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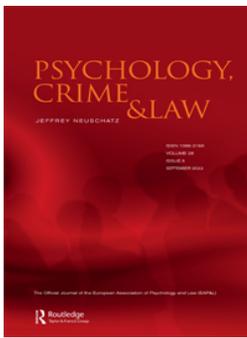
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Memory and credibility perceptions of alcohol and other drug intoxicated witnesses and victims of crime

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ABSTRACT

Research into juror perceptions regarding the impact of intoxication on eyewitness memory and credibility is scarce for substances other than alcohol. However, jurors are frequently told to draw on their personal beliefs and experience with intoxicating substances to infer their impact on the case. It is therefore important to investigate laypeople's perceptions regarding witness and victim intoxication across a range of substances, and whether these perceptions are associated with substance familiarity. Participants ($n=470$) completed a survey assessing familiarity and use of different substances, as well as perceptions regarding effects on the memory and credibility of intoxicated victims and witnesses. While participants most frequently reported believing that alcohol, hallucinogens, and polysubstance use of alcohol and cannabis have large negative effects on memory, they more frequently reported that they do not know the extent to which cannabis and cocaine affect memory. In addition, attitudes were found to vary based on substance familiarity. Differences with respect to the perceived impact on memory and credibility of various substances can have relevance to court proceedings, particularly in terms of *voir dire* procedures, jury instructions, and whether an expert witness is required to educate the court on the impacts of different forms of intoxication.

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Witness and victim testimony can be essential to solving a crime. However, inaccurate and unreliable testimony can mislead an investigation or result in failures of the justice system. People frequently witness crime after they have ingested alcohol and other drugs (AOD) (Palmer et al., 2013). Witness AOD intoxication during a crime can be problematic for police and courts, given it can raise concerns about the accuracy and reliability of memory reports given about the crime. In addition, perceptions regarding the credibility of intoxicated witnesses have important implications for the approach taken to criminal investigations and court proceedings (Evans & Schreiber Compo, 2010). Reduced credibility of witnesses can impact decisions regarding whether and how to prosecute, especially when other evidence of the defendant's guilt is weak or lacking (see Flowe

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et al., 2011). Erroneous witness testimony has also been identified by researchers as a leading cause of wrongful convictions (e.g. Innocence Project, 2020; Kassin & Gudjonsson, 2004), highlighting the importance of juror perceptions when they evaluate the effects of AOD on the memory and credibility of witness testimony at trial.

There has been increasing interest in recent years regarding the effect of alcohol intoxication on memory (e.g. Altman et al., 2019; Jores et al., 2019; Monds et al., 2017). A growing body of evidence suggests that alcohol intoxication decreases the completeness, but not the accuracy, of event recall in the case of low to moderate Blood Alcohol Concentration (BACs; e.g. Altman et al., 2018; Colloff & Flowe, 2016; Crossland et al., 2018; Flowe et al., 2016, 2017; Jores et al., 2019; Monds et al., 2019; van Oorsouw & Merckelbach, 2012). Similarly, face recognition does not appear to be impaired with low to moderate Blood Alcohol Concentration (BACs; e.g. Colloff & Flowe, 2016; Flowe et al., 2017; Monds et al., 2019). Other research findings suggest that the relationship between alcohol intoxication and susceptibility to false memories (i.e. recall or recognition of an event, or details about an event, that did not occur) can be influenced by the level of intoxication and time of recall. In particular, findings suggest that low to moderate levels of alcohol intoxication are not significantly related to false memory susceptibility when recalled immediately after an event (Schreiber Compo et al., 2012) or after a one week delay (Flowe et al., 2019). However, increased suggestibility (i.e. agreement with false information given on an intervening forced-choice test) has been observed following a one-week delay when recalling the event (Evans et al., 2019) and for intoxicated individuals who were self-intoxicating in a drinking establishment when the misinformation is presented using forced choice and closed questions (van Oorsouw et al., 2015, 2019).

Evidence regarding the role of non-alcoholic substance effects on eyewitness memory is still in its infancy (for a review see Kloft, Monds, Blokland, Ramaekers, et al., 2020). However, the increasing prevalence of illicit substance use and prescription drug misuse (e.g. Australian Institute of Health and Welfare [AIHW], 2016; Winstock, 2019) necessitates further investigation into the effects of these substances on memory. Several previous studies examining the impact of cannabis intoxication on eyewitness memory suggest that, despite reduced completeness of recall, the accuracy of information recalled about events witnessed while intoxicated remains unaffected (Vredeveltdt et al., 2018; Yuille et al., 1998). However, more recent research with participants who had self-intoxicated with cannabis, and then learned and were immediately tested on faces using an old/new recognition test, showed lower discrimination accuracy and lower confidence-specific accuracy at high levels of confidence compared to participants who were not intoxicated (Pezdek et al., 2020). Moreover, in another recent study, which used virtual reality-based crime scenarios, participants that were intoxicated with cannabis were found to be significantly more likely to form false memories than those receiving a placebo (Kloft, Otgaar, Blokland, Monds, et al., 2020). Together these studies suggest that the accuracy of a witness's memory for events that were observed while intoxicated with cannabis may be compromised. In contrast, a similar placebo-controlled study that examined the effects of intoxication with 3,4-Methylenedioxymethamphetamine (*MDMA*; the main psychoactive ingredient of ecstasy) did not show increased suggestibility to misinformation (Kloft, Otgaar, Blokland, Toennes, et al., 2020).

These findings on the heterogenous effects of different types of substances on memory highlight that it is important for courts to consider that the effects of a given

substance on a witness' memory accuracy and reliability depend on the specific substance consumed. Moreover, triers of fact will be better able to remedy inaccurate juror perceptions if they have a better understanding of the assumptions that jurors are likely to make about the effects of different substances on memory, all other things being equal.

At present, there appear to be no studies published on the effect of non-alcoholic substances in an eyewitness context. In addition, research has not yet considered the effects of polysubstance use (i.e. using two or more substances at the same time) on eyewitness memory. Substance use is related to crime in a myriad of ways, ranging from drug manufacture and possession, to its effects on behaviour (e.g. Dietze et al., 2013; Kloft, Monds, Blokland, Ramaekers, et al., 2020); therefore, it is of wide interest to understand how prospective jurors perceive the memory accuracy and credibility of witnesses who were acutely intoxicated with different types of substances, including multiple types of substances, at the time of the crime.

