fatal accidents. One problem with epidemiological studies of this type, however, is that alcohol is often found in combination with cannabis in the blood of accident victims (Drummer et al. 2003; Hall, Degenhardt & Lynskey 2001). A strong relationship between alcohol and accident risk has been well established, which makes it difficult to partial out the independent effects of alcohol and cannabis consumption on accident risk.[1]

One method used to separately analyse the effects of cannabis and alcohol is known as culpability analysis. This involves rating each driver among a cohort of accident victims as culpable, contributory or not responsible for their accident, based on a number of standardised criteria relating to the circumstances of the accident. Each driver's accident culpability is then assessed in terms of the drugs they had used prior to the accident, under the assumption that a higher proportion of cannabis-positive drivers should be deemed culpable for their accident if cannabis use does indeed increase accident risk (Robertson & Drummer 1994).

Culpability studies almost invariably find alcohol-affected drivers and those affected by alcohol and cannabis in combination to be culpable at a higher rate than drug-free drivers (Drummer et al. 2004; Longo et al. 2000b; Terhune & Fell 1982; Terhune et al. 1992; Williams et al. 1985). The evidence relating to cannabis use by itself is not so clear. Early studies were marred by sample size problems (Terhune & Fell 1982; Williams et al. 1985) and more recent large-scale culpability studies have found inconsistent results. Among a sample of 2,500 non-fatally injured drivers in South Australia, Longo et al. (2000b) found that drivers who tested positive for THC were no more likely to be culpable for their accident than were drug-free drivers. Drummer and colleagues, on the other hand, found large, dose-dependent effects of THC on driver culpability among a sample of 3,400 drivers killed in three Australian States over 10 years (Drummer et al. 2004). It is possible that this discrepancy is related to qualitative differences between fatal and non-fatal accident victims. It could be, for example, that when cannabis-intoxicated drivers are involved in and responsible for accidents, these accidents tend to be very serious.

While the results of Drummer and colleagues' (2004) study provide good evidence that THC has some association with accident risk — among fatally injured drivers, at least — culpability studies are not beyond criticism. A higher odds ratio among THC-positive drivers could be found simply because cannabis users have other characteristics which put them at increased risk of accident (e.g. because they are less experienced or have more relaxed attitudes to driving violations). It is difficult to control for these risk factors in culpability studies, particularly if the drivers were fatally injured in their accident, because this information is not recorded on administrative datasets. This problem is not purely hypothetical. Survey-based studies of accident risk have found evidence highlighting the importance of controlling for all risk factors when examining the influence of cannabis consumption on driving. Drivers who report cannabis-intoxicated driving within a defined period have sometimes been found to be at increased risk of accident during that same time period (e.g. del Rio & Alvarez 1995; MacDonald et al. 2004). This relationship tends to be attenuated, however, when other risk factors — such as speeding, street-racing and regularly running red lights — are controlled for (Blows et al. 2005; Fergusson & Horwood 2001).[2]

The relationship between cannabis use and accident risk is clearly a contentious one. The balance of evidence generally suggests that cannabis use puts drivers at increased risk of accident — particularly at higher doses — but the precise effects of cannabis use on accident culpability remain somewhat unclear (European Monitoring Centre for Drugs and Drug Addiction 1999; 2003; Hall, Degenhardt & Lynskey 2001; Ramaekers et al. 2004; World Health Organisation 1997). However, in light of the harm potentially caused by DUIC, especially in conjunction with alcohol, public policy makers around Australia have recently begun to focus on how DUIC might be prevented, or how the harm associated with DUIC might be mitigated.

THE CURRENT STUDY

The current study had three primary aims. The first was to further assess the relationship between DUIC and accident risk. We examined this relationship by comparing the accident rates of cannabis users who reported DUIC in the past year with the accident rates of cannabis users who said they had not driven under the influence of cannabis in the past year. Information on potential confounders of this relationship (such as driving experience and driving frequency) was also collected. To supplement this analysis we also asked participants in the sample about their perceived risk of having an accident after using cannabis, their beliefs about their ability to control a vehicle when intoxicated by cannabis, their actual frequency of having an accident within a short time of using cannabis and whether they felt that their cannabis use contributed to the accident.

The second aim of this paper was to assess the likely effectiveness of three drug-driving prevention strategies:
(a) roadside drug testing (RDT),
(b) more severe penalties for DUIC and
(c) providing factual information about the risk of accident associated with DUIC.[3] To assess the likely deterrent effect of introducing RDT and increasing the severity of penalties for DUIC, we used an experimental deterrence paradigm developed by Nagin and Paternoster (1993). Participants in the survey were presented with a hypothetical scenario in which they had the opportunity to drive after using cannabis. They were randomly assigned to one of four different groups which differed according to the perceived certainty and severity of sanctions for DUIC. Participants were asked to rate their likelihood of driving given the conditions presented in the scenario. The question of interest in this part of the study was whether participants in the high certainty or severity conditions were less likely to indicate a willingness to drive while intoxicated than participants in the lower certainty/severity conditions. To assess the likely effect of educational initiatives on DUIC, participants were asked to state their likelihood of driving if they came to believe that cannabis-intoxicated drivers were more likely to be responsible for accidents than drug-free drivers.

Any prevention strategy would be greatly improved by a detailed understanding of who is more likely to DUIC. For this reason, this study's third aim was to determine what factors were predictive of having driven under the influence of cannabis in the previous year. This was assessed by regressing the probability of reporting DUIC in the past year against a number of potential risk factors, such as the drug-driving behaviour of their peers, the participants' use of cannabis and other drugs, and their past driving history.

METHOD

RECRUITMENT OF PARTICIPANTS

In pursuit of these aims we interviewed 320 recent cannabis users in Sydney and Newcastle. Recruitment to the study was reliant on targeted advertising on national and local radio stations, in mainstream newspapers, posting notices at one university campus, posting advertisements at social services outlets, and advertising in popular street press and student magazines. Some participants were also recruited through snowballing, whereby the initial base of participants used informal social networks to refer the interviewer on to other potential participants. Participants who read or heard about the study were encouraged to phone a 1800-number to arrange a time to complete the interview. Participants were screened during the initial phone call to ensure that they met each of the inclusion criteria. Injecting drug users and callers who were not NSW residents were screened out towards the end of the data collection period in order to limit their representation in the final sample. Interviewing began in October 2004 and ceased in early March 2005. The final sample consisted of 120 Newcastle participants and 200 Sydney participants.

To be eligible for inclusion in the survey, participants had to be aged 18 years or older, have used cannabis at least once in the previous 12 months and have driven a motor vehicle within the previous 12 months (although not necessarily engaging in the two behaviours simultaneously). All participants were volunteers who were paid $30 immediately after the interview as compensation for out-of-pocket expenses. The mean age of participants was 29 years (range: 18–73), two-thirds were male and only a small proportion (6%) identified as Indigenous. Three quarters of the sample were born in Australia and all but one participant, who was a native German speaker, spoke English as their first language. Forty-six per cent of the sample were in some form of paid employment. Slightly more than one-quarter (29%) had not completed their higher school certificate (HSC).

