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Implicit Associations between Smoking and Social Consequences Among Smokers in Cessation Treatment

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Abstract

Explicit expectations of the negative and positive social consequences of smoking are likely to have substantial influence on decisions regarding smoking. However, among smokers trying to quit, success in smoking cessation may be related not only to the content of expectancies about smoking's social effects but also to the ease with which these cognitive contents come to mind when confronted with smoking stimuli. To examine this possibility, we used the Implicit Association Test (IAT; A.G. Greenwald, D.E. McGhee, & J.L.K. Schwartz, 1998) to assess implicit cognitive associations between smoking and negative vs. positive social consequences among 67 heavy social drinkers seeking smoking cessation treatment in a randomized clinical trial. Results showed that the relative strength of implicit, negative, social associations with smoking at baseline predicted higher odds of smoking abstinence during treatment over and above the effects of relevant explicit measures. The only variable that significantly correlated with IAT scores was the density of smokers in participants' social environment; those with more smoking in their social environment showed weaker negative social associations with smoking. Results suggest implicit cognition regarding the social consequences of smoking may be a relevant predictor of smoking cessation outcome.

Keywords

smoking cessation; implicit cognition; social cognition; smoking expectancies; social influences

1. Introduction

Interpersonal processes play an important role in smoking behavior (e.g., Cohen & Lichtenstein, 1990;Thomas et al., 2005). From a social cognitive perspective, perceptions of how others feel about and react to tobacco use are likely to have substantial influence on decisions regarding smoking. For example, individuals who believe that smoking will be judged negatively by others and lead to social censure may be discouraged from smoking and be more likely to quit. Indeed, beliefs that smoking is associated with negative social consequences, such as peer rejection, are related to a lower likelihood of smoking (Chassin, Presson, Sherman, & Edwards, 1991;Shore, Tashchian, & Adams, 2000) and less susceptibility to smoking initiation (Unger, Rohrbach, Howard-Pitney, Ritt-Olson, & Mouttapa, 2001).

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Studies of adolescent smokers suggest that those who report negative social effects as a reason to quit are more likely to quit successfully (Rose, Chassin, Presson, & Sherman, 1996). Additional evidence indicates that smokers who are at a greater stage of readiness for cessation endorse greater motivation on the extrinsic social influence subscale of the Reasons for Quitting Scale, which include items such as "People are mad at me for smoking" (RFQ; Curry, Grothaus, & McBride, 1997;McBride et al., 2001). Finally, male, but not female, smokers who believe that smoking makes them feel different from their friends are more likely to remain abstinent after a cessation attempt (Westmaas & Langsam, 2005).

Other studies have failed to show a link between smoking cessation and perceived negative social effects of smoking. Several investigations have found that greater motivation on the extrinsic social influence subscale of the RFQ is not associated with a greater likelihood of successful cessation (Curry, Wagner, & Grothaus, 1990;Kahler, Strong, Niaura, & Brown, 2004). In a separate study, Curry et al. (1997) demonstrated that, although baseline differences in readiness to quit smoking were associated with higher scores on the social influence subscale of the RFQ, changes on this measure were not associated with movement to a greater stage of readiness to quit smoking. Finally, a subset of items on the Smoking Effects Questionnaire (Rohsenow et al., 2003), which assess expectations that smoking leads to negative social evaluation, did not predict cessation outcome in smokers with a history of major depressive disorder (Kahler et al., 2004).

The link between perceived *positive* social consequences of smoking and tobacco use and cessation also has been inconsistent. Social learning theory would suggest that individuals who expect smoking to facilitate social interactions and result in greater social acceptance would be more likely to decide to smoke and be less likely to quit. Consistent with this hypothesis, adolescent smokers have been shown to score higher than nonsmokers on the Social Facilitation subscale of the Smoking Consequences Questionnaire (SCQ-SF; Brandon & Baker, 1991), which assesses the degree to which people believe that smoking makes one more socially desirable (Lewis-Esquerre, Rodrigue, & Kahler, 2005). Likewise, in a study of college student smokers, the SCQ-SF was positively associated with severity of nicotine dependence (Cepeda-Benito & Reig Ferrer, 2000). Regarding cessation, Copeland et al. (1995) found that a greater reduction on the SCQ-SF during treatment was associated with abstinence. In this study, however, baseline SCQ-SF scores did not predict outcome and did not differ among treatment-seeking smokers, non-treatment-seeking smokers, and ex-smokers. Likewise, Kahler et al. (2004) found smoking for social facilitation motives did not predict smoking cessation outcome.

