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Script-guided imagery of social drinking induces both alcohol and cigarette craving in a sample of nicotine-dependent smokers

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Abstract

Laboratory exposure to alcoholic beverage cues has been demonstrated to elicit urges to drink. Less well examined is the possibility that imaginal cues also elicit such urges, providing a model of conditioned effects not dependent on the presence of physical stimuli associated with alcohol. Studies of possible cross-reactivity between smoking and drinking cues are also scarce. To that end, nicotine-dependent nonalcoholic smokers ($n=54$) were exposed to social drinking-relevant, and for comparison, neutral and smoking-relevant standardized script-guided imagery. Cravings were measured before and after each imaginal exposure. As hypothesized, the drinking script induced alcohol and cigarette cravings, providing support for both direct and cross-cue reactivity effects. Further validating the social-drinking script, craving reactions were significantly stronger among participants who reported frequent drinking in social situations. Finally, smoking imagery induced both cigarette and alcohol cravings, providing further support for the cross-cue-induced craving phenomenon. Results suggest that the present alcohol script may be a useful tool for eliciting craving responses under laboratory conditions, and provide an additional means for better understanding addiction.

Keywords

Imagery; Cue; Craving; Alcohol; Smoking

1. Introduction

Alcohol dependence continues to be a major public health concern worldwide. According to DSM-IV, it is expected that one in every ten people will develop an alcohol-related disorder at some point during their lifetimes (American Psychiatric Association, 1994). Although treatments for alcohol problems are widely available, overall rates of alcohol dependence within the general population continue to present a burdensome problem. One hypothesized barrier to successful treatment is the ubiquitous presence of classically conditioned environmental and contextual cues that trigger strong urges to consume (Drummond, Cooper, & Glautier, 1990; Childress et al., 1993; Ludwig, 1986). It is now well established that this cue reactivity can be reliably modeled under laboratory conditions. Indeed, studies of both

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alcohol dependent individuals, as well as non-alcoholic heavy drinkers have demonstrated elevated levels of cravings to consume alcohol following in vivo or pictorial exposure to beverage cues, compared to non-alcohol dependent persons and lighter drinkers (Streeter et al., 2002; Childress et al., 1993; Drummond et al., 1990; Glautier & Drummond, 1994b). This phenomenon of cue-induced craving for alcoholic beverages is consistent with a broader literature with other addictive substances, including cocaine and nicotine. For example, Sinha et al. (Sinha, Fuse, Aubin, & O'Malley, 2000) found that exposure to cocaine-related paraphernalia induced significant drug cravings among cocaine-dependent individuals. Similarly, we (Erblich & Bovbjerg, 2004) and others (e.g., (Carter & Tiffany, 1999) have demonstrated that in vivo exposure to smoking paraphernalia induces cigarette cravings.

Longitudinal studies have pointed to the importance of cue-reactivity as a predictor of key drug use outcomes. For example, in a prospective study (Abrams, Monti, Carey, Pinto, & Jacobus, 1988) of smokers engaging in a quit attempt, lower levels of pretreatment cue-reactivity were predictive of six-month cessation success. In a study of male alcoholics (Rohsenow et al., 1994), higher levels of cue-reactivity at baseline predicted greater frequency of drinking at a three-month follow-up. In another study of alcoholics (Litt, Cooney, & Morse, 2000), greater cue-reactivity was related to higher levels of drinking in the days following the task. In addition, numerous retrospective studies have found that the magnitude of cue-induced craving reactions are related to drug use history, including the severity of use and the duration of recent attempts at abstinence (e.g., (Niaura, Abrams, Demuth, Pinto, & Monti, 1989; Erblich et al., 2004).

More recently, studies have suggested that imaginal exposure to cues associated with the use of addictive substances may elicit comparable levels of craving to those seen with in vivo cues (Tiffany, 1990; Erblich et al., 2004). Such imaginal exposure methodologies have potential theoretical and practical benefits. First, imaginal exposures, using scripts describing such addictive cues, are thought to provide a more contextually rich cue induction, bringing in both more distal elements and more personalized experiences than can be achieved with exposure to more proximal in vivo cues such as paraphernalia (Tiffany, 1990). Imaginal exposures are also useful in contexts when in vivo exposures are not practical or feasible (e.g., MRI studies, clinical settings such as exposure therapy 'homework'). Cigarette smoking script-guided imagery methods have been tested and used in numerous experimental settings (Shadel et al., 1998; Drobles & Tiffany, 1997; Erblich et al., 2004). Fewer studies have been conducted to test the efficacy of imaginal exposure to alcohol stimuli in inducing craving (Felstead, Love, Peadar, & Taylor, 1994; Payne et al., 1992; Fox, Bergquist, Hong, & Sinha, 2007). Moreover, the few studies that have been done focused predominantly on male alcoholics. Little is known about the impact of imaginal exposures in non-problem drinkers across genders.

