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Implicit Alcohol and Smoking Associations among Young Adult Heavy Drinkers: Associations with Smoking Status and Alcohol-Cigarette Co-Use

Jeffrey D. Wardell,

Centre for Addiction and Mental Health, Toronto, Ontario, Canada

Sarah S. Dermody,

Oregon State University and Centre for Addiction and Mental Health, Toronto, Ontario, Canada

Kristen P. Lindgren,

University of Washington

Asad M. Medina,

Centre for Addiction and Mental Health, Toronto, Ontario, Canada

Christian S. Hendershot

Centre for Addiction and Mental Health, Toronto, Ontario, Canada, and University of Toronto

Abstract

Implicit memory associations may play a role in motivation to use alcohol and cigarettes, but the relationship between implicit associations and co-use of alcohol and cigarettes is currently unknown. This study provided an initial examination of alcohol and smoking implicit associations among young adult drinkers who were either nonsmokers or relatively light smokers (i.e., 10 or fewer cigarettes per day) as a function of smoking frequency and daily-level alcohol-cigarette co-use. Drinkers ($N = 129$) completed alcohol-arousal and smoking-valence variants of the Implicit Association Test as well as a daily-level assessment of past 90-day alcohol and cigarette use. Smokers were grouped according to whether they reported daily or nondaily smoking frequency. Results showed that although implicit alcohol-arousal associations did not differ between smokers and nonsmokers, stronger implicit alcohol-arousal associations were observed for nondaily smokers relative to daily smokers after controlling for drinking frequency. Further, implicit positive-smoking associations were stronger for smokers relative to nonsmokers. Within the

Correspondence: Correspondence concerning this article should be addressed to Christian S. Hendershot, 60 White Squirrel Way, 4th Floor, Toronto, ON, Canada M6J 1H4. Phone: (416) 535-8501 x36730. christian.hendershot@utoronto.ca.

Author Note

Jeffrey D. Wardell, Institute for Mental Health Policy Research, Centre for Addiction and Mental Health, Toronto, Ontario, Canada; Sarah S. Dermody, Department of Psychology, Oregon State University, Corvallis, OR and Centre for Addiction and Mental Health, Toronto, Ontario, Canada; Kristen P. Lindgren, Department of Psychology, University of Washington, Seattle, WA; Asad M. Medina, Centre for Addiction and Mental Health, Toronto, Ontario, Canada; Christian S. Hendershot, Campbell Family Mental Health Research Institute and Institute for Mental Health Policy Research, Centre for Addiction and Mental Health, Toronto, Ontario, Canada and Departments of Psychology and Psychiatry, University of Toronto.

Ethical Approval

All procedures were in accordance with the ethical standards of the institutional research ethics board and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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subgroup of nondaily smokers, more frequent co-use of alcohol and cigarettes was associated with stronger implicit positive-smoking associations when controlling for total drinking and smoking frequency. The findings suggest that implicit alcohol and smoking associations may be linked with smoking patterns (daily vs. nondaily) and co-use of alcohol and cigarettes among young adult drinkers who are not heavy smokers, highlighting the need for more research on the role of implicit associations in the co-use of cigarettes and alcohol.

Keywords

Implicit association test; binge drinkers; chippers; occasional smokers; simultaneous use

Introduction

Cigarette smoking is common among young adult heavy drinkers. A national survey of U.S. college students found that past-month cigarette use was reported by 44% of heavy drinkers (Weitzman & Chen, 2005). However, less than 5% of the heavy drinking college students were classified as heavy smokers (i.e., smoking more than half of a pack per day; Weitzman & Chen, 2005), suggesting that a large proportion of young adult drinkers who smoke are light and/or nondaily smokers (see also Harrison, Desai, & McKee, 2008; Jackson, Colby, & Sher, 2010). Light smoking typically refers to consuming a relatively low number of cigarettes per day (e.g., 5–10, depending on the study), whereas nondaily smoking refers to a pattern in which nonsmoking days are interspersed among smoking days (for reviews see Coggins, Murrelle, Carchman, & Heidbreder, 2009; Husten, 2009). Although historically receiving less research attention than heavy smokers, light and nondaily smokers are still at risk for considerable harms from tobacco (Halperin, Smith, Heiligenstein, Brown, & Fleming, 2010; Schane, Ling, & Glantz, 2010). Further, heavy drinkers who smoke are a high priority for interventions, as they tend to be more hazardous drinkers and are at greater risk for harms than drinkers who do not smoke (McKee & Weinberger, 2013; Yardley, Mirbaba, & Ray, 2015).