Results of previous studies suggest that explicit measures of expected social consequences of smoking do relate to the likelihood of choosing to smoke and being a smoker but show a less consistent relation to success in quitting smoking. Inconsistent findings may be explained, in part, by the measurement techniques employed. Studies examining beliefs about interpersonal effects of smoking have relied primarily on self-report methods, which are known to suffer from a number of limitations (Nisbett & Wilson, 1977), including susceptibility to artifacts such as impression management and demand characteristics (Greenwald & Banaji, 1995). Accordingly, more objective indicators of social environmental factors can be used, such as the number of friends who smoke. Indeed, both adolescents and adults who have more friends who smoke and who spend more time around smokers are less likely to successfully quit following a cessation attempt (Piper et al., 2004;Rose et al., 1996). Although these findings are useful, such measures do not shed light on the role of cognitive process in smoking cessation.

Although explicit expectancies about the social consequences of smoking may influence conscious intentions to initiate smoking, once smoking behavior has become well-established,

the importance of explicit expectancies of smoking's social consequences may become less relevant in predicting continued smoking. Smoking behavior among established smokers is thought to be maintained largely by implicit cognitive processes that are automatic, unavailable to conscious introspection, and immeasurable using self-reports (Waters & Sayette, 2006). Therefore, among well-established smokers, implicit measures of smoking expectancies may be especially relevant for predicting successful cessation. Specifically, smoking cessation outcomes may be enhanced not just by believing that smoking leads to negative rather than positive social consequences, but also by the extent to which these negative social consequences are activated automatically in response to smoking cues. If negative social effects of smoking are automatically activated in memory, intentions to avoid smoking should be more readily supported. Only implicit measures of associations in memory can tap these types of cognitions.

The most widely used and psychometrically supported task for assessing implicit cognitions is the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998). The IAT is a timed categorization task that indirectly assesses the relative strength of association between mental concepts. Although there is some debate regarding the underlying cognitive processes that contribute results on the IAT (e.g., Rothermund & Wentura, 2004; Greenwald, Nosek, Banaji, & Klauer, 2005), there is considerable support for the construct validity of the IAT as a measure of automatically activated cognitive associations in a number of circumstances (Greenwald, Banaji, Rudman, Farnham, Nosek, & Mellott, 2002;Nosek, Greenwald, & Banaji, 2005), including its use in addictions research (Houben & Wiers, 2006;Ostafin & Palfai, 2006). Previous reports have used the IAT to demonstrate that the strength of associations between smoking and positive (versus negative) attributes relative to a contrast category (e.g., exercise, non-smoking, sweets) differs in smokers and nonsmokers (Huijding, de Jong, Wiers, & Verkooijen, 2005;Perugini, 2005;Robinson, Meier, Zetocha, & McCaul, 2005, exp 1; Sherman, Rose, Koch, Presson, & Chassin, 2003, exp 1; Swanson, Rudman, & Greenwald, 2001, exp 3). Additional studies have shown that different variants of the IAT can be used to discriminate between smokers and nonsmokers (Huijding & de Jong, 2006) and can predict severity of addictive behaviors incrementally to the effects of self report (Wiers, Van Woerden, Smulders, & De Jong, 2002). However, we know of no studies to date that have used the IAT to predict smoking cessation outcomes.

Most prior investigations of smoking using the IAT have examined associations between smoking and more global good vs. bad judgments. In the current study, we used a more narrowly focused IAT variant to examine implicit associations between smoking and negative social outcomes (e.g., feeling attacked or criticized) vs. positive social outcomes (e.g., feeling welcomed or accepted) relative to a neutral contrast category (furniture). The primary aim of this study was to examine whether this IAT variant would significantly predict smoking cessation outcomes in a clinical trial for heavy social drinkers who smoke. We hypothesized that the relative strength of negative social associations with smoking would be associated with greater odds of being abstinent at 2 and 8 weeks after quit date. Further, we hypothesized that IAT performance would predict treatment outcome over and above self report measures of smoking's expected effects on social interactions and of the relative number of smokers in participants' social environment.

