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Substance usage intention does not affect attentional bias: implications from Ecstasy/MDMA users and alcohol drinkers



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HIGHLIGHTS

- Attentional biases occur irrespective of context/use intention.
- Attentional bias observed for MDMA-related stimuli in MDMA users.
- Attentional bias observed for alcohol-related stimuli in alcohol users.
- Attentional biases not affected by use intention.
- Subtle differences between MDMA and alcohol for attentional bias, craving, and expectancy

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ABSTRACT

Background: An attentional bias towards substance-related stimuli has been demonstrated with alcohol drinkers and many other types of substance user. There is evidence to suggest that the strength of an attentional bias may vary as a result of context (or use intention), especially within Ecstasy/MDMA users.

Objective: Our aim was to empirically investigate attentional biases by observing the affect that use intention plays in recreational MDMA users and compare the findings with that of alcohol users.

Method: Regular alcohol drinkers were compared with MDMA users. Performance was assessed for each group separately using two versions of an eye-tracking attentional bias task with pairs of matched neutral, and alcohol or MDMA-related visual stimuli. Dwell time was recorded for alcohol or MDMA. Participants were tested twice, when intending and not intending to use MDMA or alcohol. Note, participants in the alcohol group did not complete any tasks which involved MDMA-related stimuli and vice versa.

Results: Significant attentional biases were found with both MDMA and alcohol users for respective substance-related stimuli, but not control stimuli. Critically, use intention did not affect attentional biases. Attentional biases were demonstrated with both MDMA users and alcohol drinkers when usage was and was not intended.

Conclusions: These findings demonstrate the robust nature of attentional biases i.e. once an attentional bias has developed, it is not readily affected by intention.

1. Introduction

Attentional biases (AB) are the preferential processing of substance-related stimuli for a substance which has been used excessively. Most straightforwardly, level of use seems to be associated with a corresponding AB, e.g., heavy alcohol drinkers display a stronger AB for alcohol-related stimuli than light drinkers (Field & Cox, 2008). However, both stronger craving and more positive outcome expectancies appear to lead to greater (corresponding) ABs as well (Field & Cox,

2008). For alcohol users, greater use can generally be equated with greater craving and outcome expectancies, with no particular pattern across time. However, would a contrasting hypothesis emerge for different substances? For MDMA (3,4-methylenedioxyamphetamine) users, craving and outcome expectancies are thought to vary depending on proximity of use (Conner, Sherlock, & Orbell, 1998; Hopper et al., 2006). Importantly for the current study, both craving and outcome expectancies have been found to have an association with attentional biases (AB).

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Hopper et al. (Hopper et al., 2006) found that MDMA cravings only occurred during the few hours prior to planned MDMA usage. Hence MDMA dependence symptoms are strongly time-related, with (apparently) minimal symptoms at other times. Indeed it has been observed that for recreational MDMA users, although craving was generally found to be mild, it was significantly higher in subjects who subsequently used the drug than in those who did not (Huxster, Pirona, & Morgan, 2006). Therefore, craving for MDMA may dramatically increase prior to MDMA usage. Further, outcome expectancies are the effects attributed to taking a substance which the individual expects to experience (Brown, Creamer, & Stetson, 1987). It has been observed that positive expectancies for MDMA may increase just prior to ecstasy use (Conner et al., 1998; Engels & ter Bogt, 2004). Therefore, outcome expectancies within MDMA users may differ depending on when usage is planned. This pattern of use, craving, and outcome expectancies may be unique to MDMA and may differ from alcohol. The key difference is that, within a university student sample, alcohol is (at least sometimes) spontaneous, whilst MDMA use is (often) planned (Engels & ter Bogt, 2004). Previous research has found that alcohol use is acutely sensitive to momentary fluctuations in the perceived availability of alcohol (Field et al., 2011). Therefore, there may be key similarities and distinctions between MDMA and alcohol in terms of use intention, craving,¹ and outcome expectancies.

