



Impulsivity and the role of smoking-related outcome expectancies among dependent college-aged cigarette smokers

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ABSTRACT

The relationship between trait-impulsivity and smoking expectancies on smoking progression in undergraduate college students was examined over a 48-hour period of smoking abstinence. Participants were forty-nine college-aged dependent cigarette smokers who completed measures designed to assess impulsivity, nicotine dependence, and smoking expectancies. Using a series of multilevel models, impulsivity by time analyses indicated significant differences in positive reinforcement expectancies, [$F(2, 94) = 3.19, p < .05$], but not in negative reinforcement expectancies, [$F(2, 94) = 0.49, p = .61$]. Simple slopes analyses indicated that heightened trait-impulsivity predicted greater increases in positive reinforcement outcome expectancies at 48 h of abstinence. Level of impulsivity, however, was not related to changes in negative reinforcement expectancies. Results indicate that during an abstinence period, college students higher in trait-impulsivity may be more prone to relapse due to stronger beliefs about the positive effects from smoking a cigarette. These findings highlight the importance of understanding the interaction of personality and cognitive factors when working with young adult smokers wishing to quit this health-compromising behavior.

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Tobacco use among college students is a serious, ongoing public health concern. Recent estimates show that adults aged 18–24 have the highest prevalence rates of smoking among all active cigarette smokers ([Centers for Disease Control \[CDC\], 2006](#)). Many students who never smoked before matriculating into college may experiment or become social smokers during this time ([Wetter et al., 2004](#)), while those who had a history of smoking in high school are more likely to become heavier smokers ([Patterson, Lerman, Kaufmann, Neuner, & Audrain-McGovern, 2004](#)). Estimates indicate that up to 25% of adult smokers initiated smoking after entering college ([Everett et al., 1999](#)) and that nicotine abuse peaks during this time of emerging adulthood and independence ([Chen & Kendel, 1995](#)). Although research has consistently linked college students with a heightened risk for developing nicotine dependence ([Morrell, Cohen, Bacchi, & West, 2005](#)), the factors that contribute to this relationship remain unclear.

Psychological variables including negative affect ([Stevens, Colwell, Smith, Robinson, & McMillan, 2005](#)), outcome expectancies ([Wetter et al., 2004](#)), and stress ([Naquin & Gilbert, 1996](#)) have been found to predict smoking behavior among college students. Recent studies ([Doran, McChargue, & Cohen, 2007](#); [Krishnan-Sarin et al., 2007](#)) have also highlighted the importance of considering personality traits, such as impulsivity, when investigating the relationship between smoking and young adults. The existing substance use literature defines trait-impulsivity as a pattern of behaviors predicting a tendency to respond to a given stimulus or to readily available rewards, without forethought of possible negative consequences ([Bickel, Odum, & Madden, 1999](#); [Mitchell, 1999](#); [Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001](#); [Monterosso & Ainslie, 1999](#)). This personality trait has been associated with the continued use of a variety of substances including alcohol ([Allen, Moeller, Rhoades, & Cherek, 1998](#)), cocaine ([Casella, Nagoshi Muntaner, & Walter et al., 1994](#)), heroin ([Kirby, Petry, & Bickel, 1999](#)), and cigarettes ([Bickel et al., 1999](#)).

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Several explanations have been postulated in an attempt to explain why those higher in trait-impulsivity are more likely to use substances of abuse and why these individuals may expect greater reinforcement from these substances. Specifically, research on the reinforcing values of alcohol has shown more impulsive individuals to have greater expectations for the effects of this substance (Mann, Chassin, & Sher, 1987). Lending support to this evidence is research on heightened reward-seeking characteristics, similar to that of impulsive decision making, which has been linked as a moderating variable between positive alcohol-related expectancies and drinking behaviors (McCarthy, Kroll, & Smith, 2001; Fischer, Smith, Anderson, & Flory, 2003; Finn, Bobova, Wehner, Fargo, & Rickert, 2005).

Research has been more limited in examining the association between smoking and impulsivity. A study by Perkins, Gerlach, Broge, Fonte, & Wilson (2001) suggested that individuals high in sensation seeking, a trait similar to impulsivity, may experience more reinforcing and pleasant sensations from nicotine than their low sensation-seeking peers. Sensation seeking has also been shown to account for a significant portion of the variability in the initiation of risky behaviors, including the use of illicit drugs and cigarette smoking (Stephenson, Hoyle, Palmgreen, & Slater, 2003; Zuckerman and Cloninger, 1996). Additionally, there is evidence indicating that impulsivity is higher in adolescent smokers compared to their nonsmoking peers (Audrain-McGovern et al., 2004) and this group is less likely to successfully abstain from smoking (Krishnan-Sarin et al., 2007).