Research has shown that smoking behavior among light and nondaily smokers appears to be more context- and stimulus-driven than among heavier smokers (Shiffman & Paty, 2006), with alcohol use representing a salient recurring context for smoking. For example, light and nondaily smokers are more likely to smoke – and tend to smoke more cigarettes – when they are drinking alcohol relative to when they are not drinking; this difference is less pronounced for heavier smokers (Jackson et al., 2010; Shiffman & Paty, 2006). Thus, understanding the factors that may motivate cigarette and alcohol co-use among young adult light or nondaily smokers is important for informing interventions to reduce alcohol and cigarette use in this population.

Implicit substance-related memory associations – which reflect spontaneous, reflexive, and/or automatic associations – are thought to play a role in the motivational processes underlying substance use, including alcohol and cigarette use among young adults (Rooke, Hine, & Thorsteinsson, 2008; Wiers et al., 2007). In addition to reflecting broader cultural attitudes toward substances, it has been argued that implicit substance-related associations

are influenced by past experiences with the affective outcomes of using substances (Wiers & De Jong, 2006), and so the strength of implicit associations should be related to substance use history. Several studies have examined this link using variants of the Implicit Association Test (IAT) that assess the strength of associations between alcohol or smoking and affective concepts in memory (e.g., valence [positive vs. negative] or arousal [stimulation vs. sedation]). For example, stronger implicit associations between alcohol and arousal concepts have been consistently linked with heavier drinking (for reviews, see Roefs et al., 2011; Wiers & De Jong, 2006), which may reflect, in part, heightened sensitivity – or more frequent exposure – to the psychomotor stimulant effects of alcohol (Wiers, Van Woerden, Smulders, & De Jong, 2002). While several studies also support a relationship between heavy drinking and implicit alcohol-valence associations, these findings are somewhat mixed (see Roefs et al., 2011; Wiers et al., 2002; Wiers & De Jong, 2006). Further, some studies have found that implicit alcohol-arousal associations are moderately correlated with implicit alcohol-positive associations (Wiers et al., 2002; Wiers, van de Luitgaarden, van den Wildenberg, & Smulders, 2005), suggesting that arousal and valence dimensions are related but not redundant.

For smoking, research has found that both smokers and nonsmokers show stronger implicit associations between smoking and negative concepts relative to positive concepts, perhaps reflecting generally negative societal attitudes toward smoking (Swanson, Swanson, & Greenwald, 2001; see Roefs et al., 2011 for review). Still, several studies suggest that nonsmokers may have stronger implicit negative attitudes toward smoking relative to smokers, although a few studies have not observed this difference (Roefs et al., 2011). However, unlike research on implicit alcohol associations, studies of implicit smoking associations have tended not to examine implicit arousal associations.

Despite the relevance of implicit associations for understanding both drinking and smoking behavior, virtually no studies have examined cross-substance relationships (e.g., smoking behavior with alcohol IAT) or co-use of alcohol and cigarettes in relation to implicit associations. In one exception, McCarthy and Thompson (2006) examined the unique associations of drinking and smoking behavior with both alcohol and smoking IATs. Although they reported a significant positive relationship between alcohol-valence and smoking-valence IAT scores, they found little evidence for cross-substance IAT-behavior associations. However, this study did not focus on co-use of alcohol and cigarettes within the same individuals, and so further research is necessary to determine whether daily-level frequency of co-use may relate uniquely to alcohol and smoking implicit associations. Moreover, no studies to our knowledge have investigated alcohol and smoking implicit associations as a function of different smoking patterns (e.g., daily vs. nondaily) among young adult drinkers.