Since MDMA use is planned, craving and outcome expectancies would be expected to be high only prior to use and low otherwise. ABs have been found to be involved in the maintenance of substance abuse and involved in substance seeking behaviours (Cox, Fadardi, & Pothos, 2006). It has been suggested that AB is determined by both the current incentive value of the substance as well as motivational conflict arising from goals to control behaviour (Field et al., 2016). This implies that ABs alone do not direct substance seeking behaviour. Therefore, ABs may have an indirect influence over behaviour, and it is therefore important to explore the way ABs influence and are influenced by other factors such as craving, outcome expectancies, current context, and/or proximity to usage, in relation to substance seeking behaviours.

If ABs are affected by context/proximity to usage, does this mean that AB for MDMA would be higher prior to use and low otherwise? This is the main research question that we will address in the present study. In more general terms, does AB for a substance depend (just) on overall level of usage (in which case, AB for MDMA should be the same regardless of intention to use and craving/outcome expectancies) or does it depend on intention to use (in which case, AB for MDMA should be highest prior to use, together with craving and outcome expectancies; but AB for, e.g., alcohol should be at a more constant level). Either way, by comparing MDMA to alcohol (which may have stable AB due to alcohol being readily available), we are able to explore the role of actual use, use intention, and craving/outcome expectancies on ABs (although note that we will not be able to statistically compare these two groups of participants, but rather infer any putative differential effects of intention on AB using within group comparisons). The manipulation of use intention was implemented within participants, that is, for both MDMA and alcohol users we explored ABs, craving, and outcome expectancies, when intending and not intending to use. The not intending condition could be thought of as a control condition and any differences (or not) in observed attentional bias for this condition when compared to the intending condition can be inferred to represent whether attentional bias is a robust or transient phenomenon.

¹ Note, here we make the assumption that craving is an urge to elicit substance use and would be similar in both alcohol and MDMA use (Hasin et al., 2013).

2. Method

2.1. Participants

Thirty-six participants completed both sessions of the experiment (3 further participants did not complete both sessions so were removed from the study: see Table 1). Participants were 16 males and 20 females, aged 18–32 (mean age = 21.44 years; SD = 3.85). MDMA users ($N = 17$; mean age = 20.65; SD = 2.78) reported between 3 and 200 ($M = 45.94$; SD = 67.35) incidences of MDMA use since they first started consuming the substance. Alcohol users ($N = 19$; mean age = 22.24; SD = 4.63) reported typical weekly unit consumption ranging between 10 and 55 units ($M = 22.79$; SD = 15.90). Participants were recruited using snowball sampling within the Swansea University student population. That is, existing participants helped recruit future participants from amongst their acquaintances. We made potential participants aware that we were particularly interested in heavy users of MDMA or alcohol. Participants were ineligible to participate in both MDMA and alcohol conditions. Each participant was entered into a prize draw for £100. Ethical approval for the study was granted by Swansea University. All participants provided written informed consent.

3. Materials

3.1. Eye-tracking attentional bias tasks

The eye-tracking AB task comprised of presenting two pictures simultaneously on the screen (Fig. 1). One picture related to substance use (alcohol or MDMA) whilst the second picture was of control stimuli. Control stimuli were matched (see below) with specific alcohol or MDMA stimuli. Note, alcohol-users saw only alcohol-related and control stimuli, MDMA-users saw only MDMA-related and control stimuli. There were 18 unique trials, each consisting of two pictures. Picture presentation was randomised. Pictures were presented for four seconds and were interspersed with a fixation cross. Participants were instructed to fixate on the fixation cross between events. This task used the EyeLink Desktop 1000 eye-tracker and ExperimentBuilder (SR Research Ltd., Ontario, Canada). From the eye-tracking task, dwell time was calculated for each stimulus type (substance and control). This is the time spent fixating on a stimulus and is indicative of AB as increased dwell time would indicate attentional capture. Dwell time included time spent on first pass over the stimulus and also all subsequent time spent fixating on the stimulus (i.e. returning from fixating the other stimulus). An increased dwell time for substance stimuli over control stimuli would be interpreted as an AB. Note, there are other eye tracking variables which we could have used in the analysis, e.g. fixation counts. Overall, dwell time and fixation time correlated strongly with each other in all cases ($r > 0.8$; $p < .0005$). Therefore, due to the strong association between the AB measures, dwell time was chosen as the main independent variable that is used in all subsequent analyses.