Recently, it has been suggested that impulsivity may be related to nicotine's subjective effects, causing it to be a contributing factor in the progression of smoking behavior (Mitchell, 2004). Given the considerable body of literature that exists showing a direct relationship between smoking outcome expectancies and consumption of cigarettes (Brandon & Baker, 1991; Brandon, Juliano, & Copeland, 1999; Copeland & Brandon, 2000), it may be that impulsivity influences this relationship. To date, it appears that only one study (Doran et al., 2007) has investigated this relationship. Specifically, this study found that college-aged smokers with higher levels of trait-impulsivity also had increased expectancies about the positive and negative reinforcement values of a cigarette.

The primary aim of the present study was to build upon the study conducted by Doran and colleagues. Specifically, this research team was interested in examining whether heightened levels of impulsivity predicted increases in smoking-related outcome expectancies during a 48-hour abstinence period in a sample of nicotine dependent college students. Using a cognitive-motivational framework (Finn, 2002; Finn, Mazas, Justus, & Steinmetz, 2002), it was anticipated that the expectation of reinforcement from smoking a cigarette would increase over a 48-hour period due to the subjective interpretation of decreased reward consumption from smoking abstinence as well as the heightened emotional reactivity experienced due to nicotine withdrawal. A 48-hour period of abstinence was utilized in the design of this study due to previous literature describing how most tobacco withdrawal symptoms have been shown to peak during the first 48 h after abstinence (e.g., Hughes, 2007).

1. Method

1.1. Participants

Participants were 49 undergraduate students, recruited via flyers and listserv announcements, who reported smoking 16 or more cigarettes per day for the past 6 months. Study inclusion required a score of five or greater on the Fagerström Test of Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerström, 1991), as well as endorsement of the Diagnostic and Statistical Manual of Mental Disorders Fourth Edition-Text Revision (DSM-IV-TR) criteria for Nicotine Dependence (American Psychiatric Association [APA], 2000). See Table 1 for more information on participant characteristics. All students received monetary compensation for their participation in this study. It is important to note that this study is a secondary analysis of a larger study examining the effectiveness of a confectionary product on 48-hour nicotine withdrawal. Data from this study only included the baseline (no-product control) condition.

1.2. Procedure

After being screened over the telephone, eligible participants were asked to come to the laboratory for three consecutive days (either Monday through Wednesday or Wednesday through Friday). The purpose of the first day of the experimental protocol

Table 1
Sample characteristics (N=49)

Variable	Mean (SD)
Age	22.37 (4.1)
Gender (% female)	32.7
Nicotine dependence ^a	6.2 (1.3)
Cigs. smoked per day	19.51 (3.9)
Impulsivity ^b	67.27 (12.4)
Ethnicity (%)	
African-American	2.0
Asian/Pacific Islander	2.0
Caucasian	87.8
Hispanic	2.0
Multi-ethnic	4.2
Native American	2.0

^a Fagerström Test for Nicotine Dependence (FTND; Heatherton et al., 1991).

^b The Barratt Impulsiveness Scale, version 11 (BIS-11; Patton et al., 1995).

(CO) monitor (Model 2900; Vitalograph, Lenexa, KS., USA) with a value of >10 parts per million (ppm). Participants were informed that they would be asked to provide a CO measure at the beginning of each experimental session in order to biologically confirm their self-reported 24- and 48-hour abstinence.

Participants were then asked to complete study questionnaires and to abstain from any form of nicotine use for the following 48 h. Appointments were scheduled with the participant to ensure that questionnaires would be completed at the same time for the following 2 days. To confirm smoking abstinence at both 24 and 48 h, a CO level of less than 10 (ppm) or at least 50% less than the baseline CO reading had to be obtained at the start of Day 2 (24 h abstinence) and Day 3 (48 h abstinence). These levels are consistent with the recommendations of the [Society for Research on Nicotine and Tobacco \[SRNT\] Subcommittee on Biochemical Verification \(2002\)](#). If participants had CO levels greater than this criterion on either Day 2 or Day 3, they were asked to reschedule all days for the following week. If participants had appropriate CO levels, they were asked to complete the same measures they completed at Baseline. All 49 participants in this sample successfully abstained from nicotine for the full 48 h; however 12 of these participants had to be rescheduled for the following week due to CO levels falling above the cutoff. Median CO levels for this sample during baseline measurement was 19 (range=10–34 ppm). At 24- and 48 h of abstinence, the median CO levels dropped to 4 (range=0–13 ppm) and 3 (range=1–9 ppm), respectively. At the end of Day 3, participants were debriefed and any questions related to the study were answered.

