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Take Me Away: The Relationship Between Escape Drinking and Attentional Bias for Alcohol-Related Cues

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ABSTRACT

Previous research has indicated that implicit attentional bias to alcohol-related cues may serve as a cognitive measure of susceptibility to alcohol dependence. The primary goal of the current study was to examine whether college students who drink to escape dysphoric emotions or moods (i.e., escape drinkers) have stronger attentional biases for alcohol-related cues than non-escape drinkers. Additionally, because previous research has shown that presentation time and content of smoking-related stimuli moderates differences between smokers' and nonsmokers' reaction times, this study sought to determine whether these effects generalized to alcohol-related stimuli. Participants who were identified as either escape ($n = 74$) or non-escape drinkers ($n = 48$) completed a dot-probe task in which alcohol-related pictures that contained humans interacting with the alcohol-related cues (active) or alcohol-related cues alone (inactive) were presented along with matched control pictures. These stimuli were presented for either 500 ms or 2000 ms to determine whether attentional biases occur as a function of initial or maintained attention to the alcohol-related cues. Escape drinkers displayed a significantly stronger attentional bias for alcohol-related inactive cues at longer presentation times (i.e., 2000 ms) compared to non-escape drinkers. This bias was independent of alcohol dependence and family history for alcoholism. These results suggest that in addition to dependence and family history, escape drinking is an important factor to consider when examining attentional biases to alcohol-related cues.

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Despite the fact that it is illegal for many college students to purchase and consume alcoholic beverages, its use and abuse are widespread among this cohort. Indeed, more than 40% of college students report at least one incidence of binge drinking (i.e., consuming five or more drinks in a row) during a two week period (Hingson, Zha, & Weitzman, 2009). That the prevalence of binge drinking amongst college students is significantly higher compared to their peers who never attend college (Timberlake et al., 2007) suggests that drinking behavior may be potentiated by the college environment which consists of peers who influence alcohol use, as well as social opportunities that encourage alcohol consumption. College students who engage in excessive drinking place themselves as well as others at considerable risk. In 2001, 10% of full-time four-year college students were unintentionally injured because of drinking, 12% were physically assaulted by another drinking college student, and 2% were victims of alcohol-related sexual assault or date rape (Hingson et al., 2009). As a result of these destructive and often tragic consequences, researchers and policy makers alike have joined forces to develop evidence-based prevention and treatment strategies to reduce alcohol use on college campuses (e.g., Department of Health and Human Services, 2007; Toomey & Wagenaar, 2002).

The development of effective prevention and treatment strategies is facilitated by an understanding of the etiology of alcohol use. Although many problem drinkers readily acknowledge the negative consequences of their drinking and appear strongly motivated to stop, this can prove to be difficult. That is, research has shown that through repeated consumption, decisions about drinking may become highly automatic (e.g., Marlatt, 1985; Tiffany, 1990), resulting in a lack of awareness of the factors that influence decisions to drink (e.g., McCusker, 2001; Wiers, Van Woerden, Smulders, & De Jong, 2002). According to the model of incentive sensitization (Robinson & Berridge, 2000, 2008), repeated consumption of substances of abuse results in an increased drug-induced dopaminergic response in brain areas such as the nucleus accumbens (Wise, 1998). These neurological changes cause the substance of abuse, as well as related cues, to become especially salient, attractive, and attention-grabbing, resulting in selective attention to drug-related cues at the expense of others in the environment. This attentional bias is thought to be implicit and leads to an increase in the number of drug-related cognitions which in turn, may lead to withdrawal or

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compensatory responses, and induce undesirable states, such as mood disturbances and interference of cognitive processing (e.g., Bradley, Codispoti, Cuthbert, & Lang, 2001; Franken, 2003). As a result, these individuals may have difficulty abstaining from alcohol in the face of escalating problems and complications related to their drinking that might otherwise motivate restraint (Waters et al., 2003; Williams, Mathews, & MacLeod, 1996).

