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# Craving Effect of Unintentional Smoking Cues in Antismoking Images in Light Smokers

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CRAVING EFFECT OF UNINTENTIONAL SMOKING CUES IN ANTISMOKING IMAGES  
IN LIGHT SMOKERS

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By

Francisco Isaac Salgado-García

2011

## **Dedication**

This thesis is dedicated to my mother Ninfa, my brother Luis, my sister-in-law Ninfa, my niece and nephew Victoria and Elías, and my best friends Edgar and Ted for their support in my development and my career, and for all their love throughout this journey. I want to thank them for shaping who I am today and giving me the opportunity to open my own doors for the future.

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IN LIGHT SMOKERS

by

FRANCISCO ISAAC SALGADO-GARCÍA, B.S.

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## Abstract

Tobacco use is considered the single most preventable cause of disease, disability, and death in the nation. According to cue-reactivity models, environmental stimuli associated with smoking may elicit cravings in smokers. Antismoking advertisements, may also elicit cravings in smokers because of unintentional use of smoking cues, which may promote smoking maintenance and hinder quitting attempts. The purpose of this study is to assess if cue-reactivity elicits cravings in light and intermittent smokers and if impulsivity serves as a moderator. Data from 155 participants who reported smoking at least once in the past week to 10 cigarettes per day were collected. The mean age of participants was 20.96 years of age ( $SD = 4.14$ ), 52.3% were female, and 82.6% self-identified as Hispanic. Measures include a demographic questionnaire, a tobacco use behavior and attitude survey, the Fagerström Test of Nicotine Dependence, the Questionnaire of Smoking Urges-Brief, and the Barratt Impulsiveness Scale. Participants were exposed to one of three conditions (i.e., smoking, antismoking, and neutral). Univariate analysis showed that smoking stimuli produced higher cravings relative to antismoking ( $p = .007$ ) and neutral stimuli ( $p = .019$ ), while no differences between antismoking and neutral stimuli were observed ( $p = .793$ ). Multiple regression analysis demonstrated that gender ( $\beta = .100, p = .028$ ) and baseline cravings ( $\beta = .762, p < .001$ ) were significant predictors of cravings. Additionally, a moderation model evidenced that impulsivity moderates cravings, especially in the smoking stimuli condition. Some implications stemming from this study are the further regulation of smoking advertisements and the inclusion of smoking cues in strong antismoking advertisements.

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## Chapter 1: Introduction

Since 1964, tobacco has been considered the single most preventable cause of disease, disability, and death in the United States, with approximately 24% of the American adult population still smoking (Centers for Disease and Control [CDC], 2008). New smokers start smoking at an average age of 16.9 years of age and become daily smokers at an average age of 19.2 years (Substance Abuse and Mental Health Services Administration [SAMHSA], 2008). In 2007, 24.2% of the U.S. population had smoked cigarettes in the past month; young adults between the ages of 18 and 25 had the highest rate of tobacco use, and 25.6% of full-time college students aged 18 to 22 smoked (SAMHSA, 2008). According to the CDC (2006), smoking has been associated with 12 million deaths related to cancer, cardiovascular diseases, respiratory diseases, and infant deaths in the past 4 decades. Hence, it is clear that smoking remains a public health concern, and young adults and college students evidence smoking prevalence rates that warrant attention.

Even though there is a wide body of research on smoking, there is limited empirical information on the effects of tobacco and predictors for smoking behavior in *light and intermittent smokers* (LITS; Shiffman, 2009). Interest in low-rate smoking has increased because withdrawal models of addiction have not been able to explain low levels of smoking (Zhu, Pulvers, Zhuang, & Báezconde-Garbanati, 2007). For instance, unlike regular smoking, physical dependency has not been associated with light or intermittent smoking (Doran, McChargue, & Cohen, 2007). Thus, different processes might influence the maintenance of smoking in LITS in comparison to regular smokers.

Cue-reactivity can provide a different perspective to explaining nicotine use in LITS. Cue-reactivity paradigms have been useful in eliciting cravings in smokers by exposing them to

environmental cues associated with cigarette smoking (Carter & Tiffany, 1999), which has been further associated with smoking behavior (Rohsenow, Childress, Monti, Niaura, & Abrams, 1990). Theoretically, *unintentional stimuli* (i.e., images intended to prevent smoking) may also increase craving levels. One example of a potential unintentional stimulus is the *no smoking sign*. Even though the intention of the image is to indicate that smoking is not permitted, the sign includes a cigarette that might serve as a cue that can elicit cravings in smokers or former smokers. Similarly, images used in antismoking campaigns that include cigarettes or smoking paraphernalia may potentially elicit cravings unintentionally.

Smoking has been associated with individual differences such as impulsivity (Reimers, Maylor, Stewart & Chater, 2009). Assessment of moderator variables is relevant in the examination of how individual differences affect behavior (Baron & Kenny, 1986). Therefore, variables that affect the strength of the relationship between smoking cues and cravings can be valuable in the exploration of cue-reactivity in light smokers. In fact, there is limited research on how impulsivity affects light smokers in cue-reactivity paradigms. Hence, understanding how unintentional cues and impulsivity affect cravings in light smokers may help clinicians, researchers, and smoking cessation programs address cue-reactivity and impulsivity in treatment, thus improving quit rates.

### **1.1 Light and Intermittent Smoking**

Light smokers have been defined as people who smoke fewer than 10 cigarettes per day (e.g., Ahluwalia et al., 2006; Okuyemi et al., 2002). Intermittent smokers have been defined as people who smoke weekly, but not daily (e.g., Trinidad et al., 2009). While heavy smoking rates have decreased, light and intermittent smoking rates are increasing (Pierce, White, & Messer, 2009). In terms of prevalence, Trinidad et al. (2009) reported that 28.3% of their participants

were light smokers, and intermittent smokers were 19.7% of their sample. Also, it has been suggested that 16% of current smokers are nondaily smokers, which represent 3.2% of the population in the U.S. (Wortley, Husten, Trosclair, Chrismon, & Pederson, 2003). Others have observed that the proportion of smokers who smoke less than daily in the U.S. has ranged from 20 to 33% (Shiffman, 2009). Colwell, Smith, and Law (2007) reported that 14.6% of El Pasoans were light smokers, with Hispanics being light smokers at higher rates in comparison to non-Hispanics. Similarly, Rodríguez-Esquivel, Cooper, Blow, and Resor (2009) have also demonstrated that Hispanics in the El Paso area are light smokers.

LITS differ from heavier smokers in several meaningful ways and may demonstrate unique smoking behavior patterns. For example, LITS are able to abstain from smoking for a few days without experiencing withdrawal symptoms, latency between cigarettes is longer, they smoke more often in the presence of other smokers, they report positive affect when smoking, and their smoking behavior is more frequent on the weekends in comparison to heavy smokers (Shiffman, Paty, Kassel, Gnys, & Zettler-Segal, 1994). In addition, Taylor and Cooper (2010) suggest that drinking, weekends, different locations, and later times of the day predict light smoking. These findings suggest that environmental triggers are important factors in LITS' smoking patterns.

## **1.2 Health Consequences of Light Smoking**

Health consequences associated with light smoking may be overlooked by LITS; however, such consequences exist and are non-trivial. First, intermittent smoking has been related to cough, sore throat, shortness of breath, and fatigue (An et al., 2009). Second, light smoking increases the risk for myocardial infarction (Prescott, Scharling, Osler, & Schnohr, 2002). Third, smoking one to four cigarettes per day has been related to increased risk of death

from ischemic heart disease, any type of cancer, and other causes (Bjartveit & Tverdal, 2005). Finally, light smoking has an association with higher mortality rates (Luoto, Uutela, & Puska, 2000). Interestingly, LITS do not perceive increased risk of health consequences such as heart disease or cancer (Ayanian & Cleary, 1999), which might affect LITS' motivation to decrease or quit smoking (SAMHSA, 2008). Thus, acknowledging and educating individuals on health consequences of light and intermittent smoking may be important in the promotion of cessation.

### **1.3 Important Characteristics of LITS**

Characteristics associated with light and intermittent smoking can provide a better understanding of LITS. Several studies have found higher rates of LITS in Hispanics (Cokkinides, Halpern, Barbeau, Ward, & Thun, 2008; Trinidad et al., 2009; Wortley et al., 2003; Zhu et al., 2007). Specifically, there seems to be a high proportion of LITS in the Hispanic population of El Paso region (Rodríguez-Esquivel et al., 2009). In this study, 52.3% of respondents were daily, weekly, or monthly smokers; daily smokers reported on average smoking fewer than 10 cigarettes per day. In addition, a study revealed that 20% of LITS were individuals aged 18 to 24 and reported higher rates of nondaily smoking in comparison to any other age group (Wortley et al., 2003). Similarly, Trinidad et al. (2009) observed that being younger (20 to 34 years of age) was related to light and intermittent smoking. Light and intermittent smoking might disproportionately affect both young adults and Hispanics.