An equal number of pictures were used for each category. For the MDMA stimuli, 18 pictures were obtained using a Google image search. The search criteria included three categories: 'ecstasy', 'MDMA', and 'rave'. The pictures contained images related to MDMA taking, e.g. ecstasy pills, MDMA powder, DJs at raves, etc. The value of these forms of stimuli is supported by research that suggests the important role that the environment (music, club, rave) plays in the experience of MDMA intoxication (Parrott, 2004). Alcohol pictures were taken from (Wilcockson & Pothos, 2015). Within the stimuli were images containing lagers, other beers, wines, and spirits. Control stimuli were taken from the same database and contained images related to office equipment. The same control stimuli were used for both versions of the task. The MDMA pictures were broadly matched in terms of colour, complexity, and content to the alcohol and control stimuli as independently verified by the authors, but no more formal evaluation was

Table 1
Descriptive statistics of the participants.

	N	Mean age (SD)	% male	Consumption* (SD)
MDMA	17	20.65 (2.78)	52.94%	45.94 (67.35)
Alcohol	19	22.24 (4.63)	36.84%	22.79 (15.90)

*Note, MDMA consumption is lifetime usage, whereas alcohol consumption is weekly usage.



Fig. 1. An example of a trial from the eye-tracking task. The stimulus on the right depicts a hand reaching for a pint of lager. The stimulus on the left is a carefully matched control stimulus that depicts a hand reaching for a folder. Note, the stimuli used in the task were in full colour.

carried out. It is still possible that the neutral stimuli may have been less well matched with e.g. the alcohol stimuli than the neutral stimuli with the MDMA stimuli. However, even if this is the case, the impact on results is unclear, since we were interested in changes in the AB between use and non-use intention, within each group (MDMA or alcohol: i.e. MDMA users when intending vs the same MDMA users when not intending). Importantly, in order to ensure the MDMA stimuli accurately depicted MDMA use, the MDMA pictures were verified through a pilot study. Each picture was 105 mm × 105 mm. The pilot study involved six MDMA users who verified the MDMA relevance of each MDMA picture. Participants rated each picture out of five for its relevance to MDMA use. 44 MDMA-related pictures were rated and the 18 pictures with the highest scores in each category (six ecstasy-related, six MDMA-related, and six rave-related) were used in the study. Note, such a pilot study was not required for the alcohol pictures, as an established database of alcohol pictures was used (Fig. 2).

Table 2
Statements used in the MDMA craving questionnaire.

MDMA craving statement
I crave ecstasy right now.
Sometimes I want to take ecstasy – even in situations where it is not really possible.
If I used ecstasy now, I would feel more accepted by everyone.
When dancing or partying – I need to take ecstasy.
I would feel more emotionally aware if I used ecstasy now.
When on-ecstasy I feel more energetic.
I have an urge to use or take some ecstasy.
When on-ecstasy everyone generally is much nicer.
Taking ecstasy would make me feel better right now.
When planning to take ecstasy - my desire for it gradually becomes stronger.
If a friend offered me some Ecstasy right now – I would take it.
Nothing is better than being-on ecstasy.
I would love some ecstasy right now.
When partying I cannot really enjoy myself without taking ecstasy.
I want some ecstasy now - and do not care how pure it is.
I plan my weekends around when and where I can get ecstasy.
I would like to score some ecstasy right now.
Handling the pills is part of the enjoyment of using ecstasy.
I want to be with friends now - all of us on ecstasy.
I love the build-up of anticipation before taking ecstasy

3.2. Craving and outcome expectancy questionnaires

In order to measure MDMA craving, we employed a craving questionnaire which had been developed and validated in several unpublished MDMA student projects (e.g. (Davis, n.d.); see Table 2). The questionnaire was similar to that employed in (Davis & Rosenberg, 2014), except the questionnaire used in the current study contained more items (note, these questionnaires were developed independently). This consists of 20 statements with a 5-point Likert response scale. An MDMA outcome expectancies questionnaire was also administered (Engels & ter Bogt, 2004). This consists of 35 statements with a 5-point Likert response scale. The craving measure for the participants in the alcohol group was the Desire for Alcohol Questionnaire (DAQ (Love, James, & Willner, 1998)). This consists of 36 questions answered on a 7-point Likert scale. An alcohol outcome expectancy scale for alcohol was obtained from (Leigh & Stacy, 1993), which consists of 34 statements with a 6-point Likert response scale. For each of the craving questionnaires, the sum of the Likert responses were used as the dependent variable. For the outcome expectancies questionnaires the sum of the Likert responses were calculated for positive and negative expectancies separately (see (Engels & ter Bogt, 2004; Love et al., 1998)). These