The current study examined differences in both alcohol and smoking IATs as a function of smoking status (i.e., nonsmoker, daily smoker, nondaily smoker) in a sample of young adult drinkers. Further, all of the smokers (both daily and nondaily) were relatively light smokers (i.e., smoking 10 or fewer cigarettes per day, on average), making them a prime sample within which to examine processes that are relevant for alcohol-cigarette co-use. Because co-use of cigarettes and alcohol may enhance the stimulant effects and/or dampen the

sedative effects associated with alcohol (for review, see Dermody & Hendershot, 2017), we hypothesized that drinkers who smoke would have stronger alcohol-arousal associations than drinkers who do not smoke. Further, the proportion of smoking events that co-occur with alcohol consumption is much higher among nondaily smokers relative to daily smokers, and so nondaily smokers may associate the arousing effects of nicotine more closely with alcohol. Thus, we expected that nondaily smokers would have stronger implicit alcohol-arousal associations relative to daily smokers. Moreover, among nondaily smokers, we also hypothesized that co-use frequency would be uniquely associated with implicit alcohol-arousal associations over and above total drinking and smoking frequency.

We also examined differences in smoking-valence implicit associations as a function of smoking status, alcohol use, and co-use. Consistent with past studies (Roefs et al., 2011), we expected that smokers would have weaker implicit-negative associations with cigarettes than nonsmokers. Further, to parallel the analyses for the alcohol IAT, we also explored the independent association of drinking frequency with implicit smoking associations, as well as the unique relationship between co-use frequency and smoking IAT.

Method

Participants and Procedures

The present study used data from a baseline assessment session that was part of a larger experimental study of young heavy episodic drinkers (Hendersot et al., 2017). Recruitment, eligibility criteria, and procedures for the baseline assessment session have been described in detail elsewhere (Strang et al., 2015; Wardell et al., 2016). Participants were recruited via advertisements and completed an initial telephone screening for eligibility. Primary eligibility criteria included age (18–21), at least one past month heavy drinking episode (i.e., 4 or more drinks for women and 5 or more drinks for men; Wechsler & Nelson, 2001), no history of alcohol treatment or current desire to cut down on drinking, no recent illicit drug use (except for cannabis), and no contraindications to alcohol administration. Due to the aims of the larger study, participants were screened out if they endorsed moderate or severe nicotine dependence, defined as a score of 5 or higher on the Fagerström Test for Nicotine Dependence (Heatherton, Kozlowski, Frecker, & Fagerström, 1991). This resulted in a sample that included nonsmokers as well as smokers who reported relatively light smoking. Participants who were deemed eligible following the telephone screen were scheduled for the in-person baseline assessment session, at which they provided informed consent, completed the alcohol and smoking IATs, and completed an assessment of past 90 day alcohol and cigarette use (see Measures). All procedures were approved by our institution's Research Ethics Board.

The present analysis focuses on a subset of participants who were administered both alcohol and smoking IATs. A total of 129 participants had complete data and were included. This sample was 58% female ($n = 75$) with a mean age of 19.71 years ($SD = 0.82$). The racial composition was 50% Caucasian ($n = 64$), 13% Black or African Descent ($n = 17$), 12% Asian ($n = 16$), 9% East Indian ($n = 11$), 9% Other ($n = 12$), and 7% ($n = 9$) endorsed multiple categories.

Measures

IAT (Greenwald, McGhee, & Schwartz, 1998).

Participants completed two variants of the IAT: an alcohol-arousal IAT (adapted from Wiers et al., 2002) and a smoking-valence IAT (adapted from Swanson et al., 2001). Both IATs had identical formats and differed only in the target and attribute stimuli presented (all stimuli were words). Participants completed IATs individually on a desktop computer in a private laboratory room. On the alcohol-arousal IAT, participants classified target stimuli into “alcohol” (e.g., beer) or “soda” (e.g., Sprite) categories (the latter serving as an appetitive control), and categorized attribute stimuli into “active” (e.g., energetic) or “passive” (e.g., sleepy) categories. On the smoking-valence IAT, target words were classified into “cigarette” (e.g., smoke) or “sweets” (e.g., toffee) categories, and attributes were classified as “positive” (e.g., happy) or “negative” (e.g., angry). Each category contained 6 unique stimuli words (see Table 1). IATs consisted of 7 blocks of stimuli, including 3 practice blocks and 4 test blocks. On the test blocks, each target category was paired with one of the attribute categories such that the same response key was used (e.g., alcohol with active and soda with passive); after two test blocks (consisting of 20 and 40 trials, respectively), the target categories were swapped such that the target stimuli shared the response key with the opposite attribute (i.e., alcohol with passive and soda with active).