Besides age and ethnicity, higher levels of motivation and intention to quit smoking are characteristic of LITS. For instance, a study revealed that most intermittent smokers made significantly more quit attempts for at least 24 hours in the past year relative to heavier smokers (Wortley et al., 2003). Furthermore, LITS are more likely in the preparation and action stages of quitting smoking (Owen, Kent, Wakefield, & Roberts, 1995) and have a desire to quit within the

next 6 months (Tong, Ong, Vittinghoff, & Pérez-Stable, 2006) in comparison to heavier smokers. Finally, intermittent and light smokers are 3.2 times and 1.6 times respectively more likely to plan to quit smoking in comparison to heavy smokers, and believe themselves to be successful if they were to quit smoking (Boulos et al., 2009). Thus, there is evidence that LITS are motivated to quit smoking and could be responsive to antismoking campaigns and smoking cessation programs.

There is conflicting evidence in smoking behavior stability of LITS. There is evidence that LITS might maintain a light smoking pattern for several years (e.g., Owen et al., 1995; Boulos et al., 2009). For example, a longitudinal study found that a year after baseline assessment 60% of intermittent smokers remained in that category for a one-year period, and only 16% became daily smokers, while the remaining 24% stopped smoking (Lindström, & Isacson, 2009). However, there is evidence that suggests that heavy smokers are becoming light smokers since the proportion of light smokers has been increasing (Shiffman, 2009; Tong et al., 2006). Hence, helping light smokers to quit smoking can have a meaningful impact on public health.

#### **1.4 Cravings and Cue-Reactivity**

According to traditional models of addiction, smokers may be unable to abstain from smoking due to the avoidance of withdrawal symptoms (Rohsenow et al., 1990). Nevertheless, withdrawal symptoms do not seem to be present in LITS (Ahluwalia et al., 2006). Therefore, issues related to continued smoking or to relapse in LITS are important to assess. It seems that the presence of smoking cues in the environment may be a factor for relapse (Rohsenow et al., 1990). For example, LITS's reasons to smoke have been related more to social motives (i.e.,

environmental cues) and less to addiction and habit (i.e., nicotine dependence) (Shiffman, Kassel, Paty, Gnys, & Zettler-Segal, 1994).

To understand the reasons LITS continue smoking, it is important to understand the concepts of cravings and cue-reactivity. Cravings have been defined as subjective experiences (Anton, 1999) that involve an intense desire to consume a substance even after successful substance treatment (United Nations International Drug Control Program and World Health Organization [UNDCP and WHO], 1992). Cravings are related to relapse (S. Siegel, 1999) and maintenance of drug use (Miyata & Yanagita, 2001). As mentioned previously, environmental cues can be partially responsible for the elicitation of cravings in people who do not intend to quit and people who want to quit smoking. When smokers are exposed to cigarettes, smoking paraphernalia, or other individuals smoking, they experience cravings and report relapse when they attempt to quit (Rohsenow et al., 1990). This effect is known as *cue-reactivity*. There is evidence of a robust effect of cravings elicited through cue-reactivity paradigms. For instance, cue-elicited cravings have been observed with substances such as alcohol (Herrmann, Weijers, Wiesbeck, Böning, & Fallgatter, 2001; Ooteman, Koeter, Vserheul, Schippers, & van den Brink, 2006), cocaine (Sinha, Fuse, Aubin, & O'Malley, 2000), and heroin (Sherman, Zinser, Sideroff, & Baker, 1989). Hence, it is common to observe that substance users in rehabilitation treatments, regardless of their substance of choice, relapse after several months of not being in contact with the substance. Nevertheless, this effect is not limited to the restriction or absence of the substance, since cravings seem to predict smoking after exposure to cues in people who are not seeking treatment to quit (Carpenter et al., 2009).

Different modalities on the presentation of stimuli in cue-reactivity paradigms have been used. Cues have been delivered through in vivo exposures (Carpenter et al., 2009), video

exposure (Upadhyaya, Drobles, & Thomas, 2004), and through mixed methods to compare which stimuli produce the most cravings (Shadel, Niaura, & Abrams, 2001). Cue-reactivity paradigms have elicited cravings in laboratory settings (Field & Duka, 2004; Versland & Rosenberg, 2007), in virtual worlds (Baumann & Sayette, 2006), and even in natural environments (Warthen & Tiffany, 2009). Consistently, environmental cues that are related to the use of a substance seem to produce cravings in smokers, regardless of the type of stimuli manipulation. Even though in vivo cues seem to produce the highest cravings scores for smokers (Shadel et al., 2001), pictorial stimuli have also been effective in the elicitation of cravings (Warthen & Tiffany, 2009). Hence, using pictorial stimuli seems to be a valid and inexpensive way of eliciting cravings in a cue-reactivity paradigm.

### **1.5 Physiological vs. Self-Report Craving Measures**

Since previous models of addiction have conceptualized withdrawal symptoms as an indicator for relapse (Rohsenow et al., 1990), biological models have been used to explain relapse. Therefore, both physiological and self-report measures have been used to measure cravings in cue exposure. Nevertheless, there is inconclusive evidence in terms of which type of instrument is more effective in measuring cue-reactivity. On one hand, self-report of cravings has produced larger effects than physiological measurements (Tong, Bovbjerg, & Erblich, 2007). Carpenter et al. (2009) observed that physiological elements of craving were less predictive of smoking in comparison to self-reported cravings with cue exposure. In addition, Carter and Tiffany (1999) found that effect sizes for self-report of cravings were large in comparison to physiological effects, concluding that self-report might provide accurate information on cue-reactivity by reducing noise information that is present in physiological measures. Even though the reason why effect sizes might have been larger for self-reports and not for physiological

measurements is inconclusive, it is important to consider that self-report of cravings is a valid, powerful, and inexpensive method to assess cravings in a cue-reactivity paradigm.

## **1.6 Impulsivity and Smoking**

Individual differences, such as personality traits, are related to the use of diverse substances (Gilbert, Gilbert, & Schultz, 1998). Impulsivity is a personality trait that has been defined as “reflecting deficits in self-directedness due to certain core characteristics that reflect longstanding behavior patterns” (Doran, McChargue et al., 2007). Impulsivity is a personality trait of interest in the field of nicotine research because it has been associated with cigarette rewards (Doran, Spring, McChargue, 2007), smoking (Mitchell, 1999), smoking initiation and maintenance (VanderVeen, Cohen, Cukrowicz, & Trotter, 2008), smoking relapse (Doran, Spring, McChargue, Pergadia, & Richmond, 2004), cravings and light smoking (Billieux, Van der Linden, & Ceschi, 2007), and young age (Granö, Virtanen, Vahtera, Elovianio, & Kivimäki, 2004). In addition, similar to environmental cues, impulsivity has been related to increases in cravings (VanderVeen, Cohen, Cukrowicz, et al., 2008; Doran, Spring, et al., 2007). As well, other studies have reported a relationship between impulsivity and smoking levels (Gurpegui et al., 2007) and with the positive reinforcement effects of nicotine (Perkins et al., 2008).

Young adults and college students seem to be an important population for the study of the relationship between impulsivity and smoking. For instance, adolescents who cannot maintain smoking abstinence have higher levels of impulsivity relative to adolescents who can abstain from smoking (Krishnan-Sarin et al., 2007). Similarly, impulsive college students are more likely to relapse after a period of abstinence in comparison to college students with low impulsivity (VanderVeen, Cohen, Trotter, & Collins, 2008). Clinical and community efforts to

help people quit smoking could produce higher quit rates in smokers motivated to quit smoking if an appropriate treatment taking into account impulsivity is provided.

### **1.7 Predictors of Cravings**

Previous research on cue-exposure cravings has observed several correlates and predictors that could inform future research and smoking cessation treatment in LITS, whose predictors of smoking have not yet been widely researched. First, Field and Duka (2004) found that women reported higher craving relative to males after being exposed to smoking cues. Second, nicotine dependence scores have also predicted higher cravings in cue-reactivity research in heavy smokers (Donny, Griffin, Shiffman, & Sayette, 2008). Third, smoking status has also been related to cravings, such that heavy smokers have reported higher cravings after observing smoking cues relative to light smokers (Sayette, Martin, Wertz, Shiffman, & Perrott, 2001). It is not known if even at low levels of smoking (i.e., light and intermittent smoking), differences in cravings could be observed. Finally, pre-exposure (i.e., baseline) cravings have predicted cravings after exposure to smoking stimuli (Doran, Spring, et al., 2007).