QUESTIONNAIRE DESIGN

While much of the questionnaire elicited descriptive information bearing on the first and third aims of the research, it also contained a special section to assess the likely effect of perceived risk and perceived sanction severity on willingness to engage in DUIC. In this section, participants were presented with a hypothetical scenario in which they had the option of driving within a short time of using cannabis and each participant rated their likelihood of driving (out of 100) under the circumstance described in the scenario. All participants received essentially the same scenario but certain aspects of it were varied to create four different groups based on the perceived certainty of being caught and severity of sanctions for DUIC (high certainty/high severity, high certainty/low severity, low certainty/high severity, or low certainty/ low severity, see Appendix A). Participants were block-randomised to one of these four conditions prior to their arrival at the interview location. Separate randomisation schedules were established for the Sydney and Newcastle samples. Block sizes of eight were employed for the first 96 Newcastle participants and block sizes of four were used for the remaining 24 subjects. Twenty-five blocks of eight were employed for the Sydney sample.

In the high certainty condition, participants were informed that they had seen police in the area recently and were led to believe that they could randomly drug-test drivers. In the low certainty condition, participants were informed that they had seen police in the area recently but they couldn't randomly test drivers for drugs at the roadside. In the high severity condition participants were informed that, if they were to get caught for DUIC, they would get a fine of about $1000 and have their licence disqualified for a minimum of 12 months. In the lower severity condition, participants were informed that they would get a fine of about $500 and have their licence disqualified for a minimum of 6 months. The actual vignettes are presented in Appendix A. We hypothesised that, if RDT and harsher penalties for DUIC are likely to exert a deterrent effect on drug-driving, those participants who were led to believe that the certainty and severity of punishment are high would be less likely to report a willingness to drive than those in lower certainty/severity conditions.

MEASURES

Drug-driving

Participants were asked to indicate (1) their frequency of driving within one hour of using cannabis by itself in the previous 12 months (2) their frequency of driving within one hour of using cannabis and alcohol together (without using any other drugs) in the previous 12 months; and (3) their frequency of driving within an hour of using cannabis and other illicit drugs together (with or without using alcohol) in the previous 12 months. One hour was selected because psychomotor impairment is known to be most severe within the first hour of consuming cannabis (Chesher 1991; Moskowitz 1985; Ramaekers et al. 2004). Because intoxication may persist for longer than one hour, our measure gives a conservative estimate of the incidence of drug-driving among this population. These drug-driving outcome measures were later coded into a single variable which took one of the following six values: no drugs; cannabis only; cannabis and alcohol together (but not with other drugs); cannabis and other drugs together (but not with alcohol); cannabis with alcohol and cannabis with other drugs but on separate occasions; and cannabis, alcohol and other drugs simultaneously.

Accident risk

The primary measure of accident risk was whether or not a participant said they had ever been in an accident when they were the driver of a vehicle and, if so, how long ago their most recent accident was. Information that could potentially confound this relationship (such as driving experience) was also collected. In addition to this measure of accident risk, participants were asked a variety of questions about their beliefs and attitudes towards cannabis use and accident risk.

Likely effect of roadside drug testing and severe penalties

After reading their respective scenarios, participants were asked to rate their likelihood of driving on a 100-point scale ranging from 0 (not at all) to 100 (definitely). To avoid clustering around quartiles and end-points, visual analogue scales (VAS) were used. In this study, the VAS consisted of a 100mm line drawn on the page and marked with 'not at all' at the left extreme of the line and 'definitely' at the right extreme of the line. Participants were asked to mark a cross on the line to indicate how likely they would be to drive under the conditions in the scenario. The participants' responses were later converted to a numerical score by measuring, with a ruler, the distance from the left end-point of the scale to the centre of the 'x'. As an independent check on the effectiveness of the scenarios in generating variations in perceived certainty and severity, participants were asked to rate (1) their chances of being caught by the police given that scenario and (2) how big a problem the penalties for the offence would create for them if they decided to drive and were caught and convicted. Participants were also asked how likely they would be to drive home under the circumstances in the scenario if there was no possibility of being caught and punished.

Likely effect of educational initiatives

The effect of educational initiatives was assessed by asking participants to indicate (on a VAS) their likelihood of driving if they could be convinced that cannabis-intoxicated drivers were "about three to seven times more likely to be responsible for their crash [than] drivers [who] have not used drugs or alcohol". The quote was taken from a recent review of the evidence for cannabis use and accident risk (Ramaekers et al. 2004, p.109). Participants were also asked to indicate their likelihood of driving if they could be convinced that the combined use of cannabis "and alcohol produces severe driving impairment and sharply increases the risk of drivers accident" responsibility (Ramaekers et al. 2004, p.117).

Drug-driving predictors

The following potential predictors of DUIC were obtained from each participant:

1. *Socio-demographic characteristics*. Socio-demographic characteristics measured were age, gender, Indigenous status, country of birth, employment status, and education.
2. *Peer drug-driving behaviour*. All participants were asked to estimate the proportion of their friends who drive at least sometimes after using cannabis (without using other drugs).
3. *Past year cannabis use frequency*. Participants were asked how frequently they had used cannabis in the previous 12 months on a five-point scale, with 1=once or twice, 2=every few months, 3=about once a month, 4=once a week or more, and 5=every day.
4. *Cannabis dependence*. The Severity of Dependence Scale (SDS) was employed to measure cannabis dependence. The SDS is a five-item scale which focuses on the users' feelings of control, anxiety about missing a smoke, concern about cannabis use, compulsion to use and difficulty in ceasing use. Each of the five items are scored on a scale from zero to three, giving a minimum dependency score of zero and a maximum score of 15. For the purposes of this study, anyone scoring three or more on the SDS were defined as cannabis-dependent (see Swift, Copeland & Hall 1998).

5. *Other drug use measures*.
Participants were asked how old they were when they first used cannabis. They were also asked whether they had ever used each of alcohol, inhalants, hallucinogens, amphetamines, cocaine, other 'party' drugs, benzodiazepines, heroin and other illicitly sourced opiates, and furthermore whether they had ever injected each of these drugs (with the exception of inhalants). Two variables were then created to indicate (a) the number of drug types they reported using in their lifetime and (b) whether they had ever injected any of these drugs. Participants were also asked to rate, on a seven-item scale, how frequently they had consumed alcohol at acute-risk levels over the preceding 12 months. National Health and Medical Research Council (NHMRC) guidelines of six standard drinks in one day for men, and four standard drinks for women, were used to measure acute-risk drinking. A standard drink was defined as "a middy of full strength beer, a schooner of light beer, a small glass of wine, a glass of port or a nip of spirits".