The role of attentional bias in the maintenance of alcoholism (for reviews see Field & Cox, 2008; Franken, 2003; Robbins & Ehrman, 2004) as well as for other substances of abuse (e.g., Lubman, Peters, Mogg, Bradley, & Deakin, 2000) has been well-documented. This research has provided evidence suggesting that increased dependence on a particular drug is correlated with an increased attentional bias for drug-related cues (Bradley, Mogg, Wright, & Field, 2003; Cox, Brown, & Rowlands, 2003; Cox, Yeates, & Regan, 1999; Littel & Franken, 2007; Mogg, Bradley, Field, & De Houwer, 2003; Ryan, 2002; Townshend & Duka, 2001; Warren & McDonough, 1999). For example, alcohol abusers show a greater attentional bias to alcohol-related cues than heavy drinkers, while heavy drinkers demonstrate a greater bias than light and occasional drinkers (Cox, Fadardi, & Pothos, 2006; Field, Mogg, Zetteler, & Bradley, 2004; Jones, Jones, Smith, & Copley, 2003; Noël et al., 2006; Townshend & Duka, 2001), who typically show weak attentional biases for alcohol-related cues relative to non-alcohol-related cues (Johnsen, Laberg, Cox, Vaksdal, & Hugdahl, 1994; Sharma et al., 2001; Stormark et al., 2000). Attentional bias appears to play a causal role in the generation of drug craving and drug-seeking behaviors, as demonstrated by Field and Eastwood (2005), who showed that heavy drinkers who were trained to attend to alcohol-related stimuli demonstrated an increase in their attentional bias to these cues, which led to more subsequent drinking behavior.

Although previous studies have focused primarily on how consumption levels and dependence relate to attentional bias, problem alcohol consumption is predicted by specific reasons for drinking (Beck, Summons, & Thombs, 1991). One reason for drinking associated with problematic behaviors is drinking to avoid dysphoric emotions or negative mood; individuals who drink for this reason are referred to as escape drinkers (Cahalan, Cisin, and Crossley, 1969). Escape drinking has been shown to be a predictor of binge drinking (Williams & Clark, 1998), and is associated with alcohol-related problems (Abbey, Smith, & Scott, 1993; Farber, Khavari, & Douglass, 1980; Mennella & Forestell, 2008), independently of consumption levels (Polich & Orvis, 1979). Thus, it is of interest to determine whether attentional biases observed in heavy drinkers are specifically a result of dependence, or of escape drinking habits. Although previous research has failed to demonstrate that those who drink alcohol to cope show attentional biases to alcohol-related stimuli (Field & Powell, 2007; Field & Quigley, 2009; Grant, Stewart, & Birch, 2007), there are further methodological details to be considered before concluding that escape drinking does not independently predict attentional biases to alcohol-related cues.

Toward this goal, the primary aim of the present study was to delineate the role of escape drinking in predicting attentional bias for alcohol-related cues using a dot-probe paradigm. This task has been successfully used in examining attentional biases to alcohol-related stimuli relative to non-alcohol-related control stimuli in previous work (e.g., Townshend & Duka, 2001). In addition to examining how attentional bias to alcohol cues differs as a function of escape drinking, this study also aimed to investigate the potential moderating roles of presentation time of the picture cues and their content. While previous work has failed to show attentional biases for cue exposures that last for only 200 ms, a duration which is thought to assess initial orienting to the alcohol-related cues (Field et al., 2004), researchers have demonstrated biases in heavy social drinkers relative to light social drinkers at 500 ms (Field et al., 2004; Field,

Mogg, & Bradley, 2005; Townshend & Duka, 2001). Biases for stimuli presented for 500 ms might involve initial orienting (Bradley et al., 2000) as well as maintained attention (Fox et al., 2001). However, despite the robust evidence for heavy drinkers to demonstrate an attentional bias for alcohol-related stimuli presented for this duration, Field and colleagues have reported only marginal effects for heavy drinkers who score high on coping-motivated drinking (i.e., escape drinkers) unless they were first exposed to a stressor. Thus, in the current study, we included trials with 500 ms as well as a longer stimulus duration which is commonly used within the literature (i.e., 2000 ms; Bradley et al., 2003, Bradley, Field, Mogg, & De Houwer, 2004; Ehrman et al., 2002; Field et al., 2004) to assess maintained attention in escape and non-escape drinkers.