### **1.8 Theoretical Framework**

Chiamulera (2004) concluded that smoking behavior is maintained by acting as a primary reinforcer and by enhancing the process of stimuli association, which might explain why nicotine produces and maintains persistent cravings when smokers are exposed to smoking stimuli. The repeated association of an environment and the effects of nicotine will induce a conditioned response in smokers (Rohsenow et al., 1990). Theoretically, the pairing of the environmental cues with smoking may be responsible for cue-reactivity. Rohsenow et al. (1991) reviewed three conditioning models that might explain this phenomenon. First, the *conditioned withdrawal model of relapse* explains that states similar to withdrawal symptoms are the conditioned

response as the result of the association of environmental stimuli with withdrawal symptoms. This model predicts that people will seek nicotine to relieve the states similar to withdrawal symptoms. Second, the *conditioned compensatory response model* posits that the association of environmental stimuli (CS) with drug consumption (US) and with the effect of the drug (US) can evoke a conditioned response (CR) that is opposite to the pharmacological effect of the drug even when the drug is not present. Third, the *conditioned appetitive motivational model* speculates that the association between a substance and drug related stimuli will elicit a positive state similar to that experienced when the drug is administered. Hence, the user will seek the drug to experience this positive state. Of these three models, the *appetitive motivational model* has received more empirical evidence. Whether positive or negative affective states hold responsible for the behavioral actions towards the use of a substance, it is clear that cue-reactivity is an important construct to explain relapse or maintenance of substance use (see Rohsenow et al. 1991 for a complete explanation on affective states and drug use).

Thus, the cue-reactivity model would generally predict that smoking cues in smoking advertisements will elicit cravings. However, not only can cues elicit cravings in smoking advertisements, but the cue-reactivity model would also predict that smoking cues in antismoking advertisements will elicit cravings as well at comparable levels to smoking advertisements. Nonetheless, the latter assumption has not been as widely researched as the former; thus, insufficient information exists on the effect of smoking cues used in antismoking messages. Moreover, cue-reactivity has not been addressed in LITS as it has been in heavy smokers, resulting in limited information on how robust cue-reactivity is across different types of smokers.

## **1.9 Smoking and the Media**

Exposure to smoking cues in the environment is granted since tobacco is a legal substance that can be readily available and is widely advertised through different means (Peters et al., 2006). Indeed, tobacco advertisement has been associated with smoking behavior (Choi, Ahluwalia, Harris, & Okuyemi, 2002; López et al., 2004). In contrast, antismoking campaigns' effectiveness in reducing smoking has been inconclusive (Leshner & Cheng, 2009). Therefore, effective antismoking campaigns are needed to have an impact on smoking prevalence.

Interestingly, some antismoking campaigns use images such as cigarettes and other smoking stimuli (e.g., cigarette packs, people smoking, and ashtrays) that theoretically and unintentionally might elicit cravings. As a matter of fact, there is evidence that video advertisements targeted to smoking cessation and treatment that include smoking cues can elicit cravings in smokers (Kang, Cappella, Strasser, & Lerman, 2009). Thus, it is important to examine how antismoking media campaigns and advertisements affect LITS. Even though cue-reactivity has been extensively researched using different modalities and types of stimuli, there has not yet been a study that compares smoking pictorial stimuli with antismoking pictorial stimuli to assess cue-reactivity in LITS.

## **1.10 The Current Study**

One purpose of this study is to explore if smoking pictorial cues promote cue-reactivity in LITS, which has not been explored before. The second purpose is to assess whether impulsivity serves as a moderator of craving levels when participants are exposed to smoking stimuli. The hypotheses for this study are that (a) there will be no differences in terms of cravings for smoking and antismoking pictorial stimuli since such stimuli should be theoretically similar; (b) neutral stimuli will produce fewer cravings than both smoking and antismoking stimuli as has

been consistently reported in previous studies; and (c) impulsivity will increase the strength of the relationship between cue-reactivity and craving levels.

## Chapter 2: Method

### 2.1 Participants

In previous studies light smokers have been defined as individuals who smoke fewer than 10 cigarettes per day (e.g., Ahluwalia et al., 2006; Okuyemi et al., 2002) and intermittent smokers have been defined as individuals smoking weekly, but not daily (e.g., Trinidad et al., 2009). Thus the smoking inclusion criteria were to have smoked at least one cigarette in the past week but fewer than 10 cigarettes per day. One hundred seventy-five smokers were recruited for participation; however, 20 participants did not meet the inclusion criteria (i.e., they smoked more than 10 cigarettes per day or less than one cigarette per month) at the time of survey completion. Thus, data from 155 light and intermittent smokers at the University of Texas at El Paso recruited through Experimetrix and Sona Systems for Introduction to Psychology course credit were used.

The sample size was based on an a priori power analysis based on the findings from Stritzke, Breiner, Curtin, and Lang (2004). The small effect presented in Stritzke's article was chosen to provide the most conservative estimate of sample size necessary to detect an effect in the proposed study. For neutral cues examined relative to smoking cues, a moderate sized effect was observed ( $F(4,730) = 11.13, p < .001, \eta^2 = .06$ ). This translates to an  $f$  of .253. This value was used to estimate the point effect of condition in a one-way analysis of variance with 3 groups,  $\alpha = .05$  and  $1-\beta = .80$ . Based on these calculations, a required sample size of approximately 160 individuals is necessary to observe a moderate effect size.

### 2.2 Measures

Participants were assessed via paper and pencil questionnaires (see Appendix A). The measures selected for this study are the following:

Demographic questionnaire: Information about age, gender, level of education, marital status, ethnicity, and history of past mental health services were assessed.

Tobacco use behavior and attitude survey: Information about current smoking behavior, age of first use, use of other tobacco products, history of past quit attempts, cessation-related weight concern, type of preferred cigarettes, interest in quitting tobacco, reasons to quit smoking, smoking attitudes, cessation aids during quit attempts, and number of hours since last cigarette smoked were assessed. This survey has been used in multiple past studies (e.g., Rodríguez-Esquivel et al., 2009).

The Fagerström Test of Nicotine Dependence: The FTND is a one-dimensional, 6-item questionnaire which was adapted from The Fagerström Tolerance Questionnaire (FTQ; Fagerström, 1978). The FTND assesses the degree of dependence on nicotine (FTND; Heatherton, Lynn, Frecker, & Fagerström, 1991). The questions included in the FTND are the (a) time elapsed between waking up and smoking the first cigarette, (b) difficulty in abstaining from smoking in forbidden places, (c) cigarette that would be most difficult to give up, (d) number of cigarettes smoked per day, (e) if more cigarettes are smoked after waking or during the rest of the day, and (f) if cigarettes are smoked even during illness. The lowest attainable score for the FTND is 0, while the highest attainable score is 10. Higher scores indicate higher levels of nicotine dependence. The FTND has shown acceptable levels of internal consistency and associations to biochemical indices of smoking (Heatherton et al., 1991) and psychological dependence measures (Dijkstra & Tromp, 2002).

Questionnaire of Smoking Urges-Brief: The QSU-Brief is intended to measure urges and cravings to smoke. This instrument is based on the Questionnaire of Smoking Urges (QSU; Tiffany & Drobes, 1991). The intention of the brief version was to provide a more effective and

simpler way to administer the QSU while maintaining the most robust items from the original instrument (Toll, Katulak, & McKee, 2006). It has been suggested that the inclusion of the items with the highest factor loadings from the original QSU to present psychometric improvement of the instrument (Kozlowski, Pillitteri, Sweeney, Whitfield, & Graham, 1996). Two factors of the measure have been demonstrated in previous studies (e.g., Toll et al., 2006; Toll, McKee, Krishnan-Sarin, & O'Malley, 2004; Cox, Tiffany, & Christen, 2001): Factor 1, intention and desire to smoke, and Factor 2, relief of negative affect. Respondents rate on a scale from 1 to 7 how strongly they agree or disagree with the items. Scores range from 7 to 70 with higher scores connoting greater urge/craving. Both factors have demonstrated high levels of internal consistency (Factor 1,  $\alpha = .91$ ; Factor 2,  $\alpha = .80$ , as has the overall measure ( $\alpha = .92-.97$ ) (Cox et al., 2001).

Barratt Impulsiveness Scale: The BIS version 11 is a 30-item self report measure of impulsivity (BIS-11; Patton, Stanford, & Barratt, 1995). The items are responded to on a 4-point scale (*rarely/never, occasionally, often, almost always/always*) with scores ranging from 30 to 120 where higher scores denote higher levels of impulsiveness. The measure has three subscales, which include "Attentional Impulsiveness," "Motor Impulsiveness," and "Non-planning Impulsiveness." The BIS has been normed both in undergraduate student and clinical populations and has shown adequate internal consistency (e.g., Cronbach's  $\alpha = .82$ ) for undergraduate students (Patton et al., 1995). This instrument has been used with smokers in studies assessing how impulsivity contributes to the maintenance of tobacco smoking (e.g., VanderVeen, Cohen, Cukrowicz, et al., 2008) and cravings experienced after exposure to smoking cues (Doran, Spring, et al., 2007).

### **2.3 Apparatus**

Pictorial stimuli was presented through a Dell Optiplex 760 computer with a Dell VGA Ultrasharp 17" model 1708FP monitor with a 1280 x 1024 resolution at 60Hz image refreshing rate and an 800:1 contrast ratio.