Surveys of lay persons, including jury-eligible members of the public, suggest that people commonly believe alcohol impairs witness memory (Benton et al., 2006; Houston et al., 2013; Lynch et al., 2013). A mock-juror study (Evans & Schreiber Compo, 2010) revealed that participants were sensitive to the potential for alcohol to have a negative effect on witnesses' memory ability, but did not appear to consider dose-dependent effects. Furthermore, participants' perceptions of witness impairment informed their witness' credibility ratings and consequently their verdicts. Another mock juror study found that defendants were less likely to be found guilty if rape victims had consumed alcohol prior to the event (Schuller & Wall, 1998). In light of studies demonstrating that alcohol intoxication affects the completeness, but not the accuracy of memory, these findings may reflect misconceptions among the general public regarding how alcohol intoxication affects memory. In addition, although mock jury studies have investigated credibility perceptions with regard to alcohol intoxication, they have not explored attitudes toward intoxication with other substances (e.g. cannabis, amphetamines, opioids etc.) or polysubstance use.

Jurors' own personal experience may be a crucial factor to understanding perceptions of the memory and credibility effects associated with intoxication. In court, jurors are frequently responsible for determining eyewitness credibility (Slovenko, 2004) and are often asked to assess the relevance of alcohol to the facts of the case by drawing on their own personal experience rather than scientific evidence (Quilter & McNamara, 2018). If in the past jurors have consumed the substance of interest and do or do not remember having experienced memory issues as a result, this may influence their assessment of the substance's effects on the witnesses in the case. Thus, prospective juror's personal history with regard to different substance classes have clear relevance to *voir dire* proceedings (i.e. the selection of a fair and impartial jury).

Previous research exploring the relationship between personal experience and perceptions of how drugs affect memory performance is limited. However, Evans and Schreiber Compo (2010) found a negative relationship between personal alcohol consumption and perceived accuracy of sober witnesses, with individuals who reported consuming more alcohol rating sober witnesses as being more impaired. At the same time, participant ratings of an intoxicated witness's memory accuracy did not vary in relation to their own personal alcohol consumption. Given the mixed findings with regard to how personal experience affects judgments of alcohol-intoxicated and sober witnesses, it is important that these findings are clarified through further investigation. Moreover, the

potential effects of personal experience with substances other than alcohol on perceptions of associated memory impairment should be examined.

The current study

We administered a survey to investigate perceptions regarding the memory effects of AOD intoxication, as well as the perceived credibility of witnesses and victims providing testimony regarding a crime that occurred while they were intoxicated. We assessed perceptions of intoxication with a range of substances (e.g. alcohol, cannabis, stimulants, sedatives, and hallucinogens) and substance combinations (i.e. polysubstance use, e.g. alcohol and cannabis taken together). Because past research has predominantly focused on alcohol, it is important that gaps are addressed with respect to other substances and their combinations. Another major aim of the study was to investigate the extent to which participant familiarity with each substance, whether through their own personal use or through observing others who had consumed the drug, influences perceptions of the drug's effects on memory. This information may help inform legal practitioners about whether prospective jurors' personal experiences are likely to impact their perceptions of eyewitness and victim memory accuracy and credibility. Legal professionals will also benefit from an improved understanding regarding the types of information jurors should be educated about to avoid misconceptions about the effects of drugs on memory during criminal proceedings.

Method

Participants

Participants included 498 first-year psychology students in Australia, who participated in exchange for course credit. Of these, 19 participants were excluded for failing to provide substantive data, and nine responses were excluded because they completed the survey twice (only their first response was retained). The final sample therefore included 470 participants (77.7% female). All participants were above the legal drinking age in Australia (18 years), with participants ranging from 18 to 53 ($M = 20.54$, $SD = 5.05$) years. The majority (97.1%) of participants reported that they were Australian residents, suggesting that most were likely to be eligible for jury service in Australia. A person is considered eligible for jury service in Australia if they are a resident and at least 18 years. People are ineligible for juror service if they have been previously convicted of a criminal offence, are unable to read or understand English, are too unwell, have a disability that prevents them from carrying out the duties of a juror, or are currently employed within the public legal system (e.g. police officers, judges).

Materials and procedure

The study was approved by the University of Sydney Human Research Ethics Committee and all participants gave informed consent before their participation. The questionnaire was adapted from a survey of law enforcement officers that explored perceptions about alcohol intoxication (Evans et al., 2009). Notably, the original survey only asked

questions regarding alcohol intoxication; therefore, the current survey was extended to include a range of additional substances, including amphetamines, cannabis, cocaine, ecstasy, gamma-hydroxybutyrate (GHB), hallucinogens, opioids, sedatives, along with combinations involving two substances (e.g. alcohol and cannabis, alcohol and amphetamines). Police-specific questions from the original survey were removed (e.g. questions about interviewing procedures) and additional questions were added regarding observable cues to intoxication. The survey consisted of a combination of Likert-type scale, multiple choice, and open-ended questions, similar to Evans et al. (2009). While participants were required to answer questions based on their familiarity with the given substance, they were able to respond with 'I don't know' if they were unsure of an answer, or 'prefer not to answer' due to the sensitivity of the research topic (see *Appendix – Survey Questions* for additional information).

Demographics

Participants were asked about their age, gender, country of residence, employment status, whether they had worked in a role where they served alcohol, and whether they previously obtained any alcohol accreditation (i.e. training in the responsible service of alcohol). It is worth noting that there is a legal requirement in Australia to obtain alcohol accreditation to work in a role providing alcohol.