IATs were scored using the *d*-600 algorithm by Greenwald, Nosek, and Banaji (2003), in which scores reflect the standardized differences in reaction times for the two different target-attribute combinations. Higher *d* scores represent stronger alcohol-arousal or smoking-positive associations, respectively. One participant (not included in the sample reported here) was an extreme outlier with respect to error rates (> 35% on both IATs; *z*-scores > 4) and was excluded from analyses. For the included participants, error rates ranged from 1–27%, and mean response latencies ranged from 572 ms to 1895 ms (the scoring algorithm automatically eliminated trials longer than 10,000 ms; Greenwald et al., 2003). Internal consistency was estimated following procedures described in Greenwald et al. (2003), and estimates ($r = .54$ for both variants of IAT) were consistent with other studies of young adults (Lindgren et al., 2016; Lindgren et al., 2013).

Timeline Follow Back (TLFB; Sobell & Sobell, 1992).

The TLFB – a widely used, calendar-based assessment of daily-level substance use – was administered by a trained research assistant. Participants reported the number of standard drinks consumed on each day over the past 90 days, and smokers indicated whether or not they smoked cigarettes on each day (yes or no). Smokers also provided an overall estimate of typical number of cigarettes smoked per smoking day. Data from the TLFB were used to derive number of drinking days, number of heavy drinking days (defined as consuming 4 or more drinks for women or 5 or more drinks for men), average drinks per drinking day, number of smoking days, and number of days on which both drinking and smoking occurred (i.e., co-use days). Five nondaily smokers had incomplete data for daily-level smoking frequency and thus were also missing data for co-use frequency. The TLFB has been shown in several studies to provide a reliable and valid assessment of both alcohol use (Sobell & Sobell, 1992, 1995) and smoking behavior (Lewis-Esquerre et al., 2015; Robinson, Sobell,

Sobell, & Leo, 2014), including nondaily smoking behavior (Harris, Goldbeck, Cronk, Catley, Conway, & Williams, 2009).

Participants were classified as nonsmokers if they reported no smoking, nondaily smokers if they reported smoking on some but not all days, and daily smokers if they reported smoking on all 90 days. While there is considerable variability across studies in the criteria used to define nondaily smoking, several past studies have applied a broad definition that includes individuals who reported smoking as little as one day during the assessment period as well as individuals who reported smoking nearly every day (for review, see Husten, 2009). We applied a similarly broad definition of nondaily smokers in the current study (smoking at least once in the past 90 days but not all 90 days), although two participants who reported smoking nearly every day were classified as daily smokers for specific reasons (see Table 2 for details).

Results

Table 2 contains a descriptive summary of demographics, alcohol use, cigarette use, and IAT scores by smoking status. None of the smokers in the daily or nondaily smoker groups reported smoking more than 10 cigarettes per day on average across the days that they smoked, and thus all smokers were relatively light smokers. The mean number of smoking days in the past 90 days among the nondaily smokers was 11.58, which equates to slightly less than one smoking day per week on average. With respect to alcohol-cigarette co-use among nondaily smokers, smoking occurred on an average of 29.19% of drinking days ($SD = 25.01$) and alcohol was consumed on an average of 74.23% of smoking days ($SD = 37.10$). Also, in the full sample, there was a positive correlation between drinking and smoking frequencies ($r = .21$, $p = .018$). However, there was no significant correlation between the alcohol-arousal and smoking-valence IAT scores ($r = -.07$, $p = .426$).

To test our hypothesis that IAT scores would differ as a function of smoking status, we specified a general linear model in SPSS v.21 (IBM, Inc.) for each variant of the IAT (alcohol and smoking). As we hypothesized that nonsmokers would differ from smokers, and that the two subgroups of smokers (daily and nondaily) would differ from one another, smoking status was represented by two orthogonal contrasts (nonsmokers vs. mean of two smoking groups; nondaily smokers vs. daily smokers). Contrast codes were adjusted for unequal group sizes. Both models included drinking frequency as a covariate in order to examine the unique associations of smoking status and alcohol use with IAT scores.

For alcohol-arousal IAT scores, the difference between nonsmokers and smokers was not statistically significant ($B = -0.03$, $SE = 0.04$, $p = .459$). However, the nondaily and daily smokers differed significantly from one another ($B = -0.26$, $SE = 0.08$, $p = .001$), such that implicit alcohol-arousal associations were stronger among nondaily smokers relative to daily smokers, as hypothesized (see Figure 1). However, drinking frequency was not a significant, unique predictor of alcohol IAT scores ($B = 0.01$, $SE = 0.00$, $p = .250$).