### **2.4 Stimuli**

Three different stimuli were presented on the computer screen with four pictures being included in each set of stimuli; namely, smoking stimuli, antismoking stimuli, and neutral stimuli. First, the pictures selected for smoking stimuli were based on the Carter et al. (2006) study in which the psychometric properties were evaluated for twelve different pictures portraying cigarettes, smoking paraphernalia, and social situations in which individuals were displayed smoking cigarettes. Even two of the pictures used in Carter et al. (2006) with the highest craving means had strong internal consistency with a Cronbach's alpha ranging from .89 to .91 suggesting that even two pictures can be used for craving assessment in smokers. Since the proposed study explored the level of cravings in light smokers, four similar pictures, instead of two, were used (see Appendix B). Second, the pictures used for antismoking stimuli were selected from the internet (i.e., the universal no smoking sign) and from antismoking media campaigns that have used images to promote smoking cessation (see Appendix C). Third, the pictures used for neutral stimuli were extracted from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2008). This system was developed to provide standardized pictorial stimuli to rate emotion and attention. The pictures selected from the IAPS have shown to be neutral in terms of affectivity or arousal. The neutral pictures used from the IAPS were pictures 7150, 7190, 7235, and 7950 (see Appendix D). To counterbalance stimuli presentation, pictures were randomly presented to participants.

## **2.5 Procedure**

IRB approval was obtained for this study. Participants were recruited through Experimatrix and Sona Systems and received 1 hour credit as part of their Introduction to Psychology course requirements. Upon arrival, participants completed the consent process. Afterward, the participants were randomly assigned to one of three conditions according to the stimuli previously described (i.e., smoking stimuli, antismoking stimuli, and neutral stimuli). Pictorial stimuli were delivered through Microsoft Power Point 2007 on a computer screen. Each participant rated his or her urges through the QSU-Brief before exposure to the pictures to assess baseline cravings and also after the exposure of each picture. To replicate the methodology used in Stritzke et al. (2004), the participants were exposed for 6 seconds to each picture and were given 45 seconds to respond the QSU-Brief before the next picture appears automatically on the screen. Next, participants completed the questionnaire packet. At the end, both smoking and antismoking pictures were presented in a sheet of paper to assess participants' understanding of the nature of the stimuli. Once the participants finished, they were debriefed and thanked for their participation. Additionally, participants were encouraged to ask any questions regarding the purpose and hypotheses of this study. To ensure participants' confidentiality, consent forms and surveys were filed separately.

## **2.6 Approach to Analyses**

Descriptive analyses were used to assess participant characteristics. A one-way analysis of variance (ANOVA) was conducted, with smoking cravings as the dependent variable and stimuli condition (i.e., smoking stimuli, quit smoking stimuli, and neutral stimuli) as the independent variable. To test for the third hypothesis and assess for multiple predictors of smoking cravings, a multiple regression analysis was conducted to assess the impact of the

following independent variables on craving: gender, level of impulsivity, level of nicotine dependence, smoking status (i.e., light vs. intermittent smoking), and baseline craving levels.

To examine how impulsivity might have moderated stimuli conditions' (smoking vs. antismoking, smoking vs. neutral) impact on craving, moderation analysis was used (Fairchild & MacKinnon, 2009; MacKinnon & Luecken, 2008). Before conducting the analysis, continuous variables were centered. The variable of cigarettes per month was not normally distributed; thus, a log transformation was used in this variable before centering. The resulting covariate had an appropriate distribution for multivariate linear regression analyses. To address heteroskedasticity, robust standard errors were calculated in the model. Both baseline cravings and cigarettes per month served as control variables for the moderation analysis. The dependent variable was cue-elicited cravings; the predictor variable was stimuli (antismoking and neutral stimuli were compared relative to smoking stimuli); the moderator variable was impulsivity (i.e., mean BIS score). Also, the moderation model was compared to a nested model that did not contain interaction terms. This comparison facilitated the evaluation of whether the additional interaction terms contributed to an explanation of the variance above what could be accounted for by an additive model. Model comparisons were made by a nested comparison  $F$  statistic of  $R^2$  values, the Akaike Information Criterion (AIC), and the Bayesian Information Criterion (BIC).

## Chapter 3: Results

### 3.1 Participant Characteristics

Participant characteristics for categorical and continuous variables are presented in Table 3.1. The mean age of participants was 20.96 years of age ( $SD = 4.14$ ) and 52.3% were female. One-hundred twenty-eight (82.6%) participants self-identified as Hispanic. Approximately, 43% of participants reported being light smokers, while 57% reported being intermittent smokers. On average, participants reported smoking 2 cigarettes per day (cpd) ( $M = 2.39$ ,  $SD = 2.18$ ), an average of 18 days of smoking in the past 30 days ( $M = 18.47$ ,  $SD = 9.912$ ), and low levels of nicotine dependence (FTND;  $M = 1.06$ ,  $SD = 1.20$ ). Eighty-seven percent of participants had tried to quit smoking for 24 hours at least once. Half of the participants had been able to quit smoking at least for a month in their longest quit attempt, and approximately 86% of the participants were at least a little interested in quitting smoking. The mean age of smoking initiation was approximately 16 years old ( $M = 15.76$ ,  $SD = 2.14$ ). Participants reported a mean of pre-stimuli exposure (i.e., baseline) cravings of 27.83 ( $SD = 12.26$ ) and mean post-exposure cravings scores of 28.27 ( $SD = 12.27$ ). Scores on impulsivity were relatively high ( $M = 71.06$ ,  $SD = 9.15$ ).

Table 3.1. Participant characteristics and differences between light and intermittent smokers (N = 155)

Category	N	%	Intermittent	Light	<i>p</i>
Stimuli					.534
Smoking	43	27.7	26	17	
Anti-smoking	62	40.0	35	27	
Neutral	50	32.3	27	23	
Gender					.749
Male	74	47.7	43	31	
Female	81	52.3	45	36	
Marital status					.874
Single	129	83.2	73	56	

Married	12	7.7	6	6	
Divorced	6	3.9	4	2	
Separated	1	0.6	1	0	
Living with someone	7	4.5	4	3	
Ethnicity					.164
Mexican National	14	9.0	5	9	
Mexican American	100	64.5	61	39	
Other Hispanic/Latin ethnic group	23	14.8	16	7	
White	10	6.5	3	7	
African American	2	1.3	1	1	
Asian American	1	0.6	0	1	
Native American	1	0.6	0	1	
Other	4	2.6	2	2	
Mental health services					.632
None	125	80.6	73	52	
Substance abuse	3	1.9	1	2	
Depression	9	5.8	4	5	
Anxiety	1	0.6	1	0	
PTSD	4	2.6	3	1	
Schizophrenia	1	0.6	0	1	
Other	12	7.7	6	6	
<b>Smoking status</b>					<b>&lt; .001</b>
Between 5 and 10 cpd	26	16.8	0	26	
Less than 5 cpd	41	26.5	0	41	
Weekly but not everyday	83	53.5	83	0	
Monthly but not weekly	5	3.2	5	0	
Type of cigarette					.663
Regular	34	21.9	17	17	
Lights	29	18.7	17	12	
Ultralights	3	1.9	2	1	
Menthol	25	16.1	11	14	
Menthol lights	9	5.8	6	3	
Other	4	2.6	3	1	
Multiple types	51	32.9	32	19	
Quitting smoking attempts					.757
None	20	12.9	11	9	
Once	17	11.0	8	9	
Twice	19	12.3	13	6	
Three times	8	5.2	4	4	
More than three times	91	58.7	52	39	
Abstinence <sup>a</sup>					.164
Never	21	13.5	11	10	

One day	2	1.3	1	1		
More than a day but less than a week	9	5.8	3	6		
One week	18	11.6	9	9		
More than a week but less than a month	26	16.8	13	13		
1 to 3 months	36	23.2	21	15		
4 to 6 months	15	9.7	14	1		
6 to 12 months	11	7.1	7	4		
More than one year	16	10.3	8	8		
Missing	1	0.6				
Interest in Quitting					.859	
Not at all	20	12.9	11	9		
A little	31	20.0	17	14		
Some	57	36.8	35	22		
A lot	23	14.8	13	12		
Very much	23	14.8	27	67		
Missing	1	0.6				
Continuous Variable	Mean	SD	Intermittent mean	Light mean	<i>p</i>	95% CI
Age	20.96	4.14	20.70	21.30	.404	[-2.00, 0.81]
<b>cpd<sup>b</sup></b>	<b>2.39</b>	<b>2.18</b>	<b>1.02</b>	<b>3.99</b>	<b>&lt; .001</b>	<b>[-3.34, -2.22]</b>
<b>Days smoking in the past 30 days<sup>c</sup></b>	<b>18.47</b>	<b>9.912</b>	<b>12.17</b>	<b>27.08</b>	<b>&lt; .001</b>	<b>[-16.93, -12.90]</b>
Age first smoke	15.76	2.14	15.76	15.75	.983	[-0.69, 0.71]
<b>Baseline cravings</b>	<b>27.83</b>	<b>12.26</b>	<b>25.09</b>	<b>31.42</b>	<b>.002</b>	<b>[-10.21, -2.45]</b>
<b>Post-exposure cravings</b>	<b>28.27</b>	<b>12.75</b>	<b>24.69</b>	<b>32.94</b>	<b>&lt; .001</b>	<b>[-12.29, -4.28]</b>
BIS	71.06	9.15	70.52	71.76	.407	[-4.18, 1.70]
<b>FTND</b>	<b>1.06**</b>	<b>1.20</b>	<b>0.65</b>	<b>1.60</b>	<b>&lt; .001</b>	<b>[-1.33, -0.56]</b>

Note. cpd = cigarettes per day; BIS = Barratt Impulsiveness Scale; FTND = Fagerstrom Test of Nicotine Dependence. Significant *ps* are in **bold**.