1.3. Assessments – screening and experimental sessions

1.3.1. Impulsivity

The Barratt Impulsiveness Scale, version 11 (BIS-11; [Patton, Stanford, & Barratt, 1995](#)) provides a measure of trait-impulsivity, divided on three impulsiveness subtraits: acting without forethought, being focused on the present rather than the future, and quick cognitive decision making ([Patton et al., 1995](#)). The BIS-11 is a 30-item self-report questionnaire that asks participants to rate on a 4-point Likert scale the degree to which a series of statement applies to them from “Rarely/Never” (1) to “Always/Almost Always” (4). Cumulative scores range from 30 (low in trait-impulsivity) to 120 (high in trait-impulsivity). The average BIS-11 score in the present sample was 67.27 (SD=12.4). This value is similar to previous studies using a nonclinical sample ([Doran, Spring, McChargue, Pergadia, & Richmond, 2004](#); [Doran et al., 2006](#)). The BIS-11 is structured to evaluate long term patterns of behavior, and has been used to assess trait levels of impulsivity across a variety of populations (e.g., [Mitchell, 1999](#); [Moeller & Dougherty, 2002](#); [Stanford, Greve, Boudreaux, Mathias, & Brumbelow, 1996](#)).

1.3.2. Nicotine dependence

The Fagerström Test for Nicotine Dependence was used to assess level of nicotine dependence (FTND; [Heatherton et al., 1991](#)). The FTND is a brief self-report instrument designed to correlate with physiological measures of nicotine tolerance. The FTND consists of six items rated either from 0 to 1 or from 0 to 3 (depending on the question) that can yield a total score of 10, with higher scores indicating greater nicotine dependence. The FTND has demonstrated adequate internal consistency (Cronbach's $\alpha = .64$; [Pomerleau, Carton, Lutzke, & Flessland, 1994](#)) and strong test–retest reliability over time ($r = .88$, [Pomerleau et al., 1994](#)).

1.3.3. Smoking reinforcement expectancies

The Smoking Consequences Questionnaire (SCQ; [Brandon & Baker, 1991](#)) was used to assess positive and negative reinforcement expectancies about cigarette smoking. The SCQ is a 60-item measure that depicts a variety of consequences from smoking. Participants are asked to rate each item on a 10-point Likert scale relative to how likely they believe each consequence to be. Principal components analyses have yielded four factors for this measure: negative consequences, positive reinforcement, negative reinforcement, and appetite–weight control. For the purpose of this study, only the positive and negative reinforcement subscales were used.

1.3.4. Smoking status/abstinence

Participants' smoking status as well as abstinence from smoking was assessed via a CO monitor (Model 2900; Vitalograph, Lenexa, KS., USA). Carbon Monoxide (CO) measures provide a biological marker to validate smoking status as well as to corroborate self-reported smoking abstinence. According to the guidelines set forth by the [Society for Research on Nicotine and Tobacco's Subcommittee on Biochemical Verification \(2002\)](#) abstinent participants must have CO levels below 10 parts per million (ppm). Due to the fact that some participants may have very high levels at baseline, a second criterion for the verification of abstinence will be considered. Individuals with initial CO levels above 20 ppm must demonstrate a drop in CO level by at least 50%. This criterion has been used in other studies ([Bickel, deGrandpre, Hughes, & Higgins, 1991](#); [Tidey, Higgins, Bickel, & Steingard, 1999](#)).

1.4. Data analysis

Using a series of repeated measures multilevel model analyses via the SAS Proc Mixed Procedure, impulsivity was included as a continuous time-invariant variable, while positive and negative reinforcement smoking expectancies were analyzed across three time-points (baseline, 24 h, 48 h). Using this analysis provided a way to account for variation in the intercepts and slopes across each participant ([Littell, Milliken, Stroup, Wolfinger, & Schabenberger, 2006](#)). The Proc Mixed method also allows for the ability to specify the covariance structure within a between subjects research design. The covariance structure used for this analysis was the first-order autoregressive, or AR(1) model. This covariance structure was chosen after obtaining estimates of the correlation and

covariance among residuals as well as estimates for model fit, as recommended by Littell et al. (2006). An AR(1) covariance structure models variance within an observation caused by its relationship with the previous observation. This is appropriate when there is an equal spacing between observations. Simple slopes analyses were examined using simple linear regression.

2. Results

2.1. Preliminary analyses

Prior to conducting the primary analyses, relationships between impulsivity, the sample characteristics, and the two outcome variables were examined. Impulsivity was not significantly related to age, gender, nicotine dependence, or positive and negative reinforcement smoking expectancies. However, there were significant correlations observed between daily number of cigarettes smoked and nicotine dependence ($r=.31$) as well as daily number of cigarettes smoked and age ($r=.36$).