Substance use history and familiarity

Participants were asked to indicate whether they were familiar with the effects of each substance and substance combination. Familiarity in this instance was defined as prior personal or witnessed consumption, or general knowledge. Participants only received follow-up questions about these substances or any combination of substances with which they reported familiarity, with the exception that all participants answered questions relating to alcohol and cannabis. Since alcohol and cannabis are, along with tobacco, the most widely used recreational substances worldwide (e.g. Winstock, 2019) and also frequently implicated in crime across several countries (Evans et al., 2009; Kloft, Monds, Blokland, Ramaekers, et al., 2020; Palmer et al., 2013), it was assumed that participants would have sufficient familiarity with these substances to provide a response. Thus, these were compulsory questions to all.

For each substance and combination of substances, participants were asked about their personal experience, including history and frequency of their own consumption based on the Alcohol Use Disorders Identification Test (AUDIT-C; Bush et al., 1998). They were also asked how frequently they had witnessed others consuming that substance. In addition, participants were asked about the ease or difficulty in their detecting intoxication for each substance and substance combination, the visual and verbal signs they use to determine intoxication, and their perceived accuracy of each sign in detecting intoxication. However, intoxication detection is not a focus of the present investigation and therefore, will not be discussed further in this article.

Intoxication and crime

For each substance and combination of substances with which participants reported being familiar, they were asked whether they had ever witnessed a crime in which either the victim or suspect was perceived to be intoxicated at the time.

Intoxication, memory and credibility

For each substance or combination of substances that participants indicated familiarity with, they were asked about their perceptions regarding the effect of that substance/combination on eyewitness and victim memory accuracy and credibility. Specifically, participants were asked five questions regarding their perceptions of how intoxication by each substance and substance combination affects event memory. First, participants were asked to rate the degree to which intoxication negatively affects a person's memory of events, using a five-point Likert scale ranging from 'not-at-all' to 'extremely'. Second, participants were asked to rate the credibility of an intoxicated witness compared to a non-intoxicated (i.e. sober) witness (i.e. 'just as credible', 'less credible' or 'more credible'). They were also asked this question with respect to victims of crime. Lastly, participants were asked to indicate when witnesses and victims intoxicated by each substance or combination of substances at the time the crime occurred would be the most accurate. Perceptions regarding memory effects over time are not the focus of the current investigation and therefore not discussed further in this article.

Research questions and data analysis

The current investigation sought to address the following questions:

1. How familiar are participants with the different substances (own or witnessed consumption)?
2. Have participants ever experienced a crime involving AOD use?
3. How do participants perceive AOD intoxicated victims and witnesses of crime in terms of their memory and credibility?
4. Is past personal or witnessed AOD use (or in the case of alcohol, past work serving alcohol to others) related to participants' perceptions of memory accuracy and credibility?

Descriptive statistics (means, standard deviations and/or frequencies) were generated for the data reflecting demographics, substance familiarity, experience with AOD-related crime, and perceptions regarding the memory and credibility of intoxicated witnesses. Pearson's Chi Square Goodness of Fit analyses were conducted to assess participant responses across the different substances. Following this, Pearson's Chi Square Tests of Independence (or Fisher's Exact Tests where this was indicated by small cell counts) were conducted to assess participant perceptions for the different substances by personal/witnessed consumption and experience serving alcohol. Cramer's V was used to evaluate effect sizes.

Results

Experience, familiarity, and consumption of substances

In total, 26.2% of participants reported having completed some form of alcohol accreditation (i.e. Responsible Service of Alcohol or equivalent) and 21.9% reported previous experience in an occupation that involved the service, sale or supply of alcohol. [Table 1](#)

provides the proportion of participants that were familiar with each substance and poly-substance combination. As expected, the majority of participants were familiar with alcohol (93.6%), with the second most-familiar substance being cannabis (51.1%). Familiarity with the remaining drugs was relatively low ($\leq 30.9\%$ of the sample was familiar with each of the other substances).

Participants were asked to indicate how frequently they consume alcohol, cannabis and each of the other substances with which they reported familiarity. They were also asked to indicate how often they witness the consumption of each of these substances. Due to low cell counts across a number of substances, results relating to the frequency of personal and witnessed consumption were collapsed from a five-point Likert scale (i.e. 'never', 'less than monthly', 'monthly', 'weekly', 'daily or almost daily') to a two-point dichotomous scale (i.e. 'never consumed/witnessed' or 'consumed/witnessed'). As shown in Table 1, participants' self-reported own personal and/or witnessed consumption of different types of drugs was highest for alcohol (86.1% and 97.9%, respectively). For all substances and substance combinations, a larger proportion of participants reported having witnessed another person's consumption than having consumed the substance themselves. Because only a small proportion of participants reported familiarity with heroin and GHB (8.9% and 4.9%, respectively), these substances were excluded from further analysis.

Table 1 also provides the number and proportion of respondents that reported being familiar with each combination of polysubstance intoxication. In total, 33.7% of the sample reported that they had personally consumed or witnessed the consumption of two substances at the same time. Aside from Alcohol and Cannabis, with which 30.9% of participants said they were familiar, low familiarity was reported for each substance combination. The combination of Alcohol and Ecstasy was the next most familiar combination, with 10.4% of participants reporting familiarity. Due to low levels of familiarity, each substance combination, except Alcohol and Cannabis, was excluded from further analyses.

Table 1. Percentage of survey respondents who reported familiarity with each substance.

Substance	Respondents familiar with substance (%)	<i>n</i>	Consumed (%)	Witnessed (%)
Alcohol	93.6	470	86.1	97.9
Cannabis	51.1	470	17.5	52.5
Sedatives	29.6	139	51.5	63.4
Ecstasy	27.2	128	28.9	66.4
Cocaine	24.5	115	21.9	56.6
Hallucinogens	18.7	88	27.1	48.2
Amphetamines	15.5	73	23.6	47.9
Heroin	8.9	42	0 ^a	15.4
GHB	4.9	23	17.4	39.1
No familiarity	5.7			
Polysubstance intoxication	33.7	469		
Alcohol and Cannabis	30.9	145	27.6	88.3
Alcohol and Ecstasy	10.4	49	34.0	80.0
Alcohol and Cocaine	8.5	40	41.5	75.6
Alcohol and Hallucinogens	4.0	19	20.0	65.0
Alcohol and Amphetamines	3.0	14	28.6	57.1
Cannabis and Amphetamines	1.5	7	28.6	71.4
Alcohol and Heroin	1.1	5	0	60.0
Other	1.1	5	42.9	42.9

^a97.6% never consumed, 2.4% prefer not to answer.