<sup>a</sup>Participants that did not report quit attempts were excluded from the count

<sup>b</sup>*n* = 146

<sup>c</sup>*n* = 151

As expected, differences in smoking status, cpd, days smoking in the past 30 days, baseline cravings scores, mean post-exposure cravings, and nicotine dependence between light and intermittent smokers were observed. Light smokers smoked significantly more cpd ( $t(144) = -9.82, p < .001$ ), smoked more days in the past 30 days ( $t(145) = -15.70, p < .001$ ), reported

higher cravings at baseline ( $t(153) = -3.28, p = .001$ ) and post-exposure cravings ( $t(153) = -4.22, p < .001$ ), and had higher nicotine dependence scores ( $t(153) = -5.28, p < .001$ ) relative to intermittent smokers. These differences support the notion that light smokers differ in terms of smoking characteristics (i.e., frequency) and nicotine dependence relative to intermittent smokers.

### **3.2 Differences in Cravings across Stimuli**

No differences in terms of smoking status (i.e., intermittent vs. light smoking) ( $\chi^2(2) = .398, p = .819$ ), cigarettes per day ( $F(2, 143) = .478, p = .621$ ), and baseline cravings ( $F(2, 152) = .489, p = .614$ ) were observed among the three stimuli conditions. To test the first and second hypotheses, a one way ANOVA was conducted with cravings as the dependent variable and stimuli condition as the independent variable. Smoking stimuli produced the highest craving scores ( $M = 31.92, SD = 15.35$ ), followed by antismoking stimuli ( $M = 27.29, SD = 10.14$ ), and neutral stimuli ( $M = 26.33, SD = 12.81$ ). Univariate analysis revealed that cravings after stimuli exposure were significantly different among the three stimuli conditions when controlling for baseline craving scores, with a moderate effect size ( $F(2, 151) = 4.23, p = .016, \eta^2 = .05$ ). More specifically, smoking stimuli had significantly higher craving scores relative to antismoking stimuli ( $SE = 1.40, 95\% CI [1.064, 6.60], p = .007$ ) and neutral stimuli ( $SE = 1.47, 95\% CI [.057, 6.39], p = .019$ ). No differences in cravings between antismoking stimuli and neutral stimuli ( $SE = 1.34, 95\% CI [-2.30, 3.01], p = .793$ ) were observed (see Figure 3.1).

Figure 3.1. Estimated Means of Cravings across Stimuli

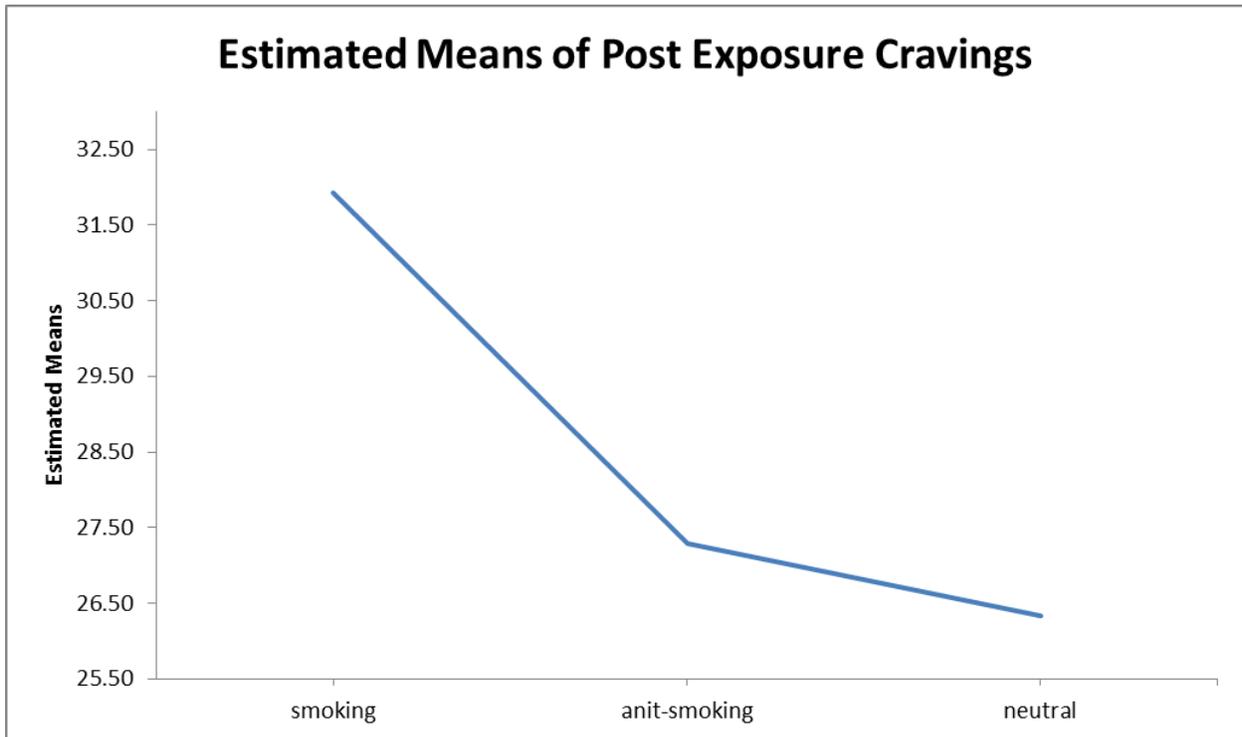


Figure 3.1. Estimated Means of Cravings across Stimuli. Covariates appearing in the model are evaluated at the following values: BaseCrave (baseline cravings) = 27.8258

### 3.3 Predictors of Smoking Cravings

To test the third hypothesis, a multiple regression analysis was performed including smoking cravings as the dependent variable and gender, impulsivity, nicotine dependence, smoking status, and baseline cravings as the independent variables. This model was statistically significant and explained 71% of the variance according to the adjusted  $R^2$  that controls for the number of predictors ( $F(5, 149) = 75.250, p < .001, R^2_{\text{adj}} = .707$ ). Table 3.2 shows the results of the multiple regression analysis. When controlling for nicotine addiction, gender ( $\beta = .100, p = .028$ ) and baseline cravings ( $\beta = .762, p < .001$ ) demonstrated statistically significant associations, such that female gender and higher baseline cravings significantly predicted higher smoking cravings after stimuli exposure. Additionally, there was a significant difference in

baseline ( $t(153) = -2.412, p = .017$ ) and post-exposure cravings ( $t(153) = -3.037, p = .003$ ) between males and females, such that females demonstrated higher cravings in both instances. Smoking status (i.e., being a light or intermittent smoker) ( $\beta = .084, p = .084$ ), impulsivity ( $\beta = .058, p = .212$ ), and nicotine addiction ( $\beta = .093, p = .068$ ) were not significant in the model. Collinearity statistics for predictors were performed. Tolerance values (.738 - .940) and Variance Inflation Factor (VIF) values ( $< 10$ ) indicated the absence of multicollinearity among predictors.

Table 3.2. Predictors of smoking cravings in LITS

IV	$\beta$	<i>B</i>	<i>SE</i>	<i>t</i>	<i>p</i>	95% CI	
						<i>LL</i>	<i>UL</i>
Gender	.100	2.540	1.145	2.219	<b>.028</b>	.279	4.802
BIS	.058	.081	.064	1.254	.212	-.046	.208
FTND	.093	.991	.539	1.839	.068	-.074	2.056
Smoking Status	.084	2.165	1.246	1.738	.084	-.297	4.627
Baseline cravings	.762	.792	.048	16.414	<b>.000</b>	.697	.887

*Note.* *CI* = Confidence Interval; *SE* = Standard Error; *LL* = Lower Limit; *UL* = Upper Limit; BIS = Barratt Impulsiveness Scale; FTND = Fagerstrom Test for Nicotine Dependence. Significant *ps* are in **bold**.

### 3.4 Moderation Analysis

Moderation analysis was performed to test if impulsivity moderated the relationship between stimuli condition and cravings. Model fit statistics are presented in Table 3.3 for both the moderation model and the nested model that did not contain interaction terms. Both the AIC and BIC suggest that the moderation model is of better fit to the data than the nested model lacking interaction terms. Additionally, a comparison of the two models in terms of variance accounted for suggests that the moderation model fits the data better than the nested model that did not contain interactions ( $F(1, 145) = 4.90, p < .05$ ), meaning that impulsivity moderates craving within smoking stimulus condition. Estimates from the moderation model ( $F(7, 138) =$

64.81,  $p < .001$ ,  $R^2 = .72$ ), are presented in Table 3.4. Because of the difficulty in interpretation of coefficients in moderation models, estimates from the model are plotted in Figure 3.2. As can be seen from the figure, the slope for the smoking stimulus is steepest. Analysis of the simple slopes reveals that the anti-smoking and neutral stimuli do not differ from each other in promoting craving ( $F(1, 138) = .01$ ,  $p > .91$ ). This is in line with the substantial overlap in CIs that can be seen by viewing the neutral and anti-smoking panels of Figure 3.2. In contrast, the smoking stimulus slope is significantly stronger than both the neutral stimulus ( $F(1, 138) = 10.12$ ,  $p < .01$ ) and the anti-smoking stimulus ( $F(1, 138) = 10.34$ ,  $p < .01$ ) simple slopes.

