

Evidence for the Incentive Sensitization Model of Addiction in Adolescent Smokers

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
BQSU	Brief Questionnaire on Smoking Urges
DSM	Diagnostic and Statistical Manual of Mental Disorders
HLM/MLM	Hierarchical Linear Modeling
IS	Incentive-Sensitization Theory of Addiction
IV	Intravenous
NDSS	Nicotine Dependence Syndrome Scale
SSE	Subjective Smoking Experiences – Current

SUMMARY

The Incentive Sensitization Theory of Addiction (I-S) was first proposed by Robinson and Berridge in 1993, and since then has garnered support in a variety of drugs of abuse. The theory postulates that over time and repeated administration, and through learning processes, drugs of abuse produce incremental and measurable changes within the mesolimbic dopaminergic system, which manifests as increases in appetitive behavior (“wanting”). Interestingly, these changes may occur independently from systems that regulate the hedonic evaluation of the substance (“liking”). This process results in a growing dissociation over time between an individual’s ratings of “liking” and “wanting”, and that this dissociation may be predictive of maladaptive substance use. A number of issues have prevented researches from examining this theory within the context of cigarette smoking, chiefly that adults have already reached a ceiling in terms of “wanting” and that the variance in measured “liking” has already been lost. This study attempted to lend support for the I-S model within a population of adolescent smokers, and found that early on in the course of cigarette use, ratings of “liking” were associated with cigarette consumption, but over time, “wanting” was the only factor that was predictive of use. Future directions include more nuanced measures of the pleasure effects of nicotine as well as “wanting”, and more momentary assessments of these effects to garner a larger, more varied sample.

1. INTRODUCTION

This project addresses the internal factors that may affect the course of an individual's progression from low levels of cigarette smoking to higher levels of cigarette use in the context of nicotine dependence in a community-based adolescent sample. The goal of this study is to model changing subjective feelings of cigarette smoking in adolescents, through changing self-report ratings of "liking" and "wanting", as well as how other subjective variables such as motives and expectancies may influence cigarette-smoking behavior, longitudinally, in an identified high-risk community based sample. University of Michigan researchers Robinson & Berridge's seminal 1993 theory of the progression to substance dependence from substance abuse, known as the "insensitive sensitization model," is uniquely positioned to test these effects on smoking behavior and their changes over time.

Nationwide, tobacco-associated illness costs the American government 192 billion dollars annually in health care and related productivity costs (Federal Trade Commission, 2012). At an individual level, regular smoking increases one's risk for cancer and heart disease, making it one of the leading causes of preventable death in the nation, with 443,000 premature deaths caused annually by smoking in the US alone, and an additional 8.5 million people affected by smoking related illnesses (Centers for Disease Control and Prevention, 2008). In recent years, policy changes have resulted in increased public awareness of these well-validated facts, legislation to prevent tobacco marketing (particularly towards minors), and municipal smoking bans in public places like restaurants. Despite these efforts, however, 18% of 12-18 year olds acknowledge smoking cigarettes in their lifetime (Centers for Disease Control and Prevention, 2010). As such, research addressing the time course of the development of nicotine dependence throughout the critical developmental stage of adolescence proves important for targeting

differential treatment options depending on teens' level of nicotine dependence (i.e. brief intervention strategies for early stage/low risk teens compared to more intensive pharmacological options for severe/high risk teens).

The lifetime prevalence of nicotine dependence is 18% in the United States, and nearly half of the people who have smoked daily for at least one month or more become addicted to nicotine (Center for Disease Control, 2014). Clinically, nicotine dependence is defined by repeated unsuccessful attempts to quit smoking, acute withdrawal symptoms (i.e. irritability, anxiousness), and the inability to refrain from smoking despite concurrent health issues (American Psychiatric Association, 2000). These indicators of nicotine dependence have been well documented and there is a rich literature devoted to describing this behavior in both adolescents and adults (Goodwin, Pagura, Spiwak, Lemeshow, & Sareen, 2011; DiFranza et al., 2000). The development of dependence symptomatology is accelerated in individuals who smoke more often and have a longer time course of smoking (Horn, Fernandes, Dino, Massey, & Kalsekar, 2003). As such, the construct of substance dependence, across varying drugs of abuse, must be adequately addressed.

1.1 Theories of Substance Dependence

There are many different theories that originate from a number of diverse scientific domains that attempt to explain the nature of substance dependence (West, 2001). To enumerate each would be outside the scope of this project, but there are several perspectives that are particularly relevant and related enough to each other and the current project to warrant discussion. The first, the *Negative Reinforcement Model* of drug motivation, is over 50 years old and grounded in Skinnerian conditioning (Wikler, 1948). Initially, this model argued that people use substances primarily to avoid or escape the negative consequences of substance withdrawal

(McCarthy, Curtin, Piper, & Baker, 2010). Proponents cite that the first 2-7 days after the initial discontinuation of drug use provides the greatest threat to relapse (Kenford et al., 1994), and that the severity of these withdrawal symptoms is predictive of future use (Piasecki, Jorenby, Smith, Fiore, & Baker, 2003). Baker et al.'s 2004 reformulation of this model stipulates that it is the affective component of withdrawal distress (i.e., negative emotionality) more so than physical symptoms that renders one vulnerable to relapse (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004). Baker et al. also argue that, while the user is aware of their drug use, they are not cognizant of the specific motivations behind their drug seeking behavior. Accordingly, McCarthy et al. (2010) suggest that repeated use leads to the automation of this process in the context of withdrawal, and this automatic, unconscious repetitive behavior leads to subsequent substance dependence (see also Tiffany, 1990 for a similar discussion of the role of craving).

Another operant conditioning-based model of substance dependence is the *Positive Reinforcement Theory* of substance dependence. Also over 50 years old (Thompson & Schuster, 1964), this perspective argues that drugs have the same reinforcing capabilities as life's basic necessities such as food or water, and recent literature on the addictive nature of sugary foods can attest to the complex of ingestible substances and their effect on reward processing (Vucetic & Reyes, 2010). Because drug seeking and drug taking behavior similarly follow the predictable pattern of laboratory-established positively valenced reinforcers (i.e. variable reinforcement, extinction, and reinstatement; de Wit, 1996), proponents of the theory argue that substance users are primarily motivated by the positive rather than negative features of drug taking.

Because classical conditioning via positive reinforcement has been the most studied paradigm for motivational learning research throughout the 20th century, the literature addressing animal models of positively valenced, hedonic reinforcement is rich. Research has emphasized

the interconnected and tridirectional role of the mesolimbic dopaminergic system (Wise & Bozarth, 1987; Koob & Le Moal, 1997), the nucleus accumbens (Koob & Nestler, 1997), and the amygdala (Koob, 1999). These structures, along with the striatum and orbitofrontal cortex, combine to form the mesolimbic-mesocortical reward circuit (de Wit & Phan, 2010), which regulates hedonic appetitive behaviors for primary reinforcers like eating and drinking (Vucetic & Reyes, 2010), as well as habit-forming drug self-administration (Wise, 2005). Aberration in this dopaminergic system of pleasure seeking and craving has also been found to be related to other maladaptive behaviors such as pathological gambling (Bergh, Eklund, Södersten, & Nordin, 1997), Internet gaming (Kuss & Griffiths, 2011), and compulsive shopping (Voon et al., 2010), potentially reflecting to this neural substrate's importance with respect to behaviors with an intrinsic hedonic, appetitive component.

Opponents of reinforcement-based theories of substance dependence put forth that if individuals who engage in these hedonically motivated behaviors are escaping negative, withdrawal symptoms and this escape behavior is what leads to dependence, why, then, do some regular drug users report no withdrawal symptoms at all (Robinson & Berridge, 1993)? Moreover, if the primary motivation for continued drug-seeking behavior is that of pure hedonic reinforcement, then that desired sensation must be so inherently powerful as to be the sole purpose for driving the individual to repeated and often unabated use (Robinson & Berridge 1993). There is relevant counter-factual evidence to this notion in nicotine, as research has shown that adolescent smokers reported negative affect relief but not positive affect modulation in a dose-dependent manner in a nicotine challenge study (Kassel et al., 2007), which implies that, at least in the case of nicotine, the hedonic component should not be strong enough to compel an individual to use. Similarly, one ecological momentary assessment study in adolescent

smokers found that increased smoking behavior was preceded by positive affect in non-dependent smokers, but not those with higher levels of dependence (Selya et al., 2015). These findings together suggest that subjectively positive ratings of a substance (i.e. the degree to which a substance modulates mood) and the degree to which an individual craves it (i.e. appetitive drive or the need to alleviate negative withdrawal symptoms such as in negative reinforcement models) may be linked in early encounters, but then dissociate over time.

1.2 The Incentive-Sensitization Theory of Substance Dependence

In 1993, Robinson and Berridge demonstrated that the two aspects of drug seeking behavior thought to be most relevant to seeking out and maintaining substance use, the feelings of *liking* and *wanting* of the substance, could be dissociated from each other in an animal model. This led them to theorize that throughout the course of addiction, the “wanting” of a substance is maintained and exacerbated through continued use by imbuing drug related stimuli with salience (through the learning process), while the pleasurable sensations or “liking” the substance would stay the same or even decrease over time (Robinson & Berridge, 2003). Simply stated, feelings of “liking” a substance plateau or decrease whereas “wanting” increases over time. The implications of this theory include the ability to predict both behavioral and neurological adaptations that can occur as the individual sensitizes drug response over the course of substance use (Berridge & Robinson, 1998).

1.3 Reward and the Perception of “Liking” and “Wanting”

Whereas some might argue that the debate over the importance of “liking” and “wanting” and how individuals differentially experience each of them may best be waged by philosophers (Sytsma & Machery, 2009), empirical data help define the specific dimensions of these arguably immeasurable and dynamic internal phenomena. Research has shown that the experience of

liking something, while most often characterized as an explicit process, can also be induced (and measured) implicitly, with one study showing that viewing positive images prompts participants to drink more of a fruity beverage, as well as rate the taste more favorably, than those presented with neutral images (Berridge & Winkielman, 2003). The notion of unconscious liking is almost paradoxical given our colloquial understanding of emotion - the idea that if one is not aware that they are enjoying something, how can one be sure they actually like it? This speaks to the proposed multidimensional nature of affective experience.