Intoxication and crime

For participants that reported having witnessed a crime involving AOD, alcohol was the substance most frequently implicated (19.4% of all participants), followed by amphetamines (12.3%), ecstasy (3.9%), cocaine (2.6%), sedatives (2.2%), and alcohol and cannabis combined (2.1%). Cannabis was reported least often as being involved in witnessed crime (1.7%). Participants that reported having witnessed a crime involving AOD were asked to provide details regarding the nature of the crime. Physical assault was the most commonly reported crime for all substances except cannabis, for which theft was most commonly reported. No participants reported having witnessed a crime related to hallucinogen intoxication.

Intoxication, memory and credibility

To understand participants' beliefs regarding how each substance affects memory, participants were asked the following questions: (1) To what extent do you believe the substance negatively affects memory of events? (2) Do you believe a witness/victim intoxicated by the substance would be less credible, just as credible, or more credible, than a sober witness/victim?

Negative impact of intoxication on memory

Due to low cell counts among some of the response options, these were collapsed into four main categories (i.e. 'little negative effect', 'moderate negative effect', 'large negative effect', and 'don't know'). Specifically, the 'not at all' and 'slightly' response options were combined into the 'little negative effect' category, the 'moderately' response option made up the 'moderate negative effect' category, and the 'very much' and 'extremely' response options were combined into the 'large negative effect' category. A high proportion of participants reported that intoxication with alcohol, hallucinogens, or alcohol and cannabis combined, is associated with 'large negative effects' on memory (see Table 2). In contrast, participants frequently reported that they 'don't know' how much cannabis and cocaine intoxication negatively affects memory. Chi-square analyses for all other substances (i.e. amphetamines, ecstasy, and sedatives) were not significant (all $ps > .145$), suggesting that beliefs regarding intoxication and memory based on these substances were relatively equally distributed across response options (see Table 2).

Table 2. Responses (%) as to whether the substance negatively impacts upon memory.

Substance	<i>n</i>	Little negative effect	Moderate negative effect	Large negative effect	Don't know	χ^2	<i>p</i>
Alcohol	465	5.6	30.3	62.8	1.3	445.60	<.001
Cannabis	456	25.2	21.3	21.1	32.5	15.53	.001
Amphetamines	70	24.3	17.1	34.3	24.3	4.10	.251
Cocaine	109	28.4	11.9	20.2	39.4	18.08	<.001
Ecstasy	125	25.6	16.8	26.4	31.2	5.49	.139
Hallucinogens	81	6.3	8.6	66.7	18.5	77.77	<.001
Sedatives	131	32.8	22.9	19.8	24.4	4.85	.183
Alcohol and Cannabis	135	5.9	22.2	57.0	14.8	85.04	<.001

Perceptions regarding the effect of cannabis consumption on memory varied between those that reported having consumed cannabis and those who reported never having done so, $\chi^2(3, N = 453) = 50.85, p < .001$, Cramer's $V = .335$. A higher proportion of those who reported having consumed cannabis perceived it as having 'little negative effect' on memory compared to those who had never consumed cannabis (54% vs 18%), while those who reported never having consumed cannabis more frequently reported that they 'don't know' compared to those who had (38% vs 9.6%). Similar differences emerged between participants who reported ever having witnessed cannabis being consumed and those who reported never having done so, $\chi^2(3, N = 453) = 29.84, p < .001$, Cramer's $V = .257$. Significant differences were also observed regarding the memory effects associated with ecstasy intoxication between participants who reported having previously consumed ecstasy and those who reported never having done so, $\chi^2(3, N = 124) = 12.90, p = .005$, Cramer's $V = .322$. A higher proportion of those who had consumed ecstasy reported that it had 'little negative effect' on memory compared to those who had not consumed ecstasy (45.9% vs 17.0%), while those who had not previously consumed ecstasy more frequently reported that they 'don't know' (36.4% vs 16.2%). Perceptions of memory accuracy for the other substances did not significantly differ as a function of personal or witnessed consumption (all $ps > .06$ and all $ps > .17$, respectively).

Given that the vast majority of the sample reported having personally consumed or witnessed the consumption of alcohol, beliefs about memory for alcohol were instead examined on the basis of whether or not participants reported holding accreditation to serve alcohol. Perceptions with regard to the memory effects of alcohol intoxication were not found to differ significantly between these groups, $FET = 2.14, p = .56$, Cramer's $V = .07$.

Perceived credibility of intoxicated witnesses

Participant responses to questions regarding the effect of intoxication on witness and victim credibility were highly similar (see [Tables 3](#) and [4](#)). Because responses that an intoxicated witness would be 'more credible' than a sober witness were rare, analyses were constrained to include only 'less credible', 'just as credible', and 'don't know' response options.

For all substances, chi-square analyses indicated an association between witness intoxication and perceived credibility. The proportions of participants reporting that intoxicated witnesses are 'less credible' were higher than those suggesting that they

Table 3. Responses (%) as to whether an intoxicated witness is less, just as, or more credible than a sober witness.

Substance	<i>n</i>	Less credible	Just as credible	Don't know	χ^2	<i>p</i>
Alcohol	463	87.2	6.5	6.3	605.84	<.001
Cannabis	445	58.7	14.4	27.0	138.94	<.001
Amphetamines	68	61.8	16.2	22.0	25.09	<.001
Cocaine	106	45.3	18.0	36.8	12.47	.002
Ecstasy	124	61.3	13.7	25.0	45.98	<.001
Hallucinogens	79	82.3	2.6	15.1	87.06	<.001
Sedatives	127	56.0	18.1	26.0	30.30	<.001
Alcohol and Cannabis	136	79.4	5.9	14.7	131.53	<.001

Table 4. Responses (%) as to whether an intoxicated victim is less, just as, or more credible than a sober victim.