An independent concern associated with the health consequences of alcohol consumption is the high level of co-occurring tobacco use. Indeed, epidemiological studies have demonstrated that individuals diagnosed with alcohol dependence are more than six times more likely to be nicotine dependent as well (Grant, Hasin, Chou, Stinson, & Dawson, 2004). Similarly, smoking rates are greater among non-alcoholic heavy drinkers than among lighter drinkers (Zacny, 1990). Numerous hypotheses have been advanced to account for this high level of concurrent substance use. In light of the fact that drinking and smoking frequently co-occur, it has been suggested that the two drugs may serve as craving triggers for one another. Consistent with the possibility, a few studies have found that exposure to in vivo alcohol cues induced cigarette cravings (Rohsenow et al., 1997; Gulliver et al., 1995; Drobles, 2002). Conversely, in a small sample of alcoholic smokers, smoking cues were found to induce cravings for alcohol as well as for smoking (Drobles, 2002). 'Cross-cue'-induced alcohol cravings (by smoking cues) in non-alcoholic samples of smokers, however, have not been reported to date.

The objective of the present study was to test the efficacy of a standard imaginal alcohol script in inducing alcohol craving in a sample of non-alcoholic smokers. We further investigated the possibility that the alcohol script would concurrently induce cigarette cravings. Given the social-drinking context of the script (see Appendix), we also hypothesized that participants reporting more frequent alcohol use in social contexts would display stronger craving reactions to the script. Finally, to fully explore cross-cue-induced cravings, we examined the possibility that exposure to a standard imaginal smoking script would induce alcohol cravings.

2. Method

2.1. Participants

Fifty-four nicotine-dependent adults were recruited in response to ads requesting smokers for a research study. Participants were included in the study if they smoked on average a minimum of 10 cigarettes per day for at least 5 years, qualified for a DSM-IV diagnosis of nicotine dependence, and reported consuming at least one alcoholic beverage in the past month. Participants with histories of hospitalization or treatment for major mental illness (e.g., schizophrenia) or illicit substance abuse/alcohol dependence were excluded. Similarly, participants reporting problem drinking as measured by a score of greater than 5 on the Brief MAST (see Measures) were excluded. Other exclusions included pregnancy, and current cardiovascular disease or cancer. Mean age of the sample was 36.9 (± 1.7) years, and 54% ($n=29$) were female. Thirty-nine percent ($n=21$) of the participants reported African-American ethnicity, 31% ($n=17$) reported Hispanic ethnicity, 26% ($n=14$) of participants reported Caucasian ethnicity, and the remaining participants reported other ethnicities. Thirty-seven percent ($n=20$) of the sample reported household incomes of less than \$20,000 per annum, and 92% of the sample reported having at least a high school diploma.

2.2. Measures

2.2.1. Background Variables—This face-valid questionnaire assessed basic demographic information, including age, gender, ethnicity, income, and education levels. In addition, smoking variables, including number of cigarettes per day, number of years having smoked, and previous cessation attempts, were assessed (Erblich et al., 2004). In addition, a face valid screening interview assessed DSM-IV criteria for nicotine dependence.

2.2.2. Drinking Habits—To assess drinking habits, participants completed Cahalan's (Cahalan, Cisin, & Crossley, 1969) Quantity-Frequency-Variability questionnaire. In addition to assessing quantitative drinking measures (e.g., quantity and frequency), this instrument also assesses contexts in which alcohol consumption occurs. The questionnaire has been used extensively and had demonstrated good psychometric qualities.

2.2.3. Problem drinking—To rule out drinking problems, all participants completed the Brief Michigan Alcoholism Screening Test (Selzer, Vinokur, & van, 1975). This 10-item instrument has been used widely as a screening measure and correlates well with more lengthy clinical interviews. The test has good psychometric properties.

