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Testing impulsivity as a moderator of smoking motivation following exposure to negative affect and smoking cues

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Testing Impulsivity as a Moderator of Smoking Motivation Following Exposure to Negative Affect and Smoking Cues

by

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Dedication

I dedicate this master's thesis to my parents, Susan and Kenneth Litvin, who have supported me unconditionally and in every way possible throughout my life and my education.

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Table of Contents

List of Tables

Testing Impulsivity as a Moderator of Smoking Motivation

Following Exposure to Negative Affect and Smoking Cues

Erika B. Litvin

ABSTRACT

Consistent with classical conditioning theories of drug use, previous research has demonstrated that presenting smokers with either exteroceptive (e.g., pictures of cigarettes) or interoceptive (e.g., negative affect) cues results in increased motivation to smoke, as measured by urge and smoking topography (e.g., shorter latency to begin smoking). However, few studies have presented both types of cues to determine whether and how they might interact in the production of smoking motivation, and little research has focused on identifying potential moderators of cue reactivity. In a randomized 2 x 2 crossed factorial between-subjects design, the current study tested whether an interoceptive cue (anxiety induced via a speech preparation task) and an exteroceptive cue (exposure to a lit cigarette) interacted in the production of urge and behavioral reactivity and whether the personality trait of impulsivity moderated these effects. Results indicated main effects but no interactive effects for the two cue types on self-reported urge, no main or interactive effects on smoking topography, and no moderating effects of impulsivity. However, impulsivity was significantly correlated with urge to smoke, self-reported negative affect, and expectancies that smoking relieves negative

affect, suggesting that this trait plays an important role in continued tobacco use. Implications for future research on the relationship between impulsivity and smoking behavior are discussed.

Introduction

Although smoking rates have declined steadily since the 1960's, an estimated 20.9 percent of adults in the U.S. continue to smoke (Centers for Disease Control and Prevention, 2005) and tobacco use remains the leading preventable cause of death (United States Department of Health and Human Services, 2004). A recent study reported that an estimated 70 percent of smokers want to quit (Centers for Disease Control and Prevention, 2002) but the best current smoking cessation treatments result in long-term abstinence rates of only 15 to 30% (Fiore et al., 2000). Therefore, it is important that researchers continue to investigate psychological and physiological mechanisms that maintain tobacco use.

It has been repeatedly observed that relapse often occurs when drug users encounter stimuli previously paired with drug use (e.g., Shiffman, Paty, Gnys, Kassel, & Hickcox, 1996). Classical conditioning (CC) theories of drug use motivation provide one possible explanation for this phenomenon. They posit that drug-related stimuli that are repeatedly paired with drug use become conditioned stimuli (CSs) capable of eliciting conditioned responses (CRs), and that these responses are subjectively experienced as craving and motivate continued drug use (Carter & Tiffany, 1999; Niaura et al., 1988). Wikler (1948) hypothesized that stimuli associated with withdrawal symptoms elicit conditioned withdrawal-like responses that prompt continued use. Siegel (1975) also proposed that CRs are withdrawal-like, that is, opposite in direction to unconditioned

drug responses (UCRs), but that stimuli associated with drug administration, rather than drug withdrawal, become CSs. In contrast, Stewart, de Wit, and Eikelboom (1984) proposed an incentive model whereby stimuli associated with drug use invoke a positive motivational state and responses that are isodirectional to drug UCRs. Cue reactivity research in the laboratory, which involves exposing drug users to cues associated with drug administration and measuring their reactions, has provided general support for CC theories and valuable insight into basic phenomena related to drug addiction. A large body of research has demonstrated that exteroceptive cues, such as pictures of cigarettes, reliably induce self-reported craving or urge, as well as physiological responses, in smokers (Carter & Tiffany, 1999). A smaller number of studies have shown that interoceptive cues, such as negative affect, also result in increased urge (e.g., Payne, Schare, Levis, & Colletti, 1991; Tiffany & Drobes, 1990).

Outside of the laboratory, smokers are likely to encounter both exteroceptive and interoceptive cues in close temporal proximity. However, to our knowledge, only one laboratory study has investigated reactivity to exteroceptive smoking cues during a negative mood induction (Payne et al., 1991). Additionally, there is only limited evidence that reactions to smoking cues in the laboratory predict actual drug use behavior (Payne et al., 1991), and relapse following a quit attempt (Niaura, Abrams, Demuth, Pinto, & Monti, 1989; Payne, Smith, Adams, & Diefenbach, 2006). The value of cue-elicited reactions for predicting actual smoking behavior and cessation outcomes may remain uncertain because individuals differ in both response magnitude, with some failing to show any reactions (Rees & Heather, 1995), and their tendency to act on cravings (Tracy, 1994). The need for research on potential moderators of cue reactivity, such as

personality traits, has recently been highlighted (Carter & Tiffany, 1999; Rees & Heather, 1995). Such research has the potential to explain individual differences in susceptibility to drug conditioning and subsequently aid in refining classical conditioning theories (Rees & Heather, 1995).

We will first review the relationship between smoking and negative affect, with a focus on studies that induced negative affect in the laboratory. Second, we will review the construct of impulsivity, a personality trait that is strongly associated with drug use. We will present evidence to suggest that impulsivity may affect reactivity to both exteroceptive and interoceptive cues. The current study tested experimentally whether these two cue types would interact in the production of smoking motivation, and whether impulsivity would moderate these effects.

Smoking and Negative Affect

Many smokers believe that negative affect states, such as stress, anxiety, and depression, motivate them to smoke and that smoking relieves negative affect (NA) (Brandon, 1994; Copeland, Brandon, & Quinn, 1995). Likewise, a number of theorists have also identified NA as a key motivator of drug use behavior (e.g., Baker, Piper, McCarthy, Majeskie, & Fiore, 2004). Whereas smoking rapidly relieves NA directly caused by nicotine withdrawal, the relationship between tobacco use and NA independent of withdrawal is complex, may be reciprocal, and is not yet fully understood (for an extensive review, see Kassel, Stroud, & Paronis, 2003). Correlational and cross-sectional studies consistently demonstrate a relationship between all stages of smoking behavior and NA (Kassel et al., 2003). For example, there is considerable evidence that negative life experiences such as abuse and parental divorce (e.g., Anda et al., 1999), other acute

and chronic stressors (e.g., Koval, Pederson, Mills, McGrady, & Carvajal, 2000), and affective disorders such as depression (e.g., Breslau, Peterson, Schultz, Chilcoat, & Andreski, 1998; Brown, Lewinsohn, Seeley, & Wagner, 1996; Dierker, Avenevoli, Merikangas, Flaherty, & Stolar, 2001) are associated with initiation of smoking, progression to daily smoking, and development of nicotine dependence. Regarding smoking maintenance, smokers generally report higher levels of stressful life events and NA (e.g., Hellerstedt & Jeffery, 1997; Jorm et al., 1999b), and are more likely to suffer from depression and some anxiety disorders (e.g., Anda et al., 1990; Breslau, 1995; Zvolensky, Feldner, Leen-Feldner, & McLeish, 2005) than non-smokers. NA is even more strongly linked to cessation outcomes. Individuals with a history of depression (Covey, 1999), current depressive symptoms (e.g., Glassman et al., 1990), and relatively higher levels of post-cessation NA (Kenford et al., 2002) are more likely to relapse. In one study, smokers who reported that they were motivated to smoke primarily by NA were also at greater risk of relapse (Pomerleau, Adkins, & Pertschuk, 1978). Most compelling of all, both retrospective and real-time field studies indicate that a large proportion of relapses are attributable to situational increases in NA (e.g., Brandon, Tiffany, Obremski, & Baker, 1990; Shiffman et al., 1996).

Nevertheless, it remains somewhat unclear whether situational increases in NA actually maintain smoking behavior in continuing smokers, and consequently, whether smoking relieves NA. Laboratory studies that have investigated these questions have used a variety of different procedures to induce NA, including music (Conklin & Perkins, 2005; Willner & Jones, 1996), images (Conklin & Perkins, 2005), imagery scripts (e.g., Tiffany & Drobes, 1990), exposure to aversive noise (Jarvik, Caskey, Rose, Herskovic, &

Sadeghpour, 1989; Payne et al., 1991), watching a stressful movie (Gilbert, Robinson, Chamberlin, & Spielberger, 1989), engaging in a competitive mental arithmetic task (Pomerleau & Pomerleau, 1987), telling participants they will need to perform a comedy monologue (Rose, Ananda, & Jarvik, 1983) or give a speech about what they dislike about their body (Juliano & Brandon, 2002; Kassel & Shiffman, 1997; Kassel & Unrod, 2000), and making participants try to solve unsolvable anagrams (Jarvik et al., 1989; Pomerleau, Turk, & Fertig, 1984). Regarding whether smoking reduces NA, findings are mixed, depending on the mood induction procedure used and other situational factors (e.g., engaging in a distracting activity while smoking, see Kassel & Shiffman, 1997; Kassel & Unrod, 2000). For example, a recent study by Conklin and Perkins (2005) that employed a robust music and imagery mood induction, found that smoking did reduce NA, but not more than sipping water.

Regarding whether smokers increase their smoking behavior when they experience NA, Shiffman et al. (2002) reported real-time data that indicated no relationship between situational increases in NA and timing of smoking episodes. Baker et al. (2004) have recently presented a negative reinforcement model of addiction that may explain these null findings. They have proposed that NA is primarily responsible for continued drug use, but that when drugs are freely available, as they are for most smokers, drug users learn to detect interoceptive, withdrawal-related NA before it becomes conscious. When drug use is interrupted, such as during a quit attempt or because drugs are otherwise unavailable, this withdrawal-related NA reaches consciousness and prompts continued use. Over time, drug users come to associate drug use with relief not only from withdrawal-related NA, but also from other sources of NA,

and NA becomes a potent CS for continued use. However, because the majority of drug use occurs before NA reaches consciousness, Baker et al.'s theory would actually predict the results that Shiffman et al. obtained. Further supporting Baker et al.'s theory, laboratory studies that have induced NA in minimally or moderately-deprived smokers have generally (but not always, see Brandon, Wetter, & Baker, 1996) shown that NA decreases latency to smoke (Conklin & Perkins, 2005) and increases the intensity of smoking behavior, measured by the number of puffs taken and puff volume (Conklin & Perkins, 2005; Payne et al., 1991; Pomerleau & Pomerleau, 1987; Rose et al., 1983; Willner & Jones, 1996).

Whereas numerous studies have presented smokers with exteroceptive cues to induce craving, many fewer studies have examined the effect of NA on craving, despite both theoretical and empirical interest in the significance of craving as a predictor of drug use and its relationship to relapse (e.g., Killen & Fortmann, 1997; Toneatto, 1999). Perkins and Grobe (1992) reported that desire to smoke increased during a stressful task that involved repeating digit sequences presented at varying speeds tailored for each participant to maintain his/her success rate at approximately 40 percent. Similarly, NA induced by leading participants to believe they had performed poorly on an IQ test has also been shown to increase craving (Brandon et al., 1996). Using a musical mood induction procedure, Willner and Jones (1996) found that craving increased in a depressed mood condition relative to an elated mood condition. Employing a similar music and imagery mood induction procedure, Conklin and Perkins (2005) reported that craving increased in a negative mood condition relative to a positive mood condition, but not more so than in a neutral mood condition. Tiffany and colleagues have conducted a

series of studies using standardized imagery scripts. They have demonstrated that scripts intended to induce NA increase urge to smoke relative to neutral mood scripts (Maude-Griffin & Tiffany, 1996; Tiffany & Drobes, 1990).

During everyday life, drug users are likely to encounter both NA and drug cues in close temporal proximity. To investigate how these two cue types might interact, several studies in the alcohol literature have investigated the impact of NA on urge reactivity to exteroceptive alcohol cues (e.g., sight and smell of an alcoholic beverage) and subsequent alcohol consumption (Cooney, Litt, Morse, Bauer, & Gaupp, 1997; Jansma, Breteler, Schippers, de Jong, & Van Der Staak, 2000; Litt, Cooney, Kadden, & Gaupp, 1990; Nesic & Duka, 2006; Rubonis et al., 1994). These studies have so far produced mixed findings, which may have resulted from different mood induction procedures and participant characteristics (i.e. social drinkers vs. alcoholics) (Nesic & Duka, 2006). For example, some studies have failed to find any effect for alcohol cues (Litt et al., 1990), or mood (Jansma et al., 2000), while others have found additive effects (Cooney et al., 1997). Gender differences have also been reported (Nesic & Duka, 2006; Rubonis et al., 1994).

Surprisingly, very few studies in the smoking literature have presented both cue types in the same study. Tiffany and colleagues have reported that imagery scripts containing both NA and urge cues result in greater craving increases than scripts containing either cue type alone (Maude-Griffin & Tiffany, 1996; Tiffany & Drobes, 1990). Payne et al. (1991) found that negative mood induced via a stressful noise-escape task increased urge to smoke. The presence of smoking cues in the experimental room (i.e. ashtrays with butts, packs of cigarettes, matches, odor of smoke) while participants

completed the task did not affect urge to smoke, but did decrease latency to smoke and increase puff duration for the first cigarette smoked during a 20 minute ad-lib smoking opportunity following completion of the task. In Tiffany and colleagues' as well as in Payne et al.'s study, the NA and smoking cues were presented simultaneously. In the Payne et al. study, it is possible that the smoking cues did not affect urge because they were not as salient as the mood induction, considering the attentional demands of the noise-escape task. Additionally, simultaneous presentation may not reflect the actual experiences of drug users. It seems more likely that drug users experiencing NA would subsequently encounter drug cues just before use occurs. Consistent with this assumption, the alcohol studies described previously introduced the alcohol cues *after* participants already had been induced into a negative mood. To our knowledge, no smoking study has presented smoking cues *after* a negative mood induction, to ensure the salience of the smoking cues and to investigate how NA affects subsequent reactivity to smoking cues.