Prior to conducting these analyses, we examined the correlations between IAT performance and other relevant variables. We hypothesized that smokers with a social environment that was less dense in smokers would demonstrate relatively stronger implicit associations between smoking and negative relative to positive social consequences. We also hypothesized that those who reported greater smoking for social facilitation motives would demonstrate weaker implicit associations between smoking and negative social consequences. Finally, as a test of discriminant validity, we examined the correlations of IAT social consequences scores with

severity of tobacco dependence, cigarettes smoked per day, and smoking for either positive or negative reinforcement motives. We expected these correlations would be small and nonsignificant given that smoking for social environmental motives appears relatively independent from tolerance and smoking for other motives (Piper et al., 2004).

2. Method

2.1. Participants

Participants were 67 smokers recruited from the community as part of a larger, ongoing, randomized clinical trial comparing standard smoking cessation treatment (ST) to standard treatment incorporating a brief alcohol intervention (ST-BI). All participants in the trial drank heavily according to guidelines from the National Institute on Alcohol Abuse and Alcoholism (National Institute on Alcohol Abuse and Alcoholism, 1995) but were not alcohol dependent. We began to administer the present version of the IAT after 98 participants had already been enrolled in the trial. The measure was then taken out of the assessment battery after 67 subjects completed it in order to allow other new measures to be administered in the baseline assessment.

To be included in the trial, participants had to: (a) be at least 18 years of age; (b) have smoked cigarettes regularly for at least one year; (c) currently smoke at least 10 cigarettes a day; (d) currently use no other tobacco products or nicotine replacement therapy; and (e) currently drink heavily according to self-report (>14 drinks per week or ≥5 drinks per occasion at least once per month over the last 12 months for men; >7 drinks per week or ≥4 drinks per occasion at least once per month over the past 12 months for women).

Participants were excluded if they: (a) met full DSM-IV criteria for alcohol dependence in the past 12 months; (b) met criteria for other current psychoactive substance abuse or dependence (excluding nicotine dependence and alcohol abuse) in the past 12 months; (c) met criteria for dysthymia, a major depressive episode, or a manic episode in the past month; (d) were currently psychotic or suicidal; (e) had an unstable medical condition that would suggest caution in the use of the nicotine patch (e.g., unstable angina pectoris, arrhythmia, recent congestive heart failure); (f) were currently pregnant or lactating or intended to become pregnant. Smokers had to agree to be available for 6 months and not to seek other smoking cessation treatment during the active phase of treatment (i.e., during the 8 weeks after their quit date while on the nicotine patch).

The sample used in these analyses was 56.7% (n = 38) female and 43.3% (n = 29) male, with 32.8% (n = 22) married or cohabiting. The mean age of the sample was 39.4 (SD = 10.1) years, and the mean education was 13.9 (SD = 2.2) years. The vast majority of participants (n = 62, 92.5%) identified themselves as non-Hispanic White. Three participants were African American, and two were Hispanic/Latino. At baseline, participants smoked an average of 21.0 (SD = 8.7) cigarettes per day and had been smoking for an average of 21.0 years (SD = 9.2). The sample mean on the Fagerstrom Test for Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerström, 1991) was 5.0 (SD = 1.8). Participants drank an average of 14.5 (SD = 9.1) drinks per week. As assessed by the Structured Clinical Interview for DSM-IV (SCID; First, Spitzer, Gibbon, & Williams, 1995), 13.4% of participants had a lifetime history of alcohol dependence, and 46.3% had a history of major depressive disorder.

2.2 Procedure

Participants were recruited from the community using postings on community bulletin boards and newspaper and radio advertisements, which asked for social drinkers who wanted to quit smoking. Potential participants were screened by telephone before completing an intake interview, at which they signed a statement of informed consent approved by the Brown

University Institutional Review Board. At this baseline interview, participants also provided the name and contact information for two collateral informants; these collaterals were interviewed by telephone if we were unable to obtain from participants either self-report data or biochemical verification of abstinence. Thirty-five participants in this subsample were randomized to the ST condition, and 32 were randomized to ST-BI.

Treatment consisted of four individual counseling sessions over three weeks with the quit date occurring at session 2, one week after session 1. Sessions ranged in length from 70 minutes for session 1, 40 minutes for session 2, and 20 minutes each for sessions 3 and 4. Standard treatment was based on recent clinical practice guidelines (Fiore et al., 2000) and focused on problem solving regarding high-risk situations for smoking relapse, providing support within the treatment, and encouraging participants to seek support for quitting smoking outside of treatment (Kahler, Zvolensky, Goldstein, & Brown, 2003). All participants received treatment with transdermal nicotine patch with the initial dose starting at 21 mg for four weeks, followed by two weeks of 14 mg patch, and then two weeks of 7 mg patch.