The experience of liking something (in particular an intrinsically rewarding ingested substance) is not necessarily as one-dimensional as many self-report questionnaires would render it. Asking participants the face valid question of how much they enjoy a substance is but one aspect of this experience. However, there is much subjective interpretation, left wholly up to the participant, when presenting them with that statement. Does the researcher denote the enjoyment derived from the current intake, or the activating expectation of a future encounter? Could there be individual motivations at play, which allow for a higher overall subjective liking rating compared to other participants (a sort of “inherent priming” related to the aforementioned juice ratings study)?

Subjective “liking” has generally been regarded as more important for other drugs of abuse, as the effects of nicotine are not always subjectively (or objectively) pleasant (light headedness, dizziness, etc). Heavy drinking alcohol users, for example (i.e. more than 10 drinks and one binge episode per week) report liking alcohol more and greater levels of stimulation than their light-drinking peers, a finding associated with future heavy drinking and increased alcohol problems (King, de Wit, McNamara, & Cao, 2011; King, McNamara, Hasin, & Cao, 2014). The same lab group replicated these findings in a similar study (Roche, Palmeri, & King, 2014),

suggesting that the enjoyment of perceived subjective effects may be more intrinsically related to substance intake behavior than previously thought. Whereas the literature in illegal drugs of abuse (i.e. cocaine, amphetamine) is lacking with respect to predictive longitudinal outcomes using an individual's perceived feelings about those substances, cross sectional descriptive studies of the subjective effects of drugs of abuse are still important in understanding potential risk factors for exacerbating use. Work by Richard Foltin and colleagues have attempted to characterize in-vitro subjective effects of cocaine on non-naive users. They found that cocaine does increase self-report ratings of "good drug effects" in a dose dependent manner (Foltin & Haney, 2004). Despite the difficulties in quantifying the way individuals perceive the subjective effects of cigarettes, there has been important work describing such effects.

Early influential laboratory work by Jack Henningfield showed that intravenous (IV) nicotine produced dose-dependent changes in subjective ratings as well as physiological responses akin to other drugs of abuse (opioids, psychomotor stimulants). Interestingly, whereas IV nicotine produced rapid and linear dose-dependent subjectively stimulating effects, these seasoned smokers only reported "liking" the drug more than placebo at much higher doses (Henningfield, Miyasato, & Jasinski, 1986). Conversely, individuals with little to no experience with nicotine reported no dose dependent difference in subjective liking, and only a difference in subjective stimulation between placebo and higher doses when administered nicotine gum (Heishman, Snyder, & Henningfield, 1993). It should be noted, however, that finding robust dose-dependent differences given the methodology of these studies proves difficult, as they both included a relatively small number of participants (N=8 and 16, respectively).

In a head-to-head study using the same nicotine delivery device (IV) for both smokers and nonsmokers, only smokers reported effects that are traditionally thought of as positive

(“good effects”, feeling “high”, and energetic). Nonsmokers reported more negative effects (via the face valid question “Bad Effects”) of nicotine compared to smokers in the same study, but the negative effects in question were not corroborated by negatively valenced items on the Profile of Mood States (POMS) (Soria et al., 1996). More recent work has shown that the subjective response to nicotine may lie on one of five factors: “head rush,” “positive affect,” “negative affect,” “fatigued,” and “energized”. Despite the parsimony of this assessment, the authors concede that the mean factor scores found may be modifiable by tolerance (Perkins, Jetton, & Keenan, 2003). Because the subjectively rewarding evaluations of nicotine may be disparate between individuals and shifting within an individual, it proves difficult to classify consistently. The value of doing so, especially in light of work done in other, comparable abused substances becomes apparent.

Berridge and Robinson distinguish between cognitive wanting (closely related to liking) and motivational (or incentive salient) wanting (Berridge & Robinson, 2003). They argue that the more complex, motivational “wanting” neurological pathways (as opposed to the simple cognition of “I want that”) are important in transforming innocuous sensory information like sights and smells into desired incentives. The distinction between types or stages of “wanting” has also been supported more recently, specifically in the nicotine literature.

Over the course of the last half-decade, initial evidence has surfaced in support of a progression through stages of “wanting” in nicotine withdrawal. In one qualitative study, nearly all participants described a mild desire to smoke called “wanting” (defined as a short-lived and easily ignored mental state that does not intrude on thoughts) as the first stage of withdrawal (DiFranza, Ursprung, & Carson, 2010). Regular tobacco users then entered the more intense and intrusive psychological states of “craving” and “needing”, sequentially (DiFranza et al., 2010).

These stages are defined by their persistence and difficulty to ignore, as well as the degree to which they intrude on the person's other thoughts (DiFranza et al., 2010). Research has shown that individuals experience the "wanting" stage by the first weeks to months of repeated (though not necessarily daily) tobacco use (DiFranza, Ursprung, & Biller, 2012). While this experience of wanting is infrequent, as the user progresses to "craving" and "needing", the feelings can occur much more rapidly, up to every 30-40 minutes in someone who smokes regularly around 15 cigarettes per day (DiFranza et al., 2012).

1.4 Craving in the Nicotine Literature

The phenomenon of craving has been well studied within the substance use literature and was recently added as criteria in the newest iteration of the Diagnostic and Statistical Manual of Mental Disorder (DSM; APA, 2013). According to the Substance Use Disorders work group (the individuals responsible for changes in the DSM), their rationale for the inclusion of craving in the manual was that it was present in many individuals on the more severe end of the dependence spectrum (Hasin et al., 2013). Some theories of substance dependence list craving as the central reason for compulsive drug seeking behavior (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004; Brian L. Carter & Tiffany, 1999). These theories rely on the assumption that early in the dependence process, individuals subconsciously and introspectively identify cue-induced sensations related to negative reinforcement (i.e. the removal of a negative affective state related to withdrawal from a substance). However, given the context of the Incentive Sensitization theory, one would be hard pressed to empirically determine whether or not the locomotive behavior in rats thought to correspond to "wanting" in humans is the result of appetitive drive or relief from negative symptoms of withdrawal.

1.5 Sensitization

Robinson and Berridge define sensitization as “an increase in a drug effect caused by repeated drug administration” (Robinson & Berridge, 2008). This increasing response to drug exposure can be behavioral, such as increased eye blink response in amphetamine users (Strakowski, Sax, Setters, & Keck, 1996), neurological, as in L-DOPA induced spiked levels of dopamine in the ventral striatum in patients with Parkinson’s disease who compulsively take medication (Evans et al., 2006), or subjective in individuals’ changing vocabulary of drug craving throughout the course of use (Everitt & Robbins, 2005).

Interestingly, drugs of abuse have been shown to sensitize only the motivational neural processes and not the systems that produce the subjectively pleasurable effects of the substance, resulting in a marked dissociation of these processes over time (Robinson & Berridge, 1993). In other words, the repeated use of a drug does not affect how much pleasure someone derives from it, as the relative hedonic-feeling increase induced by a substance does not change over repeated use (i.e. cocaine induced euphoria does not get typically get stronger with subsequent dose administration). However, what does appear to be affected are the neural substrates that mediate craving, as the incentive value of substances become sensitized over subsequent dosings as the drug imbues related stimuli with salience.

There is evidence supporting the I-S model of addiction in humans across a number of drugs of abuse, including non-naive stimulant users and sensitization to cocaine (Lambert, McLeod, & Schenk, 2006), differential dopamine release in the mesocortical and mesolimbic brain areas and its effect on psychomotor response over repeated dosing of methamphetamine (Boileau et al., 2006), and a priming dose of alcohol increasing wanting but not liking in heavy drinkers (Hobbs, Remington, & Glautier, 2005). At the same time, evidence for the theory is

notably lacking within the human nicotine literature. There are a number of plausible explanations for this dearth of research, foremost of which is the relative difficulty of observing behaviors potentially sensitized by nicotine, as the exact behavioral effects of acute nicotine intoxication remain in dispute (Heishman, Kleykamp, & Singleton, 2010; Heishman, Taylor, & Henningfield, 1994). Also, it may be difficult to discern nicotine-induced effects versus the effects induced by the myriad of other constituent substances contained in cigarettes (Rabinoff, Caskey, Rissling, & Park, 2007), although an attempt was made to do so by Rose, Behm, Westman, & Johnson (2000). Perhaps most importantly, however, is the dearth of studies targeting adolescent nicotine users.

1.6 Critical Period of Adolescence

Adolescence is a time of particular interest and importance to the study of drug use trajectories, as it is typically the period of first exposure to a number of substances including tobacco. Nonetheless, much of the research on nicotine dependence has been in adult rather than adolescent samples. For example, a simple *PubMed* search for “adults, cigarette” generates over 24,000 articles, while “adolescents, cigarette” yields merely 8,400. Typically, by the time prolonged nicotine use is studied in adults, participants already have achieved some level of measurable dependence. Also, analyses for adult studies frequently compare validated self-report measure-defined dependent individuals and healthy/non-dependent controls. This methodology is not limited to questionnaire-based studies but also those examining cognitive (Parrott & Garnham, 1998; Rezvani & Levin, 2001) and neurobiological (Brody et al., 2004; David et al., 2005) aspects of nicotine use and dependence. Ceiling effects further complicate studies in adults, as they frequently reveal high levels of in-laboratory craving even after short durations of abstinence (i.e. 4 hours) (Willner, Hardman, & Eaton, 1995, using an in-lab assessment of

craving: the brief questionnaire on smoking urges BQSU, Tiffany & Drobes, 1991). In the context of the incentive sensitization theory, these ceiling effects neutralize the room for upward growth in the context of craving, making longitudinal study of adult changes in craving difficult (Sayette et al., 2000; Taylor, Ussher, & Faulkner, 2007).

Studies examining the perceived subjective effects of nicotine in adolescents are rare but do exist. Findings from research previously published from our group indicate that adolescents respond with reductions in both positive and negative affect, moderated by the level of nicotine contained within the cigarette (Kassel et al., 2007). It is crucial to capture people in their first few years of smoking and longitudinally follow them to best look at changes in craving and liking over time in the context of the incentive sensitization theory of addiction.

1.7 Summary

Nicotine use continues to represent a large public health issue in the United States, and one that is currently growing in adolescents. There are a number of competing theories as to how to best define the progression of casual substance use to dependence, including Robinson & Berridge's 1993 incentive sensitization theory of addiction. This theory is of interest because it lends itself to a wealth of testing opportunities, including the use of self-report questionnaires. By examining the subjective reports of liking and wanting in adolescent smokers, how they change over time, and their relationship to quantity and frequency of cigarette consumption, we may be able to test the tenets of this influential theory with respect to cigarette use.