A third factor that was manipulated was the context of the picture cues in the dot-probe paradigm, which included stimuli that varied based on the presence or absence of human content. This manipulation addresses an identified limitation in the field, as many studies have not controlled for the human content presented in stimulus pictures. This is problematic because human-related stimuli yield greater cognitive processing than pictures of objects alone (e.g., Bentin, Allison, Puce, Perez, & McCarthy, 1996), which may cause participants to focus primarily on the human components of the pictures, distracting them from the alcohol-related stimuli. Indeed, previous research from our laboratory that manipulated the human content within the stimulus pictures found attentional biases only to smoking-related pictures that did not contain a human element (Dickter & Forestell, 2012; Forestell, Dickter, Wright, & Young, 2011). As in our previous work, the current study included a set of stimuli in which the pictures were carefully matched in familiarity, brightness, and color. Picture stimuli either depicted the alcohol and control stimuli alone (i.e., inactive) or with a human interacting with the cues (i.e., active). Taken together, it was hypothesized that escape drinkers would show a greater attentional bias for alcohol-related cues compared to non-escape drinkers, and that this bias would be moderated by stimulus presentation time (e.g., Field et al., 2004; Noël et al., 2006) as well as stimulus content (Dickter & Forestell, 2012; Forestell et al., 2011).

Materials and methods

Participants

One hundred seventy-three (78 female) undergraduate students at a medium-sized liberal arts college participated in this study for introductory psychology course credit or for $10 cash. Because an additional goal of this research program was to measure responses to smoking-related cues (data presented elsewhere), introductory students who indicated that they smoked cigarettes were invited to participate and fliers were placed around the campus to recruit additional smokers. All procedures were approved by the college's Protection of Human Subjects Committee, and written informed consent was obtained from each participant.

Materials

Stimuli
The dot-probe stimuli consisted of 120 color photographs, 60 of which were alcohol-related items or matched control items.[1] Thirty

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[1] The remaining photographs consisted of 60 smoking-related and matched non-smoking-related control pictures. However, only reaction times to alcohol and non-alcohol-related target stimuli (i.e., those replaced by a probe in the dot-probe task) were analyzed since the theoretical focus of the present study was to investigate participants' reactions to alcohol-related stimuli.

photographs depicted a stimulus in an active setting, in which a human was interacting with the stimulus (e.g., drinking from a beer bottle or drinking from a bottle of soda), whereas the remaining 30 photographs depicted a stimulus in an inactive scene, in which the stimulus was presented alone (e.g., a bottle of beer or a bottle of another liquid such as soda). Active and inactive alcohol-related cues depicted the same proportion of pictures of beer, wine, and liquor. In all pictures, stimuli were presented against a black background. Pictures were presented in pairs, with one alcohol-related image presented beside a matched control image. Control pictures were created to resemble alcohol cues in terms of brightness, color, and object position. All pictures were pilot-tested with 10 undergraduate students to verify that the contents could be correctly identified and judged as alcohol- or non-alcohol-related. The average accuracy rate for alcohol and non-alcohol-related photographs was $97\% \pm 0.19$ (Range: 80%–100%). Accuracy of identification did not differ between the alcohol-related and control stimuli, nor between the active and inactive stimuli (all p values > 0.05).

Dot-probe task

Participants completed the dot-probe task, which consisted of two blocks, one that presented picture pairs for 500 milliseconds (ms), and the other for 2000 ms in counterbalanced order. Each block contained 60 trials, with a total of 120 trials. As shown in Fig. 1, each trial began with a fixation cross in the center of the screen for 1000 ms. Pairs of stimuli were then presented simultaneously on either side of the fixation cross for either 500 or 2000 ms, depending on the block. Combinations of stimuli were presented with equal likelihood in a randomized order. Following the picture pair, participants saw a visual mask for 433 ms. A black dot then appeared on the screen where one of the pictures had been, and remained there until the participant pressed a key denoting which side (left or right) the dot had appeared on the screen. The intertrial interval varied between 1500 and 3000 ms to guard against the influence of expectation.

Questionnaires

A demographic questionnaire asked participants to indicate their gender, age, race, family income, and parental education levels. Additionally, participants completed an electronically-based questionnaire that included a variety of items to assess their drinking habits (e.g., when they drank, what they drank, how they and others felt about their drinking). This included a 20-item escape questionnaire developed by Cahalan et al. (1969) as part of a national survey to determine the extent to which individuals consume alcohol to reduce stress and dysphoric feelings. Participants received one point for agreeing with any of the five following reasons for drinking: to forget their worries or problems, to help them to relax, to forget everything, to cheer themselves up when they are in a bad mood, or when they are tense and nervous. Thus, total escape scores could vary from 1 to 5. Additional questions that were not related to escape drinking included items such as "to alleviate pain" or "to celebrate special occasions." According to Cahalan et al. (1969), a total score of two or greater on this scale is indicative of an escape drinking pattern and is associated with problem drinking. The questionnaire demonstrated high levels of internal consistency with our sample (KR-20 = 0.90).