The ST and ST-BI conditions were matched on amount of therapist contact time. In the ST condition, 40 minutes of session 1 and 20 minutes of session 2 were dedicated to teaching progressive muscle relaxation. In ST-BI, this same amount of time was dedicated to an in-depth discussion of the participant's alcohol use, which included open-ended discussion of current drinking and smoking patterns, feedback on drinking levels and the risk of smoking relapse associated with drinking, and goal setting regarding changing drinking during smoking cessation. A brief, 5-minute, check-in regarding use of relaxation skills in ST or achievement of drinking goals in ST-BI was included in sessions 3 and 4. Because this study focuses on only a subset of participants in a larger clinical trial, we do not report treatment effects in this paper. However, we did run analyses controlling for treatment assignment and testing interactions between treatment condition and IAT social consequences scores. The effect of IAT score was not altered by covarying treatment assignment, nor did IAT interact significantly with treatment condition in predicting outcome.

2.3 Measures

Prior to treatment, participants provided demographic and smoking-related information such as number of years of regular smoking and average number of cigarettes smoked per day. Severity of nicotine dependence was assessed using the FTND (Heatherton et al., 1991), a well-validated 6-item measure. Lifetime and current DSM-IV Axis I diagnoses were determined with the SCID (First et al., 1995). The Timeline Followback Interview (Sobell & Sobell, 1998) was used at baseline to assess the number of drinks consumed per day in the prior 8 weeks.

Density of smokers in the social environment was assessed with the Social Environmental Goads scale of the Wisconsin Inventory of Smoking Dependence Motives (Piper et al., 2004). This measure contains four items (e.g., "Most of the people I spend time with are smokers") and uses a 7-point response scale from 1 = *Not true of me at all* to 7 = *Extremely true of me*. Internal consistency of the scale in this sample was high, α=.91. The Negative Reinforcement (e.g., "Smoking helps me deal with stress; 6 items, α=.87) and Positive Reinforcement (e.g., "Smoking brings me a lot of pleasure; 5 items, α=.87) scales of the WISDM were used to assess negative and positive reinforcement smoking, respectively. Smoking for social facilitation was assessed with three items based on the social scale of the Smoking Motivation Questionnaire (SMQ; Russell, Peto, & Patel, 1974) (e.g., "It is easier to talk and get along with other people when smoking"; α=.86), which were assessed on the same 7-point rating scale as the WISDM.

2.3.1. Smoking outcome—Outcome analyses were based on 7-day point prevalence abstinence (i.e., reported abstinence of at least 7 days prior to the assessment day) as assessed 2 weeks after quit date (session 4) and 8 weeks after quit date (post-treatment follow-up). Self-reported abstinence was verified by alveolar carbon monoxide (CO) using a Bedfont Scientific Smokelyzer® breath CO monitor with abstinence confirmed by a CO ≤ 10 ppm (SRNT Subcommittee on Biochemical Verification, 2002). We obtained collateral reports of smoking (See Section 2.2.) status at post-treatment for 4 participants. (3 smoking; 1 abstinent) who did not complete the post-treatment follow-up. Smoking data, verified either biochemically or by collateral report, was obtained from 94.0% of participants at both 2 and 8 weeks. Individuals (4 at each assessment) who had missing self-report and collateral data or whose self-reported abstinence was unverified were considered smoking (i.e., a worst-case assumption). Running analyses without missing data substitution did not alter results.

2.4. Implicit Association Test (IAT)

Implicit associations between smoking and negative vs. positive social consequences were assessed using a modification of the IAT (Greenwald et al., 2003). This IAT modification was programmed using the Inquisit software package (Millisecond Software LLC) and was completed by participants at baseline. In each IAT trial, a single stimulus is presented on the screen. The task of the participant is to classify it as quickly and as accurately as possible into its respective category. For the current IAT variant, the stimuli for the IAT consisted of six smoking-related pictures (e.g., cigarette, lighter, an individual smoking) and six pictures of furniture chosen from available images on the internet. Six negative social consequences words (disrespected, blamed, insulted, cheated, screwed, and attacked), and six positive social consequences words (appreciated, accepted, valued, supported, trusted, welcomed) were chosen based on rationale criteria and agreement among the investigators that each represented the intended category, i.e., either a negative or positive social consequence. For the target blocks, participants were instructed to categorize the picture as either ‘Smoking’ or ‘Furniture’. The use of neutral target pictures, such as furniture, has been supported in other IAT studies; for example, Jajodia and Earleywine (2003) have successfully used mammals as neutral targets in a study of alcohol expectancies.