6. *Driving-related factors*.
Participants were asked whether they had ever had their licence disqualified or revoked for a traffic offence, the average distance driven in a typical week, how frequently they had been randomly breath tested for alcohol during the past year, and whether they had been convicted for a variety of driving offences. A variable was post-coded '0' if they had never been convicted for a driving offence and '1' if they had been convicted for one or more offences.

7. *Perceived risk of accident*.
Participants were asked whether they felt that their accident risk increased, decreased or remained stable if they drove while feeling intoxicated by cannabis.

8. *Perceived risk of apprehension and perceived sanction severity*.
Participants nominated their perceived likelihood of being caught for DUIC on a five-point scale, ranging from 'extremely unlikely' to 'extremely likely'. Participants were also asked to state whether they could be fined for DUIC and, if so, what they thought the maximum fine for the offence would be under NSW legislation; whether they could have their licence disqualified and, if so, what they thought the maximum disqualification would be under NSW legislation; and, finally, whether they could be sentenced to imprisonment and, if so, what they thought the maximum sentence would be under NSW legislation.

Table 1: Proportion of sample who reported driving within one hour of using cannabis alone (DUIC), cannabis in combination with alcohol (DUICA), and cannabis and other drugs together (DUICO) during the previous 12 months

	% At least once	*% Weekly or more*
DUIC	77.8	26.9
DUICA	29.1	1.6
DUICO	30.4	3.4

Procedure

Approval was obtained from the University of NSW Human Research Ethics Committee. A two-stage pilot study, with 20 participants in each stage, was then conducted to ensure that the randomisation procedures were practicable and that the questionnaire items were coherent and informative. Newcastle interviews were conducted in the offices of the contractor employed to undertake the interviews. Most Sydney interviews were conducted in a community room in one inner-western city suburb. Trained interviewers administered all interviews face-to-face with the participant. The mean interview time was 35 minutes. The interviewer first read an information statement to ensure that the participant understood what was required of them and to inform them of their rights and entitlements. A copy of this document was given to the participants at the end of the interview for them to keep. Participants were also required to sign an informed consent statement prior to completing the interview. Participants were read each question aloud and the interviewer coded responses on a paper copy of the questionnaire. Only for the questions where visual analogue scales were used did the participants mark the questionnaire themselves.

RESULTS

Table 1 shows the past year frequency of driving within one hour of using cannabis by itself (DUIC), cannabis in combination with alcohol (DUICA), and cannabis in combination with other drugs, with or without using alcohol at the same time (DUICO). A very high proportion (78%) of this sample reported driving within one hour of using cannabis at least once in the previous year. While the proportion reporting DUICA and DUICO were somewhat lower, nearly a third of all participants still reported each of these behaviours at least once in the preceding year. Among this sample, 15 per cent had driven after using cannabis in combination with each of ecstasy and amphetamines, two per cent after using cannabis with hallucinogens, one per cent with benzodiazepines, four per cent with heroin, three per cent with cocaine, one per cent with methadone, and one per cent with GHB.[4] A high proportion of this sample also reported very frequent cannabis-intoxicated driving during the previous 12 months. More than one quarter of the sample reported DUIC weekly or more frequently in the previous year. Very few participants reported DUICA (2%) or DUICO (3%) with such frequency.

Many of the participants who had driven after using cannabis by itself at some point in the past year had also used cannabis in combination with some other drug. This can be seen in **Table 2**, which shows the proportion of participants who had driven under the influence of various combinations of drugs in the past year. About one-third of participants had driven after using cannabis on its own; 16 per cent had driven after using cannabis with alcohol (but not with other illicit drugs); 15 per cent had driven after using

Table 2: Drugs used while driving in the previous 12 months (n=319)

	N	*%*
None	68	21.3
Cannabis by itself	103	32.2
Cannabis/alcohol (but no other illicit drugs)	51	15.9
Cannabis/other (but not with alcohol)	47	14.7
Cannabis/alcohol *and* cannabis/other (on separate occasions)	13	4.1
Cannabis/alcohol/other (simultaneously)	37	11.6

Table 3: Likelihood of accident in previous year by drug-driving behaviour (n=319)

		Accident	
Drugs used while driving	***No. in group***	***N***	***%***
None	68	5	7.4
Cannabis by itself	103	11	10.7
Cannabis/alcohol (but no other illicit drugs)	51	4	7.8
Cannabis/other (but not with alcohol)	47	4	8.5
Cannabis/alcohol *and* cannabis/other (on separate occasions)	13	3	23.1
Cannabis/alcohol/other (simultaneously)	37	9	24.3

Table 4: Mean and median driving likelihood scores (out of 100), by scenario

Scenario	***N***	***Mean***	***Median***
Total sample			
High certainty/high severity	80	32	19
High certainty/low severity	80	27	14
Low certainty/high severity	80	54	54
Low certainty/low severity	80	59	69
Kruskal-Wallis χ^2=41.3, df=3, *p*<0.01			
Current offenders			
High certainty/high severity	63	36	27
High certainty/low severity	59	31	19
Low certainty/high severity	62	62	73
Low certainty/low severity	65	67	75
Kruskal-Wallis χ^2=42.7, df=3, *p*<0.01			
Current non-offenders			
High certainty/high severity	17	16	5
High certainty/low severity	21	16	7
Low certainty/high severity	18	29	11
Low certainty/low severity	15	27	16
Kruskal-Wallis χ^2=2.3, df=3, *p*=0.52			

cannabis with other illicit drugs (but not with alcohol); four per cent had driven — on separate occasions — after using cannabis with alcohol (but not with other illicit drugs) and cannabis with other illicit drugs (but not with alcohol); and 12 per cent had driven after using cannabis, alcohol and other drugs all at the same time. One-fifth of participants had not driven after using any drugs in the previous 12 months. Among the participants who had driven after using cannabis in combination with other illicit drugs, most had used ecstasy and/or amphetamines, although a smaller proportion had also used heroin.