Smoking and Impulsivity

Impulsivity, a prominent construct in most theories of personality, encompasses a broad range of traits and behavior associated with impaired self-regulation, such as poor planning, premature responding before considering consequences, sensation-seeking, risk-taking, an inability to inhibit behavior, and a preference for immediate over delayed rewards (Evenden, 1999; Whiteside & Lynam, 2001). Methods used to assess impulsivity include both self-report and behavioral measures. Factor analytic studies of impulsivity scales have revealed that impulsivity is not a unitary construct (e.g., Whiteside & Lynam, 2001), and it remains unclear which measures best capture certain

aspects of impulsivity. Nevertheless, a large body of research has demonstrated that impulsivity, broadly defined, is associated with some forms of psychopathology (Swann, Bjork, Moeller, & Dougherty, 2002) and many health risk behaviors, including tobacco and other drug use (Bogg & Roberts, 2004).

Impulsivity questionnaires derived from personality theory. Smoking is associated with impulsivity as measured with a variety of impulsivity-related scales based on the major three- and five-factor models of personality proposed by Cloninger (1987), Eysenck (Eysenck & Eysenck, 1969, 1975; Eysenck, Pearson, Easting, & Allsoff, 1985), Costa and McRae (Costa & McCrae, 1992; McCrae & Costa, 1990), and Zuckerman (1994). The majority of studies including these measures have shown that, as a group, adolescent and adult smokers are more impulsive than nonsmokers (Carton, Jouvent, & Widlocher, 1994; Golding, Harpur, & Brent-Smith, 1983; Kassel, Shiffman, Gnys, Paty, & Zettler-Segal, 1994; Mitchell, 1999; Terracciano & Costa, 2004; Vollrath & Torgersen, 2002; Wills, Vaccaro, & McNamara, 1994; Zuckerman, Ball, & Black, 1990). Two impulsivity-related scales in Cloninger's model have also been shown to predict substance use initiation (Masse & Tremblay, 1997).

Barratt Impulsiveness Scale. The Barratt Impulsiveness Scale (BIS-11; Patton, Stanford, & Barratt, 1995) is a 30 item scale that consists of three factors labeled attentional impulsiveness, motor impulsiveness, and nonplanning impulsiveness. Adult smokers report greater impulsivity on the BIS-11 than non-smokers (Mitchell, 1999), and frequency of smoking among adolescent and young adult smokers has been positively associated with BIS-11 scores (Fossati, Barratt, Acquarini, & Di Ceglie, 2002; Fossati, Di Ceglie, Acquarini, & Barratt, 2001). Additionally, Dom, Hulstijn, and Sabbe (2006)

reported that BIS-11 scores correlated positively with the number of cigarettes smoked daily among a group of alcohol-dependent smokers.

Gray's BAS and BIS. Gray's Reinforcement Sensitivity Theory (RST) of personality (Fowles, 1987; Gray, 1970, 1987) proposes that two systems primarily influence behavior. The Behavioral Activation or Behavioral Approach System (BAS) motivates reward-seeking behavior and positive affect, while the Behavioral Inhibition System (BIS), motivates avoidance behavior and anxiety reactions. Although both an overactive BAS and an underactive BIS may be thought to represent impulsivity, most research has focused on an overactive BAS as a predictor of impulsive behavior. The most commonly used measures associated with RST are the BIS/BAS scales (Carver & White, 1994). To our knowledge, no studies have yet determined whether BAS scores of smokers differ from non-smokers, but higher scores on BAS measures are associated with alcohol use (Franken, Muris, & Georgieva, 2006; Jorm et al., 1999a). Also, Knyazev (2004) reported that a BAS measure predicted substance use (including tobacco use) among a group of adolescents and young adults.

Other self-report measures. In addition to the measures described above, a variety of other impulsivity-related scales predict smoking initiation (Burt, Dinh, Peterson, & Sarason, 2000; Elkins, King, McGue, & Iacono, 2006; Grano, Virtanen, Vahtera, Elovainio, & Kivimaki, 2004; Lipkus, Barefoot, Williams, & Siegler, 1994) and discriminate smokers from non-smokers (Geist & Herrmann, 1990; Lewinsohn, Brown, Seeley, & Ramsey, 2000; Lipkus, Barefoot, Feaganes, & Williams, 1994).

Behavioral impulsivity measures—delay discounting tasks. In a "delay discounting" task, individuals are given a series of choices between a small reward that

they can receive immediately or a larger reward that is available after a time delay (e.g., one week). Typically, they choose between two monetary amounts (either hypothetical or real). Reward value and delay length are varied such that a "discounting" rate corresponding to a hyperbolic function can be estimated for each individual. A higher discounting rate reflects a stronger preference for smaller, immediate rewards and indicates greater impulsivity. Discounting rates from computerized and paper and pencil versions of the task are highly correlated (r = .82, Epstein et al., 2003). Likewise, versions of the task employing real versus hypothetical rewards have not shown significant differences in discounting patterns (Madden, Begotka, Raiff, & Kastern, 2003; Madden et al., 2004). Several studies have demonstrated that adult smokers are more impulsive than non-smokers on the delay discounting task (Baker, Johnson, & Bickel, 2003; Bickel, Odum, & Madden, 1999; Mitchell, 1999; Reynolds, Richards, Horn, & Karraker, 2004). Additionally, adult smokers discount the value of cigarette rewards more than monetary rewards (Baker et al., 2003; Bickel et al., 1999; Field, Santarcangelo, Sumnall, Goudie, & Cole, 2006), and discounting rate correlates positively with number of cigarettes smoked per day (Epstein et al., 2003; Ohmura, Takahashi, & Kitamura, 2005; Reynolds, 2004). Some researchers have suggested that the discounting task assesses state impulsivity, whereas personality measures tap trait impulsivity. Studies that have manipulated nicotine deprivation state among smokers have shown mixed results, with one study reporting that deprivation increased discounting rate (Field et al., 2006) and another finding no differences (Mitchell, 2004a). Furthermore, two studies have reported high test-retest reliability rates for the discounting task for time periods ranging from one-week (r = .71 to .90; Baker et al., 2003) to three months (r = .45 to .75;

Ohmura, Takahashi, Kitamura, & Wehr, 2006). However, studies that have administered both discounting tasks and personality measures have reported only low to moderate correlations between them (e.g., Kirby, Petry, & Bickel, 1999; Mitchell, 1999).

Mechanisms Linking Impulsivity and Smoking

Only a handful of studies have investigated potential mechanisms that may link impulsivity and tobacco use. Mitchell (2004b) reviews evidence from the literature on both tobacco and other drugs that suggests a reciprocal relationship: 1) nicotine may cause neuroadaptions that increase impulsive behavior and 2) impulsivity plays a role in the maintenance of smoking behavior. Regarding the first possibility, studies from the animal literature suggest that nicotine may cause neurological changes that increase impulsivity, or lead individuals to become more impulsive when deprived of nicotine (see Mitchell, 2004b). Regarding the second possibility, impulsivity may be related to both motivation and ability to quit smoking. More impulsive smokers report stronger expectancies for both positive and negative reinforcement benefits from nicotine (Doran, McChargue, & Cohen, 2007). These expectations may reflect actual experience, as more impulsive individuals may receive greater reinforcement from nicotine than less impulsive individuals (Perkins, Gerlach, Broge, Grobe, & Wilson, 2000), including greater relief from NA (Doran et al., 2006). Additionally, the results of several studies have suggested that impulsivity is associated with smoking relapse (Doran, Spring, McChargue, Pergadia, & Richmond, 2004; Jacobs, 1972; Rukstalis, Jepson, Patterson, & Lerman, 2005).

Impulsivity has also been implicated to account for individual differences in craving and acting on craving. Zilberman, Tavares, and el-Guebaly (2003) reported that

craving in treatment-seeking drug-dependent women was positively related to scores on the BIS-11 and other impulsivity scales. Tracy (1994) distinguished between craving and acting on craving, suggesting that more impulsive individuals may be more likely to act on craving, and that considering variables such as impulsivity may improve the power of craving measures to predict relapse outcomes.

Impulsivity and Reactivity to Exteroceptive Cues

Given that exteroceptive smoking cues robustly induce craving (Carter & Tiffany, 1999) and commonly prompt relapse (Shiffman et al., 1996), and that impulsivity has been defined as a preference for immediate rewards and a tendency to respond prematurely, it has been suggested that perhaps more impulsive smokers are more responsive to smoking cues (Doran et al., 2004; Mitchell, 2004b; Rees & Heather, 1995). At the time that the current study was originally proposed, no published studies had yet investigated the relationship between impulsivity and reactivity to smoking cues. However, two studies had reported that BAS scores, measured with the BIS/BAS scales (Carver & White, 1994) correlated positively with reactivity to alcohol cues (Franken, 2002; Kambouropoulos & Staiger, 2001). Additionally, Powell, Bradley, and Gray (1992) reported that impulsivity correlated significantly with cue-elicited craving among opiate-dependent individuals. Since this study was proposed, two studies examining the relationship between impulsivity and reactivity to exteroceptive smoking cues have been published, with mixed results. Doran, Spring, and McChargue (2007) found that impulsivity was associated with increased cue-elicited craving, while Doran, McChargue, and Spring (2008) reported that impulsivity was associated with increased mean arterial

pressure response following cue exposure but not heart rate or craving. Thus, the current study may help clarify this relationship.

Impulsivity and Reactivity to Interoceptive Cues

Although the hypothesis has not been directly tested, there is also theoretical and empirical literature to suggest that more impulsive smokers may also be more reactive to affective cues. For example, Tice and Bratslavsky (2000) view emotion regulation as simply one form of general self-regulation, albeit with some special properties. They review evidence to suggest that emotion regulation takes priority over other forms of self-regulation, that negative mood decreases one's capacity for general self-regulation, and that continued attempts at self-control can in turn lead to negative mood, creating a downward spiral. They conclude that many individuals fail at self-regulation (e.g., fail to quit smoking) because they continue to regulate their affect by engaging in the very behaviors they are trying to modify (e.g., smoking). Because impulsive individuals by definition already have less capacity for self-control in the absence of NA, a negative mood may leave them especially vulnerable to self-control failure. Furthermore, as noted above, two recent studies have shown that more impulsive smokers may derive greater relief from NA through smoking (Doran et al., 2006), and that they report stronger expectancies for NA relief from smoking (Doran, McChargue, & Cohen, 2007). As such, more impulsive smokers may be triply hampered in their cessation efforts by generally impaired self-regulation, stronger expectations that smoking will reduce NA, and greater subjectively experienced relief from NA after smoking.

Kassel et al. (2003) offer another perspective on the potential connection between impulsivity and NA-related motivation to smoke. Citing evidence that externalizing

problems predict smoking initiation even more reliably than internalizing problems, they suggest the possibility that the relationship between various indices of NA and smoking initiation is actually spurious and is due to high rates of comorbidity between externalizing and internalizing problems. Deficits in self-regulation that are common to both types of problems, particularly affect regulation, may link them to smoking initation.

Furthermore, a growing body of literature suggests that impulsive individuals, including smokers, may show greater responses to affectively charged material and deficits in affect regulation compared to peers. For example, a recent study demonstrated that boys with attention-deficit hyperactivity disorder (ADHD), a disorder characterized by impulsive and hyperactive behavior and associated with tobacco use (e.g., Tercyak, Lerman, & Audrain, 2002), were less able than comparison boys to mask and regulate their emotions during a competitive puzzle task (Walcott & Landau, 2004). In another study examining the interaction between impulsivity and mood reactivity, Bekker, van de Meerendonk, and Mollerus (2004) reported that more impulsive female college students had a marginally significant tendency to show a greater increase in self-reported emotional eating after a negative mood induction. Finally, Doran et al. (2006) found that more impulsive smokers not only reported greater reductions in NA after smoking, as previously noted, but that level of self-reported NA following the negative mood induction correlated positively with impulsivity. Given the expectancies that impulsive smokers have (Doran, McChargue, & Cohen, 2007), and the fact that NA correlates positively with craving and with all stages of smoking behavior (Kassel et al., 2003), more impulsive smokers may show greater urge reactivity to a negative mood induction. Additionally, if more impulsive smokers are more likely to act on their cravings, as

suggested by Tracy (1994), they may also evidence greater motivation to smoke as indicated by smoking topography assessment.

The Current Study

More studies are clearly necessary to elucidate the connections between urge, smoking behavior, NA, and exteroceptive smoking cues, and to identify potential moderators of these relationships. The primary purpose of the current study was to test experimentally the effect of negative mood on urge and behavioral reactivity to exteroceptive smoking cues and subsequent smoking behavior. The smoking cues were presented after the mood induction, rather than during it as Payne et al. (1991) did, in order to increase their salience, and more precisely assess the effect of a negative mood on reactivity to the smoking cues. As mentioned previously, several studies in the alcohol literature have used similar methodology (mood induction followed by cue exposure). After exposure to both cue types, participants were given an opportunity to smoke and their smoking behavior was recorded. Additionally, we investigated whether impulsivity moderated urge and behavioral reactivity. That is, we examined whether more impulsive smokers, identified from personality and behavioral measures, experienced stronger motivation to smoke in response to these two types of cues, compared to less impulsive smokers.

Specific Aim 1: To investigate the effect of negative affect on urge and behavioral reactivity to exteroceptive smoking cues and subsequent smoking behavior. We hypothesized that both negative affect and exteroceptive smoking cues would result in increased motivation to smoke, as indicated by increased self-

reported craving and smoking topography variables such as decreased latency to smoke.

Specific Aim 2: To test the hypothesis that impulsivity moderates reactivity to both affect and smoking cues. Specifically, we hypothesized that more impulsive smokers would report stronger urges and show evidence of greater motivation to smoke than less impulsive smokers, after induction of negative affect and exposure to smoking cues.

Method

Experimental Design and Overview

Participants were recruited to participate in an individual laboratory session to learn more about personality and mood in smokers. A 2 X 2 crossed factorial between-subjects design (Negative Mood/Neutral Mood X Smoking Cue/Neutral Cue) was used. First, participants completed baseline measures that assessed demographics, nicotine dependence, impulsivity, beliefs about negative reinforcement benefits from smoking, trait and state mood, and current urge level. Participants were then randomly assigned to one of four conditions: 1) negative mood induction followed by exposure to smoking cues, 2) negative mood induction followed by exposure to neutral cues, 3) neutral mood induction followed by exposure to smoking cues, or 4) neutral mood induction followed by exposure to neutral cues. Following the mood induction and cue exposure procedures, participants were asked to complete additional questionnaires that assessed urge and state mood. After completing both the mood induction and cue exposure procedures, they were given an opportunity to smoke and their smoking behavior was recorded. After smoking, state mood was again assessed and participants were debriefed and paid.