The attributes of negative and positive social responses to smoking is a complex target that is not easily represented by single target categories. To address this issue, participants were instructed that they would be asked to classify a series of words as to whether they represented positive or negative outcomes of social interactions with others. For each social consequence attribute, subjects were asked to classify them as either “I Feel Negative” to represent negative outcomes of social interactions or “I Feel Positive” to represent positive outcomes of social interactions. Olson and Fazio (2003) have successfully used such multiple word labels (e.g., “I don’t like”) for attribute categories in order to “personalize” IATs.

Participants categorized stimuli by pressing one of two response keys. For example, some trials would include ‘Smoking’ and ‘I Feel Negative’ as category labels on the upper left side of the screen and ‘Furniture’ and ‘I Feel Positive’ as category labels on the right side of the screen. On such trials, the participant would be instructed to press the left key whenever smoking or “I Feel Negative” stimuli were presented, and the right key would be pressed whenever furniture or “I Feel Positive” stimuli were presented. Alternatively, other trials would be structured so that ‘Smoking’ and ‘I feel positive’ share a label one side of the screen (and response key) and ‘Furniture’ and ‘I feel negative’ share a label on the other side of the screen. Thus, each target category is pared with one attribute (e.g., I feel negative) on some trials and the other attribute (e.g., I feel positive) on other trials. Assuming that participants associate smoking with negative social consequences, trials in which smoking and negative

consequences share a response key are “congruent,” whereas trials in which smoking and positive consequences share a response key are “incongruent.”

Following procedures based on Greenwald et al. (2003), the IAT was presented in seven blocks: (a) a 24-trial attribute discrimination block (for the congruent-block-first IAT order, left = negative and right = positive); (b) a 24-trial target discrimination block (left = smoking and right = furniture); (c) a 24-trial “practice” congruent combination block (left = negative or smoking and right = positive or furniture); (d) a 40-trial congruent test block of the same combination in (c); (e) a 24-trial attribute discrimination block in which the attribute categories were reversed (left = positive and right = negative); (f) a 24-trial practice incongruent combination block; and (g) a 40-trial incongruent test block of the same combination in (f). The stimuli for the target and attribute discrimination blocks were presented randomly. The stimuli for the combination blocks were presented randomly with the restriction that the trials alternated between target and attribute stimuli. Incorrect responses resulted in a red ‘X’ being presented on the screen. The stimuli remained on the screen until the correct key was pressed providing a built-in error penalty (Greenwald et al., 2003). A 250-ms interval separated each trial after a response was made in all blocks.

Blocks c, d, f, and g are the critical blocks used in scoring the IAT; the inclusion of the so-called practice blocks in scoring increases the criterion validity of the task (Greenwald et al., 2003). The IAT score is then calculated as a difference score between incongruent (i.e., the smoking-positive/furniture-negative practice and test blocks) and congruent (i.e., the smoking-negative/furniture-positive practice and test blocks) response times. Larger IAT scores indicate that the task is easier (i.e., response latencies are lower) for trials in which smoking and “I Feel Negative” share a response key compared to trials in which smoking and “I Feel Positive” share a response key. Thus, higher IAT scores suggest a stronger implicit, negative, social association with smoking.

The IAT was counterbalanced in two ways to prevent methodological confounds. First, the placements of the target stimuli labels (left or right) were counterbalanced, such that the smoking label was first presented on the left side for the even trials and on the right side for the odd trials. Second, two IAT orders were used: one with the smoking and negative social consequences combination first and one with the smoking and positive consequences combination first. The two IAT orders were counterbalanced across participants. Presenting the smoking and negative social consequences combination first resulted in relatively faster responding to smoking and negative consequences pairings, $t(65) = 4.0$, $p < .001$. Therefore, we controlled for the effect of order in all analyses. Analyses conducted without controlling for order yielded equivalent results. Order effects are commonly reported in studies using the IAT and do not appear to impact the reliability and validity of this measure (Nosek, Greenwald, & Banaji, 2005).