We next examined whether frequency of alcohol-cigarette co-use was associated uniquely with alcohol IAT scores over and above total drinking and smoking frequency. For these

analyses, we examined only the subsample of nondaily smokers because co-use frequency for daily smokers is entirely redundant with drinking frequency (i.e., daily smokers smoked on 100% of drinking days). Among the nondaily smokers with complete data for co-use frequency ($n = 19$), there was no significant relationship between number of co-use days and alcohol-arousal IAT scores ($B = 0.03$, $SE = 0.02$, $p = .198$), nor were drinking or smoking frequency significantly associated with alcohol-arousal associations among nondaily smokers ($ps > .435$).

With respect to the smoking-valence IAT, Figure 1 shows that all groups had stronger negative implicit bias toward smoking (relative to sweets) as evidenced by negative average d scores. Still, nonsmokers had significantly stronger implicit negative-smoking associations than smokers ($B = 0.08$, $SE = 0.04$, $p = .030$), although there was no significant difference between daily and nondaily smokers on the smoking-valence IAT ($B = 0.05$, $SE = 0.07$, $p = .443$), nor was drinking frequency a significant, unique predictor ($B = -0.01$, $SE = 0.00$, $p = .164$). However, within the nondaily smoker subgroup ($n = 19$), a greater number of alcohol and cigarette co-use days predicted higher smoking-valence IAT scores ($B = 0.06$, $SE = 0.03$, $p = .041$) when controlling for total number of drinking days and smoking days (which were not unique predictors; $ps > .283$).

Discussion

This study provided an initial examination of alcohol and smoking implicit associations as a function of smoking status and alcohol-cigarette co-use in a sample of young adult drinkers. Although we did not observe the hypothesized difference between nonsmokers and smokers on implicit alcohol-arousal associations, we did find that – controlling for alcohol use frequency – nondaily smokers had significantly stronger implicit alcohol-arousal associations than daily smokers. We anticipated this finding for nondaily smokers – who tend to smoke more often when drinking than when not drinking (Jackson et al., 2010) – because the actual or expected stimulant effects of nicotine (and perhaps the actual or expected interactive effects with alcohol and/or the drinking context) may become implicitly linked with drinking via associative learning processes. However, within the nondaily smoker group, we did not observe the anticipated unique relationship between frequency of alcohol-cigarette co-use and alcohol-arousal IAT scores. Moreover, the difference between nondaily and daily smokers appears to be driven by a tendency toward *weaker* alcohol-arousal associations among daily smokers, rather than stronger alcohol-arousal associations among nondaily smokers (see Figure 1). While speculative, this finding could reflect, in part, differences between daily and nondaily smokers in cross-tolerance processes, or genetic and/or learning processes that reduce sensitivity to alcohol's effects among daily smokers (Madden, Bucholz, Martin, & Heath, 2000). However, because these processes were not examined in this study, and given the relatively small number of smokers in the sample, future research is necessary to replicate and clarify these findings.

With respect to the smoking-valence IAT, we found that participants tended to have negative implicit attitudes toward smoking regardless of smoking status, which is consistent with some prior research (Swanson et al., 2001). Still, we observed a statistically significant tendency toward stronger negative-smoking associations among nonsmokers relative to

smokers (daily and nondaily combined). This is generally consistent with the literature comparing smokers and nonsmokers on implicit smoking attitudes (Roefs et al., 2011). This study adds to this literature by providing some potential evidence for differences in the smoking-valence IAT between drinkers who do not smoke and drinkers who are relatively light smokers (i.e., 10 or fewer cigarettes per day, on average). This suggests that a tendency toward relatively more positive implicit associations with smoking may be a cognitive risk factor underlying smoking behavior even among light and nondaily smokers; thus, implicit smoking associations should be further studied in this population to clarify the underlying mechanisms and to determine if this implicit bias may be an appropriate target for interventions.