Participants

Participants included 175 smokers recruited from the Tampa, Florida area via flyers and newspaper advertisements. All interested individuals were screened via phone and were invited to participate if they reported that they were English-speaking, between

the ages of 18 and 65, smoked at least 10 cigarettes per day and had smoked for at least one year, were not currently attempting to quit or using pharmacotherapy, were not currently enrolled in a formal cessation treatment program, were not pregnant, and had not participated in any recent TRIP study with similar procedures to the current study (e.g., some manipulation followed by repeated measurement of craving, this was determined on a case-by-case basis). Additionally, upon arrival at the laboratory each participant provided a breath sample to determine exhaled carbon monoxide (CO) level in parts per million. If their CO level was below 8ppm, an accepted cut-off to determine smoking status, they were excluded from the study. Each participant was paid $20 for participation in the study, which lasted approximately 1 to 1.5 hours.

Measures

Exhaled Carbon Monoxide (CO). Upon arrival at the laboratory, participants provided a breath sample to determine exhaled CO level and verify their smoking status. They were asked to inhale deeply, hold their breath for 20 seconds, and then exhale into a disposable tube attached to a CO monitor. Participants were excluded from the study if their breath CO level was below 8ppm. Exhaled CO level was also measured at the end of the study, after participants had smoked a cigarette.

Demographic Questionnaire. Single items assessed participants' age, marital status, race and ethnicity, education level, and household income. (See Appendix A).

Smoking Status Questionnaire (SSQ). The SSQ was used to assess participants' smoking history and level of nicotine dependence. The SSQ included items from the Fagerstrom Test for Nicotine Dependence (FTND), which has been shown reliable and

valid for measuring nicotine dependence (Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991). (See Appendix B).

Questionnaire of Smoking Urges-Brief (QSU-brief; Cox, Tiffany, & Christen, 2001). The QSU-brief was used to assess participants' self-reported urge to smoke at baseline and following the mood and cue manipulations. The QSU-brief contains 10 items taken from the original 32-item Questionnaire of Smoking Urges (QSU; Tiffany & Drobes, 1991). The items consist of two subscales that assess both positive (i.e. desire to smoke, pleasure) and negative reinforcement benefits (i.e. relieve NA). Participants rated each item using a scale that ranged from 1 (very slightly or not at all) to 5 (extremely). Higher scores indicated greater craving. The QSU-brief has been shown highly reliable (α = .92-.97) in the measurement of smoking urges in the laboratory. (See Appendix C).

Smoking Consequences Questionnaire – Adult (SCQ-A; Copeland et al., 1995). The original Smoking Consequences Questionnaire (Brandon & Baker, 1991) assesses smokers' expectations about the benefits of smoking, referred to as expectancies, and has been validated in a college student sample. The SCQ-A is a modified version of the SCQ that has been validated in a sample of adult smokers. Each item is rated on a scale from 0 (completely unlikely) to 9 (completely likely). Three of the 10 subscales were included in the proposed study: Negative Affect Reduction (e.g., Smoking calms me down when I feel nervous), Stimulation/State Enhancement (e.g., Cigarettes can really make me feel good), and Craving/Addiction (e.g., Smoking will satisfy my nicotine cravings). These three subscales have demonstrated high internal consistency (α = .83-.96). (See Appendix D).

Mood Form (Diener & Emmons, 1984). The Mood Form was used to assess participants' trait and state mood. It consists of 4 items that assess positive affect (e.g., happy, pleased) and 5 items that assess negative affect (e.g., depressed/blue, frustrated). Each item is rated on a 7 point scale from "not at all" to "extremely much." The ratings for the positive and negative adjectives were summed to produce total Positive Affect and Negative Affect scores. To measure participants' general mood (i.e. trait mood), participants were asked to indicate how much they had experienced each affect state over the past 3 weeks. To measure participants' state mood before and after the two manipulations and after smoking, participants were asked how much they were currently experiencing each affect state. This measure was chosen for its brevity and high reliability ($\alpha = .89$ for the positive affect items and $\alpha = .84$ for the negative affect items). (See Appendices E and F)

State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). The STAI was used to more thoroughly assess participants' anxiety, the affect state most likely to be affected by the mood manipulation. The STAI consists of 20 items that assess trait anxiety (STAI-T) (e.g., I feel nervous and restless), and 20 similar items that assess state anxiety (STAI-S) (e.g., I am tense). In the original measure, both the trait and state items are rated on a 4-point scale ("almost never" to "almost always" for the trait items and "not at all" to "very much so" for the state items). However, to obtain more variability towards the high end of the scales, recent research in the area of smoking and negative affect has used a 7-point scale with the same labels placed at equal intervals (Juliano & Brandon, 2002; Kassel & Unrod, 2000). We used the 7-point scale for both the trait and state versions. Reported alphas for the 7 point scale

are .89 for the trait measure (Kassel & Unrod, 2000) and .90 to .96 for the state measure (Juliano & Brandon, 2002; Kassel & Unrod, 2000). (See Appendices G and H).

Barratt Impulsiveness Scale (BIS-11; Patton et al., 1995). The BIS-11 is a 30 item self-report measure of impulsivity. It consists of three subscales representing three factors: attentional impulsiveness (difficulty staying on task, racing thoughts), motor impulsiveness (acting without forethought), and non-planning impulsiveness (failure to plan and think carefully). Each item is answered on a 4-point scale from "rarely/never" to "almost always/always," with some items reverse-coded. Higher scores represent greater impulsiveness. Reported alphas for various populations (e.g., undergraduates, substance-abuse patients) are acceptable and have ranged from .79 to .83 (Patton et al. 1995). Smokers have been shown to score higher on this measure than non-smokers (Mitchell, 1999) and this measure has been commonly used in a variety of research related to impulsivity. (See Appendix I).

BIS/BAS scales (Carver & White, 1994). The BIS/BAS scales are self-report measures that correspond to anxiety and impulsivity, the two major dimensions of Gray's theory of personality (Gray, 1970). Anxiety is associated with the behavioral inhibition system (BIS) and impulsivity with the behavioral activation system (BAS). The BIS scale contains 7 items (e.g., "I worry about making mistakes"), with a reported alpha of .76 in a large community sample (Jorm et al., 1999a). The BAS scale (reported alpha of .83, Jorm et al., 1999a) has 3 subscales: Reward Responsiveness (e.g., "When I get something I want, I feel excited and energized."), Drive (e.g., "I go out of my way to get things I want."), and Fun Seeking (e.g., "I often act on the spur of the moment) (Carver & White, 1994). Although its validity as a measure of impulsivity remains debatable

(Carver & White, 1994), this measure is included in the present study because two previous studies have shown that BAS scores correlate with reactivity to alcohol cues (Franken, 2002; Kambouropoulos & Staiger, 2001). (See Appendix J).

Delay Discounting Task (DDT; Kirby et al., 1999). In this delay discounting task, participants were given a list of 27 questions, each requiring a choice between a smaller, hypothetical monetary reward available immediately, and a larger reward available after a delay. Immediate amounts ranged from $11 to $80, while delayed amounts ranged from $25 to $85 and were available at delays of 7 to 186 days. Discounting rate (k) estimates are derived by fitting an individual's indifference points (point at which an immediate and delayed reward are equally preferred) into a hyperbolic equation, $V=A/1 + kD$. V refers to the current value of delayed reward A, and D is the number of days the reward is delayed. More choices for immediate rewards results in a higher k value and indicates greater impulsivity. This measure covers eight ranges of discounting rates and two endpoint values for small, medium, and large rewards. Within each reward category, individuals are assigned a value of k corresponding to the geometric midpoint of one of the ranges or an endpoint value that is most consistent with their choices. If an individual's choices are equally consistent with two different values of k, the geometric mean of these values is assigned. A person's overall k value is the geometric mean of their assigned k values for the small, medium, and large reward categories. This measure was chosen because it can be completed in a short amount of time (approx. 5 minutes) using paper and pencil, and has been shown to correlate highly with other more time-consuming, computerized discounting tasks in smoking populations (Epstein et al., 2003).

To ensure that participants chose the amounts they actually preferred, they were given a 1 in 50 chance to win one of the rewards they chose.

Participants were given the following instructions for the delay discounting task: "Please answer the following 27 questions in the order they appear. Circle the choice you prefer. Please take the choices seriously; they may be for *REAL MONEY.* At the end of the study, you will choose a marble from a bag that contains 1 green marble and 49 clear marbles. If you choose the green marble, you will win one of your 27 choices. To determine how much money you will win, you will choose another marble from a bag that contains 27 marbles labeled with the numbers 1 through 27, corresponding to the 27 questions listed below. For example, if you choose the 4 from the bag, you will win whatever you chose on question 4. If you circled the immediate money on that question ($31 today), you will receive the money today when you leave. If you circled the delayed money on that question ($85 in 7 days), you will receive $85 in 7 days. You or another person you designate may return to our facility to pick up the money, or you may have the money mailed to you. To make sure that you get a reward you prefer, you should answer *every question* as though it were the one you will win." (See Appendix K).

Smoking Topography. Smoking topography refers to variables that describe an individual's smoking behavior. It has been repeatedly shown that laboratory manipulations, such as negative mood induction and cue exposure, can produce group differences on various smoking topography variables (e.g., Conklin & Perkins, 2005; Payne et al., 1991). After completing the mood and cue manipulations, each participant was given an opportunity to smoke one of their own cigarettes. An unobtrusive video camera recorded participants' smoking behavior. Two raters coded each participant's

tape using a computer program that instructed them to press a key when participants lit their cigarette, began and ended each puff, and extinguished their cigarette. The time elapsed between key presses was averaged for the two raters and used to compute latency to begin smoking, mean puff duration, mean interpuff interval duration, total number of puffs, total time spent puffing, and total time spent smoking. The primary measure of smoking topography was latency, because this variable has been most consistently affected by laboratory manipulations in previous research (e.g., Conklin & Perkins, 2005).

Cigarette Rating Form (CRF). This form contains 3 items that assess participants' opinions about the taste, smell, and enjoyableness of their cigarette. Each item is rated from "1) not at all" to "4) very much." The CRF was administered after participants smoked their cigarette to mask the true purpose of the smoking topography assessment (see Appendix L).

Procedure

Recruitment. Participants were recruited from the Tampa area via newspaper advertisements and flyers for a study about personality and mood in smokers. They were briefly screened over the phone to make sure they met the requirements previously described (see Appendix M). Those who qualified and agree to participate were scheduled for an individual appointment expected to last about 1 to 1.5 hours. They were asked to bring a pack of their own cigarettes to their appointment and were given directions to the Tobacco Research and Intervention Program (TRIP) facility. To prevent withdrawal effects and induce a state of mild deprivation during the study, they were told

to smoke a cigarette 30 minutes before their appointment (and not smoke for the 30 minutes prior to their appointment).

Consent. Upon arrival at TRIP, a research assistant greeted the participants and escorted them to an experimental room. They were given a brief description of the purpose of the study. Next, they were asked to sign an informed consent form that explained the study procedures and their rights as research participants and HIPAA policy. The experimenter then collected their pack of cigarettes, which was returned later.

Part I: Baseline measures. After they signed the consent and HIPAA forms and their cigarettes were collected, participants' exhaled CO level was measured to verify their smoking status (must have been 8ppm or greater), and their self-report of the time that they last smoked was recorded on a Usage form (see Appendix N). If they smoked less than 30 minutes before their appointment, they waited until 30 minutes had passed before beginning the study. If they smoked more than 60 minutes before their appointment, they were asked to go outside, smoke a cigarette and wait 30 minutes before beginning the study, or reschedule for another day. If their CO level was below 8ppm, it was explained to them that they did not qualify for the study and they were paid $5. After their smoking status was verified, participants completed the baseline measures in the following order: demographic questionnaire, DDT, SSQ, SCQ-A, BIS-11, BIS/BAS scales, Mood Form (trait), STAI-T, QSU-brief, Mood Form (state), STAI-S. This order was chosen to minimize the salience of the impulsivity questionnaires and reduce the chance that participants' choices on the DDT would be influenced by their responses to the other questionnaires.

Randomization. After completing the baseline questionnaires, participants were randomly assigned to one of the four conditions: 1) negative mood induction + smoking cue, 2) negative mood induction + neutral cue, 3) neutral mood induction + smoking cue, 4) neutral mood induction + neutral cue. Randomization was stratified by gender and conditions were chosen using a computerized random number program.

Part II: Mood manipulation. The negative and neutral mood conditions were matched on time duration. In the negative mood condition (speech condition), the experimenter brought a video camera into the room and positioned it in front of the participant. Participants were then told that we wanted to assess their personality in a more "open-ended" way than was possible with written surveys. They were told that they should imagine they are on a job interview. They were given 3 minutes to prepare a 3-minute speech to answer the question "what are your greatest personal strengths and weaknesses?" (adapted from van Eck, Nicolson, Berkhof, & Sulon, 1996). Participants were also given the following additional instructions: "Your speech will be videotaped and evaluated by two other experimenters for various psychological and personality factors. One experimenter is going to rate what you say, while the other is going to rate how you say it, including your body language, tone of voice, and speaking style."

At this point, the experimenter left the participant alone for 3 minutes to think about the speech. Participants were not given any writing utensils or paper during the speech preparation period. After the 3-minute preparation period, the experimenter re-entered the room and explained that a cord needed for the camera was being used in another study and would be available soon. Participants were told that in the meantime, they would skip to the next part of the study and that they would complete the speech

later. They were then given the QSU-brief, Mood Form (state), and STAI-S to complete. In reality, participants in the negative mood condition never gave the speech and were debriefed at the end of the study. However, to sustain their anxiety about the speech throughout the rest of the study, the experimenter repeatedly reminded them that their speech would be taped at some later point.