1.8 Specific Aims

The primary goal of the current study is to provide a preliminary test of the incentive sensitization theory of addiction in a sample of adolescent smokers followed longitudinally over two years. More specifically, I predict that adolescents will experience measurable changes in

their subjective ratings of “liking” and “wanting” over time and that these changes will meaningfully impact their past month smoking behavior (i.e. over time and repeated experiences with smoking, evaluations of “liking” cigarettes will be less associated with increasing consumption whereas increased evaluations of “wanting” and intensive “craving” will become more associated over time with increased use). Additionally, and in an exploratory manner, social and coping motivation, as well as negative affect relief expectancy are also predicted to relate to increases in smoking behavior and be correlated with “liking”.

2. METHODS

2.1 Participants

Data from this study come from a project examining the social and emotional contexts of adolescent smoking behavior. The present study utilized the baseline, 6-, 15-, and 24-month assessment waves whose focus was on delineating patterns and predictors of adolescent and young adult smoking. Participants were 9th and 10th graders recruited from 16 Chicago-area high schools; 12,970 completed a brief screening survey of smoking behavior and were eligible to complete the study if they fell into one of the following four categories: 1) never smokers; 2) former experimenters (i.e. smoked at least one cigarette in past but have not smoked in the last 90 days); 3) current experimenters (i.e. smoked in past 90 days but fewer than 100 cigarettes in their lifetime); and 4) regular smokers (smoked in the past 30 days and have smoked more than 100 cigarettes in their lifetime). Participants provided assent and their legal guardians provided informed consent prior to beginning the study (see Appendix A).

A total of 1,263 participants completed the baseline measurement wave. These participants were eligible to complete all components of the program project, including longitudinal questionnaire assessments, an ecological momentary assessment study, a family interview study, and a psychophysiological laboratory assessment study. Participants were over sampled to include smokers. In the interest of the current project, only data gleaned from the first two years comprised of 3 waves of the longitudinal self-report questionnaires will be examined, as items of relevance to the analyses presented here were removed from the battery after that time. These participants must have reported at least two instances of smoking in order to measure changes in their perceptions of the subjective effects of cigarette smoking.

Five hundred seventy-three participants reported smoking in at least two of the four assessment waves from baseline to 24-months post baseline. Of these, 45.2% were male, 74.5% identified as White and 12.4% identified as African American. At baseline, the participants reported smoking on average 29.8 cigarettes in the past month and total lifetime consumption between 16 and 25 (see Table 1 for full demographic information).

2.2 Primary Measures

“Liking”

To assess participants’ “liking” with respect to cigarette consumption, participants completed the 7 item, four point (none, some, moderate, and intense), “Subjective Smoking Experiences – Current” questionnaire (SSE), adapted from Pomerleau, Pomerleau, and Namenek, 1998, at baseline and each subsequent follow up wave. The SSE has two subscales: a three item pleasurable subscale assessing the level of pleasure, relaxation, and “buzz” derived from smoking a cigarette (coefficient alpha = 0.84) and a four item unpleasurable subscale assessing displeasure, nausea, coughing, and dizziness when smoking (coefficient alpha = 0.72; for the current study, only the pleasurable subscale will be examined as it offers the best proxy measurement of “liking” available in the dataset, see Appendix B).

“Wanting”

Participants’ “wanting” was assessed using a shortened, 10-item version of the Nicotine Dependence Syndrome Scale (NDSS; (Shiffman, Waters, & Hickcox, 2004)). The original NDSS was reduced for use in adolescents by way of a factor analysis (Sterling et al., 2009), and reflects primarily the “drive/tolerance” subscale from the original. Scored on a four-point Likert scale ranging from 1 (not at all true) to 4 (very true), participants completed this measure at baseline and each subsequent follow up wave (see Appendix E for individual items). The

modified NDSS exhibited good reliability at all assessment waves (average coefficient alpha = 0.94; see Appendix B for all items from the questionnaire).

2.3 Secondary Measures

Participants were administered the “Smoking Expectancies” questionnaire adopted from (Wahl, Turner, Mermelstein, & Flay, 2005) at baseline and each subsequent follow up wave. The “Smoking Expectancies” questionnaire has demonstrated good reliability, coefficient alpha = 0.89. The questionnaire has been modified to include three of the original four subscales: weight control, boredom, and negative affect relief, with taste being omitted. Of most interest to the present study is the negative affect relief subscale, as the expectation of negative affect relief is an often-replicated predictor of cigarette use. The scale as a whole is comprised of 10 items, rated on a 4 point Likert scale (disagree, disagree a little, agree a little, and agree). The weight control and boredom relief subscales are composed of 3 items and the negative affect relief subscale is composed of 4 items (see Appendix C).

Participants were also administered a shortened version of the “Wills Tobacco Motives Inventory” (Wills, Sandy, & Shinar, 1999). The 11-item measure asks respondents to rate each potential motive for smoking with respect to how true they think it is. Responses were made on a 5-point scale ranging from 1 (not at all true) to 5 (very true), and summed to create the overall scale score ranging from 11-55, yielding a high coefficient alpha (0.90). The original measure included 3 subscales: self-enhancement, boredom relief, and affect regulation. The self-enhancement and affect regulation subscales contain items related to pleasurable experiences while smoking (i.e. “smoking makes you feel more energetic”, “smoking cheers you up when you’re in a bad mood”). All subscales were included in these exploratory analyses (see Appendix D for all items).

Smoking Behavior

At each wave of assessment, participants answered questions pertaining to their current smoking patterns, including quantity and frequency over the course of 7 days, 30 days, and cumulatively over the lifetime (see Appendix F for individual items). Total cigarettes smoked in the past month was selected as the best estimate for smoking behavior as it takes into account both quantity and frequency of cigarette smoking.

2.4 Analyses

Data Management

Participants completing only one longitudinal assessment will be excluded from analyses as logically there is no way to test changes in subjective smoking experiences with only one measured data point. Remaining participants' demographic information from baseline and relevant dependent measures (i.e. monthly quantity and frequency cigarette consumption) from each assessment wave were compiled into a vertical dataset to assess changes in use over time with respect to changes in self-report "liking" and "wanting". Scale scores from both the SSE and NDSS were obtained from each participant at each assessment wave in which they provided data to conduct the primary analyses.

The data were assessed for outliers using Z-scores to determine if any observations were outside the acceptable two standard deviation limit and, using Mahalanobis distance, to determine if any observations were exhibiting undue influence on the data set. Observations deemed disruptive were removed from analyses. The data were assessed for normalcy using histograms and skewness/kurtosis values, and many of the variables of interest were positively skewed (Current Pleasurable Experience, NDSS), possibly due to the young age of the participants and their relative lack of experience with cigarettes. These data were Windsorized to

remove the influence of outliers. Due to the robustness of multilevel modeling to insults to normality, and for ease of interpretation, the data were left untransformed, aside from outlier removal (see Tabachnick & Fidell, 2013, p. 840 for a discussion on data transformation and interpretability). Tests for multicollinearity were done by observing bivariate correlation values between variables of interest and removing those that were greater than .08.

Analytic Approach

Bivariate correlations between each variable of interest were run at each of the four data collection points in order to generally describe the pattern with which these variables relate to each other, if further exploration using more sophisticated statistical analyses would be warranted, and whether or not there would be issues of multicollinearity with which to contend. Then, simple repeated measures ANOVAs were then run in order to determine if the individual variables (SSE, NDSS, coping motives, social motives, negative affect relief expectancy, and past month quantity and frequency smoking) were changing over time, controlling for baseline cigarette consumption. Post-hoc, Bonferroni corrected contrasts were then run to see how each data collection point related to the others. In order to determine if baseline values of the independent variables were associated with wave 4 cigarette smoking quantity/frequency, linear regression analyses were run, also controlling for baseline cigarette consumption.

Several multilevel models were then conducted with HLM version 7.0. Null models were constructed to determine the trends of past month smoking behavior in the absence of variables of interest, and then controlling for time of collection and subsequently baseline smoking behavior. These models served as a comparison to determine a measure of local effect size, Cohen's f^2 , which can be calculated by comparing null model variances to variances including hypothesized significant predictors (see Selya, Rose, Dierker, Hedeker, &

Mermelstein, 2012) for a discussion). Single predictor models (independent variables nested within individuals over time models for the SSE, NDSS, motives, coping motives, social motives, and negative affect relief scales, with random intercepts and slopes) were run to determine if the variance gained by modeling individuals' responses over time is enough to produce significantly different results from the repeated measures ANOVAs run previously (which by design groups the individual variance at each timepoint together). Then, a larger model was constructed with the NDSS and subjective smoking experiences-pleasurable subscales as level-one predictors with random slopes and intercepts, nested within individuals. Finally, in an exploratory fashion, a model was fit to determine if the motives and expectancies of interest were associated with past month smoking behavior over and above SSE and NDSS drive ("liking" and "wanting"), respectively. Also, additional exploratory analyses were run to determine the association between "liking" and "wanting" over time, with models run with each predicting the other. Within each model, every variable of interest (i.e. those not being controlled for) was individual-mean centered in order to serve as reference points for these intra-individual comparisons.

Each model featured level-1 fixed effects of time and baseline lifetime cigarette consumption, served to statistically control for individual factors that may unduly influence both subjective reporting of the effects of cigarettes and the past month calculated quantity and frequency index of use. The intercept of these regression equations was allowed to be random, as theoretically, the individuals enter the study at different points along a trajectory of past smoking behavior and subjective evaluation. The variables of interest (SSE pleasurable, NDSS drive, Social Motives, Coping Motives, and Negative Affect Relief Expectancies) were centered along the means of the individual to compare changes from the mean and its relation to the dependent

variable (i.e. past month cigarette consumption) and then added individually into the model with random slopes, as theoretically each individual can have a different time varying slope depending on their levels of current and past use. The level two equations included only the grand mean for each independent variable as well as a random intercept, which is necessary as there are no theoretical reasons to include any other level-2 variables and stacking of the data in the level-1 equations accounts for its longitudinal nature (see Figure 1 for each mixed model equation). Deviance statistics from each model were used to determine goodness of fit, by comparing differences in deviance between each model and using a χ^2 distribution to test for statistical significance (see Holden, Kelley, & Agarwal, 2008; Peugh, 2010 for a discussion).

As is the case in many longitudinal studies, participants may not have data from every collection wave; multilevel modeling is ideal for this project because it is robust to insults of missing data. MLM is also ideal because it allows for the modeling of individual variance, whereas a method such as repeated measures ANOVA loses the nuance that may be important when measuring something as subtle as adolescents' changing subjective evaluation of smoking by grouping together individual means during the analysis. Despite these advantages, N=3 participants were removed from the final HLM analyses for not having sufficient data at the second level, resulting in a final samples size of N=570 participants.