2.2. Primary analyses

Analysis of the relationship between impulsivity and smoking-related outcome expectancies revealed mixed results. For positive reinforcement expectancies, analyses indicated a significant impulsivity \times time interaction, $F(2, 94)=3.19, p<.05$. To determine the nature of the interaction, simple slopes were estimated via simple linear regression. Results indicated that at 48 hours of abstinence ($\beta=.292, t(48)=2.09, p<.05$), higher impulsivity predicted increased levels of positive reinforcement smoking expectancies. This relationship was not significant at baseline ($\beta=-.173, t(48)=-1.20, p=.23$) or 24 h of abstinence ($\beta=-.135, t(48)=-.933, p=.35$). This indicates that at the 48-hour mark, but not at baseline or 24 h of abstinence, the more impulsive smokers had increased levels of positive reinforcement smoking expectancies compared to their less impulsive peers. For negative reinforcement expectancies, analyses indicated that the impulsivity \times time interaction was not significant, $F(2, 94)=0.49, p=.61$. Thus, for this sample, it appears that heightened levels of impulsivity solely predict increased expectations about the positive reinforcement values of a cigarette at 48 h of smoking abstinence.

3. Discussion

The present study examined the role of trait-impulsivity on smoking expectancies among nicotine dependent college students. The primary aim was to measure differences regarding the subjective effects of nicotine at 48 h of nicotine abstinence and how those effects were influenced by trait-impulsivity. In order to test this, repeated measurements of positive and negative smoking reinforcement expectancies were measured. Overall, the findings indicated that higher levels of trait-impulsivity were related to significant increases in positive reinforcement expectancies at 48 h of smoking abstinence. Items related to this factor involve enjoyment derived from tasting, touching, and feeling the effects from both the smoke of the cigarette and the cigarette itself. With respect to negative reinforcement expectancies (e.g., reduction of negative affect), no such differences were found. These results indicate that during a period of smoking abstinence, those with higher levels of trait-impulsivity may be more prone to relapse as a response to satisfy an immediate desire for a more pleasurable and rewarding stimuli.

To our knowledge, the present study was the first to assess changes in positive and negative reinforcement expectancies while also considering levels of trait-impulsivity over an abstinence period. Findings from the present study build upon previous research in the field as well as highlight the need to gain a better understanding for the role of impulsivity on the initiation, progression and maintenance of smoking behavior among college students. This study also enhances findings from previous research that examined mostly nondependent college-aged, social smokers. Specifically, while Doran et al. (2007) found that higher levels of impulsivity were associated with an increased expectation in both the positive and negative reinforcement value of a cigarette, the present study suggests that for dependent smokers only the expectation of positive reinforcement increases among individuals with higher levels of impulsivity. One possibility for this finding is that for those with heightened levels of impulsivity, cigarette smoking is more of an automatic response (i.e., nonplanning impulsiveness) than a coping mechanism. In this case, even a brief period of abstinence could promote impulsive decision making, thereby contributing to an elevated risk of relapse during a cessation attempt.

Important limitations do need to be taken into consideration when interpreting or generalizing the findings from the present study. First, the sample that we used was college-aged dependent smokers. However, since this age group (18–24 years) has the highest prevalence rates among those who currently smoke (CDC, 2006), developing a better understanding of the mechanisms of smoking maintenance is important if we wish to minimize the continuation of this health-compromising behavior on a new generation of smokers. A second limitation is that the current sample was primarily Caucasian and male, making gender and ethnic group comparisons impossible. Additionally, those who participated were current smokers who were not planning to quit smoking. The results therefore, could be different if study participants were not planning to resume smoking after 48 h.

In sum, the present findings expand upon the existing literature and show that heightened levels of trait-impulsivity are related to increases in positive reinforcement smoking expectancies during a period of abstinence. These results suggest that college students who are classified as highly impulsive and who wish to quit smoking could experience increased difficulty during a cessation attempt. In line with previous research showing that individuals higher in impulsivity experience disproportionate levels of self-reported craving (Doran, Spring, McChargue, 2007) and cessation success (Doran et al., 2004), these present findings lend support to the belief that these individuals may experience increased difficulty in finding adequate substitutes for a cigarette

during an abstinence period. Future research may examine potential cigarette substitutes, such as nicotine replacement therapies (i.e., nicotine gum, nicotine patch), that are both widely accessible and physiologically rewarding to those higher in trait-impulsivity. Additionally, it would be interesting to measure smoking-related outcome expectancies over 48 h among those who are making an actual quit attempt. This is especially relevant given that those higher in impulsivity may be less likely to make such an attempt. Additionally, it may also be important to examine the inclusion of personality factors, such as impulsivity, in the design and implementation of smoking cessation programs across college campuses.

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