Similar speech tasks are commonly used in psychological research and reliably induce anxiety and related negative emotions (Feldman et al., 1999). Studies have used numerous different topics for the speech task (e.g., what participants dislike about their body, presenting a defense for speeding or shoplifting, discussing a controversial political issue). The strengths and weaknesses topic was chosen for the current study because it fit well with the study's general theme (personality in smokers). This topic also has been shown to increase self-reported negative affect in male adults (van Eck et al., 1996), and therefore we believed it was likely to induce anxiety in the adult community sample we recruited. In contrast, other topics used in past research seem more relevant for the specific populations included in those studies, such as women or university students (e.g., body topic, controversial political issues). Additionally, some variations of the speech task actually make participants deliver the speech. We chose not to have participants give the speech because we wanted to sustain their negative mood throughout the rest of the study. If they actually gave their speech, their mood might become more positive afterward because of feeling relief that the speech is over. Moreover, a recent study employing the speech task demonstrated that anticipation alone increased ratings of negative emotion and induced a cardiovascular (CV) response, and that actually

delivering the speech did not further augment CV response (Feldman, Cohen, Hamrick, & Lepore, 2004).

For the neutral mood condition (art condition), we used a paradigm adapted from Nesic and Duka (2006). Participants in the neutral mood condition were given 3 pictures of paintings with neutral themes (e.g., landscapes). They were told that we were interested in their opinions of the paintings. They rated the paintings using an Art Rating Form (see Appendix O). They were also told that the experimenter needed a few minutes to complete the set-up for the next part of the study. If they finished rating the paintings before the experimenter returned, they just sat quietly in the room. After 3 minutes, the experimenter returned and gave participants the QSU-brief, Mood Form (state), and STAI-S to complete for the second time.

Part III: Cue exposure manipulation. The cue exposure manipulation began immediately after participants completed the second set of urge and mood measures. We used an in-vivo cue exposure paradigm adapted from Sayette, Loewenstein, Kirchner, and Travis (2005) that has successfully produced group differences in several other studies (Sayette & Hufford, 1994; Sayette, Martin, Hull, Wertz, & Perrott, 2003; Sayette, Martin, Wertz, Shiffman, & Perrott, 2001; Waters et al., 2004). The experimenter entered the room and placed a covered tray and a packet of questionnaires (face-down) on the table in front of the participants. The experimenter told participants that they would receive additional instructions via intercom and that they should not touch the tray or packet until they were told to do so. The experimenter then left the room to complete the intercom instructions. Participants in the smoking cue condition were instructed via intercom to remove the cover, which revealed a pack of their own cigarettes, a lighter,

and an ashtray. They were asked to remove a cigarette from the pack and light it without raising it to their mouth. They were then asked to hold the lit cigarette and look at it for 30 seconds. After 30 seconds, they were asked to rate verbally their urge for a cigarette on a scale from 1-100. Immediately thereafter, they were asked to extinguish the cigarette in the ashtray and then complete the QSU-brief, Mood Form (state), and STAI-S for the third time. Participants in the neutral cue condition received the same instructions to remove the tray's cover, but the tray instead revealed a stapler and a roll of tape. They were asked to pick up the tape and then the stapler with their dominant hand and look at these items for 30 seconds. After 30 seconds, they were asked to rate verbally their urge for a cigarette. They then placed the stapler back on the tray and completed the QSU-brief, Mood Form (state), and STAI-S for the third time.

Part IV: Smoking topography assessment. Immediately following the completion of the third set of urge and mood measures, participants were given an opportunity to smoke one of their own cigarettes. In the smoking cue condition, the experimenter returned to the room carrying an empty bowl. First, the experimenter asked participants to place their extinguished cigarette (from the smoking cue manipulation) in the bowl and told them that they would get this cigarette back at the end of the study. They were then told that for the next task, we were interested in their opinions about their cigarettes. They were asked to remove a new cigarette from their pack and place it in the ashtray. In the neutral cue condition, the experimenter returned to the room carrying a second covered tray that contained participants' pack of cigarettes, an ashtray, and a lighter. The experimenter removed the tray with the stapler and tape from view and placed the second tray on the table. Participants were then told that for the next task, we were interested in

their opinions about their cigarettes. The experimenter then removed the tray cover to reveal their cigarettes, ashtray, and lighter. Participants were asked to remove a cigarette from the pack and place it in the ashtray.

At this point, all participants (regardless of condition) were told that they would now have an opportunity to smoke as much of the cigarette in the ashtray as they wanted, but that they had to take at least one puff. To ensure that participants would not rush through smoking their cigarette because they believed doing so would allow them to complete the study faster, they were also told that because of the way the indoor ventilation system worked, they would need to remain in the room for about 10 minutes and therefore could take their time smoking. They could pick up their cigarette and begin smoking anytime after the experimenter shut the door. While they were smoking, the experimenter left the room and an unobtrusive video camera recorded their smoking behavior. After 10 minutes (or about 30 seconds after participants extinguished their cigarette, whichever came first), the experimenter returned to the room and instructed participants to complete a final set of forms, including the Mood Form (state), STAI-S and the Cigarette Rating Form. After participants completed these forms, their exhaled CO level was measured a second time and recorded (see Appendix P).

Debriefing. After they completed the second CO measurement, participants were debriefed and paid. During debriefing, participants were first asked a series of questions to assess their level of insight into the study's purpose (see Appendix Q). The experimenter then informed them that the purpose of the study was to evaluate how different moods and personality might affect their responses to the various questionnaires and tasks. Participants in the speech condition were told that the speech task was

intended to increase feelings of mild stress. Additionally, we told them that smokers often report that smoking helps them deal with stress, and we wanted to see how mild stress would affect their responses in this study. Although several participants expressed relief at not having to complete the speech, none became noticeably upset and none continued to display signs of anxiety.

Payment. As described earlier, participants then chose a marble from a bag to determine if they won any additional money. The results of this "lottery" were recorded for each participant (see Appendix R). Six participants "won" the lottery. Five received additional money immediately and one received money after a 30-day delay. Finally, all participants were paid $20 (plus any additional money won in the lottery) for participation.

Table 1.

Outline of the Procedure

1. Recruitment • Individuals screened via phone and scheduled for an individual appointment
2. Consent • Informed about the purpose of the study • Signed informed consent/HIPAA form • Cigarettes collected
3. Part I: Completion of baseline questionnaires in the following order 1. Exhaled CO level measured (must have been above 8 ppm) 2. Demographic questionnaire 3. Delay Discounting Task (DDT) 4. Smoking Status Questionnaire (SSQ) 5. Smoking Consequences Questionnaire-Adult (SCQ-A) 6. Barratt Impulsiveness Scale (BIS-11) 7. BIS/BAS scales 8. Mood Form (trait) 9. State-Trait Anxiety Inventory (Trait version, STAI-T) 10. Questionnaire of Smoking Urges-Brief (QSU-brief) 11. Mood Form (state) 12. State-Trait Anxiety Inventory (State version, STAI-S)
4. Randomization: Participants were randomly assigned to one of four conditions, stratified by gender: • Negative mood induction (speech task) + Smoking Cue (cigarettes/lighter) • Negative mood induction (speech task) + Neutral Cue (tape/stapler) • Neutral mood induction (art rating task) + Smoking Cue (cigarettes/lighter) • Neutral mood induction (art rating task) + Neutral Cue (tape/stapler)
5. Part II: Mood manipulation followed by 2nd QSU-brief, Mood Form (state), and STAI-S
6. Part III: Cue exposure manipulation followed by 3rd QSU-brief, Mood Form (state), and STAI-S
7. Part IV: Smoking topography assessment • Told they could smoke as much of one cigarette as they want • Told that experimenter would return in about 10 minutes • Smoking behavior was recorded by unobtrusive video camera • Completion of 4th Mood Form (state) and STAI-S, and Cigarette Rating Form (CRF) • When experimenter returned, second breath CO measure was taken
8. Debriefing • All participants were informed that the true purpose of the study was to evaluate the effect of mood and personality on smoking behavior • Participants in speech condition were told that they would not actually have to give the speech • Participants in the speech condition were assessed for continuing anxiety • Chose marble(s) to determine additional compensation from DDT • Paid $20 for participation

Results

Data screening

Self-report questionnaire data. All questionnaire data was checked for completeness during the study and participants were prompted to answer any missing items immediately. Any remaining missing items on the QSU-brief, BIS-11, and STAI were imputed using the mean value of the participant's responses to the other items on that questionnaire, provided that the participant completed at least 90 percent of the items. If a participant answered less than 90 percent of the items, that participant was not included in the analyses involving that questionnaire. Because the Mood Form and BIS/BAS scales contained less than 10 items each, no missing items were imputed on these measures and participants who did not answer every item were excluded from analyses that involved these measures. In general, the amount of missing questionnaire data was very small and fewer than 5 individuals were not included in any particular analysis.

Behavioral (topography) data. Due to technical problems that prevented coding of the data (e.g., recording started after participant began smoking), 12 participants were missing all topography data. For an additional 5 participants, some topography data was dropped or missing due to technical problems or participant idiosyncrasies (e.g., one individual kept the cigarette in his mouth for long periods of time and it was impossible

to determine when he was puffing). For 30 participants, the two raters initially disagreed about the number of puffs taken. These tapes were recoded until agreement was reached.

Participant Characteristics

The final sample included 175 participants (91 males, 84 females) who met all inclusion criteria. Demographic characteristics are presented in Table 2 and mean scores on baseline measures are presented in Table 3. There were no significant differences among the four study conditions (all *ps* > .05) on any of the demographic variables. There were also no significant differences in other baseline measures (e.g., affect, impulsivity), except that number of cigarettes smoked per day was significantly lower in the neutral cue condition than in the smoking cue condition ($p < .001$). Because number of cigarettes per day was significantly correlated with baseline QSU-brief, BIS-11, and STAI-S scores, this variable was included as a covariate in all analyses.[1] Also, there was a trend toward a difference in baseline QSU-brief scores ($p=.07$) such that speech group was somewhat lower than the art group. Because the QSU-brief was the primary dependent measure in this study, baseline QSU-brief scores were included as a covariate in all analyses involving post-manipulation QSU-brief scores.

[1] All analyses were also run without number of cigarettes smoked per day as a covariate. Results that differed depending on the inclusion of this covariate are noted in footnotes.

Table 2.

Participant Demographic Characteristics (Percentages)

Variable	Speech/ Smoking Cue	Speech/ Neutral Cue	Art/ Smoking Cue	Art/ Neutral Cue	Overall	*p* *(Speech vs. Art; Smoking Cue vs.Neutral Cue)*
N	45	44	43	43	175	
Age (mean)	38.91 (12.46)	40.02 (11.58)	39.33 (11.91)	38.79 (11.47)	39.26 (11.77)	ns; ns
Race						
Caucasian	72.7	71.4	71.4	69.8	71.3	ns; ns
Black	22.7	23.8	28.6	20.9	24.0	
Ethnicity						
Hispanic	15.6	11.4	9.3	16.3	13.1	ns; ns
Marital status						
Single	68.9	43.2	48.8	53.5	53.7	ns; ns
Married	15.6	18.2	7.0	14.0	13.7	
Separated	2.2	9.1	16.3	11.6	9.7	
Divorced	11.1	25.0	25.6	18.6	20.0	
Widowed	2.2	4.5	2.3	2.3	2.9	
Education						
< HS	26.7	25.0	27.9	25.6	26.3	ns; ns
HS grad	24.4	27.3	18.6	16.3	21.7	
Some college	40.0	43.2	51.2	48.8	45.7	
≥ 4-yr degree	8.9	4.5	2.3	9.3	6.3	
Income						
Under $10,000	45.5	36.4	32.6	39.5	38.5	ns; ns

Table 3.

Participant Baseline Characteristics (Means and Standard Deviations)

Variable	Speech/ Smoking Cue	Speech/ Neutral Cue	Art/ Smoking Cue	Art/ Neutral Cue	Overall	*p (Speech vs. Art; Smoking Cue vs.Neutral Cue)*
N	45	44	43	42	175	
Years Smoked	21.33 (12.48)	21.15 (12.44)	22.15 (11.46)	20.38 (10.80)	21.25 (11.74)	ns; ns
Cigarettes per day	25.53 (10.92)	19.57 (8.68)	24.40 (10.12)	19.74 (7.91)	22.33 (9.79)	ns; <.001
FTND score	5.96 (2.54)	5.16 (2.39)	5.84 (2.10)	5.53 (1.94)	5.62 (2.26)	ns; ns
CO (ppm)	26.72 (18.33)	25.39 (14.37)	23.95 (12.43)	20.33 (8.80)	24.12 (14.03)	.07; ns
QSU-brief	27.59 (12.13)	24.36 (10.06)	28.71 (11.15)	29.56 (11.62)	27.54 (11.35)	.07; ns
STAI-Trait	68.96 (27.52)	65.93 (23.75)	73.98 (20.23)	71.67 (23.23)	70.11 (23.86)	ns; ns
STAI-state	60.12 (32.91)	50.78 (19.37)	59.09 (23.22)	57.65 (27.09)	56.91 (26.22)	ns; ns
Trait Positive Affect	16.80 (5.44)	17.93 (5.62)	17.12 (5.49)	15.81 (5.05)	16.91 (5.41)	ns; ns
Trait Negative Affect	18.48 (7.20)	16.44 (6.66)	20.09 (7.19)	18.59 (7.18)	18.40 (7.12)	.08; ns
State Positive Affect	14.11 (6.73)	16.05 (5.49)	15.14 (6.22)	15.14 (6.28)	15.10 (6.18)	ns; ns
State Negative Affect	12.04 (7.61)	9.30 (4.73)	10.95 (6.97)	10.93 (7.00)	10.81 (6.69)	ns; ns
BIS-11	67.62 (15.48)	64.68 (11.03)	70.21 (9.66)	67.67 (11.43)	67.53 (12.19)	ns; ns
BAS drive	11.53 (2.73)	11.66 (2.47)	11.70 (2.95)	11.33 (2.64)	11.55 (2.68)	ns; ns
BAS fun-seeking	12.24 (2.81)	12.00 (2.44)	12.70 (2.09)	12.40 (2.63)	12.33 (2.50)	ns; ns
BAS reward-seeking	17.47 (2.29)	17.77 (2.06)	17.49 (2.28)	18.07 (2.19)	17.70 (2.20)	ns; ns
BIS total	20.69 (3.79)	19.95 (4.05)	20.58 (4.07)	21.05 (4.21)	20.57 (4.02)	ns; ns