DUIC AND ACCIDENT RISK

Overall, 167 participants (52%) reported having been in one or more accidents in their lifetime, while 36 participants (11%) reported having been involved in an accident in the previous year. The relationship between the reported likelihood of having had an accident in the previous 12 months and the drugs used while driving in the past 12 months is presented in **Table 3**. The likelihood of having had an accident in the previous year was much the same for those who said they had not driven within an hour of using a drug in the previous 12 months (7.4%), those who reported driving after using cannabis only (10.7%), those who reported driving after using cannabis and alcohol together (7.8%) and those who reported driving after using cannabis and other illicit drugs (8.5%). The proportion who reported an accident in the previous year was much higher for those who reported driving after using cannabis with alcohol and other illicit drugs — either simultaneously (24%) or on different occasions (23%) — than it was for the other drivers. However the analysis lacked power to detect differences in accident rates between groups due to the low number of participants in each group reporting an accident in the previous year.[5]

While we found no apparent relationship between the use of cannabis by itself and accident risk in the above analysis, there was some evidence that participants were driving while feeling at increased risk of having an accident. When participants who reported DUIC (by itself) in the last year were asked about their feelings of intoxication on their last occasion of doing so, more than half (55%) said they felt intoxicated by cannabis while driving. More than a quarter (29%) said they felt that their ability to drive the vehicle was impaired by their cannabis use. In total, 53 per cent of all participants said they thought their risk of having an accident increased when they drove while intoxicated by cannabis. Of these 171 participants, 67 per cent reported driving within one hour of using cannabis at least once in the past 12 months and 16 per cent reported doing so weekly or more often. A small proportion of the total sample also reported actually having a 'cannabis-related' accident. Twenty-eight participants (9%) reported having ever been in an accident when they had consumed cannabis within one hour of driving. Twelve participants (4% of the sample) who reported such an accident also suggested that their cannabis use contributed to at least one of these accidents. We will discuss possible reasons for the discrepancy between these findings and those shown in Table 3 later in the Discussion section.

POTENTIAL IMPACT OF RDT AND MORE SEVERE PENALTIES FOR DUIC

The mean and median driving likelihood scores are presented in **Table 4**, by scenario condition and participants' past year drug-driving behaviour. It is clear from the discrepancy between each of the mean and median values that the scores were not normally distributed. Non-parametric Kruskal-Wallis tests were therefore employed to test for differences in driving likelihood scores as a function of certainty/severity conditions. There was no apparent relationship between penalty severity and driving likelihood scores. Among the total sample of cannabis users, however, participants who were told that police could not randomly test for cannabis were significantly more likely to report that they would drive than participants who believed that police could randomly test for drugs (Kruskal-Wallis χ^2=41.3, df=3, p<0.01). When the total sample was divided into those who had engaged in DUIC in the past year and those who had not, there was a strong significant association between scenario condition and likelihood of driving for participants who reported past year DUIC (Kruskal-Wallis χ^2=42.7, df=3, p<0.01) but no such relationship for participants who did not report DUIC in the previous year (Kruskal-Wallis χ^2=2.3, df=3, p=0.52). The non-significant finding in the latter case ought not to be treated as unambiguous evidence that those who have not engaged in DUIC over the previous year are insensitive to the risk of apprehension. There is a lot more variability in responses among the non-drug-drivers due to the smaller sample size (n=71). Since the mean and median driving likelihood scores were in the same direction as those for current drug-drivers, a larger sample of participants might have produced a significant result for both groups.

Further analyses revealed that, irrespective of the scenario condition, men, dependent users, injecting drug users, participants who had used more classes of drugs, participants who had been convicted for one or more driving offences, participants who perceived the risks of being caught to be lower, and those who perceived the risks of having an accident to be lower were all more likely to report driving under the conditions outlined in each scenario. Chi-square analyses were computed to ensure that the randomisation had worked and that each group was equally represented across scenario conditions. The outcome of these analyses confirmed that the randomisation was indeed successful.

Participants assigned to the high certainty scenario conditions rated their likelihood of apprehension given the scenario as significantly higher than those in the low certainty conditions (Kruskal-Wallis χ^2=31.0, df=1, p<0.01). However there was no significant difference between the low and high severity groups in their ratings of how problematic the penalties would be for them if they were to be caught and convicted (Kruskal-Wallis χ^2=2.5, df=1, p=0.11). This suggests that the introduction of RDT would successfully increase the perceived certainty of apprehension among this group of cannabis users but that there would be no relative difference in perceived sanction severity should fines and disqualification periods be doubled.

These results say little about the absolute deterrent effect of sanctions. It could be that sanctions do deter people from driving, even though doubling the severity of those sanctions would add little additional deterrent benefit. To investigate this issue, participants were asked to rate their likelihood of driving under the conditions mentioned in the scenario if there was no possibility of being caught, convicted and punished. Scores ranged from 0 (not at all likely) to 100 (definitely). The distributions of scores are presented in **Figure 1** by

Figure 1: Likelihood of driving if there were no possibility of being caught and punished, by current drug-driving behaviour

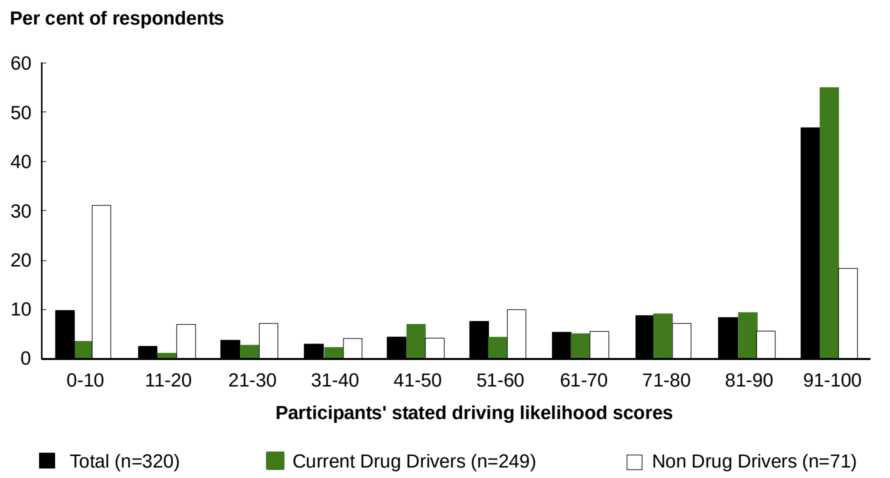
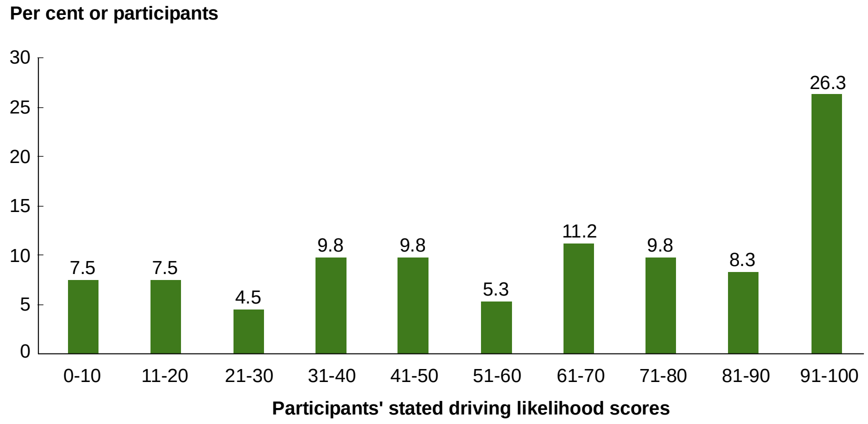