Table 3.3. Moderation models for cravings and impulsivity

Model	$R^2$	AIC	BIC
Nested Model (no interaction terms)	0.70	1392.06	1409.96
Full Model (moderation model)	0.72	1385.97	1409.84

*Note.* Nested model comparison,  $F(1, 145) = 4.90$ ,  $p < .05$

Table 3.4. Moderation of stimulus by impulsivity level

Outcome: Post-Crave	$\beta$	$B$	$SE$	$p$	95% CI	
					$LL$	$UL$
<b>Cigarettes per month (ln)</b>	<b>0.11</b>	<b>5.27</b>	<b>2.40</b>	<b>&lt; .05</b>	<b>0.54</b>	<b>10.01</b>
<b>Baseline Craving (centered)</b>	<b>0.74</b>	<b>3.08</b>	<b>0.21</b>	<b>&lt; .001</b>	<b>2.65</b>	<b>3.50</b>
<b>Impulsivity (centered)</b>	<b>0.25</b>	<b>1.37</b>	<b>0.43</b>	<b>&lt; .01</b>	<b>0.51</b>	<b>2.22</b>
Stimuli (ref. is smoking)						
<b>Anti-Smoking</b>	<b>-0.17</b>	<b>-17.32</b>	<b>5.84</b>	<b>&lt; .01</b>	<b>-28.87</b>	<b>-5.77</b>
<b>Neutral</b>	<b>-0.17</b>	<b>-18.24</b>	<b>5.63</b>	<b>&lt; .001</b>	<b>-29.37</b>	<b>-7.11</b>
Interaction Terms						
<b>Anti-Smoking by Impulsivity</b>	<b>-0.20</b>	<b>-1.72</b>	<b>0.59</b>	<b>&lt; .01</b>	<b>-2.89</b>	<b>-0.56</b>
Neutral by Impulsivity	-0.03	-0.26	0.59	0.66	-1.44	0.92
Model Constant		<b>13.10</b>	<b>4.49</b>	<b>&lt; .01</b>	<b>4.22</b>	<b>21.97</b>

*Note.* Bold are  $p < .05$

Figure 3.2. Impulsivity Slopes by Stimuli

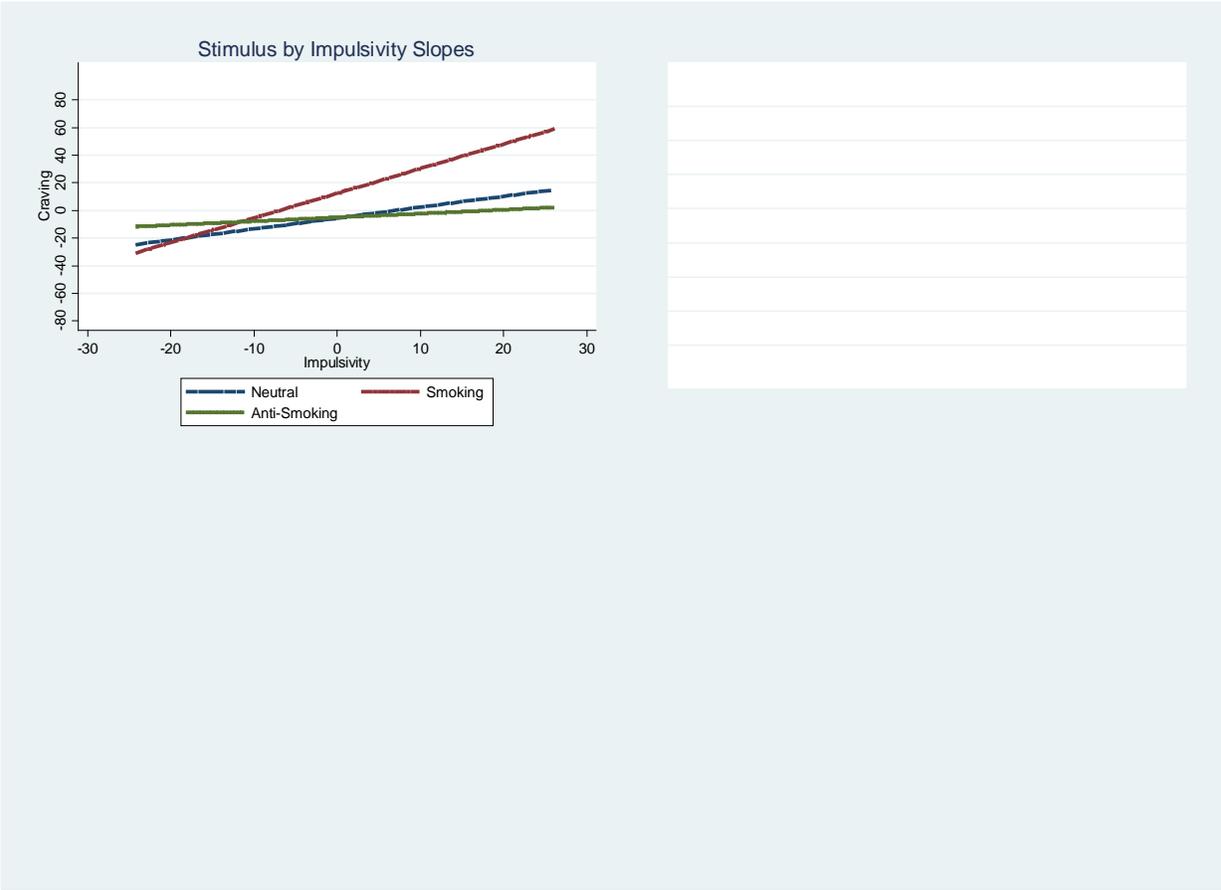


Table 3.5. Count and proportion of correct evaluation of pictorial stimuli

Picture	Description	Stimuli	<i>n</i>	%
1	Cigarette and ashtray	Smoking	148	95.5
2	Gun and cigarettes	Antismoking	151	97.4
3	No smoking sign	Antismoking	147	94.8
4	Young male smoking	Smoking	146	94.2
5	Beer and cigarette	Smoking	140	90.3
6	Ash with crawling human figure	Antismoking	144	92.9
7	Smoke resembling a gun	Antismoking	138	89.0
8	Cigarette and coffee	Smoking	151	97.4

*Note.*  $N = 155$ .  $n$  = Number of participants who answered correctly when evaluating the nature of each picture.

## Chapter 4: Discussion

The aims of the present study were to assess the effect of smoking and antismoking stimuli in cravings and the moderation relationship of impulsivity on cue-reactivity. Consistent with hypotheses, cravings associated with smoking stimuli were significantly higher relative to neutral stimuli. This extends previous study findings suggesting that among all smokers, smoking stimuli elicit cravings (Field & Duka, 2004; Rohsenow et al., 1990). More specific to low level smokers, Knott et al. (2008) observed brain imaging indicators that demonstrate that LITS experience more cravings to smoking cues relative to neutral cues. Thus, even minimal smoking stimuli can powerfully affect cravings even in low level smokers.

Inconsistent with hypotheses, antismoking stimuli did not significantly elicit cravings to the extent of smoking stimuli or greater than neutral stimuli. These results suggest that environmental cues and smoking behavior may promote cue-reactivity when cues are presented in a positive light relative to their presentation in a more negative antismoking message. It is possible that characteristics of implicit antismoking messages may distract people from attending to smoking cues or may be encoded first, further suppressing cravings. For example, Kang et al. (2009) observed that antismoking messages that had a weak argument, rather than a strong argument against smoking, elicited increases in cravings. Additionally, in a study by Leshner and Cheng (2009), participants spent more time encoding antismoking messages that depicted health consequences, further helping the processing of antismoking messages. Hence, antismoking advertisements with smoking cues can be expected to be effective in suppressing cue-reactivity if the antismoking message is strong. The antismoking pictures used in this study seemed to contain a strong antismoking message; however, future studies may wish to pre-test stimuli more rigorously, compare weak and strong antismoking messages, compare pure

smoking stimuli with stimuli embedding written antismoking messages, and/or compare within antismoking messages the presence or absence of cues to further the understanding of antismoking cue-reactivity in light and intermittent smokers.