3. Results

3.1. Data Reduction and Scoring

Performance on the IAT was scored using the improved algorithm proposed and extensively supported by Greenwald at al. (2003). This measure, D_2, calculates the standardized difference between response latencies on blocks when positive social consequences are paired with smoking compared to blocks when negative social consequences are paired with smoking, providing an index of the magnitude of this difference, analogous to an effect size, *d*. Data from blocks c, d, f, and g were used. Following the algorithm from Greenwald at al. (2003), response latencies less than 400 ms or greater than 10,000 ms were removed. No individual participant had more than 10% of responses with latencies above or below these cutoffs. The median percent errors on trials was 3.25%. Latencies on trials with errors were included; a

"built-in" error penalty is provided by the fact that participants have to press the correct key before proceeding to the next trial (Greenwald et al., 2003). Higher IAT negative social association scores reflect relatively faster response times when smoking and negative social consequences/outcomes are classified using the same key compared to when smoking and positive social consequences/outcomes are classified using the same key. The mean IAT negative social association score was 0.30 (SD = 0.47) indicating that responses were significantly faster when smoking was paired with negative vs. positive social consequences, $t(66) = 5.3$, $p < .0001$.

3.2. IAT and Concurrent Measures

We calculated correlations between IAT negative social association scores and Social Environmental Goads and social facilitation smoking, partialling the effect of order. These partial correlations are presented in Table 1. As hypothesized, higher IAT negative social association scores were significantly and negatively correlated with the Social Environmental Goads subscale of the WISDM, p$r = -.24$, $p = .047$. However, the partial correlation with social facilitation smoking was small (p$r = -.11$) and nonsignificant. As anticipated, IAT negative social association scores showed very low, nonsignificant partial correlations with level of nicotine dependence, cigarettes smoked per day, and smoking for either negative or positive reinforcement motives.

3.3. IAT and Smoking Cessation Outcome

At 2 weeks, 53.7% of participants were confirmed abstinent. The partial correlation between strength of negative social associations with smoking and abstinence at 2 weeks was positive and significant, p$r = .35$, $p = .004$ (bottom of Table 1). At 8 weeks, 37.3% of participants were confirmed abstinent. The partial correlation with abstinence at 8 weeks was also positive, p$r = .23$, although the effect did not quite reach traditional significance at $p = .067$. To test whether the relative strength of negative social associations with smoking predicted smoking outcomes over and above the effects of social environmental smoking and smoking for social facilitation, we conducted generalized estimating equations (GEE; Zeger & Liang, 1986) analysis to account for correlated dichotomous smoking outcomes (Hall et al., 2001). Analyses were conducted in SAS using PROC GENMOD (SAS Institute Inc., 2003) and the logit link function. Independent variables for the GEE analysis included the effect of time (dichotomized with 2 weeks as the reference), IAT negative social associations score, Social Environmental Goads, and social facilitation smoking. To facilitate comparison of odds ratios (*OR*) across measures, continuous variables were standardized so that the odds ratio reflects the increase in the odds of abstinence associated with one standard deviation increase in the independent variable.

In the GEE model, the effect of IAT negative social associations score was positive and significant, $OR = 2.17$, 95% confidence interval (CI) = 1.26 –3.74, $p = .005$. That is, stronger implicit associations between smoking and negative vs. positive social consequences/outcomes were associated with a greater odds of being abstinent at 2 and 8 weeks after quit date. The effect of social facilitation smoking also was significant, $OR = .60$, 95% $CI = 0.36 – 0.99$, $p = .046$, indicating that greater social facilitation smoking reduced the odds of abstinence. The effect of Social Environmental Goads was clearly nonsignificant, $p = .60$.

4. Discussion

Consistent with our hypotheses, greater relative strength of implicit, negative, social associations with smoking at baseline predicted higher odds of smoking abstinence at 2 and 8 weeks after quit date. This effect of IAT scores on smoking outcome remained even when controlling for the density of smokers in participants' social environment and for explicit expectancies regarding smoking's effect on social interactions. This is only the second study

of which we are aware that has shown an implicit measure predicting smoking cessation outcome, with the Waters et al. (2003) study being the other. This result is consistent with other studies showing that implicit measures predict variance in substance use behavior over and above that of self report measures (Jajodia & Earleywine, 2003;Ostafin & Palfai, 2006;Palfai, 2002;Wiers et al., 2002) and highlights the potential value of implicit measures of social processes and smoking.