Figure 2: Likelihood of driving among all drug drivers (n=133)* if convinced that cannabis increased accident risk



* Past-year drug-drivers who felt their accident risk did not increase after using cannabis

Table 5a: Demographic and peer-related correlates of driving within one hour of using cannabis in the previous 12 months

Covariate	*Comparison*	*No. participants in group*	*% DUIC*	*Sign.*
Age group	18-22	88	76.1	ns
	23-26	73	74.0	
	27-33	81	79.0	
	34+	78	82.1	
Gender	Female	103	66.0	p<.01
	Male	217	83.4	
Indigenous status (n=319)	Non-indigenous	300	77.3	ns
	Indigenous	19	84.2	
Country of birth	Australia	244	78.3	ns
	Other	76	76.3	
Employment status	Full-time	48	83.3	ns
	Part-time	91	71.4	
	Temporary benefit	64	75.0	
	Pension	52	82.7	
	Student allowance	32	81.3	
	Other	33	81.8	
Education	Not completed HSC	92	84.8	ns
	Completed HSC	103	75.7	
	Trade/other cert.	48	70.8	
	Degree/diploma or higher	77	76.6	
Friends who DUIC (n=319)	None/a few/about half	230	74.8	p<.05
	Most/all	89	85.4	

current drug-driving behaviour. Overall, three-quarters of the sample rated their chances of driving as 50 per cent or greater (i.e. scored greater than 50 on the VAS). Nearly half suggested that they would be highly likely to drive if there were no chance of being caught (i.e. scored between 91 and 100). Current drug-drivers were significantly more likely than non-offenders to report a willingness to drive if there was no chance of being caught and punished (Kruskal-Wallis χ^2=47.0, df=1, p<0.01).

POTENTIAL IMPACT OF EDUCATION

Almost every participant (98%) felt that their risk of having an accident would increase if they drove while feeling intoxicated by cannabis and alcohol together. Not every participant, however, held this view in relation to driving under the influence of cannabis by itself. To explore the likely impact of factual information about the risks associated with DUIC, we focus our attention on participants who had in the past year engaged in DUIC (while not under the influence of alcohol or other drugs) and who believed that driving under the influence of cannabis on its own either reduced or did not affect their risk of having an accident. **Figure 2** shows the distribution of participants' stated driving likelihood scores (out of 100) if they could be convinced that DUIC increases their risk of accident. There are three important points to make about this distribution. First, a significant proportion (26.3%) indicated that they would be highly likely to continue to DUIC in the future (i.e. scores between 91 and 100), even if they could be convinced that DUIC increased their risk of accident. Second, it is clear from the fact that the majority of participants had scores on the right side of the distribution that the majority would be more likely than not to continue to DUIC if convinced that it increased their accident risk. Finally, very few participants (7.5%) indicated that they would be unlikely to drive if they could be convinced that cannabis increased their accident risk (i.e. scores between 0 and 10).

Among this sample of 133 participants, weekly cannabis users were more likely than less frequent users to say they would drive under the influence of cannabis, even if convinced that it increased their accident risk (Kruskal-Wallis χ^2=6.7, df=1, p<0.05). Frequent drivers (Kruskal-Wallis χ^2=9.3, df=1, p<0.01) and participants who had driven after using cannabis and other drugs in the past year (Kruskal-Wallis χ^2=7.1, df=1, p<0.01) were also more likely to say they would continue to drive under the influence of cannabis, even if convinced that they were at increased risk of an accident.

CORRELATES OF DUIC

We now turn to the question of what factors predict willingness to drive under the influence of cannabis. The bivariate relationships between demographic characteristics and the likelihood of having driven within one hour of using cannabis in the previous year are displayed in **Table 5a**. Males (χ^2=12.2, df=1, p<0.01) and participants who reported having more peers who DUIC "at least sometimes" (χ^2=4.2, df=1, p<0.05) were more likely to report DUIC in the past year. No significant associations were found between past year DUIC and age (χ^2=1.6, df=3, p=0.65), Indigenous status (χ^2=0.5, df=1, p=0.49), country of birth (χ^2=0.1, df=1, p=0.72), employment status (χ^2=4.5, df=5, p=0.48) or education (χ^2=4.3, df=3, p=0.23).

The bivariate relationships between participants' drug-using characteristics and their likelihood of having driven within one hour of using cannabis in the previous year are displayed in **Table 5b**. Weekly cannabis users (χ^2=58.3, df=1, p<0.01), dependent cannabis users (χ^2=12.2, df=1, p<0.01), earlier onset cannabis users (χ^2=7.8, df=2, p<0.05) and participants who had used more individual drug classes in their lifetime (χ^2=17.3, df=2, p<0.01) were more likely to report DUIC in the previous year. No significant associations were found between past year DUIC and history of injecting drugs (χ^2=0.1, df=1, p=0.76), nor between DUIC and acute-risk drinking frequency (χ^2=1.8, df=2, p=0.40).

The relationships between participants' driving-related characteristics and their likelihood of having driven within one hour of using cannabis in the previous year are displayed in **Table 5c**.

Table 5b: Drug-related correlates of driving within one hour of using cannabis in the previous 12 months

Covariate	*Comparison*	*No. participants in group*	*% DUIC*	*Sign.*
12 mth cannabis use freq.	Less than weekly	95	50.5	p<.01
	Weekly or more frequently	225	89.3	
Cannabis dependence	Non-dependent	177	69.5	p<.01
	Dependent	143	88.1	
Age first cannabis use	13 or younger	78	84.6	p<.05
	14-15	128	81.3	
	16 or older	114	69.3	
History of injecting	No	239	77.4	ns
	Yes	81	79.0	
No. drug types ever used	3 or less	85	62.4	p<.01
	4-5	99	79.8	
	6 or more	136	86.0	
Risky drinking freq.	Never	42	76.2	ns
	Less than weekly	121	81.8	
	Weekly or more frequently	157	75.2	

Table 5c: Driving-related correlates of driving within one hour of using cannabis in the previous 12 months

Covariate	*Comparison*	*No. participants in group*	*% DUIC*	*Sign.*
Previous licence disqual.	No	215	74.0	p<.05
	Yes	105	85.7	
Km driven per week (n=315)	20 or less	84	63.1	p<.01
	21-60	74	75.7	
	61-200	90	86.7	
	201 or more	67	86.6	
RBT freq. last year	0	100	70.0	ns
	1-2	85	76.5	
	3-4	60	85.0	
	5+	75	84.0	
Driving offence?	No	120	69.2	p<.01
	Yes	200	83.0	

Participants who had had their licence revoked at least once (χ^2=5.7, df=1, p<0.05), participants who had had one or more driving convictions (χ^2=5.7, df=1, p<0.05) and more frequent drivers (χ^2=17.8, df=3, p<0.01) were all more likely to report DUIC in the previous year. Participants who had been randomly breath tested more often in the previous year tended to be more likely to report past year DUIC, although the difference was not significant at the conventional five per cent level (χ^2=7.1, df=3, p=0.07).