Mood Manipulation Check

One of our primary goals in this study was to examine changes in smoking motivation following the induction of negative affect. As a manipulation check for the mood induction, we conducted three ANCOVAs, using post-mood manipulation STAI-S and Mood Form (state) scores as the dependent variables, condition (speech vs. art) as the independent variable, and cigarettes per day and baseline STAI and Mood Form scores as the covariates. For the STAI-S, the mean post-mood manipulation score in the speech condition (M = 61.34) did not differ from the mean post-mood manipulation score in the art condition (M = 61.54), $F(1, 171) = 1.28$, p=.26. Similarly, for the Positive Affect subscale of the Mood Form (state), post-mood manipulation scores did not differ for the two conditions (speech M =14.17, art M =13.87), $F(1, 171) = .621$, p=.43. Again, the two conditions did not differ on post-mood manipulation Negative Affect scores, (speech M =11.23, art M =11.28), $F(1, 169) = .402$, p=.53. We also compared the mean change in STAI-S and Mood Form (state) scores from baseline to post-mood manipulation for the two conditions. STAI-S scores increased a mean of 5.84 points in the speech condition and a mean of 3.17 points in the art condition. Although both of these change scores were significantly different from zero, indicating that anxiety increased in both groups, the difference in change scores between the two groups was not significant, $F(1, 172)=1.469$, p = .23. For the Mood Form (state), scores for both groups changed less than one point from baseline to post-mood manipulation. We also classified participants according to whether their STAI-S scores increased, decreased, or stayed exactly the same from baseline to post-mood manipulation. In the speech condition, STAI-S scores decreased in 30.3% of participants, stayed the same in 7.9%, and increased in 51.9%. In

the art condition, STAI-S scores decreased 31.4% of participants, stayed the same in 9.3%, and increased in 49.1%. Again, these differences between the two conditions were not significant.

These results seem to indicate that the speech preparation task was not successful at increasing negative affect relative to the art rating task. These findings are surprising because the speech task has been used in dozens of previous studies to induce self-reported negative affect reliably. Although both the speech and art tasks significantly increased STAI-S scores, the change scores were modest and well below previous studies using the speech task with smokers, which have reported mean increases in STAI-S scores from 10 to 20 points (Kassel & Unrod, 2000; Juliano & Brandon, 2002). Despite the apparent failure of the speech task to increase self-reported negative affect, we proceeded as planned with the analyses, because we had reason to believe that many participants did in fact become more anxious during the speech preparation task. For example, when they were told at the end of the study that their speech would not be taped after all, many participants displayed visible signs of relief and also correctly identified that the speech preparation task's true purpose was to increase their anxiety.

Manipulation Effects on Urge and Topography

Smoking urge after the mood manipulation. To test for an independent effect of the speech task on self-reported urge, we conducted a single factor ANCOVA, using post-mood manipulation QSU-brief total scores as the dependent variable, condition (speech vs. art) as the independent variable, and cigarettes per day and baseline QSU-brief scores as covariates. Results indicated a significant effect for condition, $F(1, 171) = 5.859$, $p = .02$. Examination of the change scores revealed that from baseline to post-

mood manipulation, QSU-brief scores increased 1.44 points in the art condition and 3.62 points in the speech condition, indicating that participants in the speech condition experienced a greater increase in urge (see Table 4).

We also conducted similar analyses using the two individual factors of the QSU-brief (anticipation of pleasure, anticipation of negative affect relief). These analyses revealed that the speech task had a significant effect on anticipation of negative affect relief, $F(1, 171) = 5.692$, $p = .02$, but there was only a trend for an effect on anticipation of pleasure, $F(1, 171) = 2.819$, $p = .095$.

Table 4.

Main Effect of the Mood Manipulation on QSU-brief Total Scores

Mood Manipulation	Baseline QSU	Post-mood QSU	Difference
Speech	25.99	29.61	3.62
Art	29.13	30.57	1.44

Smoking urge during the cue manipulation. While participants held their lit cigarette or the stapler, we asked them to rate verbally their urge to smoke from 1 to 100. To test for main effects and interaction effects of the mood and cue manipulations on this verbal urge measure, we conducted a 2 x 2 ANCOVA using verbal urge as the dependent variable, the two manipulations as the factors, and cigarettes per day as a covariate. This analysis revealed that the mean urge rating in the smoking cue condition (M=68.63) was significantly higher than in the neutral cue condition (M=51.58), $F(1, 168) = 6.319$, $p = .01$. There was no significant effect of the mood manipulation on this verbal urge rating, nor was there any significant interaction between the two manipulations.

Smoking urge after the cue manipulation. To test for main effects and interaction effects of the mood and cue manipulations on self-reported urge immediately following the cue manipulation, we conducted a 2 x 2 ANCOVA, using post-cue manipulation QSU-brief total scores as the dependent variable, the two manipulations as the factors, and cigarettes per day and baseline QSU-brief scores as covariates. This analysis revealed a trend toward the smoking cue resulting in greater urge than the neutral cue, $F(1, 169) = 3.407$, $p = .07$[2]. There was no significant main effect for the mood manipulation, nor was there any significant interaction between the two manipulations (see Table 5).

Again, we also conducted similar analyses using the two individual factors of the QSU-brief (anticipation of pleasure, anticipation of negative affect relief). These analyses revealed that smoking cue did not significantly increase urge relative to the neutral cue on the anticipation of pleasure factor, $F(1, 170) = 5.86$, $p = .12$[3], or the anticipation of negative affect relief factor, $F(1, 170) = 3.32$, $p = .15$[4]. There was no significant effect of the mood manipulation on the anticipation of pleasure factor, but there was a trend toward increased urge in the speech condition for the anticipation of negative affect relief factor, $F(1, 170) = 3.51$, $p = .07$. There were no significant interaction effects of the two manipulations on either factor of the QSU-brief.

[2] When cigarettes per day was not included as a covariate, this result was significant, $p = .02$.
[3] When cigarettes per day was not included as a covariate, this result was significant, $p = .02$.
[4] When cigarettes per day was not included as a covariate, there was a trend toward significance, $p = .07$.

Table 5.

Main Effects of the Manipulations on Post-Cue Manipulation QSU-Brief Total Scores

	Cue Manipulation					
	Lit Cigarette			Roll of Tape/Stapler		
Mood Manipulation	Baseline QSU	Post-cue QSU	Difference	Baseline QSU	Post-cue QSU	Difference
Speech	27.59	34.41	6.82	24.36	29.23	4.87
Art	28.71	33.91	5.20	29.56	32.49	2.93

Smoking topography. To test for main effects and interaction effects of the mood and cue manipulations on smoking topography variables, we conducted a series of 2 x 2 ANCOVAs, using latency to begin smoking, mean puff duration, mean interpuff interval duration, total number of puffs, total time spent puffing, and total time spent smoking as the dependent variables, the two manipulations as the factors, and cigarettes per day as a covariate. Results indicated that there were no significant main effects or interactions of the two manipulations on any of the smoking topography variables (all *ps* > .05).

Moderation Analyses

To test whether impulsivity moderated the effects of the manipulations on urge, a series of multiple regression analyses were conducted (Baron & Kenny, 1986). The two manipulations (mood and cue) were dummy coded, and separate regressions were performed for each impulsivity measure (BIS-11, BIS/BAS scales, and *k* values from the delay discounting task), using the QSU-brief and the verbal urge measure as dependent measures as appropriate (i.e., where main effects were found, moderation analyses were performed). In each regression, manipulation was entered first, followed by cigarettes per day, an impulsivity measure, and an interaction term (manipulation x impulsivity). If the QSU-brief was used as the dependent variable, baseline QSU-brief scores were also

entered as a predictor. A significant change in R^2 for the interaction term would indicate a moderating effect for impulsivity. Results indicated that none of the impulsivity measures significantly moderated the effects of the mood and cue manipulations on urge (all *p*'s > .05).

Additional Analyses

We conducted additional analyses to determine whether the impulsivity measures were correlated with each other, and whether impulsivity was correlated with other measured variables, such as demographics, smoking history, nicotine dependence, urge, expectancies, and affect. Correlations among the impulsivity measures were weak or absent and are shown in Table 6. The BIS-11, DDT *k* values, and the BAS fun-seeking scale were significantly correlated with baseline urge, as measured by the QSU-brief at baseline. Additionally, at least one impulsivity scale was significantly correlated with education, income, cigarettes smoked per day, urge, affect, and expectancies. These correlations are shown in Tables 7, 8, and 9.

Table 6.

Intercorrelations Among Impulsivity Scales

Scale	1	2	3	4	5	6	7	8
1. Barrett Impulsiveness Scale (BIS-11)	--	.80**	.82**	.83**	.11	-.05	.36**	.08
2. BIS-11 Attentional Impulsiveness		--	.49**	.53**	.12	-.02	.28**	.04
3. BIS-11 Motor Impulsiveness			--	.47**	.06	.15*	.43**	.16*
4. BIS-11 Nonplanning Impulsiveness				--	.10	-.27**	.15*	-.01
5. *k*					--	-.004	.09	-.07
6. BAS drive						--	.34**	.37**
7. BAS fun seeking							--	.35**
8. BAS reward-seeking								--

* $p < .05$, ** $p < .01$

Table 7.

Intercorrelations Among Impulsivity Scales, Demographics, and Tobacco Use

Scale	Education	Income	Years Smoked Daily	Cigarettes Smoked per Day
Barrett Impulsiveness Scale (BIS-11)	-.21**	-.15*	-.11	.26**
k	-.13	-.19*	-.003	.13
BAS drive	.20**	-.03	-.14	-.05
BAS fun seeking	-.14	-.08	-.13	.03
BAS reward-seeking	.06	-.11	-.03	-.23**

* $p < .05$, ** $p < .01$

Table 8.

Intercorrelations Among Impulsivity Scales, Baseline Urge, and Trait Affect

Scale	QSU-brief	STAI	Positive Affect	Negative Affect
Barrett Impulsiveness Scale (BIS-11)	.36**	.59**	-.23**	.41**
k	.23**	.22**	-.14	.09
BAS drive	.01	-.08	.24**	.02
BAS fun seeking	.29**	.10	.21**	.15*
BAS reward-seeking	.06	-.04	.18*	.06

* $p < .05$, ** $p < .01$

Table 9.

Intercorrelations Among Impulsivity Scales and Smoking Expectancies

Scale	SCQ-A Negative Reinforcement	SCQ-A Positive Reinforcement	SCQ-A Addiction
Barrett Impulsiveness Scale (BIS-11)	.22**	.06	.10
k	-.02	.05	-.03
BAS drive	.10	.14	-.04
BAS fun seeking	.26**	.22**	.06
BAS reward-seeking	.36**	.10	.21**

* $p < .05$, ** $p < .01$

Discussion

Previous research has demonstrated that smokers respond to both negative affect and smoking cues with increased self-reported urge and other physiological and behavioral changes. One primary aim of this study was to determine whether a negative mood induction would augment urge and behavioral reactivity to subsequently presented smoking cues (i.e. whether there is an interaction effect between these two cue types). For the mood manipulation, participants engaged in either a task that was intended to make them feel anxious (preparing a speech that they believed would be videotaped later) or a neutral task (viewing and rating pictures of landscape paintings). For the cue manipulation, which immediately followed the mood manipulation, participants were exposed to either a lit cigarette or neutral objects (stapler and roll of tape). Results indicated a main effect of the mood manipulation on post-mood manipulation urge, and a main effect of the cue manipulation on verbal urge during the cue manipulation. There were no main effects of the mood or cue manipulations on post-cue manipulation urge, nor were there any significant interactions between the two manipulations. There were also no main or interactive effects of the two manipulations on smoking topography.

Only limited evidence suggests that cue reactivity predicts actual drug use behavior (Payne et al., 1991), and relapse following a quit attempt (Niaura et al., 1989; Payne et al., 2006), perhaps because individuals vary in both response magnitude and whether they act on cue-elicited urges. However, few studies have systematically

examined individual differences in urge and behavioral reactivity. Therefore, the second purpose of this study was to test whether impulsivity, a personality trait associated with initiation and maintenance of tobacco use, would moderate the effects of the manipulations on reactivity. Results indicated that impulsivity was moderately correlated with self-reported urge, but did not moderate the effects of the manipulations on urge reactivity.

Mood Manipulation - Manipulation Check Results

We chose a speech preparation task for our negative mood induction because similar tasks have reliably increased self-reported anxiety and general negative affect in many previous studies (Feldman et al., 1999), including studies with smokers (Juliano & Brandon, 2002; Kassel & Unrod, 2000). However, our manipulation check analyses indicated that the speech task did not significantly increase self-reported anxiety relative to the art task; rather, both tasks increased anxiety by a very small amount. These results are puzzling, and prevent us from confidently concluding that reactivity associated with the speech task was a consequence of heightened anxiety or that negative mood and smoking cues do not have interactive effects. After carefully considering the speech task procedure, we have speculated on numerous possible explanations for the manipulation check results, including characteristics of the sample and features of the task itself. Each may account for some portion of our failure to induce self-reported anxiety.

We first considered that our participants did experience an increase in anxiety that was not reflected in their STAI and Mood Form scores, perhaps because they were not accustomed to evaluating themselves in this manner. Several participants commented on the "psychological" nature of the questionnaires and the difficulty they had in choosing

answers. One participant in particular was clearly anxious about the speech and expressed great relief during the debriefing. However, when her STAI scores were later checked, she actually rated herself as less anxious after the speech preparation period than at baseline. Because of this case and other anecdotal evidence that at least some participants did experience a significant increase in anxiety following the speech task, we decided to proceed with our planned analyses.