With respect to potential mechanisms, a tendency toward more positive implicit smoking associations could be reflective of learning processes that involve the repeated pairing of smoking with rewarding experiences. Given that the sample was comprised entirely of heavy episodic drinkers, it is possible that alcohol consumption represents an important recurring context in which smoking is paired with reward (e.g., subjective, social, pharmacological reinforcement). Consistent with this notion, additional analyses suggested a potential pattern related to cigarette-alcohol co-use that could be further explored in future research. Specifically, among nondaily smokers, more frequent co-use of alcohol and cigarettes was uniquely related to weaker implicit negative-smoking associations. Alcohol has been shown in some studies to enhance the rewarding effects and reduce the punishing effects of cigarettes (Piasecki et al., 2011). Thus, more frequent co-use of cigarettes with alcohol may be reflected in a shift in implicit smoking attitudes in the positive direction for heavy drinking nondaily smokers. It is also important to note that the association between co-use frequency and the smoking IAT was observed while controlling for total drinking and smoking frequency, which themselves were not significant unique predictors of smoking IAT. While McCarthy and Thompsen (2006) found little evidence for unique cross-substance behavior-IAT associations, the present findings suggest that the association between alcohol use and the smoking IAT may be apparent among nondaily smokers when isolating co-use frequency from overall drinking and smoking frequency. Although preliminary, this suggests that perhaps more frequent co-use of cigarettes and alcohol may serve to weaken negative implicit associations with cigarettes, which may in turn represent a cognitive risk factor that influences subsequent smoking behavior among young light and nondaily smokers. Future research that examines the prospective link between implicit associations and progression of smoking behavior in this population will be informative.

There were some limitations to this study that warrant discussion. First, the alcohol and smoking IATs used in this study each assessed different associations (alcohol + *arousal* vs. smoking + *valence*) and are not directly comparable with one another. We also did not observe a significant correlation between these two types of IATs in the present study. In contrast, some previous studies have reported significant associations between arousal and valence IATs within the same substance (i.e., stronger alcohol-arousal associations with stronger alcohol-positive associations; Wiers et al., 2002; Wiers et al., 2005), suggesting a relationship between the arousal and valence dimensions. Further McCarthy and Thompsen (2006) reported a positive correlation between alcohol-valence and smoking-valence IATs, indicating a cross-substance relationship between IATs assessing the same dimension. Thus,

future studies that include both arousal and valence IATs for both alcohol and smoking are needed to provide a more comprehensive examination of both within-substance and cross-substance relationships among the valence and arousal IAT dimensions. In addition, future research on this topic could examine the potential interactive effects between implicit measures of valence and arousal or focus on developing novel implicit measures that evaluate combinations of valence and arousal dimensions (e.g., positively valenced sedative effects such as relaxation).

Second, because alcohol-cigarette co-use frequency and drinking frequency were entirely confounded among daily smokers in this study, it was not possible for us to examine the direct relationship between co-use and implicit associations in this group. For this, future ecological momentary assessment studies will be needed to capture variability in co-use of alcohol and cigarettes within the same drinking episode rather than merely capturing co-use of alcohol and cigarettes in the same day. Third, even the daily smoker group in this study is comprised of relatively light smokers because smokers with moderate to severe nicotine dependence were screened out of the parent study. As such, differences observed between daily and nondaily smokers in this study may generalize only to lighter smokers who are relatively low on nicotine dependence. Although light smokers were of greatest interest in this study given that they show a closer link between alcohol and cigarette use relative to heavier smokers (Jackson et al., 2010), future studies should examine the relevance of these findings for heavier smokers.

Fourth, the subsamples of nondaily and daily smokers were relatively small, and so nonsignificant differences between these groups could be related to low power. In addition, the nondaily smoking group contained a wide range of smokers from very infrequent to relatively frequent smokers. While this is consistent with several past studies (see Husten, 2009), it also introduces more heterogeneity into this group, which may have impacted comparisons with nonsmoking and daily smoking groups. Future research with larger samples of nondaily smokers will be necessary in order to further subtype nondaily smokers.

Fifth, the sample consisted entirely of heavy episodic drinkers, restricting the range of observed drinking frequency and potentially reducing its unique relationship with implicit associations. Sixth, the findings are correlational and no conclusions can be drawn about the direction of the relationships of smoking and drinking with IAT scores. Indeed, it is thought that implicit associations both reflect substance use history and influence substance use behavior (Thush & Wiers, 2007), and so the direction of the associations examined in this study should be investigated in future prospective studies. Finally, although our sample was relatively diverse racially, it included only young adults living in an urban area in North America, and so the findings may not generalize to other populations or cultural contexts (e.g., countries with different legal ages for using alcohol and tobacco). Thus, future cross-cultural studies are needed.