The relationships between participants' beliefs and attitudes about drug-driving and their likelihood of DUIC are displayed in **Table 5d**. Participants who felt that their accident risk would either

Table 5d: Attitudinal and belief-related correlates of driving within one hour of using cannabis in the previous 12 months

Covariate	*Comparison*	*No. participants in group*	*% DUIC*	*Sign.*
Accident risk if DUIC?	Increase	171	67.3	p<.01
	Decrease	33	90.9	
	No change	116	89.7	
Risk of apprehension (DUIC)	Extremely unlikely/ unlikely	255	80.0	ns
	Moderate/likely/ extremely likely	65	69.2	
Fine severity (n=319)	Cannot be fined	32	84.4	ns
	$550 or less	59	78.0	
	$1100	55	72.7	
	$2200	127	80.3	
	No maximum	46	71.7	
Disqualification severity	Cannot be disqualified	108	74.1	ns
	9 months or less	19	84.2	
	12 months	122	79.5	
	No maximum	71	78.9	
Imprisonment severity	Cannot be imprisoned	232	80.2	ns
	9 months or less	24	70.8	
	12 months	33	69.7	
	No maximum	31	74.2	

Table 6: Logistic regression model predicting likelihood of driving within one hour of using cannabis in the previous 12 months

Covariate	*Comparison*	*B*	*S.E.*	*p-value*	*OR*	*95% CI*
Gender	Males v females	1.09	0.33	0.00	3.0	1.6-5.7
Km driven per week	21-60 v 20 or less	1.05	0.42	0.01	2.8	1.2-6.5
	61-200 v 20 or less	1.62	0.43	0.00	5.1	2.2-11.9
	200+ v 20 or less	1.72	0.49	0.00	5.6	2.2-14.5
Perceived accident risk	Decrease v Increase	1.06	0.68	0.12	2.9	0.8-11.0
	No change v Increase	1.24	0.39	0.00	3.5	1.6-7.4
Num. drugs ever used	4-5 v 3 or less	0.79	0.39	0.04	2.2	1.0-4.7
	6 or more v 3 or less	1.19	0.39	0.00	3.3	1.5-7.0
Dependent	Yes v No	0.76	0.35	0.03	2.1	1.1-4.3
Age first use	13 or younger v 16+	0.91	0.45	0.04	2.5	1.0-6.0
	14-15 v 16+	0.61	0.37	0.09	1.8	0.9-3.8
Constant		-2.2	0.50	0.00		

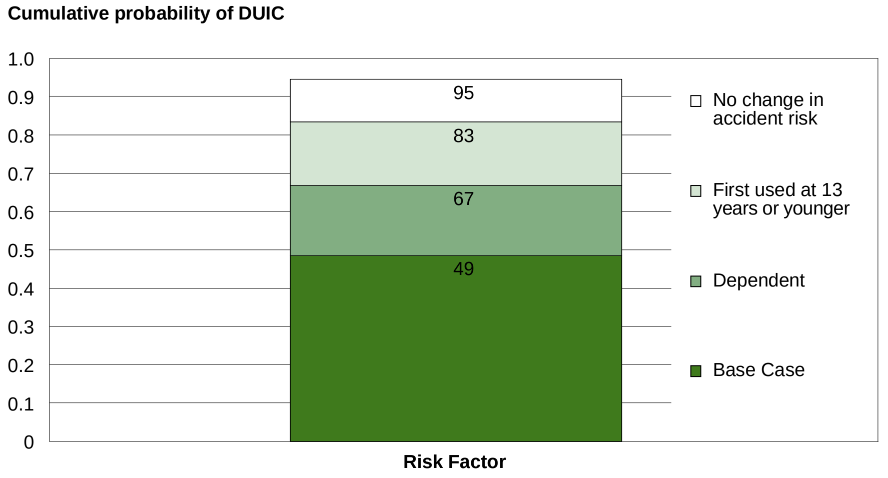
decrease or not change after cannabis use were more likely to report DUIC in the past year (χ^2=23.7, df=2, p<0.01). The relationship between perceived risk of apprehension and likelihood of DUIC approached statistical significance but was not significant at the 0.05 level (χ^2=3.5, df=1, p=0.06). There was no significant association between DUIC and perceived severity of fines (χ^2=3.1, df=4, p=0.55), perceived severity of licence disqualification (χ^2=1.6, df=3, p=0.67) or perceived severity of imprisonment if caught DUIC (χ^2=2.9, df=3, p=0.40).

Logistic regression models were fitted to the data to determine which variables independently predicted the likelihood of reporting DUIC in the past year. All covariates that were significantly associated with DUIC at a bivariate level (shown in Tables 5a–5d) were entered into the model and a backward elimination approach was taken, whereby non-significant covariates were dropped from the model one-by-one. The final model, with associated odds ratios (OR) and 95 per cent confident intervals (CI), is shown in **Table 6**.

Table 6 shows that males (OR=3), dependent cannabis users (OR=2.1), earlier onset cannabis users (OR=2.5), more frequent drivers (OR=2.8–5.6), cannabis users who had used more classes of other drugs (OR=2.2–3.3) and cannabis users who believed that their risk of accident does not change following cannabis use (OR=3.5) were more likely to report driving within an hour of using cannabis at least once in the previous 12 months. The difference between cannabis users reporting that their accident risk would decrease and those reporting that their risk would increase following cannabis use was not significant at the five per cent level (p=0.12). However this may be due to the relatively small number of people who reported that their risk would decrease (n=33). The large standard error and broad confidence interval about the odds ratio (shown in Table 6) reflect the variability associated with this small group of participants.

Odds ratios do not give a direct indication of how much additional risk (among samples such as ours, at least) one factor adds to the likelihood of DUIC. To obtain this information we converted the parameter estimates in Table 6 to predicted probabilities. In order to do this, we started from a base case that represented the probability that a 'typical' participant in our sample would DUIC. The base case that we started from was male, had driven between 21 km and 60 km per week, had used less than three drug types in their lifetime, was not cannabis-dependent, had first used cannabis aged 16 years or older, and perceived their risk of accident to increase following cannabis use. The

Figure 3: Cumulative predicted probability of reporting DUIC in the previous year, according to cannabis dependence, age of first cannabis use, and perceived accident risk



predicted probability that someone in our sample who fitted this set of characteristics would report DUIC in the previous year was estimated to be 49 per cent. Changing the 'dependence' characteristic in the base case from 'non-dependent' to 'dependent' increased the predicted probability of DUIC to 67 per cent. Adding onto this having first used cannabis at 13 or younger increased the predicted probability of reporting DUIC to 83 per cent and adding that the participant did not believe that their chances of having an accident would increase when intoxicated with cannabis increased the estimated risk among this population to 95 per cent. The cumulative predicted probabilities are shown in **Figure 3**.