3. RESULTS

As expected, the bivariate correlations for each measure of interest were generally significant and high, and these trends were sustained across each data collection point (see Tables 2-5 for complete results). One notable deviation from this trend includes subjective ratings of pleasure derived from cigarettes measured through the Subjective Smoking Experiences – Pleasurable subscale only significantly correlating with past month smoking behavior at waves 2 (6 months post baseline) and wave 3 (15 months post baseline). Another interesting finding was that “wanting” and “liking” were significantly positively associated with each other at each data collection point. Smoking for social motivation was the only examined variable to not correlate with cigarette consumption at any time.

The results of the repeated measures ANOVA found significant time effects for all variables of interest except for Social Motives (see Table 6 for all values). Self-reported ratings of SSE-Current denoted “liking” did not change from baseline to 6 months, from 6 months to 15 months, or from 15 months to 24 months, but 15 and 24 months “liking” ratings were significantly higher than baseline (see Figure 2). Self-reported NDSS “wanting” ratings were significantly different at each time point, except between 15 & 24 months (see Figure 3). Coping Motives increased between baseline and 15 & 24 months but not any time else (see figure 4). Expectancies increased between baseline and all timepoints, in addition to changing between 6 & 15 and 6 & 24 months (see figure 5). Negative affect relief expectancies increased between baseline and all other time points, as well as between 6 and 15 months (see figure 6). Past month smoking calculated quantity-frequency scores also increased from baseline compared to all other timepoints, and from 6 month to 15 and 24 months, but not between 15 and 24 months (see Figure 7). All contrasts were adjusted using a Bonferroni correction, as these post-hoc tests were

not hypothesized in advance. Linear regression analyses were conducted to test the relationship between baseline independent variables and 24-month quantity/frequency of smoking. The only significant baseline predictor of 24-month past 30-day consumption was the NDSS ($\beta = 0.231$, $p < 0.001$; see Table 7 for full results).

A null model with a random intercept predicting past month cigarette consumption at all waves was fit to establish a variance comparison point in order to determine Cohen's f^2 , and was significant, $B = 60.42$, $p < 0.001$. Then, baseline lifetime cigarette consumption, a theoretically important covariate, was treated as a fixed effect and added to the null model; this was also a significant predictor of increases in smoking behavior, $B = 0.25$, $p < 0.001$. A final fixed effect covariate, time (i.e. baseline, 6 months, 15 months, and 24 months), was then added to the model, which indicated another significant predictor of past month smoking behavior, $B = 2.18$, $p < 0.001$. To test the hypothesis that self reported ratings of “liking”, “wanting”, “Social Motives”, “Coping Motives”, “Expectancy”, and Negative Affect Relief Expectancy” over time are associated with cigarette smoking behavior over and above baseline cigarette consumption and time, models were fit with two fixed-effect covariates (baseline lifetime cigarette consumption and time) and included each individual-mean centered independent variable as a random effect in addition to a random intercept. Increases in each variable were found to be significantly associated with cigarette consumption, except for Social Motives (see Table 8 for complete, single predictor results). To compare the direct effects of “liking” and “wanting”, a model was fit containing both variables as random effects in addition to the fixed-effect covariates and random intercept, and found that increases in “wanting” were significantly associated with increases in consumption ($B = 40.72$, $p < 0.001$, $f^2 = 0.44$), but “liking” was no

longer predictive of smoking behavior ($B = -1.50$, $p=0.205$, $f^2 = 0.01$; see figures 8 through 13 for graphical representations of the single predictor results)

Exploratory analyses comparing each additional predictor variable to each “liking” and “wanting” were conducted to determine if they meaningfully explain more variance than the single predictor models and how the subjective effects of those two central constructs compare to motives and expectancies empirically shown to affect cigarette consumption. Generally, when added to models containing “liking”, coping motives, expectancy and negative affect relief expectancy were all significantly associated with increased cigarette consumption whereas the effect of “liking” became insignificant (see Table 9). Conversely, when these other predictors were added to models containing “wanting”, all other motives and expectancy measures were no longer associated with more smoking behavior, but “wanting” continued to be so (see Table 10). Other exploratory analyses were conducted examining the relationship between “liking” and “wanting,” revealing that increases in each was significantly associated with increases in the other, such that for every unit increase from an individual’s mean of liking, wanting would increase by 0.25 ($p<0.001$). For every unit increase of wanting over the individual’s mean level, liking would increase by 0.39 units ($p<0.001$), but the covariates (time & baseline lifetime consumption) were no longer significantly associated with changes in “liking”.

In order to determine goodness of model fit, deviance statistics for each model were subtracted from one another and the difference was used within a Chi-square distribution with N degrees of freedom to determine statistical significance. All models were significantly improved compared to the null model and the covariate-only model (p ’s <0.05). The only models that were not improved in terms of fit, were “liking” with expectancy and “liking” with coping motives.

“Wanting” with expectancy, “wanting” with negative affect relief expectancy, and “wanting” with coping motives were also not improved compared to the null or covariate only models (p 's > 0.05).

4. DISCUSSION

The role of craving has long been identified as an important predictor of withdrawal-induced smoking behavior in smokers (Sweitzer, Denlinger, & Donny, 2013). Many of these studies, however, neglect to characterize other, theoretically important constructs such as “liking” (e.g. B. L. Carter et al., 2009) as well as motives and expectancies and their relationship to smoking behavior. Moreover, only in the past 15 years has the research community begun to look intently at the critical period of adolescence with respect to its role in early stage nicotine dependence and rarely have they examined adolescents’ subjective perception of smoking and how it relates to use. This study is the first of its kind to incorporate adolescents’ shifting longitudinal evaluations of individually perceived “liking” and “wanting” of smoking and how they relate to cigarette use. By operating within the framework of the incentive sensitization theory and selecting its theoretically relevant constructs, “liking” and “wanting”, this study was able to show that adolescents’ evaluation of these constructs follow dissimilar trajectories over two years within the earliest stages of smoking, and that these differing trajectories provide meaningful information about changing intraindividual patterns of cigarette smoking.

Because initial experiences with cigarettes and/or nicotine produce many aversive side effects (nausea, dizziness, etc.), reports of the positive effects of nicotine may be underreported in adolescents and therefore difficult to characterize with respect to their impact on use. In fact, the debate of the early 1990s of whether or not nicotine should be considered a therapeutic cognitive and mood enhancer, sparked by an editorial in *Addiction* (West, 1993) serves as a reminder that even the brightest minds in the field disagree about what the internal benefits of smoking are. Because of this schism, the broadly defined “liking” in this study can refer to any number of subjective effects akin to “pleasure”, “buzz”, or “relaxation”, -- the latter of which

seems at odds with nicotine's well-documented ability to increase the heart rate and constrict the blood vessels (Aronow, Dendinger, & Rokaw, 1971; Black et al., 2001). This broadly defined "liking" is consistent with the literature in support of Robinson & Berridge's theory and the differing effects the various substances have on individuals who ingest them (i.e. the perceived pleasurable effects of alcohol, Hobbs, Remington, & Glautier, 2005) vs. those of amphetamine (Strakowski, Sax, Setters, & Keck, 1996). Given that the hedonic value of nicotine has less agreement within the field, any relationship found between "liking" and cigarette use, especially during early stage smoking and adolescence, is novel and warrants further exploration.

4.1 Correlation of Study Items

Many of the key study variables were highly correlated with one another at each measurement point of interest. This is to be expected to some degree given these items are conceptually related (i.e. negative affect relief expectancy can be thought of as a temporal cognitive precursor to "wanting" and "wanting" predicts relapse during smoking withdrawal (DiFranza & Wellman, 2005; Killen & Fortmann, 1997). However, the relative stability of these relationships over time in this sample of relatively light, non-dependent smokers, despite the results of the repeated measures ANOVA suggesting that evaluations of these variables were changing over time (except for social motives), was surprising. This finding may suggest that although these evaluations change over time and experience with cigarettes, there may be a stable, trait-level ratio or genetic predisposition of these factors within an individual that is present before that person initiates smoking, not unlike Marc Schuckit's Low-Level Response Theory in the alcohol literature (Schuckit, 1994). This baseline predisposition may be an important avenue to pursue in future research.

4.2 Group Level Longitudinal Pattern

Most measures (i.e. smoking quantity/frequency, “wanting”, coping motives, expectancy, and negative affect relief expectancy) plateaued from 15 months post-baseline onward, suggesting that these internal subjective factors are tied to the smoking trajectory, which may be stable around age 17. Evaluations of “liking” peaked 9 months earlier than the other variables of interest (i.e. 6 months post baseline, around age 16), which is consistent with Robinson & Berridge’s conceptualization that intrinsically hedonic, approach-motivating aspects of substance use are initially salient, but lose value over time as craving increase (Robinson & Berridge, 1993). Interestingly, literature suggests that adolescents with diminished hedonic capacity (i.e. the trait-like ability to feel pleasure when presented with natural reinforcers) start smoking earlier and smoke more cigarettes than peers with higher hedonic capacity (Audrain-McGovern et al., 2012). Individuals with diminished hedonic capacity may be compensating for their relative lack of perceived pleasure by smoking earlier and more often, which supports the notion that cigarettes may have some intrinsically pleasurable aspect that is readily discernible at younger ages and earlier stages of smoking use. The findings of the current study would suggest that, while these hedonic motivations may be relevant in describing behavior early on in the trajectory of cigarette use, as one’s craving increases, hedonic reward become less predictive of smoking behavior

The only measure that did not change over time at the group level was smoking for social motives. Within a population of younger, school aged smokers this finding was surprising, given the weight that social influence is given in the substance use initiation literature (Stacy, Sussman, Dent, Burton, & Flay, 1992; Krosnick & Judd, 1982; Urberg, Shyu, & Liang, 1990; Wang, Fitzhugh, Westerfield, & Eddy, 1995). In fact, at no point in the study did social motives

correlate significantly with past month cigarette use, suggesting that individuals in this age range may not continue to smoke in order to derive social benefit. This could be the result of insensitivity in measurement, as the data suggest that individuals in this sample smoke more for coping than social reasons. The social motives could just be statistically eclipsed by the coping motives. Further studies are needed to examine the maintaining influence, if any; social motives have on cigarette smoking in adolescents.