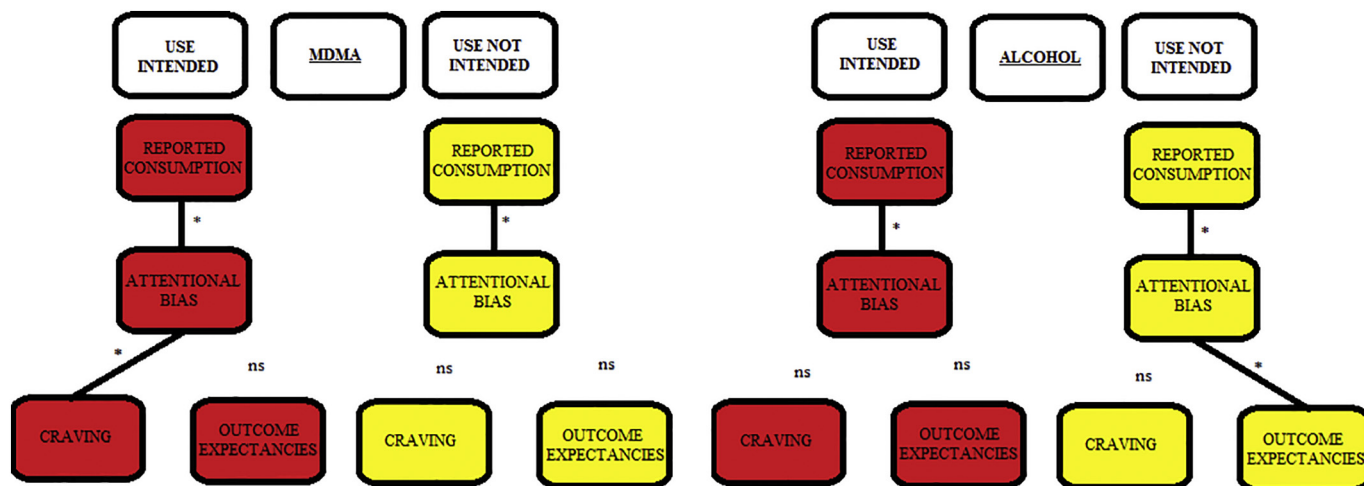


Fig. 2. The key results for both MDMA and alcohol user's attentional biases, craving, and outcome expectancies when use is intended or not. A link between reported consumption (alcohol, MDMA) and attentional bias corresponds to t-test comparing substance-related stimuli and control stimuli. Link between attentional bias and either craving or outcome expectancies were assessed using correlations. Significant links appear as solid lines with a ‘*’, nonsignificant links are indicated by an ‘ns’.

scales were collapsed in this way to simplify comparisons.

3.3. Substance use questionnaire

Each participant also completed a short questionnaire we produced, concerning his/her alcohol/MDMA use. This questioned when respondents next intended to use alcohol/MDMA. In order to assign a participant to the ‘intending to use’ condition, he/she would need to have responded with ‘today’ in the relevant question. For the ‘not intending to use’ condition participants had to state that they were not intending to use the substance that day. However, prior to participation participants were aware that they would be required to perform the study once when they were intending to use and once when they were not intending to use. Therefore, participants only attended the lab on two occasions: when intending and not intending to use. Further, this questionnaire contained eight alcohol or seven MDMA questions. The questions were generally related to usage patterns and quantities. No data was collected regarding actual substance consumption post the lab session, due to obvious practical difficulties, but this was deemed irrelevant, as it was the *intention* to use that was the key variable.