DISCUSSION

As noted in the introduction of this report, the present study had three aims. The first was to assess the relationship between DUIC and accident risk. The second was to assess the likely impact of RDT, severe penalties and the provision of factual information about accident risk on drug-driving behaviours. The third was to determine what factors were predictive of having driven under the influence of cannabis in the previous year.

We found only limited evidence to support the claim that cannabis use increases accident risk. Participants who had driven under the influence of cannabis in the previous year appeared to be no more likely than drug-free drivers to report that they had had an accident in the previous 12 months. Prima facie, this would seem to suggest that cannabis-intoxicated driving is not a risk factor for non-fatal accidents. In this sense, the results would support those of Longo et al. (2000b) who found no relationship between recent cannabis use and driver culpability for non-fatal accidents. It should be remembered, however, that this finding is based on a much smaller sample than the culpability studies reviewed in the introduction to this report. We had very limited power to detect a positive effect of cannabis intoxication on accident risk because the relatively small number of participants[6] who self-reported an accident were split over six drug combination conditions. These concerns about low statistical power are reinforced by the finding that more than a quarter of past-year cannabis-intoxicated drivers felt that their driving was impaired on the last occasion that they drove within an hour of using cannabis (and no other drug). They are further reinforced by the observation that a small but not insignificant proportion of participants reported actually having an accident within a short time of using cannabis. Further large-scale culpability analyses that compare THC-positive with drug-free accident victims while controlling for other accident risk factors may be necessary before we have a clear understanding of the impact of cannabis use on accident risk.

There was little evidence to suggest that DUIC could be discouraged through the imposition of tougher penalties. This is consistent with much of the deterrence literature (Nagin 1998). Nonetheless, it should not be interpreted as an indication that existing penalties exert no effect. Most of the drug-drivers in our sample indicated that they would be highly likely to drive if there was no possibility of being caught and punished. The present results simply suggest that further increases in the severity of existing sanctions, given the current perceived risk of apprehension for DUIC, are unlikely to exert any marginal deterrent effect.

Our results provide strong support for measures that increase the perceived risk of apprehension (e.g. roadside saliva testing). Participants who were asked to indicate how willing they would be to drive in a scenario where police could randomly test for drugs at the roadside indicated far less willingness than participants presented with scenarios in which there was little possibility of apprehension. This deterrent effect was only observed for current DUIC offenders, but this is neither surprising nor a matter of concern. A number of studies have found that non-offenders are less responsive to changes in apprehension risk than active offenders (Decker, Wright & Logie 1993; Wright et al. 2004). The theory is that non-offenders are sufficiently deterred by other beliefs, attitudes or perceptions (e.g. informal social norms or moral inhibitions about breaking some laws). These extra-legal deterrents render the effect of penalty threats irrelevant. Current offenders, on the other hand, because they are not deterred by pre-existing social norms, are more likely to be responsive to law enforcement activity.

It must be noted at this juncture that scenario-based approaches to deterrence research have not been without criticism. The primary difficulty is that there is no way of knowing whether intentions to offend would accurately reflect real-world behaviours. While we cannot check the validity of this criticism in the current study, it is worth noting that there are other real-world examples where intentions quite accurately predict behaviour. Voter intention polls, for example, usually predict election outcomes with a high degree of accuracy. Moreover, because many participants had probably experienced a situation like the one depicted in the scenario, they might be able to very accurately predict how they would behave.

Even if we accept that intentions might closely reflect real-world behaviours, it must also be stressed that the deterrent effect of RDT will rely largely on the accuracy of the tests themselves. The accuracy of roadside testing is collectively determined by four measures: (a) the proportion of drivers who have used drugs who are correctly identified as positive by the test (sensitivity); (b) the proportion of drivers who have not used drugs who are correctly identified as negative by the test (specificity); (c) the proportion of drivers with positive tests who have actually used drugs (positive predictive value or PPV); and (d) the proportion of drivers with negative tests who have not used drugs (negative predictive value or NPV). Low sensitivity and NPVs would potentially erode the deterrent effect of the enforcement, while low specificity and low PPVs would almost certainly be unacceptable to the wider driving population. An evaluation of two drug-testing devices (ORALscreen® and RapiScan®) conducted by the European ROSITA group found the sensitivity to range from 13–25 per cent, the specificity to range from 0–84 per cent, PPVs ranging between 3–50 per cent and NPVs ranging from 0–98 per cent (Verstraete & Puddu 2000).[7] Results such as these have led some researchers to recommend further research before roadside drug testing is implemented across-the-board (e.g. Laberge & Ward 2004; Lenne, Triggs & Regan 2001; Verstraete & Puddu 2000; Walsh et al. 2004).

Even if tests for drug-driving do not prove feasible in the short-run, there are other ways of increasing the perceived risk of apprehension for this offence, such as Standardised Field Sobriety Assessments (e.g. the walk-and-turn test). For cannabis at least, these sobriety tests appear to accord well with toxicological urine tests conducted at the roadside (Brookoff et al. 1994). The efficacy of these assessments is currently being evaluated in an Australian setting by Swinburne University under the auspices of the National Drug Law Enforcement Research Fund. The results of this evaluation are eagerly awaited. Another program that is undoubtedly more effective, although much more resource-intensive, is the Drug Evaluation and Classification (DEC) Training Programme developed by the Los Angeles Police Department (LAPD). Under the DEC program, police officers undergo around 200 hours of intensive training to enable them to recognise drug-affected drivers based on their performance on a number of behavioural or physical procedures (e.g. speech, appearance, performance on divided attention tests, vital signs etc.). One evaluation cited by the Victorian Parliament found that recognition experts were able to correctly identify 95 per cent of impaired drivers (99% for high dose subjects) and identify the drug category in 92 per cent of high dose subjects. While other evaluations were not so favourable, most have shown that trained recognition experts are still very accurate at detecting drug impairment (Road Safety Committee 1996b). Evaluations of DEC programs in the USA have also reputedly shown increases in drug-driving charges among police forces that have adopted the program (Lane 1988; Road Safety Committee 1996a).