The participants in the current study were recruited directly from the community via flyers in shopping centers, bus stops, etc. They were ethnically diverse, and in general middle-aged, unmarried, and very low in socioeconomic status (SES). In contrast, most studies that have used speech preparation tasks have included primarily university students or young adults recruited from university campuses (Feldman et al., 1999). Perhaps some did not experience the speech preparation task as aversive because they had not received much exposure to academic and employment environments where speech anxiety typically develops or were unfamiliar with the social norm that giving a speech and being videotaped should provoke anxiety.

Additionally, it appears as though our participants were already experiencing relatively high levels of NA at baseline. Their baseline STAI scores (M=56) were approximately 10 points higher than two previous studies with smokers (Kassel & Shiffman, 1997; Kassel & Unrod, 2000). Furthermore, some participants specifically mentioned that the study advertisement had caught their attention because they desperately needed $20 (e.g., to eat, to pay overdue bills), and others openly discussed various life stressors they were experiencing. Perhaps in the context of their already difficult lives, they viewed the speech task as insignificant. Indeed, results of previous

studies with smokers suggest that lower anxiety at baseline is associated with greater anxiety increases following speech preparation tasks. For example, Kassel and Shiffman (1997) and Kassel and Unrod (2000) reported STAI increases of 15-20 points from ratings taken just prior to participants' receiving the speech preparation instructions, while Juliano and Brandon (2002), whose participants' baseline STAI scores ($M = 54$) were similar to ours ($M = 56$) reported an average pre-preparation to post-preparation task increase of only about 10 points. It is also interesting to note that the mean post-speech task STAI score from Kassel and Unrod's study ($M = 57$) was nearly identical to our baseline mean ($M = 56$).

Other features of the speech task may also have influenced our results. We told our participants to imagine they were on a job interview and to discuss their "personal strengths and weaknesses" because this topic fit the general theme of the study and a previous study (van Eck et al., 1996) demonstrated that this topic increased anxiety in adult male employees (as opposed to college students). However, given the low levels of education and income in our sample, many participants may have lacked experience with job interviews and therefore may not have interpreted this particular topic as anxiety-provoking. Indeed, a few participants mentioned during the debriefing that they had never been on a "real" job interview before and thus did not know what type of answer was expected. Although this confusion could have increased anxiety as we desired, it could also have attenuated anxiety if it led participants to just give up on answering the question seriously. There was also anecdotal evidence that a few participants viewed the task as a positive experience. These participants told the experimenter that they were

looking forward to the opportunity to talk about their personality on camera and actually expressed disappointment during debriefing.

Another issue relates to our intention to sustain participants' anxiety for several minutes in order to determine whether negative mood would augment reactivity to subsequently presented smoking cues. Initially, participants were led to believe that their speech would be videotaped immediately following the preparation period. In reality, when the preparation period ended, they were told that another experimenter was using a needed piece of camera equipment and that their speech would be taped later. Immediately after they were told that their speech would be delayed, they completed the mood measures, and we continued to remind them about the upcoming speech throughout the rest of the study. It was presumed that participants would continue to experience anxiety until they were told that their speech would not be taped after all. However, perhaps once they were told that the speech would be delayed, their anxiety dissipated and hence would not have been reflected in their mood scores. It is also possible that their anxiety disappeared at this point because they did not believe the "story" about the missing cord and guessed that we would never tape the speech. However, during the study few participants explicitly questioned whether they would actually give the speech and during debriefing nearly all participants said that they believed that their speech would eventually be recorded.

Regardless of why the speech preparation task did not work as originally intended, the results of this study should inform future research that uses mood induction procedures. Researchers should carefully consider the population they plan to recruit and if possible choose a procedure that has been validated with similar populations. These

results may also inform research with community samples more generally. Researchers should consider that individuals from the community may be experiencing significant life stressors that may affect their responses to laboratory manipulations. Study personnel should also take extra care to ensure that participants understand all psychological assessments (e.g., mood scales).

Manipulation Effects on Urge

Mood manipulation. Consistent with our hypotheses, participants in the speech condition reported increased urge to smoke relative to participants in the art condition immediately following the mood manipulation. Given our manipulation check results, we cannot confidently conclude that NA caused this difference in urge, and we acknowledge that we may have found this result by chance. However, when the two factors of the QSU-brief were analyzed separately, the effect of the speech task on post-mood manipulation urge was significant only for Factor 2, anticipation of negative affect relief, suggesting that NA indeed contributed to the increased urge. Furthermore, our finding replicates previous research that has employed a variety of negative mood induction procedures (e.g., imagery, Tiffany & Drobes, 1990; speech task, Juliano & Brandon, 2002; aversive noise, Payne et al., 1991; music, Willner & Jones, 1996). Assuming our finding is not chance, other differences in the two tasks seem unlikely to have caused the difference. For example, we considered that, relative to the art task, the speech task may have increased feelings of boredom rather than anxiety, but boredom is also a type of NA. We also considered that perhaps the art task actually increased positive affect, but our results indicated that NA increased slightly in both groups.

Despite our efforts to maintain participants' speech-related anxiety throughout the remainder of the study by repeatedly reminding them of the upcoming speech, there was no significant effect of the mood manipulation when urge was assessed a second time via a verbal rating during the cue manipulation or a third time via the QSU-brief immediately after the cue manipulation. However, there was a trend toward an effect of the mood manipulation on post-cue manipulation QSU-brief Factor 2 (anticipation of negative affect relief) scores, such that participants in the speech condition reported greater urge than those in the art condition.

Taken together, these results indicate that the effect of the speech task on urge immediately post-mood manipulation had mostly disappeared several minutes later when urge was assessed during and immediately after the cue manipulation. We presented the mood and smoking cues sequentially rather than simultaneously in order to isolate each manipulation's effects and avoid task interference that may have affected the results of a previous study (Payne et al., 1991). However, perhaps the novelty and task demands of the cue manipulation (manipulating the tray apparatus and objects) diverted participants' attention away from any anxiety there were feeling about the upcoming speech and therefore also reduced any associated urge. Alternatively, if indeed the speech did induce anxiety, perhaps our efforts to sustain that anxiety throughout the remainder of the study simply failed.

Cue manipulation. In this study, we employed a cue exposure procedure that has successfully produced urge reactivity in numerous previous studies (e.g., Sayette et al., 2001). Participants were exposed to either a smoking cue (lit cigarette) or a neutral cue (stapler and roll of tape) for 30 seconds. Our results indicated that participants in the

smoking cue condition reported significantly greater urge (*M* = 69 points on a scale of 1 to 100) during cue exposure than participants in the neutral cue condition (*M* = 52 points). However, there was only a trend for an effect of the smoking cue on QSU-brief scores immediately following the cue manipulation, with no significant effects on either Factor 1 or Factor 2 of the QSU-brief. Taken together, these findings suggest that the smoking cue only had a transient effect on urge.

Previous research has demonstrated that numerous factors may influence the magnitude of urge reactivity to smoking cues, including deprivation state, nicotine dependence, and opportunity to smoke. Regarding time elapsed since last cigarette, it has been shown that smokers who are in withdrawal (3-12 hrs abstinence) report greater overall urges than nondeprived or mildly deprived smokers, but they do not report greater *increases* in urge from baseline to post-cue exposure (e.g., Payne, Smith, Sturges, & Holleran, 1996; Sayette & Hufford, 1994; Sayette et al., 2001), perhaps because of a ceiling effect (see Sayette et al., 2001). In this study, participants were told to smoke a cigarette 30 minutes prior to beginning the study, and cue exposure occurred approximately 30-45 minutes into the study. Thus, we expected participants to feel mildly deprived (about 60-75 minutes since last cigarette) at the time of cue exposure. However, our participants' baseline urge scores (*M* = 27 on a scale of 10-50) and verbal urge ratings (M=52 in the neutral cue condition) were around the midpoint of the scale, while previous studies have reported baseline ratings well under the midpoint of the scale (e.g., Sayette et al., 2001). Furthermore, our participants were highly dependent on nicotine (FTND, *M* = 5.62; cigarettes per day, *M* = 22) and most did not have jobs that would require them to refrain from smoking during the day (i.e. because they were all

available to participate during normal business hours). Therefore, our participants may have felt more deprived than we anticipated when cue exposure occurred, and a ceiling effect may have attenuated reactivity.

Several studies have reported stronger reactivity effects when participants are led to believe that they will have an opportunity to smoke soon after cue exposure (for a review, see Wertz & Sayette, 2001). In this study, we chose not to give participants any availability information for two primary reasons. First, we hypothesized that availability would interact with impulsivity and introduce additional unwanted variance in the data. Second, we did not want to make our cue manipulation so powerful as to obscure any moderating effect of impulsivity. However, participants were told that the study would last about 1 to 1.5 hours, and cue exposure occurred approximately 30-45 minutes into the study. Therefore, participants' knowledge that they would be able to smoke within 15-45 minutes of cue exposure may have attenuated group differences in reactivity.

In summary, based on a review of the cue reactivity literature and careful consideration of factors that affect reactivity magnitude, we chose a paradigm (exposure to a lit cigarette for 30 seconds) that we believed would produce robust, reliable group differences in reactivity, but would not be so powerful as to obscure individual differences and prevent us from detecting a moderating effect of impulsivity. Our results indicate that our manipulation produced a significant effect on urge during cue exposure but only a trend for an effect immediately afterward. Perhaps the combination of our participant characteristics (highly nicotine dependent, relatively high baseline urge) and our procedure led to a ceiling effect, or the cue manipulation was simply not powerful enough to produce more than a fleeting effect.

Interaction. Few previous studies have included both mood and smoking cues to test for interaction effects, and those studies that have included both have presented them simultaneously (e.g., Payne et al., 1991; Tiffany & Drobes, 1990). However, simultaneous presentation may not reflect the actual experiences of drug users, and prevents analysis of how negative mood states affect subsequent reactivity to drug cues. In the alcohol literature, several recent studies have presented alcohol cues *after* a negative mood induction (Cooney et al. 1997; Jansma et al., 2000; Litt et al., 1990; Nesic & Duka, 2006; Rubonis et al., 1994). These studies have shown mixed results, with one study finding additive effects (e.g., Cooney et al., 1997), some failing to find any effect of one cue type or the other (e.g., Jansma et al., 2000) and no studies finding an interaction. The current study was modeled on these alcohol cue studies, with the cue manipulation immediately following the mood manipulation. Consistent with this previous alcohol research, our results indicated no significant interaction effects between the mood and cue manipulations. Although it is recommended that future studies continue to explore the effects of mood states and smoking cues on motivation to smoke through the use of more robust manipulations and urge measures that are not as susceptible to ceiling effects (see Sayette et al., 2001), it appears unlikely that interaction effects will be found. Cooney et al. (1997) state that failure to find interactive effects may indicate that reactivity to affect and drug cues is driven by independent processes. We also suggest also that perhaps once cue-elicited urge is activated, attentional resources are diverted toward that particular cue (see Sayette & Hufford, 1994 for evidence that smoking cues affect reaction time), attenuating responses to subsequently presented cues.

Manipulation Effects on Topography

Neither the mood nor the cue manipulation significantly affected any of the smoking topography variables (latency, number of puffs, average puff length, average interpuff interval, total time spent puffing, total time spent smoking). For the smokers in our study, who were on average highly nicotine dependent and smoked over 20 cigarettes per day for over 20 years, smoking has likely become an automatized behavior resistant to manipulation (Tiffany, 1990). Given that our manipulations had only transient effects on urge, they may not have been powerful enough to alter our participants' normal smoking behavior.

Impulsivity

The second specific aim of this study was to determine whether impulsivity moderated the effects of the manipulations on urge and behavioral reactivity. We hypothesized that more impulsive individuals would demonstrate greater urge and behavioral reactivity then less impulsive individuals following both manipulations. Our primary measures of impulsivity included a commonly used self-report measure, the Barratt Impulsiveness Scale (BIS-11), and a delay discounting task (DDT). Participants also completed the BIS/BAS scales, based on Gray's theory of behavioral activation and inhibition. We also conducted additional analyses to determine whether the impulsivity measures were significantly correlated with each other and other baseline variables.

Correlations among impulsivity measures and other variables. The BIS-11 was moderately correlated with the BAS fun-seeking scale and uncorrelated with the other BAS subscales. The BIS-11 subscales were strongly correlated with each other, while the BAS subscales were only moderately correlated with each other. The personality (i.e.

BIS-11, BIS/BAS scales) and behavioral (i.e. DDT *k* values) impulsivity measures were uncorrelated, a finding generally consistent with previous research reporting weak or absent correlations among these measures (e.g., Mitchell 1999; Reynolds, Ortengren, Richards, & de Wit, 2006). These results also support other recent work that has identified different components of impulsivity (e.g., Whiteside & Lynam, 2001; for a review, see Evenden, 1999). As a group, the impulsivity measures were moderately correlated with baseline urge, affect, and expectancies for negative reinforcement, confirming a relationship between impulsivity and factors associated with tobacco use. The BIS-11 showed the strongest correlations with these variables, particularly with anxiety and negative affect, and also with education, income, and cigarettes smoked per day.

Moderating Effects on Reactivity. Contrary to our hypotheses, none of the impulsivity measures moderated the effects of the manipulations on reactivity. Given the small, transient effects of the two manipulations on reactivity for the sample as a whole, the most obvious explanation for our null results with respect to impulsivity as a moderator is that the manipulations were not powerful enough to allow us to detect individual differences. Alternatively, a ceiling effect may have occurred because impulsivity was positively correlated with urge and QSU-brief scores were restricted to a range between 10 and 50. Thus, more impulsive individuals simply could not increase their urge score as much as less impulsive individuals. Among the impulsivity measures, scores on the BIS-11 were most strongly correlated with urge. We examined the verbal urge and post-cue manipulation QSU-brief scores for those participants whose BIS-11 score was in the top 25% of the sample and compared their scores to the rest of the

sample. Providing evidence that a ceiling effect may have occurred, this analysis revealed that in the smoking cue group, 32% of individuals with high BIS-11 scores rated their verbal urge at the maximum (100) and 24% scored a 50 (maximum score) on the QSU-brief, compared to only 16% and 5%, respectively, of the rest of the sample.