3.4. Procedure

Both groups were administered a test battery on two occasions; when intending to use MDMA or alcohol (depending on group), and when not intending to use MDMA or alcohol. Each testing occasion was separated by 7–14 days. We attempted to randomise the order of the use intention variable, so that some participants were first tested when intending to use, while others when not intending to use. However, the experimenter was blind to what condition the participant was in. All lab sessions occurred late afternoon/early evening so as to minimise the duration between the experiments and when usage was to take place (Dar, Rosen-Korakin, Shapira, Gottlieb, & Frenk, 2010). The ordering of the task procedure was fixed and was administered in the following order: craving questionnaire (alcohol or MDMA), substance use questionnaire (alcohol or MDMA), outcome expectancy questionnaire (alcohol or MDMA), and the eye movement task (alcohol or MDMA).

4. Results

Firstly, the attentional bias measure is examined using a 2(stimulus type: substance-related vs. control) x 2(use intention: use intended vs. use not intended) repeated measures ANOVA with a between-subjects factor of participant group (MDMA users vs. alcohol users). Critically, if AB depends on use intention, we should observe an interaction between stimulus type and use intention, that is, the presence of an AB (stimulus type effect) depends on whether use is intended or not. Whether MDMA/alcohol AB depend on just MDMA/alcohol use or whether they depend on the use intention variable for MDMA/alcohol as well (is the novel empirical objective of the study). Additionally, a Bayes factor with default prior scales is computed for each analysis (Love et al., 2015; Morey & Rouder, 2015; Rouder, Morey, Speckman, & Province,

2012). Computing a Bayes factor provides us with the ability to interpret *p*-values > .05. By using *p*-values alone, a *p*-value > .05 could either mean that not enough data was collected or that there was indeed no differences between, e.g., two conditions. As we are speculating regarding a difference between usage intentions, for us to be able to interpret a null result between the two conditions, it is important to use Bayes factors. Therefore, if a $BF_{INCLUSION} > 1.5$, then we can interpret that finding indicating some evidence for the null hypothesis (e.g. (Love et al., 2015; Morey & Rouder, 2015; Rouder et al., 2012)).

4.1. Attentional bias

There was a main effect of stimulus type ($F(1,34) = 28.743$; $p < .0005$; $\eta^2 = 0.458$; $BF_{INCLUSION} > 100$) indicating a difference between control and substance-related stimuli, that is, an AB. Regarding the less interesting main effects of use intention and participant group, there were no main effects ($F(1,34) = 1.659$; $p = .206$; $\eta^2 = 0.047$; $BF_{INCLUSION} = 0.05$, $F(1,34) = 2.849$; $p = .101$; $\eta^2 = 0.077$; $BF_{INCLUSION} = 0.394$, respectively). We also identified a significant interaction for use intention and participant group ($F(1,34) = 7.293$; $p = .011$; $\eta^2 = 0.177$; $BF_{INCLUSION} = 0.079$; however note, this is not particularly useful) but not for stimulus type and participant group ($F(1,34) = 1.338$; $p = .255$; $\eta^2 = 0.038$; $BF_{INCLUSION} = 0.776$). Importantly, there was no interaction between use intention and stimulus type ($F(1,34) = 0.298$; $p = .589$; $\eta^2 = 0.009$; $BF_{INCLUSION} = 0.112$) which indicates that the presentation of AB was not dependent on use intention across both participant groups. In addition, the crucial three factor interaction between stimulus type, use intention, and participant group was also not significant, ($F(1,34) = 0.315$; $p = .578$; $\eta^2 = 0.009$; $BF_{INCLUSION} = 0.019$), showing that use intention did not affect AB differentially for the two substances. Therefore there are no statistical grounds for post hoc comparisons, yet we pursue a further analysis in an attempt to explore the effect of use intention, for exploratory purposes.