Our study findings in relation to the potential effectiveness of educational approaches to drug-driving are less encouraging than those in relation to roadside drug testing. In this regard, they mirror similar results from other studies (Terry 2004; Terry & Wright 2005). Educational approaches, nonetheless, should not be dismissed out of hand. Although Terry and Wright (2005) found that regular cannabis users would probably be more responsive to roadside testing, 30 per cent still indicated that they would be deterred by '…a good TV advertising campaign highlighting the dangers of driving after smoking cannabis…' (p. 624). Our finding that early-onset cannabis users were more likely to report DUIC in the past year also points to the possible utility of prevention-based education in reducing drug-driving rates. School-based education programs have been shown to reduce the risk of abusing some substances (alcohol, for example — Babor et al. 2003) and might be effective in delaying the onset of cannabis use. In fact, Midford, Lenton and Hancock (2000) in their review of cannabis education in schools suggest that these programs can be effective provided that they contain certain specific elements. These essential components include being small in scale, interactive, being implemented as planned, and ensuring that program participants have a sense of 'ownership' of the intervention. At this stage all that can be said with certainty is that education appears less promising than RDT as a means of reducing the incidence of DUIC. Further research into the effectiveness of education programs, however, may yet change our view on this issue.

Although we did not set out to evaluate the effectiveness of treatment, our finding that cannabis dependence is a strong risk factor for DUIC suggests that treatment programs dealing with cannabis dependence may provide some additional leverage over this problem. Recent evidence suggests that brief cognitive-behavioural interventions can be effective in reducing cannabis use and improving social outcomes for dependent cannabis users (Copeland et al. 2001). Motivational enhancement approaches may also be particularly useful tools for change among cannabis users who are ambivalent about their behaviour. These low-cost, client-centred and non-confrontational interventions are designed to encourage engagement and behaviour change by helping clients explore and resolve ambivalence. The approach is flexible and can be tailored for a variety of populations, including those not committed to changing their use level. Its brevity and low barriers to access encourage participation with minimal effort. Monti and colleagues (2001) have successfully used this approach to provide an opportunistic intervention among young drink-drivers in accident and emergency settings. Compared to those receiving standard care, those who received a brief motivational intervention showed significant reductions in drink-driving behaviour and alcohol-related injuries up to 12 months later. While this approach has not been applied to cannabis and driving behaviour per se, the recently completed Australian Cannabis Check-up successfully attracted and retained young, non-treatment-seeking cannabis users, who showed decreases in use and related problems at a three-month follow-up (Martin, Copeland & Swift in press).

Perhaps the final point to make is that the very high prevalence of DUIC (78%), DUICA (29%) and DUICO (30%) among this sample of cannabis users is a matter that must be viewed with serious concern. It is true that the study employed a purposive sampling framework and it cannot therefore be assumed that these prevalence figures apply to the general population of cannabis users. Our findings do, however, concur with a growing body of research in NSW and other Australian States which have found high rates of drug-driving among samples of frequent drug users (Darke, Kelly & Ross 2004; Jones, Freeman & Weatherburn 2003; Lenne et al. 2001; McLeod et al. 1998; Reilly et al. 1998).

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APPENDIX A

The four scenario conditions were:

1. High Certainty/High Severity: "Suppose you are at a friend's house one night and you've just smoked some cannabis. You suddenly remember that you have to be home in ten minutes because you are meeting another friend there. You've seen police in the area recently and have heard that they've begun conducting random roadside tests using saliva swabs to detect recent cannabis use. If you get caught, you know that you will get a fine of about $1000 and have your licence disqualified for a minimum of 12 months. You can either drive the 10 km home or find some other way home but if you leave your car at your friend's house, you will have to return early the next morning to pick it up for work."
2. High Certainty/Low Severity: "Suppose you are at a friend's house one night and you've just smoked some cannabis. You suddenly remember that you have to be home in ten minutes because you are meeting another friend there. You've seen police in the area recently and have heard that they've begun conducting random roadside tests using saliva swabs to detect recent cannabis use. If you get caught, you know that you will get a fine of about $500 and have your licence disqualified for a minimum of 6 months. You can either drive the 10 km home or find some other way home but if you leave your car at your friend's house, you will have to return early the next morning to pick it up for work."
3. Low Certainty/High Severity: "Suppose you are at a friend's house one night and you've just smoked some cannabis. You suddenly remember that you have to be home in ten minutes because you are meeting another friend there. You've seen police in the area recently but you know they can't conduct random roadside tests using equipment to detect recent cannabis use. However, if you do get caught, you know that you will get a fine of about $1000 and have your licence disqualified for a minimum of 12 months. You can either drive the 10 km home or find some other way home, but if you leave your car at your friend's house, you will have to return early the next morning to pick it up for work."
4. Low Certainty/Low Severity: "Suppose you are at a friend's house one night and you've just smoked some cannabis. You suddenly remember that you have to be home in ten minutes because you are meeting another friend there. You've seen police in the area recently but you know they can't conduct random roadside tests using equipment to detect recent cannabis use. However, if you do get caught, you know that you will get a fine of about $500 and have your licence disqualified for a minimum of 6 months. You can either drive the 10 km home or find some other way home, but if you leave your car at your friend's house, you will have to return early the next morning to pick it up for work."

NOTES

1 There is little doubt that combining the two drugs has a serious detrimental impact on psychomotor performance and actual accident risk (Chesher et al. 1986; Drummer et al. 2004; Lamers & Ramaekers 2001; Longo et al. 2000b; Moskowitz 1985; Mura et al. 2003; Ramaekers et al. 2004; Staysafe Committee 1992).

2 On a methodological note, it must also be noted that there is a tendency in these sorts of studies to 'over-control' for relevant risk factors (Fergusson 2005). For example, Blows et al. (2005) controlled for sleepiness in their analysis, which could be a direct consequence of acute cannabis intoxication. Similarly, cannabis use may play a mediating role in the relationship between these risk factors and accident risk. It could be that young, inexperienced, risk-taking drivers are more likely to use cannabis and this drug use, in turn, is causally related to accident risk.

3 While NSW police cannot currently carry out random drug testing, police in Victoria have begun a trial of saliva-based RDT. Other states, including NSW, have also signalled their intention to trial this technology.

4 The percentages do not total 30.4% because some participants drove after using cannabis and more than one other illicit drug.

5 In order to increase the power of the analysis, at the expense of the more sensitive comparison of the relationship between different drug combinations and accident risk, we collapsed across the last four groups. When we compared the accident rates of those who reported no drug-driving with those who reported driving after using cannabis by itself and those who reported driving after using cannabis and any other drug (including alcohol), we found no significant difference between groups (7.4%, 10.7% and 13.5% reported an accident respectively; χ^2=1.8, df=2, p=0.40). Replication with a larger sample size would be necessary before we could have confidence in this finding.

6 Even if we had found a relationship between cannabis use and accident risk, it might be tempting to argue that this amounts to a 'storm in a teacup' given the low frequency of accident actually reported by the sample. This argument misses the point. Notwithstanding the fact that accident rates are low in the general driving population, the proportion reporting an accident (11%) among this sample was actually quite high. The low power to detect differences between the six drug use combinations was related more to our small sample size (n=320) than it was to the overall number reporting an accident.

7 It should be noted, however, that the sample size for the RapiScan® testing was very small. The authors also note that the manufacturers were planning significant improvements to the technology in coming years. The status of this technology at the time of publication was largely unclear.

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