2.2.4. Craving—This 5-item questionnaire assesses craving on a 0-100 scale. Because of the difficulty capturing the phenomenology of craving, items with several different descriptors were used (e.g., craving, urge, want, desire). This approach, employed by our lab and others (Erblich et al., 2004; Hutchison, Niaura, & Swift, 1999) represents an improvement over traditional single-item assessments, but retains the brevity necessary for rapid assessments under experimental conditions. The instrument demonstrated excellent internal consistency, surpassing 0.90 for each administration in the study. The instrument was administered twice,

one for alcohol craving and one for cigarette craving at each assessment time point during the experimental procedure (see below).

2.3. Procedures

When participants arrived at the study site, their eligibility was re-confirmed, and they provided written consent, in accordance with the guidelines of the Institutional Review Board at the Mount Sinai School of Medicine. They then completed the study questionnaires. Following the questionnaires, an experimenter in the room presented three script-guided imaginal scenes: 1) a neutral scene, describing changing a light bulb, 2) an alcohol scene (see Appendix), describing consuming one's beverage of choice at a party and, and 3) a smoking scene, describing lighting up one's cigarette of choice after a meal. The neutral and smoking images were among those employed in a previous study (Tiffany & Hakenewerth, 1991) of cue-induced craving in smokers¹. For each scene, participants were read a 60-second vignette by the experimenter, and were then given 30 seconds of silence to continue to imagine the scene, "drawing on their own experiences." Previous studies (Payne et al., 1992; Fox et al., 2007) of alcohol imagery employed personalized imagery scripts derived from participants' personal descriptions of situations that would most likely induce alcohol craving. Because these previous studies were done in samples of alcoholic participants who were likely to also be smokers, it is quite possible that these craving scenes explicitly included smoking-related stimuli. In order to test for "cross reactivity" in the absence of such contaminating images we chose to use a common script across all participants so as to have an 'alcohol-only' imaginal exposure.

Two craving assessments (alcohol and cigarettes) were administered immediately before and immediately after each of the three imaginal exposures. To reduce the possibility of carryover craving from the smoking script, which was hypothesized to have the greatest effect in this sample of dependent smokers, the smoking imagery was always administered last, and the neutral and alcohol scripts administered first and second respectively. To further control for possible carryover, the three exposures were separated by two 3-minute rest periods, during which time participants viewed an aquatic nature video (Piferi, Kline, Younger, & Lawler, 2000). Statistical analyses comparing 'post-neutral' cravings to 'pre-alcohol' cravings, as well as post-alcohol cravings to pre-smoking cravings were conducted to formally test whether or not craving levels returned to prestimulus levels after the rest period. After the study procedures, participants were thanked for their participation, reimbursed \$50 for their time, and were provided with referrals for smoking cessation programs in the area, if desired.

3. Results

3.1. Smoking and Drinking Behavior

Participants reported a history of smoking an average of 15.2 ($\pm$ 1.3) cigarettes for 16.2 ($\pm$ 1.4) years. Thirty-nine percent of participants (n=21) reported consuming 5-6 drinks per episode "more than half the time" or "nearly every time," 18.5% (n=10) reported consuming 3-4 drinks at this frequency, and the remainder reported fewer drinks. Overall, 41% reported drinking "fairly often," with the remainder reporting "once in a while." Although there were substantial levels of drinking reported in the sample, Brief-MAST scores were low (0.8 ± 0.2). Finally, 33% (n=18) of the sample reported drinking socially in restaurants or bars "fairly often," and the remainder reported doing so only "once in a while."

¹The authors would like to thank Dr. Stephen Tiffany for providing the text of the neutral and smoking scripts.

3.2. Assessment of Carryover Effects

To test for the possibility of carryover effects in the three imaginal exposures, we conducted two one-way repeated measures ANOVAs on the 3 pre-stimulus craving responses for each outcome (i.e., alcohol craving and cigarette craving). As indicated in Table 1, there were no significant effects detected (p 's > 0.1), confirming that there were no carryover effects from one imaginal exposure to the next, and that there was a return to pre-stimulus craving levels after each of the two rest periods. This was true for both the alcohol craving responses and the cigarette craving responses.