Substance	<i>n</i>	Less credible	Just as credible	Don't know	χ^2	<i>p</i>
Alcohol	455	59.6	26.2	14.3	150.45	<.001
Cannabis	448	50.0	21.0	29.0	60.34	<.001
Amphetamines	69	56.5	18.8	24.6	17.04	<.001
Cocaine	106	41.5	19.8	38.7	8.85	.012
Ecstasy	122	54.1	19.7	26.2	24.46	<.001
Hallucinogens	80	72.5	6.3	21.3	57.93	<.001
Sedatives	126	59.6	26.2	14.3	4.33	.115
Alcohol and Cannabis	136	71.3	13.2	15.4	88.43	<.001

are 'just as credible'. While this pattern generally held for victim credibility as well, the one-way chi-square for sedatives was not found to be statistically significant.

The perceived credibility of cannabis-intoxicated witnesses differed significantly between participants who reported having previously consumed cannabis and those reporting that they had not (see Table 5). Participants who reported having consumed cannabis provided fewer 'don't know' responses compared to non-consumers. In addition, a higher proportion of consumers than non-consumers reported believing that the cannabis-intoxicated witness would be just as credible as a non-intoxicated person. Similar differences in perceived credibility were observed between participants who reported having previously witnessed others consuming cannabis and those reporting that they had not (see Table 6).

Differences in perceived credibility of ecstasy-intoxicated witnesses were also observed between participants that reported previously having consumed ecstasy and those reporting that they had not (see Table 5). Compared with participants who reported never having consumed ecstasy, a higher proportion of those reporting previous consumption thought that witnesses who were intoxicated by ecstasy would be just as credible as sober witnesses. However, the chi-square analysis comparing perceptions based on whether or not participants reported having witnessed ecstasy consumption was not statistically significant (see Table 6).

Perceptions regarding the credibility of witnesses who were intoxicated with both alcohol and cannabis at the time of a crime differed significantly between participants who had previous experience with polysubstance use of alcohol and cannabis and those that had not (see Table 6). A higher proportion of participants who reported having personally experienced polysubstance intoxication with alcohol and cannabis indicated that intoxicated witnesses were 'less credible' than those reporting that they had not. At the same time, a lower proportion reported that they 'don't know'. For all other

Table 5. Responses (%) as to whether an intoxicated witness is less, just as credible than a sober witness, or 'don't know' response as a function of whether or not participants has previously consumed the substance.

Substance	<i>n</i>	Consumed substance			Have not consumed substance			Statistic	<i>p</i>	Cramer's V
		Less credible	Just as credible	Don't know	Less credible	Just as credible	Don't know			
Cannabis	422	58	32	9.9	58.7	10.5	30.7	$\chi^2 = 31.972$	<.001	.269
Ecstasy	123	50	33.3	16.7	66.7	5.7	27.6	$FET = 14.60$	<.001	.365

Table 6. Responses (%) as to whether an intoxicated witness is less, just as credible than a sober witness, or 'don't know' response as a function of whether or not participants have previously witnessed another consume the substance.

Substance	<i>n</i>	Witnessed consumption			Have not witnessed consumption			Statistic	<i>p</i>	Cramer's V
		Less credible	Just as credible	Don't know	Less credible	Just as credible	Don't know			
Cannabis	442	57.9	19.6	22.5	58.9	8.4	32.7	$\chi^2 = 13.65$.001	.176
Ecstasy	123	57.8	18.1	24.1	70	5	25	$\chi^2 = 3.99$.138	.18
Alcohol and Cannabis	131	82.5	5.8	11.7	54.5	0	45.5	$FET = 7.05$.03	.27

substances excluding alcohol, neither personal nor witnessed consumption was significantly related to beliefs about witness credibility when intoxicated by that substance after correcting for the family-wise error rate (all $ps > .018$).

Perceptions of alcohol-intoxicated witnesses did not differ significantly between participants who reported having received alcohol accreditation training and those who did not, $\chi^2 (2, N = 463) = 4.09, p = .132$. Interestingly, perceptions regarding the credibility of victims who were intoxicated at the time of a crime were found to differ significantly between participants who did and who did not report having received alcohol accreditation training (see Table 7). In particular, a higher proportion of participants who received the training indicated that victims were 'just as credible' compared to those without training.

Discussion

This study investigated perceptions of how alcohol and other drug intoxication during a crime affects eyewitness memory accuracy and credibility in a sample of undergraduate students. In addition, we explored whether participants' familiarity with a given substance was associated with these perceptions.

Perceptions regarding the negative memory effects of intoxication

For alcohol, hallucinogens, and polysubstance use of alcohol and cannabis, participants most frequently reported believing that intoxication has a 'large negative effect' on memory. In contrast, participants most frequently reported that they 'don't know' the extent to which intoxication with cannabis or cocaine negatively affects memory. This suggests that people are more likely to believe that alcohol, either alone or in

Table 7. Responses (%) as to whether an intoxicated victim is less, just as credible than a sober victim, or 'don't know' response as a function of whether or not participants have previously received alcohol accreditation training.

Substance	<i>n</i>	Received accreditation training			No accreditation training			Statistic	<i>p</i>	Cramer's V
		Less credible	Just as credible	Don't know	Less credible	Just as credible	Don't know			
Alcohol	455	56.6	33.6	9.8	60.7	23.4	15.9	$\chi^2 = 6.10$.047	.12

combination with cannabis, has a more detrimental effect on memory than cannabis alone. For each other substance, including amphetamines, ecstasy, and sedatives, responses were relatively evenly distributed across different response options.

These results are interesting in light of the current evidence regarding the memory effects of these substances. Specifically, for alcohol and cannabis it is well established that these substances can decrease the amount of information encoded about events experienced whilst intoxicated (e.g. Broyd et al., 2016; Jores et al., 2019). Additionally, there is some evidence to suggest that relatively high doses of alcohol may increase susceptibility to false memories when suggestive questioning techniques are used and when witnesses are questioned after a relatively long delay (Evans et al., 2019; van Oorsouw et al., 2015). Participants' perceptions of alcohol's effects on memory are therefore consistent with false memory research showing that in some circumstances, particularly with higher doses, longer delays and suggestive techniques, alcohol intoxication can result in more incorrect responses. However, meta-analyses of the eyewitness literature suggest that alcohol affects the completeness but not overall accuracy of information remembered on free and cued recall tests. If jurors hold similar perceptions as the students in our sample, they may therefore require instruction regarding the circumstances in which alcohol can impair memory accuracy. Suggestibility may also increase during acute intoxication for cannabis (medium-large effects, see Kloft, Monds, Blokland, Ramaekers, et al., 2020), highlighting the potential value of jury instructions or expert testimony in assisting triers of fact in determining whether and in what ways intoxication with different substances is likely to have affected the testimony of witnesses and victims.