The Michigan Alcohol Screening Test (MAST; Selzer, 1971) was also completed to assess dependence on alcohol by measuring alcohol-related problems and risk for alcoholism. The MAST contains 25 questions regarding the severity of participants' drinking behaviors, which require participants to indicate whether or not they have ever experienced symptoms such as delirium tremens, gotten into fights, been arrested for drunken behavior or driving under the influence of alcohol, or been in trouble at work or lost their job due to their alcohol use. Answers to each question are assigned weighted values of zero, one, two, or five points, and a total score of five or above (range 0–53) is classified as at risk for alcoholism. This measure possesses good internal-consistency reliability, as indicated by Cronbach's alpha coefficients of 0.83–0.93 (Gibbs, 1983).

Participants were also interviewed about their smoking and drinking habits, frequency of alcohol consumption, and their family history of alcoholism. Each participant was asked whether they currently drank, where they did most of their drinking and with whom. Using a time-line follow-back procedure (Sobell & Sobell, 1995), they provided an account of the frequency of their recent drinking behavior by indicating the number, amount, and type of
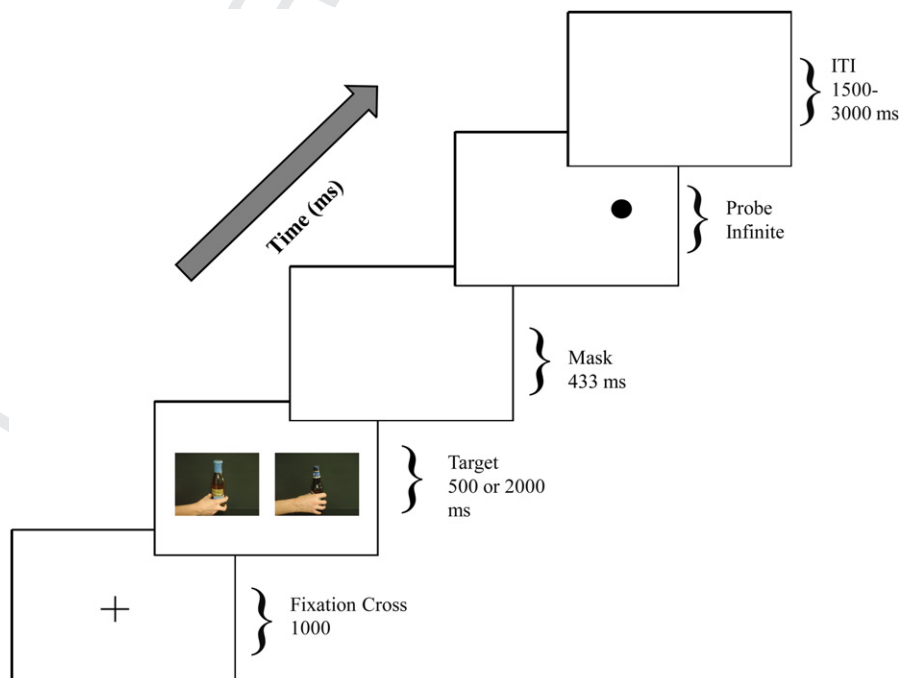

Fig. 1. A schematic of the dot-probe task. The screens were presented in chronological order. Duration is listed to the right of each screen.

alcohol (i.e., beer, wine, and liquor) consumed on each drinking occasion over the previous three weeks. From these data, we estimated the number of standard drinks consumed. Additionally, we interviewed participants to determine whether they had a family history of alcohol use by using the Family Interview for Genetic Studies (FIGS), in which a family tree of first- and second-degree relatives was completed (Mann, Sobell, Sobell, & Pavan, 1985). Participants indicated which relatives drank heavily or frequently and, for each of these relatives, answered additional questions about their drinking behavior. Family members were classified as alcohol dependent according to the DSM-III-R criteria. A family history density (FHD; Fein, McGillivray, & Finn, 2004; Stoltenberg, Mudd, Blow, & Hill, 1998) score was then calculated where biological parents that were identified as problem drinkers were given a score of 0.50. Grandparents that were identified as problem drinkers were given a score of 0.25. All other relatives were not included in the final score. Scores were summed to obtain an FHD ranging from 0 to 2.