4.3 Baseline Prediction of Wave 4

The data suggest that perturbations in craving at baseline are the only subjective factor associated with increased smoking 2 years later. This finding is unsurprising, given that individuals who are already experiencing elevated cigarette craving compared to their peers at earlier ages are at a higher risk for developing problematic use later on (Pechacek et al., 1984). It is interesting to note that constructs such as expectancies, which have been the focus of many studies of adolescent smokers, are unrelated to future use when measured at age 15. This finding is at odds with a study by Heinz, Kassel, Berbaum, & Mermelstein (2010) on the same sample of smokers as this study that found that as negative affect relief expectancies of participants increased, the odds of them smoking zero cigarettes per day decreased. This may be due to the selective inclusion of covariates in the current study and not the aforementioned one -- time and, in particular, baseline lifetime consumption. By controlling for these robust, yet theoretically important covariates, the effect of a psychosocial construct measured two years previously (i.e. expectancy) may not be as pronounced, despite results from the repeated measures ANOVA suggesting the levels are maintained. Also, individuals who have more experience with cigarettes at an early age are more likely to smoke later on (Pechacek et al., 1984) and consequently may

cause the otherwise significant results to fall out of the model. Further work is needed to explore this complex relationship

4.4 Multilevel Models & Smoking Behavior – At the Individual Level

Increasingly, multilevel modeling is being used in the substance abuse literature as one of the preferred methods to analyze longitudinal data (Hedeker & Mermelstein, 2000; Palmer, Graham, White, & Hansen, 1998; Walden, Iacono, & McGue, 2007). The flexibility in model building, by including random slopes and intercepts, in addition to its ability to withstand insults of missing data, make it ideal for populations such as adolescent smokers who may not be regularly smoking at every data collection point. In the context of this study, each construct of interest was related to smoking over time when entered as a single predictor, even when controlling for time and baseline lifetime cigarette consumption, which is to be expected given that they were selected a priori on the basis of their predictive relationship to smoking behavior. Effect size estimates revealed that subjective liking, social and coping motives each account for less than 5% of the variance in past month smoking, which could be due to the context dependent nature of those constructs (i.e. setting, internal affective state, etc). Adolescents who smoke regularly report that their primary reason for doing so is for withdrawal symptom/negative affect relief (Stevens, Colwell, Smith, Robinson, & McMillan, 2005), suggesting that these craving-related constructs have been imbued with higher cognitive salience than the hedonic evaluations, even in adolescence. This assertion is supported in the current study by higher effect sizes (i.e. greater than 15% of the variance of past month smoking explained) for negative affect relief expectancy and “wanting” in addition to models containing these constructs fitting the data better (χ^2 tests, $p < 0.05$) – and predicted by Robinson & Berridge’s I-S theory. This finding is novel in

that the predicted pattern of these two opposing processes has yet to be shown within the nicotine literature, especially with younger, less experienced smokers.

In models that examined both subjective liking and the other independent variables (wanting, expectancies, motives), the significant effect of liking was no longer observed. Because the literature on what it means to “like” a cigarette is muddled, and given that the participants were asked to retrospectively report their hedonic evaluation of smoking (rather than in vitro reporting, which may cause the subtle pleasurable sensations to be more apparent to the individual), it was unsurprising that the inclusion of items more related to “wanting” nullified the effect. Conversely, the effect of “wanting” and its association with past month smoking behavior was so robust that no other predictor remained statistically significant in head to head models. Curiously, the effect size for negative affect relief expectancy dropped from 17% of variance explained in single predictor models to just 2% of variance explained when entered group-wise with “wanting”. This could mean that negative affect relief expectancy is so closely related to the construct of “wanting” that the variance overlap in explaining past month smoking behavior is nearly identical.

The exploratory analyses, which sought to determine the direct association between “liking” and “wanting” over time, indicate a reciprocal relationship in that increases in one’s evaluation of one leads to higher expression of the other. What is interesting in these data is that “wanting” and its association with “liking” was independent of the individual’s previous smoking experience and did not change over time – that is the effect of “wanting” on “liking” and vice versa was still pronounced in the presence of those theoretically important covariates. Anecdotal reports of drug addicts posit that the craving is so strong that any positive feelings they once had about their substance of choice have long been forgotten, which is the traditional

conceptualization of the I-S model in those populations. In this case, the adolescents studied may not have yet reached the point of use that may lead to the dissociation between the two dopaminergic systems (hedonic and appetitive) within the brain, which would explain the strong link between the two. Further studies, particularly neuroimaging, would be needed to show the changing dopaminergic expression at a neurological level.

4.5 Limitations

The study has a number of strengths, in particular a large sample size of regular adolescent smokers followed longitudinally with robust, well-validated measures, but there are some weaknesses that need to be acknowledged. The constructs measured are approximations of complex neurological processes. Despite the assertion from Robinson & Berridge that the I-S theory may be approximated using “liking” and “wanting”, it’s impossible to say if the scales chosen do so in the closest way. Because cigarettes produce complex physical and psychological changes that may vary between individuals, the pleasurable effects may be inconsistent, depending on the experience one has with cigarettes. This study attempted to control for that possibly by including scale measures that incorporate a multitude of aspects of pleasurable experience and statistically by including random slopes and intercepts in the multilevel models, but because this was a secondary data analysis, including more measures of pleasurable experience at the onset would make for clearer interpretation. The project also had no way to address the third component of the I-S theory – the learning of cues associated with the rewarding process.

Adolescence is a critical time for studying smoking behavior, as it’s when the majority of individuals encounter cigarettes for the first time. However, because individuals in the current study were over-sampled to have had experience with cigarettes at baseline, those who were

nicotine naïve at that time, but smoked over the course of the sampling period may be underrepresented. Their subjective evaluations of cigarettes may be drastically different than those who reported having smoked on average upwards of twenty times at baseline. While the longitudinal nature of the study is a strength of the current study, the short (two year follow up) is not. Due to the removal of crucial measures, important data for this study were not collected right before half of the sample turned 18, which in theory would greatly increase their access to cigarettes.

4.6 Future directions

An important future direction of this study may include utilizing momentary data collection as the primary methodology, as self-report questionnaires have been shown to be less reliable, especially when measuring subjective or affective appraisals (Solhan, Trull, Jahng, & Wood, 2009), (Anestis et al., 2010). By assessing random and smoking prompts of the subjective evaluations, one may find a greater richness and better representation of the smoking experience. Laboratory based studies in which the subjective effects of cigarettes are measured before and after smoking would also offer a controlled and valid way (albeit with less external validity) to assess the direct impact smoking has on subjective evaluations in the moment. Longitudinal neuroimaging of the dopaminergic system within adolescents when in the first instances of smoking up through regular, more dependent use would allow for nuanced views of the neurochemical changes that occur, predicted by the I-S theory.

4.7 Summary

This study was the first of its kind to look at the I-S theory within the nicotine literature. Despite limitations in using proxies for complex psychological constructs, the data from this study support the prediction from the incentive sensitization theory of addiction that hedonic

evaluations of rewarding substances, cigarettes/nicotine included, are initially related to use of that substance, but over time, “wanting” is much more predictive of increased use. Exploratory analyses found that popular constructs like motives and expectancies are also associated with use, over and above “liking” but not to the same degree as “wanting”, suggesting a complex internal process for deciding to smoke and how much. Hedonic evaluations of smoking have been largely ignored in the literature for a host of reasons, including difficulty in measuring them. Data from this study suggest that pursuance of this theoretical approach holds much promise.

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Table 1.

Participant demographics

Demographic Variables	
<u>Baseline</u>	<u>Mean (SD/%)</u>
Number of Participants	573
Age	15.6 (0.6)
Sex, Male	259 (45.2%)
Race – White	427 (74.5%)
Race – Black	71 (12.4%)
Race – Asian	18 (3.1%)
Race – Pacific Islander	13 (2.3%)
Race – American Indian/Alaskan Native	8 (1.4%)
Race – More than one race	36 (6.3%)
Past Month Quant/Freq Cigarette Use	29.8 (0.5)
Average Lifetime Cigarette Consumption	20.5

Table 2.

Correlations Among Key Study Variables Baseline

	SSE	NDSS	Mot.	Mot.	Expect.	Exp.	30d
	Pleas.	Drive	Cope	Soc.		Neg.	QFI
SSE Pleas.	-						
NDSS Drive	.283**	-					
Mot. Cope	.386**	.367**	-				
Mot Soc.	.085	.086*	.288**	-			
Expect.	.377**	.599**	.514**	.101*	-		
Exp. Neg.	.439**	.531**	.509**	.060	.841**	-	
30d QFI	0.002	.461**	.070	.022	.029	.190**	-

** Correlation is significant at the 0.01 level (2-tailed)

*Correlation is significant at the 0.05 level (2-tailed)

Table 3.

Correlations Among Key Study Variables 6 Months Post-Baseline

	SSE Pleas.	NDSS Drive	Mot. Cope	Mot. Soc.	Expect.	Exp. Neg.	30d QFI
SSE Pleas.	-						
NDSS Drive	.385**	-					
Mot. Cope	.421**	.376**	-				
Mot Soc.	.177**	.041	.345**	-			
Expect.	.398**	.510**	.477**	.149**	-		
Exp. Neg	.428**	.514**	.482**	.130**	.846**	-	
30d QFI	.158**	.399**	.165**	.043	.214**	.213**	-

** Correlation is significant at the 0.01 level (2-tailed)

*Correlation is significant at the 0.05 level (2-tailed)

Table 4.

Correlations Among Key Study Variables 15 Months Post-Baseline

	SSE Pleas.	NDSS Drive	Mot. Cope	Mot. Soc.	Expect.	Exp. Neg.	30d QFI
SSE Pleas.	-						
NDSS Drive	.317**	-					
Mot. Cope	.408**	.358**	-				
Mot Soc.	.178**	.103*	.318**	-			
Expect.	.357**	.510**	.474**	.199**	-		
Exp. Neg	.405**	.488**	.471**	.094*	.835**	-	
30d QFI	.095*	.415**	.120**	-.017	.153**	.159**	-

** Correlation is significant at the 0.01 level (2-tailed)

*Correlation is significant at the 0.05 level (2-tailed)

Table 5.