Ecstasy/MDMA and sedatives have been found to induce amnesia for experienced events, for example, impairing verbal memory (e.g. Curran, 1991; Huron et al., 2001; Kuypers & Ramaekers, 2005), and exerting differential effects on false memory in word list tasks that vary with the memory stage that is most affected (Huron et al., 2001; Kloft, Otgaar, Blokland, Monds, et al., 2020; Mintzer & Griffiths, 2000, 2001). Our results indicate that such effects do not appear to be well-known in the surveyed population. There is some evidence that psychostimulants, such as cocaine and amphetamines, may not affect or even potentially enhance memory (Ballard et al., 2012, 2014; Spronk et al., 2013). However, there is also some evidence that intoxication with these substances can increase false memory in word list tasks (Ballard et al., 2012, 2014; Kloft, Monds, Blokland, Ramaekers, et al., 2020). We found that participants were not aware of the memory effects of such substances; this may reflect the preliminary and mixed scientific understanding of these substances on memory at this time.

As for hallucinogens, participants' perceptions that these drugs negatively affect memory are broadly in line with current literature, despite limitations to available research (reviewed in Kloft, Monds, Blokland, Ramaekers, et al., 2020). It should be noted, however, that these studies have generally not involved eyewitness accounts (i.e. memory for details observed during a crime) but have instead relied on basic memory tasks such as word-list recall. Despite this, the present findings may highlight discrepancies between participants' perceptions regarding the effect of various substances, and the degree to which these perceptions align with empirical findings to date. Participants' limited and inconsistent knowledge regarding the effects of alcohol and other drugs on memory further highlight the potential need for expert testimony or judicial instructions so that the effects may be appropriately considered by triers of fact.

Associations with personal and witnessed consumption

Personal and witnessed consumption of cannabis or ecstasy was associated with differences in the perception of intoxication-related memory impairment. Specifically, people who had previously consumed or witnessed consumption of either substance were more likely to state that the substance had 'little negative effect' on memory. In contrast, participants that reported never having consumed or witnessed consumption of either substance were more likely to report that they 'don't know' the extent to which intoxication has a negative effect on memory. One interpretation of these results is that participants perceived or observed few memory issues during their own experience with each substance and their responses were therefore in line with actual observations. Another interpretation is that substance-related effects may affect a person's meta-memory (i.e. awareness of memory) by impairing recollection of memory failures (see Bedi & Redman, 2008). This is in line with recent research indicating that cannabis acutely impairs metacognitive awareness at higher levels of confidence (Pezdek et al., 2020). However, the findings of alcohol research suggest that people who have consumed alcohol do not appear to have reduced meta-memory and in fact reduce confidence in their memory of events to reflect anticipated deficits (Flowe et al., 2017, 2019). Relatedly, findings may reflect a self-serving bias. For example, although it appears that cannabis and ecstasy users sometimes self-report memory impairments (Curran et al., 2002; Rodgers et al., 2001), people who use cannabis have previously not reported intoxication-related impairment to their driving (Pezdek et al., 2020; Watson et al., 2019). Another issue is that for ethical reasons, research studies only enrol participants who are recreational, as opposed to regular or habitual, users to participate. Therefore, little to no research has investigated the potential effect of chronic use or drug tolerance levels on memory performance. Both of these factors (chronic use, and tolerance) may have been present in participants and affected their perceptions in the present study. All things considered, further research is required to discern the underlying reasons for our findings in the present study.

With regard to perceptions of the credibility of intoxicated witnesses and victims, participants generally rated intoxicated witnesses and victims as 'less credible'. In terms of personal consumption, people who had previously consumed cannabis or ecstasy more frequently reported that intoxicated witnesses and victims would be 'just as credible'. In contrast, non-consumers more frequently reported that they 'don't know' whether intoxicated witnesses and victims would be more or less credible. For cannabis, this result was the same for people who reported previously witnessing consumption. However, perceptions regarding the credibility of witnesses and victims that were intoxicated with ecstasy did not differ on the basis of witnessed consumption. For polysubstance use of alcohol and cannabis, a higher proportion of people who had witnessed consumption of both substances indicated that intoxicated witnesses were less credible.

In the mock-juror study of Evans and Schreiber Compo (2010), personal alcohol consumption was not found to affect perceptions regarding the credibility of intoxicated witnesses/victims. The present study therefore highlights the importance of not assuming that findings in relation to alcohol are applicable to other substances and substance combinations. For the most part, perceptions regarding the effect of intoxication on credibility were similar with regard to both witnesses and victims. This result is in line with the study

of Evans and Schreiber Compo (2010) described above, in which mock jurors did not differentiate between alcohol-intoxicated victims and bystanders when providing verdicts for the mock case. While results of the study by Evans and Schreiber Compo (2010) also suggested that perspectives did not differ as a function of crime type (i.e. whether sexual or aggravated battery), future research may explore potential differences relating to intoxication with other substances. A recent study (Crossland et al., 2021) found that alcohol intoxicated witnesses were not perceived as less credible by mock jurors when they were not explicitly told about the witness' intoxication; however when this intoxication was paired with an incomplete account of events they were perceived as less credible. This also requires consideration in future studies in relation to other substances.