3.3. Alcohol Craving

A 3 (Cue: Neutral, Alcohol, Smoking) $\times$ 2 (Time: Pre-stimulus, Post-stimulus) repeated measures ANOVA was performed, with alcohol craving as the outcome, and a Greenhouse-Geisser adjustment for multiple comparisons. As expected, there was a significant Cue $\times$ Time interaction: $F(2, 106) = 53.1$; $p < 0.0001$. Planned comparisons demonstrated a significant decrease in alcohol craving following neutral imagery ($t = -2.8$, $p < 0.01$), and significant increases following alcohol ($t = 8.6$, $p < 0.0001$) and smoking imagery ($t = 2.5$, $p < 0.015$). Comparisons also revealed that increases in alcohol craving following the alcohol imagery (effect size $d = 1.38$) were greater than the increases observed following the smoking imagery (effect size $d = 0.37$). Results were significant with or without inclusion of drinking and smoking characteristics as covariates. Means ($\pm$ SE) are shown in Table 1.

To further validate the alcohol imagery, which depicted drinking in a social situation, we compared the craving reactions of participants reporting a history of drinking on social situations 'fairly often' ($n=18$) to those reporting less frequent social drinking ($n=36$). To that end, we added social drinking status as a between-subjects factor, and we found a significant Cue $\times$ Time $\times$ Social Drinking Status interaction: $F(2, 104) = 7.1$; $p < 0.005$ (Figure 1). Consistent with the subject matter of the alcohol imagery, planned comparisons indicated that participants who reported social drinking 'fairly often' exhibited significantly larger alcohol craving reactions to the alcohol imagery than participants who reported less frequent social drinking ($t = 3.3$, $p < 0.001$; $d = 0.94$). Interestingly, the same pattern of results was observed with alcohol craving responses to the smoking imagery ($t = 2.8$, $p < 0.001$; $d = 0.81$), which depicted smoking after a meal in a restaurant. As expected, the two subgroups of participants did not differ in their responses to the neutral imagery ($t = 1.6$, $p > 0.25$). As above, these results were significant with or without inclusion of drinking and smoking characteristics as covariates. Inclusion of gender in these analyses did not alter any of the effects, nor were there any significant gender differences in craving responses.

3.4 Cigarette Craving

Cigarette cravings were assessed in an identical fashion to alcohol cravings. As expected, there was a significant Cue $\times$ Time interaction: $F(2, 106) = 35.0$; $p < 0.0001$. As with alcohol cravings to the three imagery scripts, planned comparisons demonstrated a significant decrease in cigarette craving following neutral imagery ($t = -4.7$, $p < 0.0001$), and significant increases following smoking imagery ($t = 4.7$, $p < 0.0001$) and alcohol imagery ($t = 2.1$, $p < 0.05$). Comparisons also revealed that the increase in cigarette craving following the smoking imagery (effect size $d = 0.72$) was greater than the increase observed following the alcohol imagery (effect size $d = 0.28$). Results were significant with or without inclusion of drinking and smoking characteristics as covariates. Means ($\pm$ SE) are shown in Table 1. Unlike alcohol craving, there was no significant contribution of social drinking status to cigarette craving reactions ($p > 0.1$). As above, inclusion of gender did not alter any of the effects, nor were there any significant gender differences in craving responses.

4. Discussion

The objective of this study was to investigate the effects of exposure to an imaginal social drinking script on alcohol cravings. Consistent with the study hypothesis, exposure to the alcohol script resulted in increased alcohol cravings. Further validating the script, participants identified as frequent social drinkers had particularly strong alcohol craving reactions to the script. These findings demonstrate that, not unlike laboratory paradigms for other drugs (Fox, Hong, Siedlarz, & Sinha, 2008; Erblich et al., 2004), imaginal exposures to alcohol cues are capable of inducing cravings for alcohol. Results are consistent with previous studies employing personalized alcohol scripts (Payne et al., 1992; Fox et al., 2007) and demonstrate that strong craving reactions can be induced using a standard drinking image, even in a sample of nonalcoholic individuals without problem drinking.