Correlations Among Key Study Variables 24 Months Post-Baseline

	SSE Pleas.	NDSS Drive	Mot. Cope	Mot. Soc.	Expect.	Exp. Neg.	30d QFI
SSE Pleas.	-						
NDSS Drive	.308**	-					
Mot. Cope	.417**	.435**	-				
Mot Soc.	.142**	.135**	.400**	-			
Expect.	.427**	.537**	.553**	.222**	-		
Exp. Neg	.456**	.547**	.577**	.193**	.869**	-	
30d QFI	.048	.405**	.119**	.066	.151**	.200**	-

** Correlation is significant at the 0.01 level (2-tailed)

*Correlation is significant at the 0.05 level (2-tailed)

Table 6.

Repeated measures ANOVA for key study variables.

Variable	T1 M(SD)	T2 M(SD)	T3 M(SD)	T4 M(SD)	<i>df</i>	F	<i>p</i>
30d QFI	29.79 (75.47)	46.90 (102.14)	70.58 (131.36)	74.01 (120.40)	2.327	25.500	>0.001
Pleas. Current	2.42 (0.86)	2.54 (0.85)	2.55 (0.81)	2.54 (0.80)	2.749	4.351	0.006
NDSS Drive	1.52 (0.74)	1.61 (0.82)	1.71 (0.86)	1.78 (0.86)	2.517	39.139	>0.001
Mot. Cope	21.78 (8.55)	22.35 (8.56)	22.69 (8.60)	22.37 (8.47)	2.888	8.801	>0.001
Mot Soc.	4.03 (1.99)	3.99 (2.10)	3.92 (1.98)	3.97 (2.00)	2.946	0.947	0.416
Expectancy	1.96 (0.74)	2.06 (0.77)	2.14 (0.80)	2.14 (0.82)	2.782	19.291	>0.001
Exp. Neg.	2.27 (0.98)	2.37 (0.99)	2.48 (1.01)	2.41 (0.99)	2.729	17.257	>0.001

Table 7.

Linear regression analyses for baseline key study variables' association with wave 4 cigarette consumption, controlling for baseline lifetime cigarette consumption

Variable	<i>B</i>	<i>SE B</i>	β
Pleas. Current	-1.837	7.269	-.012
NDSS Drive	38.394	8.962	0.231**
Mot. Cope	0.182	0.636	0.013
Mot Soc.	-2.193	2.482	-0.036
Expectancy	4.641	8.162	0.028
Exp. Neg.	2.057	6.287	0.016

** $p < 0.001$

Table 7.

Linear regression analyses for baseline key study variables' association with wave 4 cigarette consumption, controlling for baseline lifetime cigarette consumption

Variable	<i>B</i>	<i>SE B</i>	β
Pleas. Current	-1.837	7.269	-.012
NDSS Drive	38.394	8.962	0.231**
Mot. Cope	0.182	0.636	0.013
Mot Soc.	-2.193	2.482	-0.036
Expectancy	4.641	8.162	0.028
Exp. Neg.	2.057	6.287	0.016

Table 8.

Single predictor multilevel models of key study variables and their relationship to past month cigarette consumption

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
Predictor	β (SE)	f^2	β (SE)	f^2	β (SE)	f^2	β (SE)	f^2	β (SE)	f^2	β (SE)	f^2
<i>Fixed effects</i>												
Baseline Consumption	0.25(0.02)**	0.01	0.23(0.01)**	-	0.25(0.02)**	-	.25(0.01)**	-	0.25(0.02)**	-	0.25(0.01)**	-
Time	2.18(0.17)**	0.08	1.33(0.12)**	-	2.17(0.17)**	-	2.22(0.14)**	-	1.95(0.17)**	-	2.00(0.13)**	-
<i>Random Effects</i>												
“Liking”	9.25(2.41)**	0.04										
“Wanting”			40.50(2.96)**	0.43								
Motives-Coping					1.47(0.22)**	0.0						
Motives-Social							0.91(1.00)	0.01				
Expectancy									20.41(2.86)**	0.20		
Expect-NegAff Relief											16.78(2.20)**	0.12

** $p < 0.001$

Table 9.

Multiple predictor multilevel models of “liking” with key study variables and their relationship to past month cigarette consumption

	Model 7		Model 8		Model 9		Model 10	
Predictor	β (SE)	f^2	β (SE)	f^2	β (SE)	f^2	β (SE)	f^2
<i>Fixed effects</i>								
Baseline Consumption	0.25(0.02)**	0.01	0.25(0.02)**	-	0.25(0.02)**	-	0.24(0.02)**	-
Time	2.16(0.17)**	0.08	2.18(0.18)**	-	1.94(0.17)**	-	1.99(0.17)**	-
<i>Random Effects</i>								
“Liking”	3.75(2.62)	0.03	9.08(2.44)**	0.04	3.31(2.56)	0.04	2.38(2.51)	0.02
Motives-Coping	1.32(0.25)**	0.0						
Motives-Social			0.38(1.00)	0.01				
Expectancy					18.67(3.13)**	0.25		
Expect-NegAff Relief							15.60(2.29)**	0.14

** $p < 0.001$

Table 10.

Multiple predictor multilevel models of “wanting” with key study variables and their relationship to past month cigarette consumption

	Model 11		Model 12		Model 13		Model 14	
Predictor	β (SE)	f^2	β (SE)	f^2	β (SE)	f^2	β (SE)	f^2
<i>Fixed effects</i>								
Baseline Consumption	0.24(0.02)**	0.01	0.23(0.02)**	-	0.23(0.02)**	-	0.24 (0.02)**	-
Time	1.34(0.14)**	0.08	1.30(0.14)**	-	1.32(0.14)**	-	1.32(0.13)**	-
<i>Random Effects</i>								
“Wanting”	39.85(3.07)**	0.49	40.86(2.87)**	0.43	40.59(3.45)**	0.62	40.33(3.34)**	0.55
Motives-Coping	0.05(0.19)	0.0						
Motives-Social			-0.27(0.87)	0.03				
Expectancy					-1.40(3.04)	0.28		
Expect-NegAff Relief							-0.26(1.94)	0.03

* $p < 0.05$; ** $p < 0.0$

Figure 1.

Mixed effects equations for multilevel models.

Model NULL: Covariate-only model for past month quantity/frequency smoking.

$$QFI30D_{ti} = \beta_{00} + \beta_{10} * BaselineConsumption_{ti} + \beta_{20} * TIME_{ti} + r_{0i} + e_{ti}$$

Model 1: “Liking” & Covariates predicting past month quantity/frequency of smoking.

$$QFI30D_{ti} = \beta_{00} + \beta_{10} * BaselineConsumption_{ti} + \beta_{20} * TIME_{ti} + \beta_{30} * Liking_{ti} + r_{0i} + r_{3i} * Liking_{ti} + e_{ti}$$

Model 2: “Wanting” & Covariates predicting past month quantity/frequency of smoking.

$$QFI30D_{ti} = \beta_{00} + \beta_{10} * BaselineConsumption_{ti} + \beta_{20} * TIME_{ti} + \beta_{30} * Wanting_{ti} + r_{0i} + r_{3i} * Wanting_{ti} + e_{ti}$$

Model 3: Coping Motives & Covariates predicting past month quantity/frequency of smoking.

$$QFI30D_{ti} = \beta_{00} + \beta_{10} * BaselineConsumption_{ti} + \beta_{20} * TIME_{ti} + \beta_{30} * MOTCOP_{ti} + r_{0i} + r_{3i} * MOTCOP_{ti} + e_{ti}$$

Model 4: Social Motives & Covariates predicting past month quantity/frequency of smoking.

$$QFI30D_{ti} = \beta_{00} + \beta_{10} * BaselineConsumption_{ti} + \beta_{20} * TIME_{ti} + \beta_{30} * MOTSOC_{ti} + r_{0i} + r_{3i} * MOTSOC_{ti} + e_{ti}$$

Model 5: Expectancy & Covariates predicting past month quantity/frequency of smoking.

$$QFI30D_{ti} = \beta_{00} + \beta_{10} * BaselineConsumption_{ti} + \beta_{20} * TIME_{ti} + \beta_{30} * EXPECT_{ti} + r_{0i} + r_{3i} * EXPECT_{ti} + e_{ti}$$

Model 6: Negative affect Relief Expectancy & Covariates predicting past month quantity/frequency of smoking.

$$QFI30D_{ti} = \beta_{00} + \beta_{10} * BaselineConsumption_{ti} + \beta_{20} * TIME_{ti} + \beta_{30} * EXPNEG_{ti} + r_{0i} + r_{3i} * EXPNEG_{ti} + e_{ti}$$

Model 7: “Liking”, Coping Motives & Covariates predicting past month quantity/frequency of smoking.

$$QFI30D_{ti} = \beta_{00} + \beta_{10} * BaselineConsumption_{ti} + \beta_{20} * TIME_{ti} + \beta_{30} * Liking_{ti} + \beta_{40} * MOTCOP_{ti} + r_{0i} + r_{3i} * Liking_{ti} + r_{4i} * MOTCOP_{ti} + e_{ti}$$

Model 8: “Liking”, Social Motives & Covariates predicting past month quantity/frequency of smoking.

$$QFI30D_{ti} = \beta_{00} + \beta_{10} * BaselineConsumption_{ti} + \beta_{20} * TIME_{ti} + \beta_{30} * Liking_{ti} + \beta_{40} * MOTSOC_{ti} + r_{0i} + r_{3i} * Liking_{ti} + r_{4i} * MOTSOC_{ti} + e_{ti}$$

Model 9: “Liking”, Expectancy & Covariates predicting past month quantity/frequency of smoking.

$$QFI30D_{ti} = \beta_{00} + \beta_{10} * BaselineConsumption_{ti} + \beta_{20} * TIME_{ti} + \beta_{30} * Liking_{ti} + \beta_{40} * EXPECT_{ti} + r_{0i} + r_{3i} * Liking_{ti} + r_{4i} * EXPECT_{ti} + e_{ti}$$

Model 10: “Liking”, Negative Affect Relief Expectancy & Covariates predicting past month quantity/frequency of smoking.

$$QFI30D_{ti} = \beta_{00} + \beta_{10} * BaselineConsumption_{ti} + \beta_{20} * TIME_{ti} + \beta_{30} * Liking_{ti} + \beta_{40} * EXPNEG_{ti} + r_{0i} + r_{3i} * Liking_{ti} + r_{4i} * EXPNEG_{ti} + e_{ti}$$

Model 11: “Wanting”, Coping Motives & Covariates predicting past month quantity/frequency of smoking.

$$QFI30D_{ti} = \beta_{00} + \beta_{10} * BaselineConsumption_{ti} + \beta_{20} * TIME_{ti} + \beta_{30} * Wanting_{ti} + \beta_{40} * MOTCOP_{ti} + r_{0i} + r_{3i} * Wanting_{ti} + r_{4i} * MOTCOP_{ti} + e_{ti}$$

