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

Thomas D.W. Wilcockson[a,c,*], Emmanuel M. Pothos[b], Andrew C. Parrott[c,d]

[a] Department of Psychology, Lancaster University, Bailrigg, Lancaster, UK
[b] Department of Psychology, City University London, UK
[c] Department of Psychology, Swansea University, Wales, UK
[d] Centre for Human Psychopharmacology, Swinburne University, Melbourne, Australia

## 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

## ARTICLE INFO

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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-methylenedioxymethamphetamine) 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).

* Corresponding author.
*E-mail address:* t.wilcockson@lancaster.ac.uk (T.D.W. Wilcockson).

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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