Procedure

The experiment consisted of two sessions that were completed on separate days. Session 1 consisted of the dot-probe task which participants completed in groups of two to four. After completing an informed consent form, participants were seated approximately 90 cm from a computer monitor at a private computer station where they received instructions on how to complete the dot-probe task, followed by six practice trials. Next, they completed both blocks of the dot-probe task, which lasted approximately 20 min. In Session 2, which lasted for approximately 45 min, participants completed the electronically-based questionnaires and were interviewed about their recent drinking habits and family history of alcoholism. Participants were then debriefed and dismissed.

Results

Participant characteristics

Of the 173 participants recruited, 51 were excluded from data analysis because they either had a large number of incorrect trials on the dot-probe task ($n = 3$), they did not return for the second session ($n = 10$), they did not answer all of the questions on the online questionnaire ($n = 16$), they were older than 25 years of age ($n = 3$), they never drank alcohol ($n = 17$), or due to a technical error with the dot-probe task, their response times were not saved ($n = 2$). The remaining 124 participants (54 female) were approximately 19.2 ($SD = 1.2$) years of age. The majority of participants were White (63.7%), with the remaining participants of the following races: 5.6% Black, 12.9% Hispanic, 4.8% Asian, and 12.9% mixed or "other". Eighty-four percent of the participants reported drinking alcohol in the past three weeks, with an average of 29.2 ($SE = 3.2$) standard drinks consumed over that time period.

Based on their scores on the escape drinking scale, participants were classified as either escape drinkers ($n = 74$), or non-escape drinkers ($n = 48$). A series of comparisons were made between these two groups using Analyses of Variance (ANOVA) for continuous and Chi-Square analyses for categorical variables. As shown in Table 1, compared to their non-escape counterparts, escape drinkers were more likely to be dependent on alcohol (as indicated by their MAST scores), were more likely to drink in the morning and afternoon, and to forget events after drinking. Over the previous three weeks, escape drinkers consumed alcohol more frequently, consumed more drinks per drinking occasion, and specifically drank more liquor than non-escape drinkers. Escape drinkers were also more likely to feel guilty about drinking, to report that others

worry about their drinking behavior, and to have a family history of alcoholism compared to non-escape drinkers. More escape drinkers indicated that they smoked ~~than non-escape drinkers~~ as well.

Attentional bias

Only reaction times (RTs) from correct trials, where participants accurately identified the location of the dot, were used in the analyses. Response latencies that were greater than three standard deviations above the mean were removed from the data, resulting in a loss of less than 1% of the data. To examine the relative attention to alcohol-related compared to non-alcohol-related cues, a difference score was calculated in which reaction times to trials in which the dot-probe appeared on the side of the alcohol picture were subtracted from the reaction times to trials in which the dot-probe appeared on the side of the non-alcohol picture separately for 500 ms and 2000 ms blocks. Positive difference scores indicated greater attention to the alcohol-related pictures relative to the non-alcohol-related pictures. Greenhouse–Geisser-adjusted p values are reported for analyses involving multiple numerator degrees of freedom.

To test the hypothesis that attentional bias to alcohol-related cues would differ based on escape drinking patterns, presentation time, and the properties of the stimuli, a mixed-model analysis of covariance (ANCOVA) was conducted with escape drinking (escape vs. non-escape) as the between-subjects variable, stimulus type (active vs. inactive), and time (500 ms vs. 2000 ms) as the repeated measures variables. MAST scores and FIGS scores were covariates.

These analyses revealed a three-way escape drinking × stimulus × time interaction; $F(1,118) = 5.6, p < 0.02, \eta^2 = 0.05$. To examine this three-way interaction, separate ANCOVAs were conducted for each type of stimulus. As shown in Fig. 2, there was an escape drinking × time interaction for the inactive cues, $F(1,118) = 6.1, p < 0.02, \eta^2 = 0.05$. While attentional bias did not differ between the escape groups for the inactive cues presented for 500 ms, $p = 0.14$, escape drinkers showed a stronger attentional bias for the alcohol-related cues than the non-escape drinkers, $F(1,118) = 4.8, p < 0.04$, for the inactive cues presented for 2000 ms (Fig. 2B). Similar analyses conducted for attentional bias to the active cues did not reveal a significant escape × time interaction, $F(1, 121) = 1.8, p > 0.15$ (Fig. 2A).