As suggested in the Introduction, success in smoking cessation may depend not only on the degree to which individuals believe that the negative social consequences of smoking outweigh its positive social consequences, but also on the degree to which these negative associations with smoking come to mind in response to smoking cues. We speculate that the implicit associations we assessed may reflect an internalization of negative social consequences of smoking. The stronger these associations are the more likely that the affective valence of smoking will be relatively negative, which may help maintain motivation to quit. Of course, there are numerous other types of smoking consequences (e.g., affective consequences, negative health effects), and the implicit associations of smoking with these consequences also may contribute to the degree to which smoking cues activate intentions to initiate or avoid smoking. Whether implicit associations between smoking and these non-social consequences predict smoking outcomes is an important question for future research. As noted previously, a variety of studies have demonstrated that implicit associations between smoking and globally positive vs. negative attributes (good vs. bad) differ between smokers and non-smokers (Huijding et al., 2005;Perugini, 2005;Robinson et al., 2005;Sherman et al., 2003;Swanson et al., 2001). Comparing the performance of these variants of the IAT with the social consequences variant tested in the present study would reveal whether the implicit associations between social consequences and smoking reflect processes specific to social treatment or reflect broader positive vs. negative associations with smoking.

If implicit measures of cognitive associations with smoking are shown to be robust predictors of smoking cessation outcome, it will be important to know what factors affect these associations. One feature of the IAT, as used in the present study, is that it can be difficult to distinguish whether the results reflect strong associations between smoking and negative social consequences or weak associations between smoking and positive social consequences or both. Rather, the attributes associated with smoking reflect a bipolar dimension between negative and positive associations, and relevant correlates may impact both ends of this continuum. In the present study, the relative strength of implicit, negative, social associations with smoking was correlated negatively with the number of social contacts who smoke. There are two potential explanations for this result. First, having more smokers in one's social environment may mean that smoking often occurs in a context in which others are friendly and accepting, leading one to implicitly associate smoking with social acceptance and other positive social consequences. On the other hand, having more non-smokers in one's social environment may result in smoking being paired more rarely with positive social consequences and also may increase the frequency with which smoking is censured. Thus, both acceptance and censure of smoking may have impacted the relative strength of negative vs. positive social associations assessed by the IAT in this study. The use of unipolar IATs in which attributes are assessed as negative vs. neutral or positive vs. neutral would represent a valuable extension of this work. Such unipolar IATs have been used successfully in recent addictions research (Houben & Wiers, 2006;Jajodia & Earleywine, 2003).

Although the self-reported density of smokers in one's social environment was negatively correlated with the relative strength of implicit, negative social associations with smoking, it only accounted for about 5% of the variance in IAT performance. Contrary to our expectations, the extent to which individuals reported that smoking made them feel more comfortable in social situations was not correlated significantly with IAT performance. Correlations between

implicit and explicit beliefs or attitudes are often low (Fazio & Olson, 2003). Furthermore, the high correlations between social facilitation smoking and both the Negative Reinforcement and Positive Reinforcement smoking subscales of the WISDM, suggest that this scale may have been tapping primarily smoking for mood regulation motives. Thus, although it was associated with worse smoking outcomes, it may not have served as an optimal measure of the degree to which an individual expects smoking to lead to social acceptance and other positive social consequences.

Beyond the density of smokers in the social environment, there are a number of other factors that are likely to influence implicit associations between smoking and negative vs. positive social consequences. For example, implicit attitudes may be particularly influenced by cultural biases and affective experiences (Rudman, 2004). It would valuable to examine whether environmental factors such as public health campaigns to restrict smoking in public places can influence implicit associations between smoking and negative social consequences and whether these changes in implicit cognition help maintain efforts to quit. Likewise, interventions that frequently prompt smokers to access affectively-relevant cognitive content about the negative effects of smoking might render those cognitive contents more available during smoking cessation. In sum, the results of this initial research, in conjunction with that of Waters et al. (2003), suggest that implicit cognitive processes may warrant study as a potential target of treatment and a potential mediator of treatment response.

4.1. Limitations

In considering the results of this study, several limitations should be considered. First, although the present results shed light on the prospective association between implicit social cognitions and smoking cessation outcome, these results do not establish a causal effect for these cognitive processes; the study's design was correlational, and no effort was made to manipulate implicit associations experimentally. Second, our sample was primarily White and limited to heavy drinking smokers who were not alcohol dependent and who chose to enroll in a smoking cessation trial. The relation between smoking cessation and implicit associations between negative social consequences and smoking may differ in the general population of smokers, who often do not present for smoking cessation treatment. Replication of these results is needed in more diverse and less selective populations of smokers. Sample size also was relatively small. Power to detect medium-sized correlations of .30 was only .70. Thus, some of the negative findings in the study may be due to insufficient power. However, the very small observed correlation between IAT scores and social facilitation smoking in this sample suggests that this relationship is likely to be quite weak.