Model 12: “Wanting”, Social Motives & Covariates predicting past month quantity/frequency of smoking.

$$QFI30D_{ti} = \beta_{00} + \beta_{10} * BaselineConsumption_{ti} + \beta_{20} * TIME_{ti} + \beta_{30} * Wanting_{ti} + \beta_{40} * MOTSOC_{ti} + r_{0i} + r_{3i} * Wanting_{ti} + r_{4i} * MOTSOC_{ti} + e_{ti}$$

Model 13: “Wanting”, Expectancy & Covariates predicting past month quantity/frequency of smoking.

$$QFI30D_{ti} = \beta_{00} + \beta_{10} * BaselineConsumption_{ti} + \beta_{20} * TIME_{ti} + \beta_{30} * Wanting_{ti} + \beta_{40} * EXPECT_{ti} + r_{0i} + r_{3i} * Wanting_{ti} + r_{4i} * EXPECT_{ti} + e_{ti}$$

Model 14: “Wanting”, Negative Affect Relief Expectancy & Covariates predicting past month quantity/frequency of smoking.

$$QFI30D_{ti} = \beta_{00} + \beta_{10} * BaselineConsumption_{ti} + \beta_{20} * TIME_{ti} + \beta_{30} * Wanting_{ti} + \beta_{40} * EXPNEG_{ti} + r_{0i} + r_{3i} * Wanting_{ti} + r_{4i} * EXPNEG_{ti} + e_{ti}$$

Model 15: “Liking”, “Wanting” & Covariates predicting past month quantity/frequency of smoking.

$$QFI30D_{ti} = \beta_{00} + \beta_{10} * BaselineConsumption_{ti} + \beta_{20} * TIME_{ti} + \beta_{30} * Liking_{ti} + \beta_{40} * Wanting_{ti} + r_{0i} + r_{3i} * Liking_{ti} + r_{4i} * Wanting_{ti} + e_{ti}$$

Figure 2.

Repeated-measures ANOVA of average self-report SSE-Current ratings of “liking” over time.

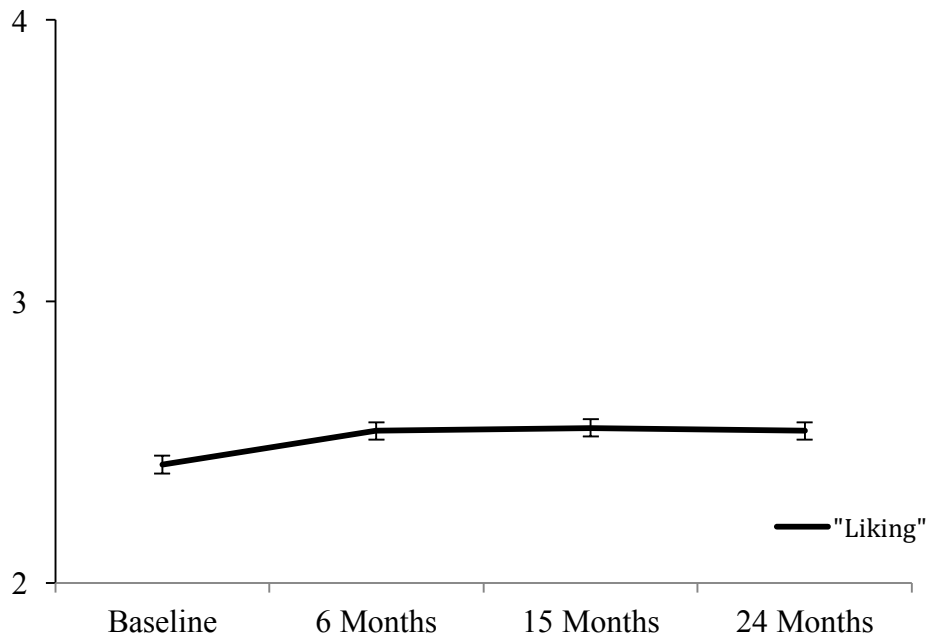


Figure 3.

Repeated-measures ANOVA of average self-report NDSS-Drive ratings of “wanting” over time.

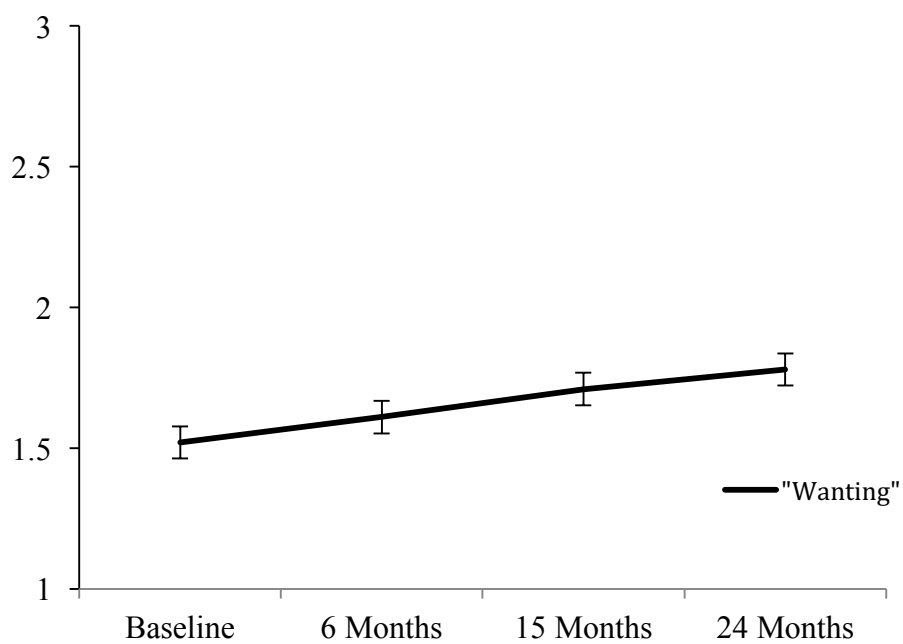


Figure 4.

Repeated-measures ANOVA of average self-report ratings of coping motives to smoke over time.

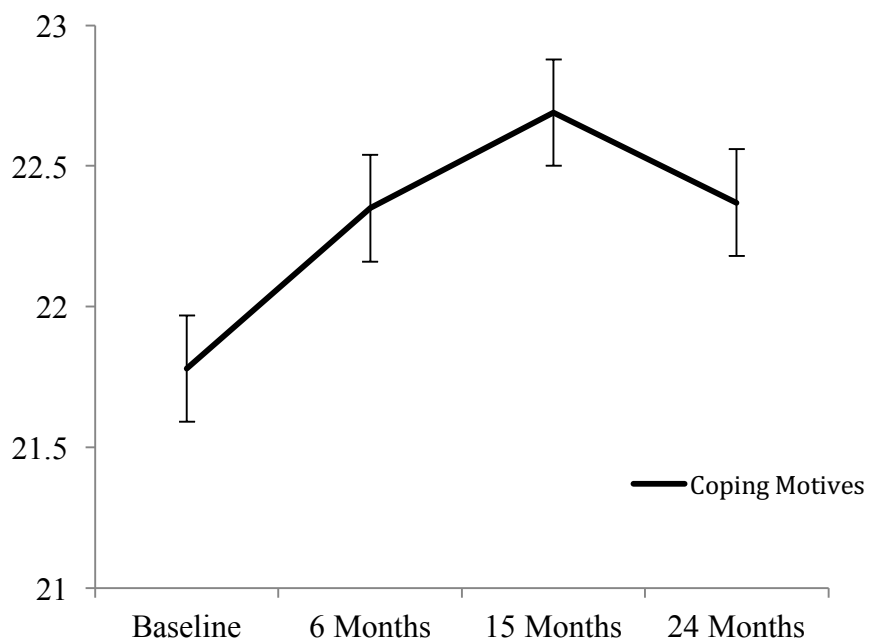


Figure 5.

Repeated-measures ANOVA of average self-report ratings of smoking expectancy over time.

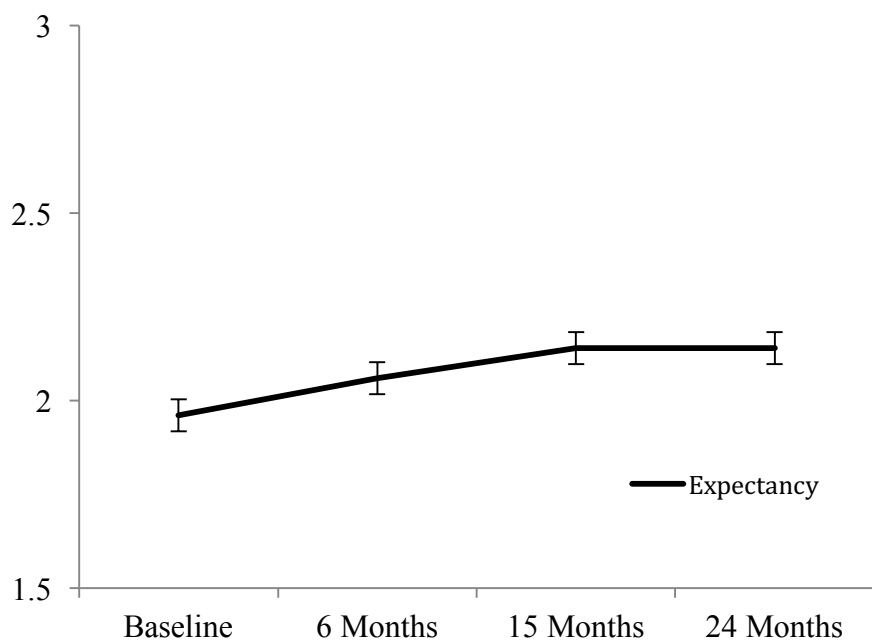


Figure 6.

Repeated-measures ANOVA of average self-report ratings of smoking negative affect relief expectancy over time.