Because visual inspection of Fig. 2A suggested that there may have been group differences for the active cues at 500 ms that were not detected, possibly because of our categorization of escape and non-escape drinkers, a series of partial correlations in which the MAST and FIGS scores were control variables were performed using the escape drinking as a continuous measure. Consistent with the results reported above, there was a significant partial correlation between the escape and attentional bias scores for the inactive cues presented for 2000 ms, $r(118) = 0.2, p < 0.02$. Additionally, there was also a significant partial correlation between escape and attentional bias for the active stimuli presented at 500 ms, $r(118) = 0.2, p < 0.03$.

Discussion

Substantial research has documented that as alcohol consumption increases, so do attentional biases for alcohol-related stimuli (Cox et al., 2006; Fadardi & Cox, 2006; Field et al., 2004; Jones et al., 2003; Noël et al., 2006; Townshend & Duka, 2001). The present work provides an important contribution to the literature because it demonstrates that attentional bias to alcohol-related cues is related to the degree to which individuals drink to escape. Consistent with previous findings, we found that although escape drinkers are more likely to report a family history of alcoholism and are more likely to be dependent on alcohol (e.g., Cahalan et al., 1969; Farber et al., 1980;

Table 1
Participant characteristics as a function of ~~their~~ escape drinking behavior.

	Escape drinker (n = 74)	Non-escape drinker (n = 48[a])	Test statistic
Age [in years]	19.3 ± 0.2[b]	19.0 ± 0.1	$F(1, 120) = 1.8$
Gender [% Female]	37.8	54.2	$\chi^2(1) = 3.2^+$
Parental Education Level[c] [%]			
High School	5.3	0	
Community College	1.4	6.2	
Undergraduate	25.7	18.8	
Graduate/Professional	67.6	75.0	$\chi^2(4) = 7.0^+$
Smoke cigarettes [%]	54.9	34.8	$\chi^2(1) = 4.55^*$
Drinking Measures			
Age started drinking [years]	17.2 ± 0.2	17.7 ± 0.3	$F(1, 119) = 2.6$
Michigan Alcohol Screening Test (MAST)			
Dependent [%]	37.8	10.4	$\chi^2(1) = 11.1^{**}$
Mean score	5.8 ± 0.6	3.2 ± 0.6	$F(1, 120) = 7.6^{**}$
Drunk in past year [frequency]	33.6 ± 3.7	19.5 ± 3.4	$F(1, 120) = 7.0^{**}$
Drinks in the morning [%]	31.1	12.5	$\chi^2(1) = 5.5^*$
Drinks in the afternoon [%]	66.2	44.7	$\chi^2(1) = 5.4^*$
Drinks weekends only [%]	66.2	91.7	$\chi^2(1) = 10.5^{**}$
Forgets events after drinking [%]	78.4	47.9	$\chi^2(1) = 12.1^{**}$
# Drinks it takes to feel high[d]	3.9 ± 0.2	3.7 ± 0.3	$F(1, 120) = 0.4$
# Drinks it takes to pass out[d]	9.6 ± 0.5	9.1 ± 0	$F(1, 120) = 0.5$
Drinking behavior over previous three weeks:			
% consumed alcohol	93.2	70.8	$\chi^2(1) = 11.1^{**}$
Number of drinking occasions	5.1 ± 0.4	3.1 ± 0.2	$F(1, 120) = 10.1^{**}$
Highest # of drinks per occasion[d]	9.0 ± 0.7	5.3 ± 0.7	$F(1, 119) = 12.0^{**}$
Mean number of drinks[d]			
Beer	20.1 ± 4.0	13.8 ± 3.0	$F(1, 120) = 1.3$
Wine	1.8 ± 0.5	0.3 ± 0.2	$F(1, 120) = 6.6^{**}$
Liquor	13.7 ± 1.6	5.4 ± 1.1	$F(1, 120) = 13.9^{**}$
Total drinks	35.7 ± 4.7	19.6 ± 3.4	$F(1, 120) = 6.3^{**}$
Perceptions about drinking behavior			
Feels guilty about drinking [%]	23.0	4.2	$\chi^2(1) = 7.8^{**}$
Feels ~~they~~ should cut down [%]	43.2	33.3	$\chi^2(1) = 1.2^*$
Others worry about drinking [%]	23.0	8.3	$\chi^2(1) = 4.4^*$
Family history of alcoholism [%]	58.1	38.3	$\chi^2(1) = 4.5^{**}$

[+]Denotes marginal effects at $p < 0.1$. [*]Denotes statistical significance at $p < 0.05$ [**]Denotes statistical significance at $p < 0.01$.
  [a] Group does not contain 17 additional participants who indicated they do not drink.
  [b] Values are presented as mean ± standard error unless otherwise specified.
  [c] Refers to the highest education level between mother and father.
  [d] Refers to number of standard drinks.