The cognitive processes underlying IAT effects are not fully known (Greenwald et al., 2004; Rothermund & Wentrua, 2004). Therefore, it cannot be concluded that IAT scores necessarily reflect underlying attitudes or motivationally relevant processes. The properties of the current IAT variant also must be taken into account when interpreting the current findings. The IAT's contrast category may be of importance, given there is previous evidence that using contrast categories that are affectively-valenced (e.g., stealing) can impact the relation between IAT scores and smoking status (Robinson et al., 2005). It is conceivable that participants in the current study had evaluative associations with furniture, which might have impacted their IAT scores. In addition, the category labels of IATs may also be of importance, given that there is some evidence that IATs tap category labels rather than exemplars (De Houwer, 2002). Although the exemplars of the attributes were social in nature (e.g., insulted, welcomed) and participants were instructed to classify whether words represented positive or negative outcomes of social interactions with others, the category labels (i.e., 'I feel positive/negative') were not social constructs. Thus, it is possible that the current IAT variant tapped general affective associations rather than those specific to social interactions, which would impact

interpretation of the present results. If this were the case, IAT scores would be expected to associate more strongly with measures tapping the tendency to smoke for affective consequences (i.e., WISDM positive and negative reinforcement subscales) than those associated with social characteristics (i.e., WISDM social and environmental goads subscale and social facilitation smoking scale). However, IAT scores did not correlate with reinforcement smoking motives but did correlate with social environmental goads (see Table 1).

Finally, an important limitation of the study was that only a limited set of variables was assessed that focused on smoking and social consequences. For example, relating performance on the IAT used in this study with the negative social consequences items from the Smoking Effects Questionnaire (Rohsenow et al., 2003) or with the social influence subscale of the Reasons for Quitting scale (Curry et al., 1990) would be highly valuable. In addition, examining the degree to which these questionnaires predict smoking outcomes in comparison to the current IAT would also be useful. Such analyses could better inform understanding of the relationship between implicit measures of the relative strength of negative social associations with smoking, explicit expectations of smoking's social consequences, and smoking cessation.

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Table 1

Correlations Among IAT Negative Social Association Scores, Other Smoking Measures, and Cessation Outcomes (N = 67)

[[Measure|]]	[[1|]]	[[2|]]	[[3|]]	[[4|]]	[[5|]]	[[6|]]	[[7|]]
1. IAT Negative Social Associations[1]	[[--|]]	[[|]]	[[|]]	[[|]]	[[|]]	[[|]]	[[|]]
2. Social Environmental Goads	[[−.24|]] *	[[---|]]	[[|]]	[[|]]	[[|]]	[[|]]	[[|]]
3. Social Facilitation Smoking	[[−.10|]]	[[.18|]]	[[---|]]	[[|]]	[[|]]	[[|]]	[[|]]
4. Tobacco Dependence (FTND)	[[−.13|]]	[[.14|]]	[[−.03|]]	[[---|]]	[[|]]	[[|]]	[[|]]
5. Cigarettes Smoked Per Day	[[−.03|]]	[[.13|]]	[[−.10|]]	[[.62|]] ***	[[---|]]	[[|]]	[[|]]
6. Negative Reinforcement Smoking	[[−.04|]]	[[.16|]]	[[.65|]] ***	[[.13|]]	[[.11|]]	[[---|]]	[[|]]
7. Positive Reinforcement Smoking	[[−.06|]]	[[.11|]]	[[.61|]] ***	[[.20|]]	[[.18|]]	[[.86|]] ***	[[---|]]
8. Smoking abstinence at 2 weeks	[[.35|]] **	[[−.04|]]	[[−.14|]]	[[−.03|]]	[[.19|]]	[[−.09|]]	[[−.04|]]
9. Smoking abstinence at 8 weeks	[[.23|]] †	[[−.17|]]	[[−.24|]] *	[[−.22|]] †	[[.04|]]	[[−.27|]] *	[[−.22|]] †

[1]*Note*. The IAT negative social associations score is scaled so that higher scores indicate relatively stronger negative vs. positive social associations with smoking. Correlations with this measure are partial correlations controlling for the effect of order of administration of IAT attribute blocks.

† $p < .10$;

* $p < .05$;

** $p < .01$;

*** $p < .001$