Associations with training in responsible service of alcohol

Perceptions regarding the memory accuracy and credibility of intoxicated witnesses and victims were generally not found to differ between those that reported having received training to serve alcohol for work and those that did not. One exception was that participants who reported having received training to serve alcohol were more likely to rate alcohol-intoxicated victims as 'just as credible' as victims that were sober. Interestingly this perspective may be consistent with the outcomes of a recent review, which found that alcohol-intoxication is associated with a reduction in the quantity, but not accuracy, of information recalled (Jores et al., 2019). Although responsible service training is focused on the detection of intoxication and not the memory or credibility effects of intoxication, experience in the service of alcohol may have contributed to a more accurate perception of such effects in these participants. However, this effect was limited to perceptions regarding the credibility of victims and not other witnesses. Future research is needed to clarify the reasons for this.

Limitations

This study is not without limitations. To limit the length of the survey, only questions relating to alcohol and cannabis were made compulsory for all participants. Questions regarding each other substance and substance combination were only presented to participants that identified familiarity with their effects. This led to very low sample sizes for some substances, and especially for polysubstance use. Further work is necessary to explore perceptions of these substances, regardless of familiarity, as jurors will commonly have little prior knowledge of the effects of many substances with which witnesses or victims may have been intoxicated. The generalisability of the results also requires further consideration, given that the sample was largely Australian university students. Replicating the survey with a sample that is more representative of the general population will be important in future research. Jury eligibility within Australia was also not able to be confirmed, given anonymity of the data collection and the likely involvement of international students in the sample may limit generalisation in this regard. Nevertheless, these results offer an important first step in exploring potential juror perceptions of AOD use and how they might impact decisions about witness memory and credibility.

It is also worth acknowledging the likely overlap between perceptions regarding memory and those of credibility, as witness credibility is likely to incorporate assessments of memory accuracy and reliability. Despite this, perceptions regarding credibility are also likely to have considered concepts such as honesty and trustworthiness (Bruer & Pozzulo, 2014). Results may therefore reflect stigma around substance use, particularly with regard to illegal substances. However, it should be noted that the credibility items were presented immediately following the question regarding how intoxication affects memory. As a result, it is possible that participants focused on reliability of memory more so than believability when judging how AOD intoxication impacts credibility. Further jury research is needed to explore the different components of AOD-related credibility within legal trials.

Conclusions

Overall, these findings have important implications for the legal system. Different substances of intoxication are potentially viewed differently by lay people in terms of their memory-impairing effects and the impact on credibility. In some cases, these perceptions are not in line with current evidence regarding the effect of substances on memory. These results, therefore, highlight the importance of incorporating expert witness testimony regarding AOD effects into court cases involving intoxication with specific substances, to ensure jurors are able to make informed decisions regarding their impact. A further implication of the present study is that potential jurors may interpret a case involving an intoxicated witness or victim differently, depending on their own familiarity with the substance or combination of substances involved. This may be essential to informing legal decisions during *voir dire* procedures. Future research is needed to explore how expert testimony about the memory effects of different substances will impact perceptions. This is especially the case if the findings from the research literature are at odds with perceptions held by people who have personal experiences with the drug, whether by their own use or observing others. By improving the accuracy with which this information may be incorporated into judicial processes, an improved understanding of perceptions regarding the memory and credibility effects of AOD intoxication will serve to deliver better and fairer outcomes for all.

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Appendix. Survey questions

Instructions

This questionnaire will ask you about

1. your experiences with alcohol and other drugs;
2. your opinions on the cues and signs of intoxication for different substances and;
3. your perceptions of victim/eyewitness credibility and memory for someone intoxicated by particular substances during an event

Your answers to this questionnaire are confidential.
Please click >> when you are ready to continue.

Demographic questions

1. Please enter your age
2. Please select your gender (Male, Female, Other)
3. Please enter your country of residence
4. Which of the following best describes your current employment status? (Full-time, part-time, casual, unemployed, student, carer/home duties, retired)

Substance familiarity

Which of the following drugs/substances do you have experience with (e.g. have personally consumed, have witnessed someone else consuming, or have general knowledge about its effects)? Please select all that apply.

- Alcohol
- Amphetamines (e.g. Crystal Meth, Speed)
- Cannabis
- Cocaine
- Ecstasy
- Hallucinogens (e.g. Ketamine, Psilocybin Mushrooms, DMT)
- Heroin
- Sedatives (e.g. Benzodiazepines, Sleeping Medication, Antihistamines)
- GHB (e.g. Liquid Ecstasy, Fantasy)
- None

Alcohol questions

The following questions will ask you about your experiences with alcohol intoxication. Intoxication refers to when an individual is affected temporarily by a substance and subsequently has diminished mental and physical control.

1. Do you currently, or have you ever worked in a role where you were required to serve alcohol? ('Yes', 'No')
2. Have you completed any compulsory training/accreditation for serving alcohol? ('Yes', 'No')
 - (a) If you selected 'Yes', please provide the name of your accreditation (e.g. Responsible Service of Alcohol) and the country it was completed in.
3. How often do you have a drink containing alcohol? ('Never', 'Less than monthly', 'Monthly', 'Weekly', 'Daily or almost daily', 'Prefer not to answer')