#### **4.1 Predictors of Cravings**

Females reported higher cravings at baseline and post-exposure stimuli relative to males. Biological characteristics of females and specific tobacco industry targeting could be partially responsible for such a disparity. These findings are consistent with previous studies in which women have reported more cravings than men without being exposed to stimuli (Dickmann, Mooney, Allen, Hanson, & Hatsukami, 2009) and after being exposed to smoking cues (Field & Duka, 2004). Similarly, Knott et al. (2008) found that women scored higher in the relief component of cravings compared to males when exposed to smoking cues. Another study found that women experienced more cravings when presented with smoking cues only when they were not deprived from smoking (Heishman, Lee, Taylor, & Singleton, 2010). Not only do women report more cravings when exposed to smoking, but they also have more problems (Bohadana, Nilsson, Rasmussen, & Martinet, 2003) and different challenges in cessation efforts (Fiore et al., 2008) perhaps due, in part, to cue-reactivity. Indeed, the relationship between smoking and gender has been recognized as a complex one (Richardson et al., 2007). Previous research has proposed that gender differences in baseline cravings may be related to use of hormonal contraceptives (Dickmann et al., 2009), while gender differences in cue-reactivity may be related to biological variables such as hormonal changes (Gray et al., 2010). Yet, this relationship could also be affected by tobacco advertisement targeting women (Carpenter, Wayne, & Connolly, 2005). Since 1950, the death rate of women due to lung cancer – which is related to smoking – has increased 600%, and in 2000 lung cancer accounted for 25% of all female cancer deaths

(Satcher, 2002). Interestingly, it has been reported that the tobacco industry has historically targeted women with appealing cigarette products since the 1950's and 1960's (American Heart Association, 2011; Boyd, Boyd, & Cash, 1999). For instance, in the present study 79.3% of those who preferred light cigarettes, and 68% of those who preferred menthol cigarettes were females. These proportions mirror the findings from a review on tobacco company advertisement strategies for females, in which authors identified that the tobacco industry specifically designed low tar and mild flavored cigarettes based on female smoking habits (Carpenter et al., 2005). Evidently, biological variables and smoking cues in advertisements are at least partially responsible for gender disparities in cigarette smoking. Future studies could utilize biopsychosocial models and methodologies to assess the impact of biology (e.g., hormonal fluctuation) and social influence through media on observed gender disparities in cue-reactivity.

In addition to gender, baseline cravings were predictors of cue-elicited cravings. Previous findings from Tolliver et al. (2010) have also evidenced that cue-elicited cravings were strongly and positively correlated with pre-exposure (i.e., baseline) cravings in a study of methamphetamine cue-reactivity. Thus, a good predictor of cravings after being exposed to smoking cues is the cravings that the individual experienced before being exposed to the cues. Perhaps cues potentiate cravings already being experienced by LITS, especially for women, since they reported higher baseline and post-exposure cravings relative to males. Hence, LITS would likely benefit from trigger management techniques (e.g., avoiding, escaping, coping) to reduce cue-induced cravings and further reduce the likelihood of relapse. Future intervention studies should assess this possibility within a randomized, controlled, perspective design.

## 4.2 Impulsivity as a Moderator

Impulsivity moderated the relationship between cravings and stimuli condition, such that smoking stimuli promoted cravings especially for participants higher in impulsivity. Consistent with the present results, previous research has demonstrated that impulsivity is related to higher levels of cravings when exposed to smoking cues (Doran, Cook, McChargue, & Spring, 2009). Notably, Donohew, Lorch, and Palmgreen (1998) have postulated that high sensation seeking (which may be related to impulsivity) individuals respond more positively to high levels of emotional impact than low sensation seekers, possibly because they pay more attention to stimuli that increase their attention (i.e., smoking cues). Additionally, it is important to note that impulsivity predicts smoking (Mitchell, 1999) and relapse (Powell, Dawkins, West, Powell, & Pickering, 2010); thus, smoking stimuli may place groups with higher levels of impulsivity, such as young adults and adolescents, at higher risk of continued smoking and relapse. Unfortunately, young adults between the ages of 18 and 25 have the highest rate of tobacco use (SAMHSA, 2008) and –similarly to women – there is evidence that tobacco advertisements target adolescents (Pierce et al., 1991).

Addressing impulsivity in smoking and other substances both in research and clinical practice is germane. LITS higher in impulsivity attempting to quit smoking would benefit from treatments that address impulsivity, although no empirically-based treatment has been established. Nevertheless, treatment for people high in impulsivity with substance abuse is available and may be useful in treating LITS' impulsivity along with tobacco use. For instance, LITS high in impulsivity may benefit from desensitization to smoking cues (Bütz & Austin, 1993), cognitive restructuring with regard to immediate satisfaction and short-term consequences (Mobini, Pearce, Grant, Mills, & Yeomans, 2006), and/or psychoeducation on healthy coping

skills to cues (Donahue & Grant, 2007). In addition, Motivational Interviewing (MI) (Colby et al., 1998) and Health Education (HE) (Nollen et al., 2006) have been useful in smoking cessation for LITS more generally. While MI strategies would enable the personalization to the smoker of cue-based smoking challenges, HE techniques would promote the normalization of cue-reactivity in low level smokers and provide specific suggestions for change. Finally, it is important to address impulsivity while smoking cessation treatment is in a relapse prevention stage since higher levels of impulsivity predict non-abstinence after smoking cessation treatment (Krishnan-Sarin et al., 2007). Future well controlled and designed assessment and intervention studies are warranted to continue to identify the impact of impulsivity on cravings, smoking, and relapse, as well as reduce impulsivity to increase cessation.

#### **4.3 Implications for Advertisement**

The results of the present study are valuable in informing how to regulate smoking advertisements and to create effective antismoking advertisements. Even though smoking advertisements have been progressively regulated in the media since 1996 by the FDA (Olstad, 2009), they can still be found in some places such as counters at convenience stores, magazines, and brochures. It is evident that smoking advertisements in the aforementioned venues can potentially elicit cravings not only in heavy smokers (Vollstädt Klein et al., 2011) but also in LITS – especially highly impulsive LITS – consequently increasing the likelihood of continued smoking (López et al., 2004) and relapse (Powell et al., 2010). Thus, smoking advertisements continue to pose a threat to public health. Advocacy for further regulation to minimize exposure to smoking advertisements may be critical to reduce smoking and relapse.

In addition, there is evidence that antismoking advertisements are effective in decreasing smoking (M. Siegel, 1998). For instance, antismoking advertisements that depict illness (Biener,

2002) and portray visceral negative smoking messages (Wakefield et al., 2003) are perceived as more effective than advertisements that do not utilize such messages. Interestingly, this effect has been especially true for smokers highly motivated to quit (Biener, McCallum-Keeler, & Nyman, 2000), but not for heavy smokers (Davis, Nonnemaker, Farrelly, & Niederdeppe, 2011), suggesting that antismoking advertisements may be particularly motivating and effective in LITS. Notably, antismoking advertisements and smoking cessation programs can work synergistically to reduce smoking (Farrelly, Niederdeppe, & Yarsevich, 2003; M. Siegel, 1998). Current findings add to this literature suggesting that including smoking cues in antismoking advertisements does not increase cravings in LITS. Nevertheless, the antismoking messages should be strong enough to divert the attention from the smoking cues in antismoking advertisements.

#### **4.4 Limitations**

Study limitations are important to note. First, results may not be generalizable to all smokers. Nevertheless, results and implications can apply to Hispanic college student LITS and potentially to other ethnocultural groups of LITS. Future research can include a representative sample in terms of smoking status and ethnicity to evaluate the generalizability of this effect across different types of smokers and across different ethnic groups. Second, participants in this study self-reported their cravings, and no measures were used to address physiological reactivity to cues. However, previous studies have recognized the advantages of self-report over physiological measures of cravings (Carpenter et al., 2009), concluding that self-report of cravings is valid, more predictive of cravings, and has less noise than physiological measures. To assess if physiological measures predict cravings in LITS, future studies could include heart rate and skin conductance measurements after stimuli exposure of smoking, antismoking, and

neutral stimuli. Third, the possibility that participants were subject to demand characteristics was not addressed in the present study. Previous studies have hypothesized that demand characteristics – cueing participants to behave according to research expectations – could influence research findings at least modestly (e.g., Laney et al., 2008). Thus, Laney et al. (2008) have proposed the Red Herring technique in which researchers deceive participants twice and ask them, from a list of topics, what they think was the real purpose of the study and then measure the differences between the results of participants who reported an accurate vs. a competing explanation of the study. Future studies could distract participants from the main purpose of the study by adding other pictures (e.g., alcohol, food) to each stimuli condition, asking them their opinion of the study, and finally measuring the differences in cravings for accurate and inaccurate guesses of the purpose of the study across smoking and antismoking stimuli.

#### **4.5 Strengths**

Nonetheless, this study has notable strengths. Several studies have addressed cue-reactivity of smoking stimuli, yet only one published article has measured the impact of smoking cues in videos of antismoking campaigns (Kang et al., 2009). Thus, the present study is one of the few emerging studies addressing the impact of unintentional smoking cues in antismoking stimuli on craving elicitation. Moreover, this is the first study to explore cue-reactivity in LITS, whose prevalence is increasing in the face of population-based smoking prevalence decreases (Pierce et al., 2009).