These findings are also largely consistent with previous studies with in vivo cues demonstrating elevated alcohol cue-induced cravings in samples of alcoholic subjects (Drummond et al., 1990; Glautier et al., 1994b; Streeter et al., 2002; Childress et al., 1993) and add to a somewhat smaller literature with non-alcoholic subjects (e.g., (Walitzer & Sher, 1990)). In addition, this study demonstrated high levels of cue-reactivity regardless of gender, consistent with the previous studies, which employed predominantly male samples; no significant differences between men and women emerged in the level of cue reactivity. These findings are also consistent with a previous study from our lab (Colamussi, Bovbjerg, & Erblich, 2007), in which no gender differences were observed for smoking cue-induced cigarette craving.

Examination of variability in cue-reactivity among non-alcoholic drinkers may prove useful in identifying individuals at risk of developing heavier drinking and/or alcohol-related disorders. Ultimately, examination of predictors of cue-reactivity may shed light on mechanisms underlying this risk factor for alcohol dependence. Indeed, studies from our lab have identified specific familial and genetic patterns that are predictive of cue-induced cigarette craving in smokers (Colamussi et al., 2007; Erblich, Lerman, Self, Diaz, & Bovbjerg, 2005; Erblich, Lerman, Self, Diaz, & Bovbjerg, 2004; Erblich, Boyarsky, Spring, Niaura, & Bovbjerg, 2003); the possibility that such patterns may emerge for alcohol craving, while intriguing, has not been well studied.

Another interesting finding in this study was that the alcohol imagery induced significant cigarette cravings and conversely, smoking imagery induced significant alcohol cravings. This cross-cue reactivity is consistent with conditioning theory and initial findings in previous small studies of alcoholics and smokers (Drobes, 2002; Gulliver et al., 1995; Rohsenow et al., 1997). This study is the first to report the phenomenon of cross-cue reactivity in a sample of non-alcoholic smokers. Cross-cue reactivity has been theorized to play an important role in the maintenance of polysubstance use (Zacny, 1990). Findings are thus especially important in light of the high levels of alcohol-tobacco comorbidity reported nationally (Grant et al., 2004). Interestingly, participants who reported being social drinkers not only exhibited stronger alcohol craving reactions to the social drinking imagery, but also to the smoking imagery, which depicted smoking in a restaurant, another social situation. These findings speak further to the importance of context in triggering cravings across substances, and suggest an important commonality between the effects of alcohol and smoking cues in inducing craving.

It should be noted though, that the magnitude of 'direct' craving reactions (i.e., alcohol craving reactions to alcohol imagery and cigarette craving reactions to smoking imagery) was substantially greater than the magnitude of cross-reactivity, suggesting considerable cue-specificity. Theories have long suggested that cue-reactivity operates via classical conditioning (Wikler, 1971; Eikelboom & Stewart, 1982; Drummond et al., 1990; Glautier & Drummond, 1994a). Consistent with conditioning theory, one would expect that the association between

alcohol stimuli and alcohol-congruent motivational responses (urges) would be stronger and more well-established than associations between alcohol stimuli and smoking-congruent motivational responses. The smaller 'cross-cue' effects, compared to 'direct-cue' effects, are thus consistent with a conditioning mechanism underlying cue reactivity. Indeed, it is possible that exposure to alcohol cues may trigger thoughts about smoking which, in turn results in cigarette craving, yielding a 'higher-order' conditioned cigarette craving response to alcohol cues (and vice versa) which is significant, but attenuated, relative to a 'first-order' conditioned alcohol craving response. This possibility is particularly intriguing in light of the imaginal methodology employed in current study, in which participants were free, and encouraged, to elaborate in their minds on the presented images, affording an opportunity for higher-order effects to occur. It is also possible that alcohol consumption (and images related to alcohol) may directly elicit smoking urges as a result of prior repeated co-occurrence of smoking and alcohol exposure in the individual's experience, having establishing two conditioned responses (urge to drink and urge to smoke) to a single cue. Whether or not participants first think of cigarettes or directly experience urges to smoke during alcohol exposure paradigms (or vice versa) remains an important untested question that would help to further elucidate the mechanisms underlying cross-cue-reactivity.

A final interesting finding in this study was the decline in craving following exposure to neutral imagery. This phenomenon is consistent with previous results from our lab (Erblich et al., 2004) and others (Conklin & Tiffany, 2001), and may reflect an effect of distraction associated with focused concentration on non-drug-related stimuli. It is tempting to speculate on the utility of employing neutral imagery as a method of managing cravings during acute episodes of urge during attempts to reduce substance use.