Jung, 1977; Mennella & Forestell, 2008), when these factors were controlled, escape drinkers displayed a significantly stronger attentional bias for alcohol-related cues than non-escape drinkers for inactive cues presented for 2000 ms. This was further supported by ~~a~~ correlational analyses which indicated that escape drinking predicted attentional bias for inactive cues that were presented for 2000 ms. At 500 ms stimulus durations, attentional biases were present only for active stimuli. These findings extend previous research in that they suggest that depending on the type of cue, escape drinkers may demonstrate either initial orientation or maintained attention to alcohol-related cues.

Although escape and non-escape drinkers' attentional biases occurred only when inactive stimuli were presented at 2000 ms in the analyses of variance, partial correlation analyses revealed that escape drinkers may have also had an attention bias for the active cues at 500 ms. According to psychophysiological work, the brain processes active and inactive scenes differently, with scenes that contain people yielding greater processing than those that contain objects alone (e.g., Allison et al., 1994; Bentin et al., 1996; Bobes, Valdés-Sosa, & Olivares, 1994; ~~Vanrullen~~ & Thorpe, 2001). There-fore, while the presence of humans in the active pictures may have captured all participants' early attention, those with higher escape scores may have focused more of their initial attention on the scene containing the alcohol-related cue due to its reinforcing qualities. Although escape drinkers may orient their initial attention to active alcohol-related cues, it appears that they maintain their attention to

inactive cues ~~only~~. These biases in attention may increase craving for alcohol (Field & Cox, 2008; Franken, 2003; Robbins & Ehrman, 2004), resulting in a vicious cycle that precludes moderation or abstinence.

Most previous work examining attention to alcohol-related stimuli has used both active and inactive stimuli without testing for potential differences, and has largely ignored escape drinking as a potential factor involved in attentional biases for alcohol-related cues (e.g., Field et al., 2004, 2005; Schoenmakers, Wiers, & Field, 2008; Townshend & Duka, 2001, 2007). While previous findings have shown that heavy drinkers have an attentional bias for alcohol-related stimuli at 500 and 2000 ms (Field et al., 2004), our results extend these earlier findings by revealing that cue characteristics interact with presentation time to affect escape drinkers' attentional biases. The results of the current study suggest that inconsistencies in research findings reported in the literature (as reviewed by Loeber et al., 2009) may be a result of methodological differences, and highlight the importance of including cue characteristics in future work examining attentional biases to drug-related stimuli.

Using a dot-probe task similar to the paradigm in the present study, Miller and Fillmore (2010) found that heavy drinkers showed an attentional bias toward alcohol-related stimuli presented for 1000 ms only if the stimuli were simple in complexity (i.e., pre-sented against a black background). This suggests that simple alcohol-related images may hold escape drinkers' attention more effectively than alcohol-related images presented within a complex
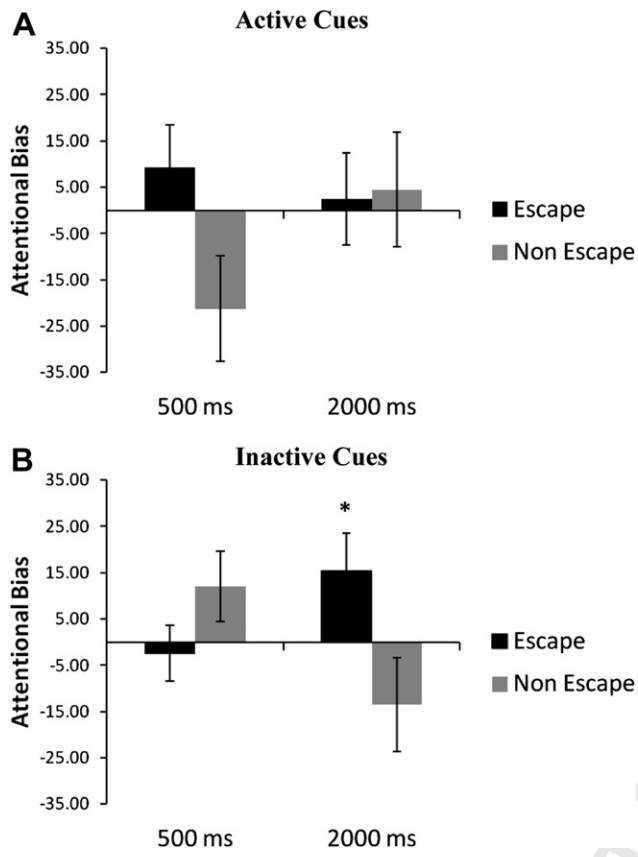
Fig. 2. Estimated marginal mean attentional bias difference scores (ms) (±SE) for escape and non-escape drinkers to inactive pictures presented at 500 ms and 2000 ms. Positive values reflect an attentional bias (i.e., faster reaction times) to the alcohol-related cues relative to the control cues, whereas negative values reflect attentional bias to the control cues relative to the alcohol-related cues.