Since this study was originally proposed, two studies have been published that examined whether impulsivity moderated urge reactivity to a smoking cue. In one study (Doran, Spring, & McChargue, 2007), adult smokers were exposed to a lit cigarette and a roll of tape for 5 minutes each. Results indicated that more impulsive smokers evidenced greater urge reactivity than less impulsive smokers. In a second study (Doran, McChargue, & Spring, 2008), adult smokers were exposed to a lit cigarette and a roll of tape for 10 minutes each. Results indicated that more impulsive smokers evidenced greater urge reactivity to the neutral cue (tape), but not to the lit cigarette. It is unclear why Doran and colleagues obtained these discrepant results because their sample characteristics and procedures were very similar for the two studies, except for the age of their participants (Doran, McChargue, & Spring 2008, $M = 41$; Doran, Spring, & McChargue, 2007, $M = 31$). Additionally, although Doran, McChargue, & Spring (2008) did not report main effects, their pre- and post- urge ratings seem to indicate that they did not find a main effect for the smoking cue. These mixed results, combined with our results, are difficult to interpret and indicate that additional studies are needed to determine whether impulsivity is related to greater urge reactivity.

Summary. In summary, our results indicate that impulsive individuals do not show enhanced urge reactivity. Rather, they experience consistently high urge and negative affect, paired with strong expectations that smoking will relieve negative affect.

Given that urge and negative affect contribute to relapse (Brandon et al., 1990; Shiffman et al., 1996), these findings suggest that the impulsivity is a pervasive trait that contributes to numerous factors associated with tobacco use initiation and maintenance, and underscore the importance of continued research on how specific aspects of impulsivity affect tobacco use. In their constant state of high urge and negative affect, impulsive individuals may feel and act as though cues are always present, which may account for our null results with respect to reactivity. Doran, McChargue, & Spring (2008) additionally suggest that impulsive smokers may tend to respond to urges by smoking immediately, which may make them less aware of, and have difficulty reporting accurately on, internal states such as craving. Because of other aforementioned issues with our manipulations and the mixed results of previous studies, future research is needed before more definitive conclusions can be drawn.

Conclusion

Consistent with previous research, the results of the current study indicated independent effects of a speech preparation task and exposure to a lit cigarette on self-reported urge to smoke. Despite the failure of the speech task to induce self-reported anxiety as intended, our finding adds some support to the relatively small group of experimental studies that have shown an effect of negative effect on urge. There were no effects of the two manipulations on smoking topography, and consistent with previous research, no interaction effects between the two manipulations. The current study also examined whether impulsivity, a trait associated with tobacco use, was related to cue reactivity. Our results extend earlier research on impulsivity, confirming a relationship

between impulsivity and overall smoking urge. However, contrary to our hypotheses, we found no evidence for a relationship between impulsivity and cue reactivity.

Many of the most widely-cited smoking cue reactivity studies have included primarily university students (e.g., Perkins & Grobe, 1992; Sayette & Hufford, 1994; Tiffany & Drobes, 1990), or young, relatively well-educated adults (e.g., Payne et al., 1991; Sayette et al., 2001; also see meta-analysis by Carter & Tiffany, 1999, average age was 27). In contrast, our participants were ethnically diverse, and in general highly dependent on nicotine, middle-aged, and very low in socioeconomic status. Additionally, our inclusion and exclusion criteria were quite liberal; we did not screen for psychological disorders or other drug use as did two previous studies examining impulsivity and cue reactivity (Doran, McChargue, & Spring, 2008; Doran, Spring, & McChargue, 2007). Our unique sample characteristics make our results difficult to compare with previous research and in that regard may be considered a limitation. However, we prefer to view them as a strength, because it is likely that our participants more closely resemble the current general population of smokers (see Wetter et al., 2005). These smokers may have more difficulty quitting than those from previous generations (Irvin & Brandon, 2000). Therefore, it is imperative that researchers prioritize the recruitment of representative samples in research focused on identifying factors that maintain tobacco use and developing more effective interventions. Although we found no evidence that more impulsive smokers were more responsive to negative affect and smoking cues, our results indicate that impulsivity is associated with factors related to smoking initiation, cessation, and relapse, and this warrants further study.

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Appendices

Appendix A: Demographic Questionnaire

The following questions are about yourself and your life situation. They are to help us better understand the people we serve. You are under no obligation to answer any question that you find objectionable, however, we would appreciate your answering as many as possible. All answers will be kept confidential.

Date: _____

1. What is your age? _____

2. What is your date of birth?_____

3. What is your marital status?
   - ❑ Single
   - ❑ Married
   - ❑ Separated
   - ❑ Divorced
   - ❑ Widowed

4. With which racial category do you most identify yourself? (please check one)
   - ❑ American Indian/Alaska Native
   - ❑ Asian
   - ❑ Native Hawaiian or Other Pacific Islander
   - ❑ Black or African American
   - ❑ White

5. Are you Hispanic/Latino?
   - ❑ Yes
   - ❑ No

6. What is the highest grade level you have completed?
   - ❑ Did not graduate high school
   - ❑ High school graduate
   - ❑ Some college
   - ❑ Technical school/Associates degree
   - ❑ 4-year college degree
   - ❑ Some school beyond 4-year college degree
   - ❑ Professional degree (e.g., MD, JD, PhD)

7. Your household income?
   - ❑ Under $10,000
   - ❑ $10,000 - $19,999
   - ❑ $20,000 - $29,999
   - ❑ $30,000 - $39,999
   - ❑ $40,000 - $49,999
   - ❑ $50,000 - $59,999
   - ❑ $60,000 - $69,999
   - ❑ $70,000 - $79,999
   - ❑ $80,000 - $89,999
   - ❑ Over $90,000

Appendix B: Smoking Status Questionnaire (SSQ)

1. Date of Birth:_____/_____/_____
   Month Day Year

2. Sex: (check one) □ Male □ Female

3. Do you smoke cigarettes everyday? □ Yes □ No
   If No, stop here; If Yes, please continue

4. How many years have you been smoking daily?_____

5. How many cigarettes do you smoke per day on average?_____

6. Do you inhale? (circle one) NEVER SOMETIMES ALWAYS

7. Do you smoke more during the first two hours of the day than during the rest of the day?
   □ Yes □ No

8. How soon after you wake up do you smoke your first cigarette?
   □ Within 5 minutes
   □ 6-30 minutes
   □ 31-60 minutes
   □ After 60 minutes

9. Which of all the cigarettes you smoke would you most hate to give up?
   □ The first one in the morning
   □ The one with breakfast
   □ The one with lunch
   □ The one with dinner
   □ The last cigarette before going to bed
   □ Other:_____

10. Do you find it difficult to refrain from smoking in places where it is forbidden (eg. in church, at the library)
    □ Yes □ No

11. Do you smoke if you are so ill that you are in bed most of the day?
    □ Yes □ No

Appendix C: Questionnaire of Smoking Urges-Brief (QSU-brief)

Please rate the statements below using the following scale to record your answers.

1	2	3	4	5
very slightly or not at all	a little	moderately	quite a bit	extremely

1. I have a desire for a cigarette right now. _____
2. Nothing would be better than smoking a cigarette right now. _____
3. If it were possible, I probably would smoke now. _____
4. I could control things better right now if I could smoke. _____
5. All I want right now is a cigarette. _____
6. I have an urge for a cigarette. _____
7. A cigarette would taste good now. _____
8. I would do almost anything for a cigarette now. _____
9. Smoking would make me less depressed. _____
10. I am going to smoke as soon as possible. _____

Appendix D: Smoking Consequences Questionnaire – Adult (SCQ-A)

Instructions: This questionnaire is designed to assess beliefs people have about the consequences of smoking a cigarette. We are interested in your general expectations about the consequences of your smoking. Below is a list of statements. Each statement contains a possible consequence of smoking. For each of the statements listed below, please rate how LIKELY or UNLIKELY you believe each consequence is for you when you smoke. If the consequence seems LIKELY to you, circle a number from 5-9. That is, if you believe that a consequence would never happen, circle 0; if you believe a consequence would happen every time you smoke, circle 9. Use the guide below to aid you further. For example, if a consequence seems completely likely to you, you would circle 9. If it seems a little unlikely to you, you would circle 4.

0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Completely		Very Extremely	Somewhat	A little	A little Somewhat		Very Extremely		Completely

←----------**UNLIKELY**----------X----------**LIKELY**----------→

		UNLIKELY									LIKELY
1.	Cigarettes help me deal with anxiety or worry.	0	1	2	3	4	5	6	7	8	9
2.	Nicotine "fits" can be controlled by smoking.	0	1	2	3	4	5	6	7	8	9
3.	When I'm angry, a cigarette can calm me down.	0	1	2	3	4	5	6	7	8	9
4.	I become more addicted the more I smoke.	0	1	2	3	4	5	6	7	8	9
5.	If I'm tense, a cigarette helps me to relax.	0	1	2	3	4	5	6	7	8	9
6.	Smoking a cigarette energizes me.	0	1	2	3	4	5	6	7	8	9
7.	Cigarettes help me deal with anger.	0	1	2	3	4	5	6	7	8	9
8.	Smoking calms me down when I feel nervous.	0	1	2	3	4	5	6	7	8	9
9.	I feel like I do a better job when I am smoking.	0	1	2	3	4	5	6	7	8	9
10.	A cigarette can give me energy when I'm bored and tired.	0	1	2	3	4	5	6	7	8	9
11.	Cigarettes can really make me feel good.	0	1	2	3	4	5	6	7	8	9
12.	When I'm feeling happy, smoking helps me keep that feeling.	0	1	2	3	4	5	6	7	8	9
13.	Smoking will satisfy my nicotine cravings.	0	1	2	3	4	5	6	7	8	9
14.	Cigarettes help me reduce or handle tension.	0	1	2	3	4	5	6	7	8	9
15.	I feel better physically after having a cigarette.	0	1	2	3	4	5	6	7	8	9
16.	A cigarette can satisfy my urge to smoke.	0	1	2	3	4	5	6	7	8	9
17.	If I'm feeling irritable, a smoke will help me relax.	0	1	2	3	4	5	6	7	8	9
18.	I will become more dependent on nicotine if I continue smoking.	0	1	2	3	4	5	6	7	8	9

19. When I'm upset with someone, a cigarette helps me cope.	0	1	2	3	4	5	6	7	8	9
20. I like the way a cigarette makes me feel physically.	0	1	2	3	4	5	6	7	8	9
21. When I am worrying about something, a cigarette is helpful.	0	1	2	3	4	5	6	7	8	9
22. Smoking temporarily reduces those repeated urges for cigarettes.	0	1	2	3	4	5	6	7	8	9

Appendix E: Mood Form (Trait)

Please indicate how much you have experienced each of the following moods **during the past three weeks** by placing a checkmark on EACH line.

	Not at all	Very slight	Some what	Moderate amount	Much	Very much	Extremely much
Happy							
Depressed/Blue							
Joyful							
Unhappy							
Pleased							
Enjoyment/Fun							
Frustrated							
Worried/Anxious							
Angry/Hostile							

Appendix F: Mood Form (State)

Please indicate how much you are experiencing each of the following moods **right now** by placing a checkmark on EACH line.

	Not at all	Very slight	Some what	Moderate amount	Much	Very much	Extremely much
Happy	_____	_____	_____	_____	_____	_____	_____
Depressed/Blue	_____	_____	_____	_____	_____	_____	_____
Joyful	_____	_____	_____	_____	_____	_____	_____
Unhappy	_____	_____	_____	_____	_____	_____	_____
Pleased	_____	_____	_____	_____	_____	_____	_____
Enjoyment/Fun	_____	_____	_____	_____	_____	_____	_____
Frustrated	_____	_____	_____	_____	_____	_____	_____
Worried/Anxious	_____	_____	_____	_____	_____	_____	_____
Angry/Hostile	_____	_____	_____	_____	_____	_____	_____

Appendix G: State-Trait Anxiety Inventory – Trait (STAI Form Y-2)

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then circle the number to the right of the statement to indicate how you *generally* feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

1=almost never 3=sometimes 5=often 7=almost always

1. I feel pleasant……..……	1 2 3 4 5 6 7
2. I feel nervous and restless……...……	1 2 3 4 5 6 7
3. I feel satisfied with myself……..……	1 2 3 4 5 6 7
4. I wish I could be as happy as others seem to be…….……	1 2 3 4 5 6 7
5. I feel like a failure……..……	1 2 3 4 5 6 7
6. I feel rested. ……...	1 2 3 4 5 6 7
7. I am "calm, cool, and collected." ……...……	1 2 3 4 5 6 7
8. I feel that difficulties are piling up so that I cannot overcome them……..	1 2 3 4 5 6 7
9. I worry too much over something that doesn't really matter…….……	1 2 3 4 5 6 7
10. I am happy……..……	1 2 3 4 5 6 7
11. I have disturbing thoughts. ……	1 2 3 4 5 6 7
12. I lack self-confidence. ……...	1 2 3 4 5 6 7
13. I feel secure. …….……..	1 2 3 4 5 6 7
14. I make decisions easily. …….……	1 2 3 4 5 6 7
15. I feel inadequate. ……...	1 2 3 4 5 6 7
16. I am content…….. ……	1 2 3 4 5 6 7
17. Some unimportant thought runs through my mind and bothers me…….……..	1 2 3 4 5 6 7
18. I take disappointments so keenly that I can't put them out of my mind……	1 2 3 4 5 6 7
19. I am a steady person……..	1 2 3 4 5 6 7
20. I get in a state of tension or turmoil as I think over my recent concerns and interests...	1 2 3 4 5 6 7

Appendix H: State-Trait Anxiety Inventory – State (STAI Form Y-1)

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then circle the number to the right of the statement to indicate how you feel *right* now, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

1=not at all 3=somewhat 5=moderately so 7=very much so

1. I feel calm……..	1 2 3 4 5 6 7
2. I feel secure…….	1 2 3 4 5 6 7
3. I am tense……	1 2 3 4 5 6 7
4. I feel strained…….	1 2 3 4 5 6 7
5. I feel at ease……	1 2 3 4 5 6 7
6. I feel upset…….	1 2 3 4 5 6 7
7. I am presently worrying over possible misfortunes……	1 2 3 4 5 6 7
8. I feel satisfied…….	1 2 3 4 5 6 7
9. I feel frightened…….	1 2 3 4 5 6 7
10. I feel comfortable……	1 2 3 4 5 6 7
11. I feel self-confident……	1 2 3 4 5 6 7
12. I feel nervous…….	1 2 3 4 5 6 7
13. I am jittery…….	1 2 3 4 5 6 7
14. I feel indecisive…….	1 2 3 4 5 6 7
15. I am relaxed……	1 2 3 4 5 6 7
16. I feel content……..	1 2 3 4 5 6 7
17. I am worried……	1 2 3 4 5 6 7
18. I feel confused……	1 2 3 4 5 6 7
19. I feel steady……	1 2 3 4 5 6 7
20. I feel pleasant…….	1 2 3 4 5 6 7

Appendix I: Barratt Impulsiveness Scale (BIS-11)

DIRECTIONS: People differ in the ways they act and think in different situations. This is a questionnaire to measure some of the ways in which you act and think. Read each statement and record your answer according to the following scale. Do not spend too much time on any statement. Answer quickly and honestly.