The study has some limitations that should be noted. First, only smokers were recruited. It would be interesting to compare responses of smokers and nonsmokers to imaginal alcohol and smoking cues within a single study. It should be emphasized, however, that nonsmokers' reactions to smoking cues are likely minimal, so with regard to the study of full cross-reactivity, the inclusion of nonsmokers would have limited utility. Imagery exposures were not counterbalanced. It is therefore impossible to entirely rule out the contribution of order effects. It should be emphasized, however, that repeated measures analyses of pre-stimulus craving levels across the three imagery conditions revealed no significant changes, arguing strongly against any order or carryover effects. These findings further underscore the robustness of the cue-reactivity phenomenon to methodological variations, as we have argued previously (Erblich et al., 2004). Finally, the study did not address the extent to which cue-reactivity may predict subsequent substance abuse and/or dependence. While some prospective studies have been done (Abrams et al., 1988; Litt et al., 2000; Rohsenow et al., 1994), additional research is needed to further explore the relationships between the strength of cue-induced urges and subsequent drug use and/or cessation success among those trying to end their dependence. Future studies might explore ways to intervene upon these cravings using appropriate counter-conditioning or extinction methods, although preliminary work in this area has had only modest success to date (Havermans & Jansen, 2003). Findings from such studies may shed light on important mechanisms underlying addiction, and may ultimately inform specific intervention modalities.

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Appendix—Imagery Scripts

Neutral

You drag a kitchen chair under a light fixture because you need to change a bulb. When you stand on the chair you can easily reach the screws that hold the fixture on to the ceiling. You start turning one of the screws, and as the glass cover begins to come loose, you place your hand over it to hold it in place. With your free hand you try to turn the last screw, but it's on pretty tight and your fingers slip. You clamp down harder this time and give it a good twist. The screw comes free and you're able to slip the cover off. You place the screws in the cover and climb off the chair. Getting back up on the chair, you start to unscrew the old bulb. It looks old and dirty; you're surprised that it hadn't burned out earlier.

Alcohol

You're standing at a party chatting with a group of people you've met, munching on some snacks, enjoying the music and the cheerful mood. You decided not to drink tonight and you feel O.K. Then you get a whiff of the unmistakable smell of your favorite drink. You realize that the couple who are now standing behind you are both sipping your favorite drink. You notice them laughing and joking with each other and you think how much you'd like to have a drink in your hand. What a perfect way to enjoy a party. As you eat some more snacks, you think how good a drink would taste right now. You offer to get the next round and start to make your way toward the bar at the side of the room.

Smoking

You're sitting in a restaurant and you've just finished a satisfying meal. As you drink your last cup of coffee, you lean back in your chair and think about how great you feel. You decided to go without smoking today and you feel O.K. As you close your eyes and draw in a deep breath, you inhale the unmistakable smell of cigarette smoke. You open your eyes and turn to see that the couple at the table next to you have just lit up cigarettes to have with their after-dinner coffee. As you watch them talking, laughing, and enjoying their cigarettes, you realize that a cigarette would be pleasant right now. What a perfect way to end this meal. As you drink some more coffee and fidget with your spoon, you think of how a cigarette would feel between your fingers.

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Figure 1. Alcohol Craving Responses to Imagery Scripts

Table 1Mean ($\pm$ Standard Error) Craving Scores

	Alcohol Craving ^a		Cigarette Craving ^b	
	Pre ¹	Post	Pre ²	Post
Neutral Imagery	7.7 (2.1)	2.6 (1.3)	43.8 (4.5)	23.0 (3.7)
Alcohol Imagery	4.8 (1.6)	46.8 (5.1)	35.5 (4.2)	45.8 (4.7)
Smoking Imagery	7.4 (2.1)	14.7 (3.4)	42.9 (4.7)	67.7 (4.6)

^{1,2} Repeated measures ANOVAs of pre-stimulus cravings across trials were not significant

^a Significant Cue $\times$ Time interaction, $p < 0.0001$, with both alcohol and smoking imagery inducing elevated alcohol craving

^b Significant Cue $\times$ Time interaction, $p < 0.0001$, with both alcohol and smoking imagery inducing elevated cigarette craving