The critical interaction between use intention and stimulus type was explored separately for each substance. For MDMA stimuli, there was no significant interaction between use intention and stimulus type ($F(1,16) = 0.000$; $p = .992$; $\eta^2 = 0.000$; $BF_{INCLUSION} = 0.355$). Likewise, for alcohol stimuli, there was no significant interaction between use intention and stimulus type ($F(1,18) = 0.628$; $p = .438$; $\eta^2 = 0.034$; $BF_{INCLUSION} = 0.300$). Note, we confirmed for each substance separately the main effects of stimulus type, which indicate that there is a reliable AB in the first place (for MDMA, $F(1,16) = 8.047$; $p = .012$; $\eta^2 = 0.335$; $BF_{INCLUSION} > 100$; for alcohol, $F(1,18) = 23.335$; $p < .0005$; $\eta^2 = 0.565$; $BF_{INCLUSION} > 100$).

We also persevered with pairwise *t*-test comparisons, again as an exploratory step, concerning always the contrast between MDMA or alcohol stimuli and neutral stimuli, when use was intended and not intended. Using this method, we can also confirm that an AB was present (see Table 3). When use was both intended and not intended, there was an AB for MDMA stimuli (a significant difference between MDMA and control stimuli). The same pattern of results was observed

Table 3
t-tests for the differences between variables for substance-related and control stimuli for MDMA and alcohol groups.

	Substance-related stimuli		Control stimuli		t-test	d	BF ₁₀
	M	SD	M	SD			
MDMA							
Dwell time when use intended	2.20	0.50	1.74	0.37	2.860*	1.046	4.841
Dwell time when non-use intended	2.30	0.57	1.84	0.40	2.229*	0.934	1.734
Alcohol							
Dwell time when use intended	2.23	0.41	1.59	0.38	4.012*	1.619	44.028
Dwell time when non-use intended	2.26	0.45	1.49	0.41	4.306*	1.789	77.966

* Indicates a *p*-value < .05.

for alcohol stimuli, a consistent AB regardless of whether use was intended or not.

In order to establish whether the attentional bias observed within the MDMA and alcohol groups was linearly associated with usage (an important prerequisite for establishing an attentional bias) we needed to establish that heavier usage of the substance was associated with an increased attentional bias. Therefore, we performed correlation analyses within each substance-type condition. This would demonstrate that heavier, e.g., MDMA use, was associated with a stronger attentional bias. When use was intended MDMA dwell time was associated with MDMA reported usage ($r(15) = 0.583; p = .014; BF_{10} = 7.334$) and when use was not intended the association was also significant ($r(15) = 0.616; p = .008; BF_{10} = 56.497$). When use was intended alcohol dwell time was associated with alcohol reported usage ($r(17) = 0.481; p = .037; BF_{10} = 2.147$) and when use was not intended the association was not significant ($r(17) = 0.317; p = .186; BF_{10} = 0.639$), but note that the Bayes factor suggests that this result is not conclusive. Nevertheless, there is strong evidence that the attentional bias exhibited by each participant was related to their substance usage history.

Participants completed the same eye-tracking task on two occasions. Although the intention condition was counterbalanced, the order in which the participants completed the two use conditions may have affected results. Therefore we performed a series of *t*-tests for MDMA and alcohol users in order to investigate the within-subjects differences that may have resulted from practice effects. For the MDMA participants, there was no significant difference between the participants who completed the use condition first ($n = 9; m = 6.33; sd = 9.44$) and participants who completed the no use condition second ($n = 8; m = 0.43; sd = 16.87$) in terms of dwell time, $t(15) = 0.903; p = .381; BF_{10} = 0.554$. Regarding dwell time in the no use intention condition, there was also no significant difference between the participants who completed the use condition first ($m = 5.96; sd = 14.60$) and participants who completed the no use condition second ($m = 3.49; sd = 19.73$), $t(15) = 0.296; p = .771; BF_{10} = 0.433$. For the alcohol participants, there was no significant difference between the participants who completed the use condition first ($n = 10; m = -7.01; sd = 12.72$) and participants who completed the no use condition second ($n = 9; m = -2.24; sd = 22.16$) in terms of dwell time, $t(17) = -0.583; p = .568; BF_{10} = 0.456$. Regarding dwell time in the no use intention condition, there was also no significant difference between the participants who completed the use condition first ($m = 15.47; sd = 18.40$) and participants who completed the no use condition second ($m = -26.97; sd = 15.72$), $t(17) = 0.537; p = .598; BF_{10} = 448$. Therefore, there was no evidence of practice effects.