#### **4.6 Future Directions and Conclusions**

While this study's findings suggest avenues for intervention to reduce smoking in LITS, the association between cue-elicited cravings, smoking change, and cessation was not addressed.

An important future direction should explore smoking and smoking cessation in the context of cue-reactivity and impulsivity. For example, self-monitoring diary studies (e.g., Taylor & Cooper, 2010) would promote the assessment of the effect of stimuli exposure on smoking changes in smoking over time, and delayed effects of cue-reactivity; while studies designed to reduce craving responses to cues and reduce impulsivity would assess and promote the efficacy of novel interventions. Moreover, given the dearth of information on the effect of antismoking pictures, future studies could select antismoking stimuli by searching for pictures on the internet that are not only readily identifiable as antismoking pictures, but that also elicit the most hits on the internet search or that are frequently used in commercials, enhancing external validity of stimuli.

Other important implications and future directions include: the continued assessment of the impact of smoking cues in antismoking messages, the assessment of the impact of strength of message in antismoking messages, biopsychosocial studies of gender disparities in cue-reactivity, the incorporation of cue-reactivity paradigms and impulsivity in smoking cessation programs, and the further regulation of smoking advertisements. Such future studies, policy efforts, and novel interventions have the potential to reduce smoking prevalence and promote public health.

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## Appendices

### Appendix A

Participant # \_\_\_\_\_

Stimuli Code: \_\_\_\_\_

#### QSU – Brief

INSTRUCTIONS: Please rate your level of agreement with the following statements using the following scale:

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

**QSU – Brief**

INSTRUCTIONS: After seeing **picture 1**, please rate your level of agreement with the following statements using the following scale:

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

**QSU – Brief**

INSTRUCTIONS: After seeing **picture 2**, please rate your level of agreement with the following statements using the following scale:

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

**QSU – Brief**

INSTRUCTIONS: After seeing **picture 3**, please rate your level of agreement with the following statements using the following scale:

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

**QSU – Brief**

INSTRUCTIONS: After seeing **picture 4**, please rate your level of agreement with the following statements using the following scale:

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

## Tobacco Use Behavior and Attitude Survey

Today's Date: \_\_\_\_\_

How old are you? \_\_\_\_\_

Gender:        \_\_\_\_\_ Male                \_\_\_\_\_ Female

What is your level of education?

- \_\_\_\_\_ Less than high school
- \_\_\_\_\_ High school diploma/GED or equivalent
- \_\_\_\_\_ Some college
- \_\_\_\_\_ College graduate (e.g., B.A., B.S.)
- \_\_\_\_\_ Graduate coursework

I am:

- \_\_\_\_\_ Single (never married)
- \_\_\_\_\_ Married
- \_\_\_\_\_ Divorced
- \_\_\_\_\_ Widow/Widower
- \_\_\_\_\_ Separated
- \_\_\_\_\_ Living with someone

Please indicate the ethnic group(s) to which you belong:

- \_\_\_\_\_ Mexican National                \_\_\_\_\_ Mexican American
- \_\_\_\_\_ Other Hispanic/Latin ethnic group (please specify) \_\_\_\_\_
- \_\_\_\_\_ White                                \_\_\_\_\_ African American
- \_\_\_\_\_ Asian American                \_\_\_\_\_ Native American
- \_\_\_\_\_ Other (please specify) \_\_\_\_\_

## Tobacco Use Behavior and Attitude Survey

Have you ever received Mental Health Services (counselor, psychologist, or psychiatrist)?

\_\_\_\_\_ Yes      \_\_\_\_\_ No

If **yes**, what conditions

were you treated for?

\_\_\_\_\_ Substance Abuse

\_\_\_\_\_ Depression

\_\_\_\_\_ Anxiety

\_\_\_\_\_ Post Traumatic Stress Disorder

\_\_\_\_\_ Schizophrenia

\_\_\_\_\_ Other (please describe) \_\_\_\_\_

What is your smoking status?

\_\_\_\_\_ I smoke daily and more than 10 cigarettes per day

\_\_\_\_\_ I smoke daily more than 5 cigarettes but less than 10 cigarettes per day

\_\_\_\_\_ I smoke daily but less than 5 cigarettes per day

\_\_\_\_\_ I smoke weekly but not every day

\_\_\_\_\_ I smoke monthly but not weekly

\_\_\_\_\_ I no longer smoke at all, but in the past I smoked \_\_\_\_\_ cigarette(s) per day;

\_\_\_\_\_ I no longer smoke at all, but in the past I smoked weekly but not daily

\_\_\_\_\_ I have smoked a cigarette or a few cigarettes, just to try it

\_\_\_\_\_ I have never smoked before, not even a puff

How many cigarettes do you smoke per day on average?

\_\_\_\_\_ Number of cigarettes per day (20 cigarettes in a pack)

In the last 30 days, how many **days** have you smoked?

\_\_\_\_\_ Number of days (please write your best estimate, even if it's just a puff)

### Tobacco Use Behavior and Attitude Survey

On the days that you smoked, about how many cigarettes did you smoke per **day**?

\_\_\_\_\_ Number of cigarettes per day (please state your best estimate)

Do you smoke cigars? \_\_\_\_\_ Yes    If so, how many per week? \_\_\_\_\_  
\_\_\_\_\_ No

Do you use dip? \_\_\_\_\_ Yes    If so, how much per week? \_\_\_\_\_  
\_\_\_\_\_ No

Do you use chew? \_\_\_\_\_ Yes    If so, how much per week? \_\_\_\_\_  
\_\_\_\_\_ No

Do you use hookah? \_\_\_\_\_ Yes    If so, how much per week? \_\_\_\_\_  
\_\_\_\_\_ No

At what age did you first smoke, even if it was a puff? \_\_\_\_\_

For how many years have you smoked at least one cigarette per day? \_\_\_\_\_

What type of cigarettes do you usually smoke?

_____ Regular	_____ Menthol
_____ Lights	_____ Menthol lights
_____ Ultralights	_____ Menthol ultralights
_____ Rolled cigarettes	_____ Other: (please specify): _____

Have you ever changed this type of cigarette?

\_\_\_\_\_ Yes                      \_\_\_\_\_ No

If so, for how long have you smoked your present brand? \_\_\_\_\_

### Tobacco Use Behavior and Attitude Survey

How many times have you intentionally stopped smoking cigarettes for at least one day?

- None
- Once
- Twice
- Three times
- More than three times

When is the last time you tried to quit smoking? (e.g., a week ago, etc.) \_\_\_\_\_

Think of the longest time you quit tobacco. For how long did you stop?

- I have never quit
- One day
- More than a day but less than a week
- One week
- More than a week but less than a month
- 1 to 3 months
- 4 to 6 months
- 6 to 12 months
- More than one year

During your longest quit attempt, did you gain weight?  Yes  No

If yes, how much weight did you gain? \_\_\_\_\_ pounds

### Tobacco Use Behavior and Attitude Survey

In attempts to quit tobacco, have you ever used (check all that apply):

- |  |   |
|--|---|
| <input type="checkbox"/> Nicotine patch                | <input type="checkbox"/> Nicotine gum         |
| <input type="checkbox"/> Nicotine inhaler              | <input type="checkbox"/> Nicotine nasal spray |
| <input type="checkbox"/> Cold turkey                   | <input type="checkbox"/> Slowly cutting back  |
| <input type="checkbox"/> Zyban (Bupropion, Wellbutrin) |   |

- How interested are you in stopping smoking?
- |                                       |
|---------------------------------------|
| <input type="checkbox"/> Not at all   |
| <input type="checkbox"/> A little     |
| <input type="checkbox"/> Some         |
| <input type="checkbox"/> A lot        |
| <input type="checkbox"/> Very much so |

If you decide to quit tobacco, why would you consider quitting? (check all that apply)

- Personal choice
- Health
- Person close to me wants me to (wife, child, friend, etc.)
- Tobacco is expensive
- My faith
- Other \_\_\_\_\_

When did you smoke your last cigarette? (e.g., 2 days ago, 4 hours ago, etc.) \_\_\_\_\_

**FTND**

How soon after you wake up do you smoke your first cigarette?

- 5 minutes or less
- 6 to 30 minutes
- 31 to 60 minutes
- Over 60 minutes

Is it hard for you to not smoke in places where it is not allowed like in church, at the library, or at the movies?

- Yes
- No

Which cigarette would you hate to give up the most?

- The first one of the day
- Other: \_\_\_\_\_

How many cigarettes per day do you smoke?

- 10 or less
- 11 to 20
- 21 to 30
- 31 or more

Do you smoke more when you first wake up than during the rest of the day?

- Yes
- No

Do you smoke even when you are so sick that you are in bed most of the day?

- Yes
- No

## Barratt Impulsiveness Scale

INSTRUCTIONS: Please rate how often do you do each of the following by putting an **X** on the box that corresponds to your answer:

	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.				
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 problem 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 B

### Smoking Stimuli



404



411



414



415

## Appendix C

### Anti-Smoking Stimuli



## Appendix D

### Neutral Stimuli



7150



7190



7235



7950