scene. Thus, it is possible that escape drinkers' attentional bias for the inactive stimuli at 2000 ms in the present study was potentiated by the fact that the cues were presented alone. This alternative view deserves further testing, given that our active stimuli were presented against a neutral background and thus would be considered simple compared to Miller and Fillmore's complex stimuli, which were depicted in the context of a complex background scene, such as a bar or restaurant.

It is important to note that the sample in the present study contained a higher proportion of escape drinkers than is typically reported (i.e., approximately 53% of our total sample). This might not be surprising given that our sample consisted of college students who have been reported to engage in frequent binge drinking. However, the high proportion of escape drinkers may have also been due to our efforts to recruit smokers. Thus, the high proportion of escape drinkers may reflect the comorbidity between smoking and drinking behaviors (Hurt et al., 1994; Pomerleau, Aubin, & Pomerleau, 1997; Romberger & Grant, 2004). Similar to previous reports (Mennella & Forestell, 2008), although our samples of escape and non-escape drinkers were similar in their demographics (i.e., age, gender, parental education), escape drinkers were more likely to have a family history of alcoholism and be dependent on alcohol themselves. They also reported consuming over 30 drinks over the previous three weeks and up to nine drinks in a single drinking occasion, which is comparable to the amount they reported consuming before passing out. Non-escape drinkers reported drinking approximately half this amount over the same time period. Escape drinkers were also more likely to report that they felt guilty about their drinking and that others worried about their drinking, but alarmingly they were not more likely than non-escape drinkers to report that they should cut back on their drinking, suggesting they may be unaware of or in denial about their drinking problems.

It is important to note that there were several limitations in the present paper. First, although we only report the results of the alcohol-related trials, it is possible that including smoking-related cues in the same task could have potentially affected participants' responses to the alcohol-related stimuli. Second, while the Cahalan et al. (1969) escape drinking measure is quick to administer and similar to other drinking motive measures used in the literature (e.g., Cooper, 1994), it is somewhat limited in that it relies on true/false questions rather than using a Likert-type scale. Future research should use Cooper's drinking motives scale to determine whether other factors such as social enhancement or conformity motives are also related to attentional biases in drinkers.

Although drinking during the early college years is a normative behavior in our society (Dusenbury & Botvin, 1992; Hillman & Sawilowsky, 1992), it places students who drink at risk for dependence, and everyone at risk for injury (Hingson et al., 2009). As a result, understanding the factors involved in students' drinking behavior is an important social problem. Our results demonstrate that escape drinking is associated with maintained attentional bias for inactive alcohol-related cues, and possibly initial attention to active cues, independent of dependence and family history of alcoholism. These findings can help inform models of alcohol addiction in that they demonstrate that factors that motivate drinking behavior, such as negative reinforcement (i.e., coping), are related to attentional bias and may lead to more targeted prevention and treatment strategies.

Uncited references   Q3

Ewing, 1984; Fadardi & Cox, 2009; Field et al., 2007; Jones et al., 2002; Morse & Flavin, 1992; Riley et al., 1948; Roberts & Koob, 1997; Robinson & Berridge, 1996; Russell, 1994.

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