4.2. Outcome expectancies and craving

A series of paired samples *t*-tests were conducted to look at whether the outcome expectancy and craving measures were affected by use

intention (see Table 4). For MDMA stimuli, positive outcome expectancies, negative outcome expectancies, and craving scores were all found to not differ when use was intended versus when use was not intended. For MDMA, it seems clear that outcome expectancies and craving are not affected by use intention.

For alcohol stimuli, positive outcome expectancies or negative outcome expectancies did not differ between when use was intended and use was not intended. However, craving scores did differ, so that when use was intended they were higher than when use was not intended.

Correlation analysis would be use in order to see whether outcome expectancies or craving were associated with AB. However, it was first necessary to define AB as a score. An AB was indicated in the previous analyses by a significant main effect of stimulus type. Therefore a single measure of AB was created by subtracting substance dwell time and control dwell time for each participant group in both use conditions. For MDMA participants, when use is intended the AB variable correlates with craving ($r(15) = 0.507; p = .038; BF_{10} = 2.213$) but not positive outcome expectancies ($BF_{10} = 0.510$: this finding is inconclusive whether or not an association is present) or negative outcome expectancies ($BF_{10} = 0.895$: inconclusive). When use is not intended the AB variable was not associated with positive outcome expectancies ($BF_{10} = 0.596$: inconclusive), negative outcome expectancies ($BF_{10} = 0.587$: inconclusive), or craving ($BF_{10} = 0.366$). For alcohol participants, when use is intended the AB variable does not correlate with positive outcome expectancies ($BF_{10} = 0.326$), negative outcome expectancies ($BF_{10} = 0.363$), or craving measure ($BF_{10} = 0.763$: inconclusive). When use is not intended AB is associated with negative outcome expectancies ($r(17) = 0.533; p = .019; BF_{10} = 3.716$) but not positive expectancies ($BF_{10} = 0.309$) or craving ($BF_{10} = 0.322$).

5. Discussion

We investigated AB when use was intended and not intended for alcohol and MDMA stimuli and corresponding (heavy) users. This research was motivated by the idea perhaps use intention generates preoccupation (Cox & Klinger, 2011) or otherwise impacts on attentional processes (Robinson & Berridge, 1993; Tiffany, 1990), so that use intention is a critical variable in whether an AB is observed or not. Moreover, we focussed on MDMA and alcohol substances because they have a very different pattern of use: MDMA use is typically planned, whereas alcohol use is not. We found that use intention made no difference in AB for both alcohol and MDMA. Outcome expectancies, both positive and negative, likewise did not differ between use and no use intention. The only difference that we did identify related to higher craving for alcohol when use was not intended, relative to when use was intended. Therefore we were unable to confirm our assumption that MDMA usage intention affects craving. These results closely support (Mogg & Bradley, 1999) who demonstrated strong evidence of an AB within MDMA users but we have extended this finding by showing that use intention did not lead to a difference in reported MDMA ABs.

Table 4

t-tests for the difference between variables when use is intended and non-use is intended for MDMA and alcohol groups.

	Use intention		Non-use intention		t-test	<i>d</i>	BF ₁₀
	M	SD	M	SD			
MDMA							
Outcome expectancies positive	58.59	28.40	56.77	28.57	0.802	0.064	0.330
Outcome expectancies negative	22.77	12.44	24.24	12.66	0.673	-0.117	0.304
Craving	35.71	19.54	33.06	15.24	0.559	0.151	0.286
Alcohol							
Outcome expectancies positive	79.79	8.13	79.53	8.66	0.129	0.031	0.239
Outcome expectancies negative	46.68	9.45	47.68	8.66	0.802	-0.110	0.316
Craving	123.47	48.55	87.95	47.81	2.146*	0.737	1.518

* Indicates a *p*-value < .05.

The finding that use intention does not affect AB demonstrates the robust nature of AB: once an AB has developed, it is not readily affected by whether a substance is about to be taken or not. This may have implications for AB research since there has been some debate regarding context dependent factors associated with AB.