1	2	3	4
rarely/never	occasionally	often	almost always/always

1. I plan tasks carefully. _____
2. I do things without thinking. _____
3. I make-up my mind quickly. _____
4. I am happy-go-lucky. _____
5. I don't "pay attention." _____
6. I have "racing" thoughts. _____
7. I plan trips well ahead of time. _____
8. I am self-controlled. _____
9. I concentrate easily. _____
10. I save regularly. _____
11. I "squirm" at plays or lectures. _____
12. I am a careful thinker. _____
13. I plan for job security. _____
14. I say things without thinking. _____
15. I like to think about complex problems. _____
16. I change jobs. _____

Appendix I: (Continued)

1 rarely/never	2 occasionally	3 often	4 almost always/always

17. I act "on impulse." _____
18. I get easily bored when solving thought problems. _____
19. I act on the spur of the moment. _____
20. I am a steady thinker. _____
21. I change residences. _____
22. I buy things on impulse. _____
23. I can only think about one thing at a time. _____
24. I change hobbies. _____
25. I spend or charge more than I earn. _____
26. I often have extraneous thoughts when thinking. _____
27. I am more interested in the present than the future. _____
28. I am restless at the theater or lectures. _____
29. I like puzzles. _____
30. I am future oriented. _____

Appendix J: BIS/BAS Scales

Please rate the statements below using the following scale to record your answers.

1	2	3	4
strongly agree	agree	disagree	strongly disagree

1. If I think something unpleasant is going to happen I usually get pretty "worked up." _____
2. I worry about making mistakes. _____
3. Criticism or scolding hurts me quit a bit. _____
4. I feel pretty worried or upset when I think or know someone is angry at me. _____
5. Even if something bad is about to happen to me, I rarely experience fear or nervousness. _____
6. I feel worried when I think I have done poorly at something. _____
7. I have very few fears compared to my friends. _____
8. When I get something I want, I feel excited and energized. _____
9. When I'm doing well at something, I love to keep at it. _____
10. When good things happen to me, it affects me strongly. _____
11. It would excite me to win a contest. _____
12. When I see an opportunity for something I like, I get excited right away. _____
13. When I want something, I usually go all-out to get it. _____
14. I go out of my way to get things I want. _____
15. If I see a chance to get something I want, I move on it right away. _____
16. When I go after something, I use a "no holds barred" approach. _____
17. I will often do things for no other reason than that they might be fun. _____

Appendix J: (Continued)

1	2	3	4
strongly agree	agree	disagree	strongly disagree

18. I crave excitement and new sensations. _____

19. I'm always willing to try something new if I think it will be fun. _____

20. I often act on the spur of the moment. _____

Appendix K: Delay Discounting Task (DDT)

Please answer the following 27 questions in the order they appear. Circle the choice you prefer. Please take the choices seriously; they may be for *REAL MONEY.* At the end of the study, you will choose a marble from a bag that contains 1 green marble and 49 clear marbles. If you choose the green marble, you will win one of your 27 choices. To determine how much money you will win, you will choose another marble from a bag that contains 27 marbles labeled with the numbers 1 through 27, corresponding to the 27 questions listed below. For example, if you choose the 4 from the bag, you will win whatever you chose on question 4. If you circled the immediate money on that question ($31 today), you will receive the money today when you leave. If you circled the delayed money on that question ($85 in 7 days), you will receive $85 in 7 days. You or another person you designate may return to our facility to pick up the money, or you may have the money mailed to you. To make sure that you get a reward you prefer, you should answer *every question* as though it were the one you will win.

1. Would you prefer $54 today, or $55 in 117 days?	$54 today	$55 in 117 days
2. Would you prefer $55 today, or $75 in 61 days?	$55 today	$75 in 61 days
3. Would you prefer $19 today, or $25 in 53 days?	$19 today	$25 in 53 days
4. Would you prefer $31 today, or $85 in 7 days?	$31 today	$85 in 7 days
5. Would you prefer $14 today, or $25 in 19 days?	$14 today	$25 in 19 days
6. Would you prefer $47 today, or $50 in 160 days?	$47 today	$50 in 160 days
7. Would you prefer $15 today, or $35 in 13 days?	$15 today	$35 in 13 days
8. Would you prefer $25 today, or $60 in 14 days?	$25 today	$60 in 14 days
9. Would you prefer $31 today, or $85 in 7 days?	$31 today	$85 in 7 days
10. Would you prefer $40 today, or $55 in 62 days?	$40 today	$55 in 62 days
11. Would you prefer $11 today, or $30 in 7 days?	$11 today	$30 in 7 days
12. Would you prefer $67 today, or $75 in 119 days?	$67 today	$75 in 7 days

Appendix K: (Continued)

13. Would you prefer $34 today, or $35 in 186 days?	$34 today	$35 in 186 days
14. Would you prefer $27 today, or $50 in 21 days?	$27 today	$50 in 21 days
15. Would you prefer $69 today, or $85 in 91 days?	$69 today	$85 in 91 days
16. Would you prefer $49 today, or $60 in 89 days?	$49 today	$60 in 89 days
17. Would you prefer $80 today, or $85 in 157 days?	$80 today	$85 in 157 days
18. Would you prefer $24 today, or $35 in 29 days?	$24 today	$35 in 29 days
19. Would you prefer $33 today, or $80 in 14 days?	$33 today	$80 in 14 days
20. Would you prefer $28 today, or $30 in 179 days?	$28 today	$30 in 179 days
21. Would you prefer $34 today, or $50 in 30 days?	$34 today	$50 in 30 days
22. Would you prefer $25 today, or $30 in 80 days?	$25 today	$30 in 80 days
23. Would you prefer $41 today, or $75 in 20 days?	$41 today	$75 in 20 days
24. Would you prefer $54 today, or $60 in 111 days?	$54 today	$60 in 111 days
25. Would you prefer $54 today, or $80 in 30 days?	$54 today	$80 in 30 days
26. Would you prefer $22 today, or $25 in 136 days?	$22 today	$25 in 136 days
27. Would you prefer $20 today, or $55 in 7 days?	$20 today	$55 in 7 days

Appendix L: Cigarette Rating Form (CRF)

Brand of cigarette you smoked: _____

Please rate the following questions from (1) *not at all* to (4) *very much* by circling the number that corresponds to your choice.

1. How much did you like the taste of the cigarette?

(1) not at all (2) a little (3) somewhat (4) very much

2. How much did you like the smell of the cigarette?

(1) not at all (2) a little (3) somewhat (4) very much

3. How enjoyable was the cigarette?

(1) not at all (2) a little (3) somewhat (4) very much

Appendix M: Telephone Screening Form

When potential participant calls regarding project:

"Thank you for your interest in this study. First I would like to ask you a few questions. Then I will tell you a little about the study and you can decide if you are interested in participating."

Where did you hear about our study from? Indicate response.

ad/flyer **(ask, *"Where did you see the flyer?"*)**
location of flyer: _____

word of mouth (**ask, *"Who told you about it? What is their name?"*)**
Name: _____

other: _____

Question	Answer		
1. Do you speak and read English well?		**YES**	**NO**
2. How old are you?		**18-65**	**Not 18-65**
3. On average, how many cigarettes do you smoke per day? *(20 cigarettes = 1 pack)*		**≥10**	**< 10**
4. How long have you been smoking?		**≥ 1 year**	**< 1 year**
5. Are you currently enrolled in any formal treatment to quit smoking, like a support group or counseling?		**NO**	**YES**
6. Are you currently using any medication to quit smoking? *Examples include: the nicotine patch, nicotine gum, nicotine lozenge, nicotine inhaler, nicotine nasal spray, Zyban, Welbutrin, Bupropion)?*		**NO**	**YES**
7. Are you currently actively attempting to quit smoking?		**NO**	**YES**
8. Are you currently pregnant, or is there any possibility that you might currently be pregnant?		**NO**	**YES**
9. Have you ever participated in any other study at our facility?		**NO**	**YES**
(If yes) When? Please describe the study:			
(Qualified?)		**YES**	**NO**

Qualified = YES <u>except for question 9</u>: *"Thank you for answering the questions. Please tell me your full name and phone number and you will receive a call back soon about scheduling an appointment."*

Qualified = NO: ***"Thank you for answering the questions. At the current time, you do not qualify for this study. However, if you would like, I can take your name and phone number so we can contact you for any later studies that you may qualify for."***

Do NOT tell them the reasons they didn't qualify!	
Name:	Phone:

Thank them and hang up.

Qualified = YES:
"Thank you for answering the questions. You are qualified for this study. Now I will tell you a little more about it."

- ***This is a study to learn more about personality and mood in smokers.***
- ***This study involves completing some paper measures and a few other tasks.***
- ***You will be paid $20 for participating in the study, which is expected to last approximately 1 to 1.5 hours. You will have a chance to win additional money.***
- ***If you decide to schedule an appointment, when you arrive we will again describe the study to you. We will also give you a consent form to read and sign before beginning the study.***
- ***Are you interested in scheduling an appointment? (Circle one):*** **YES NO**

If NO: ***"Would like us to keep your name and phone number in case other studies come up?"***

Name:	Phone:

If YES: ***"Ok, let me take down your contact information."*** Collect the following information.

Name:	Cell Phone:	Home Phone:
Email Address:	Home Address:	

Ok, let's find a time for you to come in. When would be convenient for you?

Check appointment book for available slots and schedule an appointment.

Date and time of appointment: _____

I'm going to give you directions to our facility and a few reminders. Do you have a pen and paper?
Remind them of the following (check off each box):

- ❑ ***Please smoke a cigarette 1/2 hour before your appointment. That means you should smoke a cigarette at _____. Please do <u>not</u> smoke again before your appointment, that is, do not smoke between _____ and _____.***
- ❑ ***When you come, please bring a pack of your cigarettes and a lighter.***
- ❑ ***Please call us if you will be late or need to cancel or reschedule your appointment. (Explain how important this is and how much we would appreciate a call). Please call 813-745-1753.***
- ❑ ***If we need to call you , is it OK to leave a message on your voicemail? YES NO***
- ❑ Give them directions to TRIP (see below)

Now I'm going to give you directions to our facility.
<u>Directions to TRIP</u>

- *Our address is 4115 East Fowler Ave.*
- *We are directly across from the main entrance to USF on Fowler Ave on the corner of Fowler and McKinley.*
- *We are in the second building at the front of the complex next to Lifetime Cancer Screening.*
- *Above our door is a sign that reads "Tobacco Research and Intervention Program."*
- *Park in any space and tell the receptionist that you are here for a research study.*

- ❑ ***If you have any further questions, please call 813-745-1753.***

Remind them again of their appointment date and time. Thank them and hang up.

Appendix N: Usage Form

Current time: _____

Time of last cigarette: _____

At least ½ hour since last cigarette? YES NO

If NO: Have participant wait until ½ hour has elapsed from last cigarette.

CO measure baseline: _____

Appendix O: Art Rating Form

Painting #1

How much do you like the colors in this painting?

(1) not at all (2) a little (3) somewhat (4) very much

How much do you like this painting overall?

(1) not at all (2) a little (3) somewhat (4) very much

Painting #2

How much do you like the colors in this painting?

(1) not at all (2) a little (3) somewhat (4) very much

How much do you like this painting overall?

(1) not at all (2) a little (3) somewhat (4) very much

Painting #3

How much do you like the colors in this painting?

(1) not at all (2) a little (3) somewhat (4) very much

How much do you like this painting overall?

(1) not at all (2) a little (3) somewhat (4) very much

Which painting do you like the best?

(1) Painting #1 (2) Painting #2 (3) Painting #3

Appendix P: 2nd CO reading

CO measure after smoking: _____

Appendix Q: Debriefing Questions

Debriefing Questions (Art Condition)

What do you think was the purpose of this study?

Do you think there is more to the study than we told you? (If yes, what?)

Do you have any questions or concerns about participating or about the tasks you completed?

For experimenter:
Level of insight None Partial Full

Debriefing Questions (Speech Condition)

Before we told you that you weren't going to give your speech, did you believe that you were going to have to give it?

What do you think was the purpose of this study?

(If not already answered above)
Why do you think we told you to prepare a speech but we didn't have you give the speech?

Do you have any questions or concerns about participating or about the tasks you completed?

For experimenter:
Level of insight None Partial Full

Appendix R: Lottery Results

Did the participant win extra money? Yes No

If no, this form is complete.
If yes, complete the questions below.

Which question number did the participant choose? _____

How much extra money did the participant win? _____

Was the amount immediate or delayed? immediate delayed by _____ days

If immediate, this form is complete.
If delayed, complete the questions below.

Pick up or mailed money order? (check desired option and fill out necessary information)

Option #1: Pick-up cash

Date of pick-up:

Name of person picking up cash:

Signature of participant: _____

Option #2 Mailed money order

Target date of receipt:

Name and desired receipt address:

Signature of participant: _____

Witness (investigator signature): _____