Despite some limitations, this preliminary study is the first to our knowledge to examine the relationships between both alcohol and smoking implicit memory associations and daily-level alcohol-cigarette co-use. If replicated and further clarified in future studies, it is possible that implicit associations may emerge as important factors in the motivational

processes underlying alcohol and cigarette co-use among young adult drinkers, and thus could be potentially important targets of prevention or intervention efforts.

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Figure 1.

Covariate adjusted means for alcohol-arousal and smoking-valence IAT by smoking status, controlling for frequency of alcohol use. Standard errors shown in error bars. Results of the planned comparisons are shown, which included (1) nonsmokers vs. the mean of all smokers, and (2) nondaily smokers vs. daily smokers. *** $p < .001$; * $p < .05$; *ns* = nonsignificant.

Table 1.

Category labels (in italics) and stimuli used in the alcohol-arousal IAT (adapted from Wiers et al., 2002) and smoking-valence IAT (adapted from Swanson et al., 2001).

Alcohol Arousal IAT			
Target Stimuli		Attribute Stimuli	
<i>Alcohol</i>	<i>Soda</i>	<i>Active</i>	<i>Passive</i>
Beer	Coke	Energetic	Relaxed
Wine	Pepsi	Lively	Sleepy
Gin	Sprite	Funny	Woozy
Whisky	Fanta	Cheerful	Quiet
Vodka	Tonic	Loose	Calm
Rum	Juice	Aroused	Listless
Smoking Valence IAT			
Target Stimuli		Attribute Stimuli	
<i>Cigarettes</i>	<i>Sweets</i>	<i>Positive</i>	<i>Negative</i>
Cigarette	Chocolate	Happy	Dangerous
Tobacco	Toffee	Attractive	Sick
Nicotine	Eating	Sociable	Angry
Smoke	Scone	Confident	Mean
Ashtray	Caramel	Smart	Depressed
Smoking	Sundae	Relaxed	Unhappy

Table 2.

Descriptive statistics for demographics, alcohol use, and cigarette use by smoking status

	Nonsmokers (n=91)		Nondaily Smokers (n=24)		Daily Smokers ^{††} (n=14)	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Female	53	58	12	50	10	71
White	45	50	10	42	9	64
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Age	19.66	0.85	19.88	0.74	19.71	0.83
Drinking frequency [*]	16.84 ^a	9.04	20.00 ^{a,b}	9.81	25.36 ^b	21.14
Heavy drinking frequency [*]	9.02 ^a	7.45	9.75 ^a	6.12	14.43 ^b	8.03
Drinks per drinking day	4.62	2.08	4.67	1.66	5.81	2.49
Smoking Frequency [†]	-	-	11.58	18.10	-	-
Cigarettes per smoking day [*]	-	-	2.47 ^a	2.07	4.67 ^b	2.12
Alcohol-Cigarette co-use days ^{†, *}	-	-	4.79 ^a	4.60	25.00 ^b	20.67
Alcohol-Arousal IAT [*]	0.23 ^a	0.49	0.37 ^a	0.48	-0.15 ^b	0.45
Smoking-Valence IAT	-0.82	0.35	-0.70	0.53	-0.62	0.41

Note.

Drinking and smoking frequency variables represent number of days in the past 90 days on which drinking or smoking was reported, respectively (possible range 0–90). Alcohol-cigarette co-use days are the number of days on which both drinking and smoking were reported on the same day.

[†] *n*=19 for nondaily smokers because 5 participants were missing daily-level smoking data. Observed range for nondaily smokers was 1–77 smoking days in the past 90 days.

^{††} One participant who reported one isolated non-smoking day (i.e., 89 smoking days in the past 90 days) was classified as a daily smoker. Another participant who reported a 6-day quit attempt followed by a return to daily smoking (i.e., 84 smoking days and 6 non-smoking days) was also classified as a daily smoker.

^{*} denotes statistically significant difference across smoking groups ($p < .05$); for these variables, means not sharing a superscript letter in common were found to differ significantly ($p < .05$) in Tukey's posthoc test.