4. How many standard drinks containing alcohol do you have on a typical day? ('1 or 2', '3 or 4', '5 or 6', '7-9', '10 or more', 'Prefer not to answer')
5. How often do you have six or more drinks on one occasion (i.e. in the one sitting)? ('Never', 'Less than monthly', 'Monthly', 'Weekly', 'Daily or almost daily', 'Prefer not to answer')
6. How often do you witness other people drinking alcohol? ('Never', 'Less than monthly', 'Monthly', 'Weekly', 'Daily or almost daily', 'Prefer not to answer')
7. How often do you witness other people intoxicated by alcohol? ('Never', 'Less than monthly', 'Monthly', 'Weekly', 'Daily or almost daily', 'Prefer not to answer')
8. Have you ever been a witness to an alcohol-related crime (e.g. committed by, or against, someone under the influence of alcohol; not merely the illegal use of this substance)? ('Yes', 'no', 'Prefer not to answer')
 - (a) If 'yes', describe the nature of this crime (e.g. physical assault, theft, etc.; if more than one instance, please state the most common crime)
9. How difficult do you find it to tell when someone is intoxicated by alcohol? ('Extremely difficult', 'Somewhat difficult', 'Neither easy nor difficult', 'Somewhat easy', 'Extremely easy', 'Prefer not to answer')
10. What visual cues would you look for to determine whether someone is intoxicated by alcohol? Please list up to three visual cues.
 - (a) For each visual cue you listed, how reliable would you consider this cue to be (in terms of consistently identifying intoxication rather than something else)? ('Not at all reliable', 'Slightly reliable', 'Moderately reliable', 'Very reliable', 'Extremely reliable', 'I don't know', 'Prefer not to answer')
11. What verbal cues would you look for to determine whether someone is intoxicated by alcohol? Please list up to three verbal cues.
 - (a) For each verbal cue you listed, how reliable would you consider this cue to be (in terms of consistently identifying intoxication rather than something else)? ('Not at all reliable', 'Slightly reliable', 'Moderately reliable', 'Very reliable', 'Extremely reliable', 'I don't know', 'Prefer not to answer')
12. Are there any other signs you would look for (not previously mentioned) to determine whether someone is intoxicated by alcohol? ('Yes', 'No', 'Prefer not to answer')
 - (a) If 'yes', please list any other signs you would look for to determine whether someone is intoxicated by alcohol.
13. To what degree do you believe alcohol intoxication negatively affects a person's memory of events? ('Not at all', 'Slightly', 'Moderately', 'Very much', 'Extremely', 'I don't know', 'Prefer not to answer')
 - (a) Please provide a reason for your rating.
14. Do you believe a witness who is intoxicated by alcohol while witnessing a crime is more credible, less credible, or just as credible as a sober witness? ('More', 'Less', 'Just as', 'I don't know', 'Prefer not to answer')
 - (a) Please provide a reason for your rating.
15. Do you believe a victim who is intoxicated by alcohol while witnessing a crime is more credible, less credible, or just as credible as a sober victim? ('More', 'Less', 'Just as', 'I don't know', 'Prefer not to answer')
 - (a) Please provide a reason for your rating.
16. At which point in time do you think witnesses intoxicated by alcohol would be the most accurate? ('Soon after the crime, while still intoxicated by alcohol'; 'As soon as they are sober from alcohol'; 'After a delay when intoxicated by alcohol again'; 'After a delay when sober from alcohol'; 'I don't know'; 'Prefer not to answer')
 - (a) Please provide a reason for your rating
17. At which point in time do you think victims intoxicated by alcohol would be the most accurate? ('Soon after the crime, while still intoxicated by alcohol'; 'As soon as they are sober from alcohol'; 'After a delay when intoxicated by alcohol again'; 'After a delay when sober from alcohol'; 'I don't know'; 'Prefer not to answer')
 - (a) Please provide a reason for your rating

All other substance questions

18. How often do you consume [substance]? ('Never', 'Less than monthly', 'Monthly', 'Weekly', 'Daily or almost daily', 'Prefer not to answer')
19. How often do you witness other people consuming, or under the influence of [substance]? ('Never', 'Less than monthly', 'Monthly', 'Weekly', 'Daily or almost daily', 'Prefer not to answer')
20. Have you ever been a witness to a [substance]-related crime (e.g. committed by, or against, someone under the influence of [substance]; not merely the illegal use of this substance)? ('Yes', 'No', 'Prefer not to answer')
 - (a) If 'yes', describe the nature of this crime (e.g. physical assault, theft, etc.; if more than one instance, please state the most common crime)
21. How difficult do you find it to tell when someone is intoxicated by [substance]? ('Extremely difficult', 'Somewhat difficult', 'Neither easy nor difficult', 'Somewhat easy', 'Extremely easy', 'Prefer not to answer')
22. What visual cues would you look for to determine whether someone is intoxicated by [substance]? Please list up to three visual cues.
 - (a) For each visual cue you listed, how reliable would you consider this cue to be (in terms of consistently identifying intoxication rather than something else)? ('Not at all reliable', 'Slightly reliable', 'Moderately reliable', 'Very reliable', 'Extremely reliable', 'I don't know', 'Prefer not to answer')
23. What verbal cues would you look for to determine whether someone is intoxicated by [substance]? Please list up to three verbal cues.
 - (a) For each verbal cue you listed, how reliable would you consider this cue to be (in terms of consistently identifying intoxication rather than something else)? ('Not at all reliable', 'Slightly reliable', 'Moderately reliable', 'Very reliable', 'Extremely reliable', 'I don't know', 'Prefer not to answer')
24. Are there any other signs you would look for (not previously mentioned) to determine whether someone is intoxicated by [substance]? ('Yes', 'No', 'Prefer not to answer')
 - (a) If 'yes', please list any other signs you would look for to determine whether someone is intoxicated by [substance].
25. To what degree do you believe [substance] intoxication negatively affects a person's memory of events? ('Not at all', 'Slightly', 'Moderately', 'Very much', 'Extremely', 'I don't know', 'Prefer not to answer')
 - (a) Please provide a reason for your rating.
26. Do you believe a witness who is intoxicated by [substance] while witnessing a crime is more credible, less credible, or just as credible as a sober witness? ('More', 'Less', 'Just as', 'I don't know', 'Prefer not to answer')
 - (a) Please provide a reason for your rating.
27. Do you believe a victim who is intoxicated by [substance] while witnessing a crime is more credible, less credible, or just as credible as a sober victim? ('More', 'Less', 'Just as', 'I don't know', 'Prefer not to answer')
 - (a) Please provide a reason for your rating.
28. At which point in time do you think witnesses intoxicated by [substance] would be the most accurate? ('Soon after the crime, while still intoxicated by [substance]'; 'As soon as they are sober from [substance]'; 'After a delay when intoxicated by [substance] again'; 'After a delay when sober from [substance]'; 'I don't know'; 'Prefer not to answer')
 - (a) Please provide a reason for your rating
29. At which point in time do you think victims intoxicated by [substance] would be the most accurate? ('Soon after the crime, while still intoxicated by [substance]'; 'As soon as they are sober from [substance]'; 'After a delay when intoxicated by [substance] again'; 'After a delay when sober from [substance]'; 'I don't know'; 'Prefer not to answer')
 - (a) Please provide a reason for your rating