Field, et al. (Field et al., 2016) suggest that AB is determined by both the current incentive value of the substance as well as motivational conflict arising from goals to control behaviour. Therefore, although AB may have an indirect influence over behaviour, it is important to take into account other moderating factors such as craving, outcome expectancies, current context, and/or proximity to usage, which may also be guiding substance seeking behaviours. Therefore, the finding that craving increases prior to alcohol use may have implications for substance abuse interventions as increasing motivation to abstain could lead to a decrease in craving. Such a notion would run in parallel with the incentive-sensitisation theory of addiction (Robinson & Berridge, 1993) which suggests that craving and ABs are increased in the presence of substance-related stimuli. However, an association between AB and craving was observed for MDMA (when use was intended) and not for alcohol (although Bayesian analyses indicate that these findings are inconclusive whether an association was present). Alcohol AB was observed to be associated with negative outcome expectancies when use is not intended. This suggests that use intention may mediate the association between AB and craving/outcome expectancies, but in different ways for different substances. Specifically, for alcohol, the results demonstrate that dwell time decreases for negative expectancies when use is not intended. The results may arise from positive affect-related attentional facilitation when use is intended but negative affect-related attentional avoidance when use is not intended (though clearly more work is needed to validate this hypothesis). That is, it is possible that, it is easier to think of negative aspects of substance use when use is not intended as a form of substance use self-regulation, as when not intending to use, there is potentially an associated form of AB suppression. This may in turn lead to lower AB, to avoid distracting thoughts of the substance. Perhaps when not intending to use, alcohol users display attentional avoidance in a way analogous to how anxiety sufferers or abstinent alcoholics avoid 'threatening' stimuli (Noël et al., 2006; Roberts & Garavan, 2013).

We cannot completely exclude the possibility that attentional biases, once established through substance abuse history, might make one inclined to have attentional biases for all substance abuse-related stimuli. That is, it is possible that the attentional bias is general rather than specific. However, it is more likely that attentional biases develop specifically for the substance that an abuser has learnt to associate with positive outcome expectancies (see (Field & Cox, 2008)). Would a cigarette user be expected to have an attentional bias for heroin-related stimuli? Would someone with a spider phobia have an attentional bias for snakes? There would be no basis for such biases, even though we acknowledge that these questions are beyond the scope of the current paper. Nonetheless, these are intriguing questions. Indeed, could hypersensitivity of attention develop for any salient stimuli as a result of substance abuse? Results from the antisaccade task would appear to demonstrate that heavy drinkers and light drinkers are not found to differ in terms of responding to a salient cue (Roche & King, 2010), even though they differ regarding alcohol cues. Therefore such results appear to rule out this possibility. But of course, more research may be warranted.

Within the current study, it would have been possible to include MDMA-related stimuli in the alcohol task and vice versa, so as to measure whether attentional biases develop for stimuli other than the ones relevant to the problematic behaviour. However, our statistical approach involves within group comparisons, depending on use intention (broadly spontaneous vs. broadly planned). So, regardless of the specificity or generality of ABs for alcohol or MDMA participants, we sought to clarify whether this AB changes with use intention. That is, these are separate research questions.

There are other methodological limitations, which should be addressed in future work. Notably, we were unable to directly compare MDMA users and alcohol drinkers because their respective measures were not standardised. Nevertheless we hope that the results obtained at least demonstrate that attentional biases for both MDMA and alcohol are robust and occur irrespective of context. Further, there was no verification of whether intention to use either substance was related to actual intention (a current plan to use shortly after the experiment) AND accessibility of the substance (whether they had ecstasy or alcohol available). It is thus difficult to know whether the study actually measured intention to use or a combination of intention to use and a corresponding plan regarding accessibility. Our assumption has been that an intention to use *presupposes* a plan for accessibility. However, future research should evaluate more directly this assumption and separate out the intention to use per se from any issues regarding accessibility and availability.

In conclusion, we observed a robust AB for MDMA and alcohol users. Our results also indicate that some factors associated with MDMA and alcohol use do not fluctuate across use intention conditions. If future research shows our results to generalise to other populations, there would be important implications in our understanding of ABs, their lack of fluctuation in spite of intention to use, and the evidence which may suggest that use intention may mediate an association between craving and outcome expectancies.

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