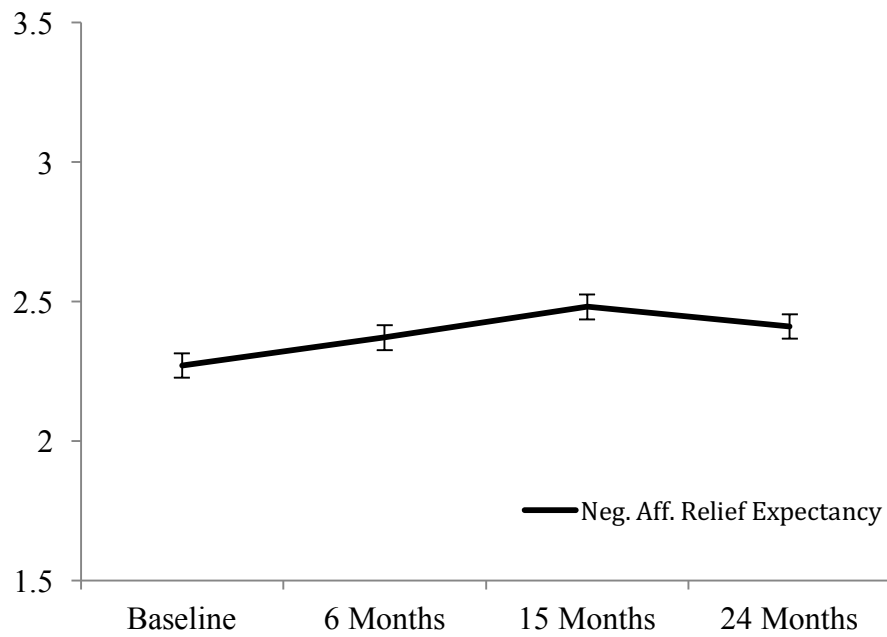


Figure 7.

Repeated-measures ANOVA of average self-report ratings of computed past month quantity/frequency cigarette smoking.

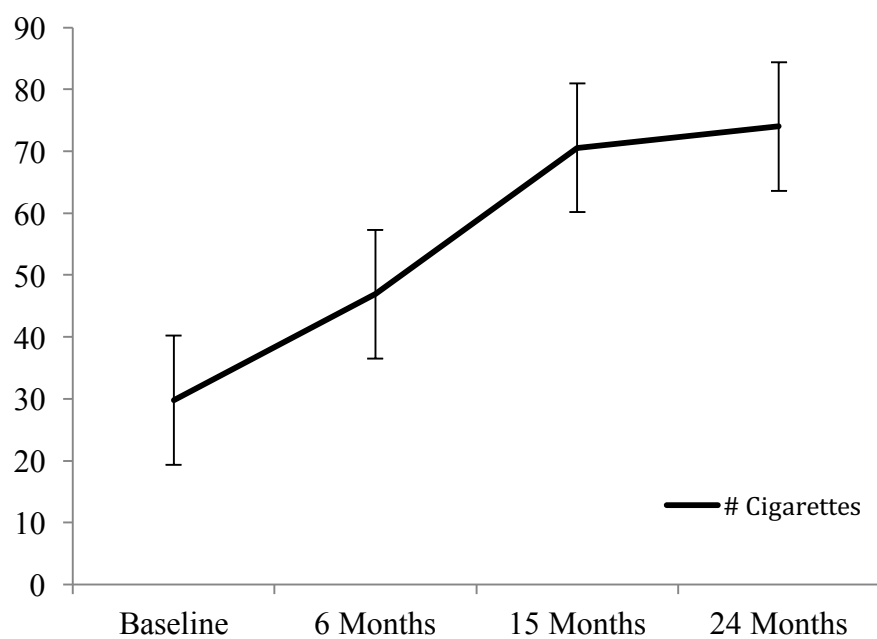


Figure 8.

Participant-level slopes for individual mean-centered “liking” association with past month smoking behavior.

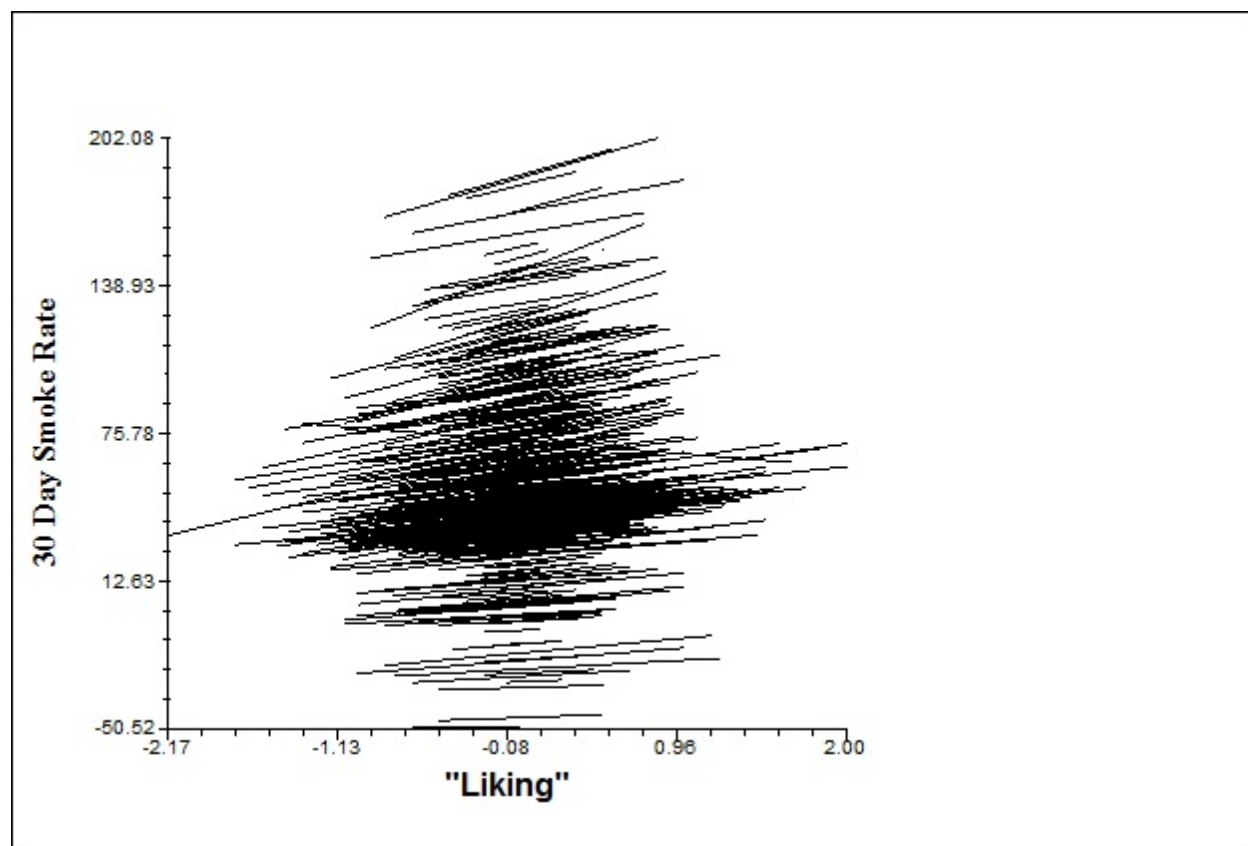


Figure 9.

Participant-level slopes for individual mean-centered “wanting” association with past month smoking behavior.

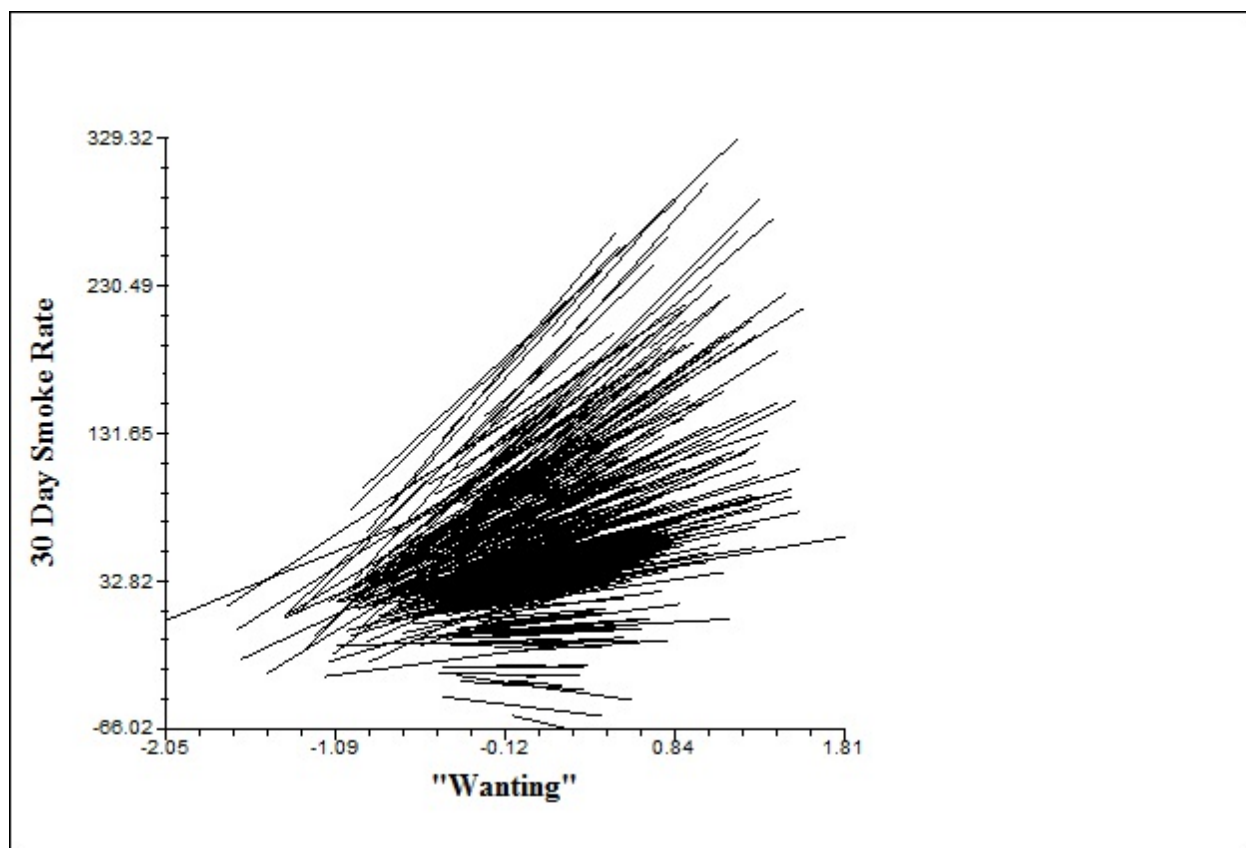


Figure 10.

Participant-level slopes for individual mean-centered coping smoking motives association with past month smoking behavior.

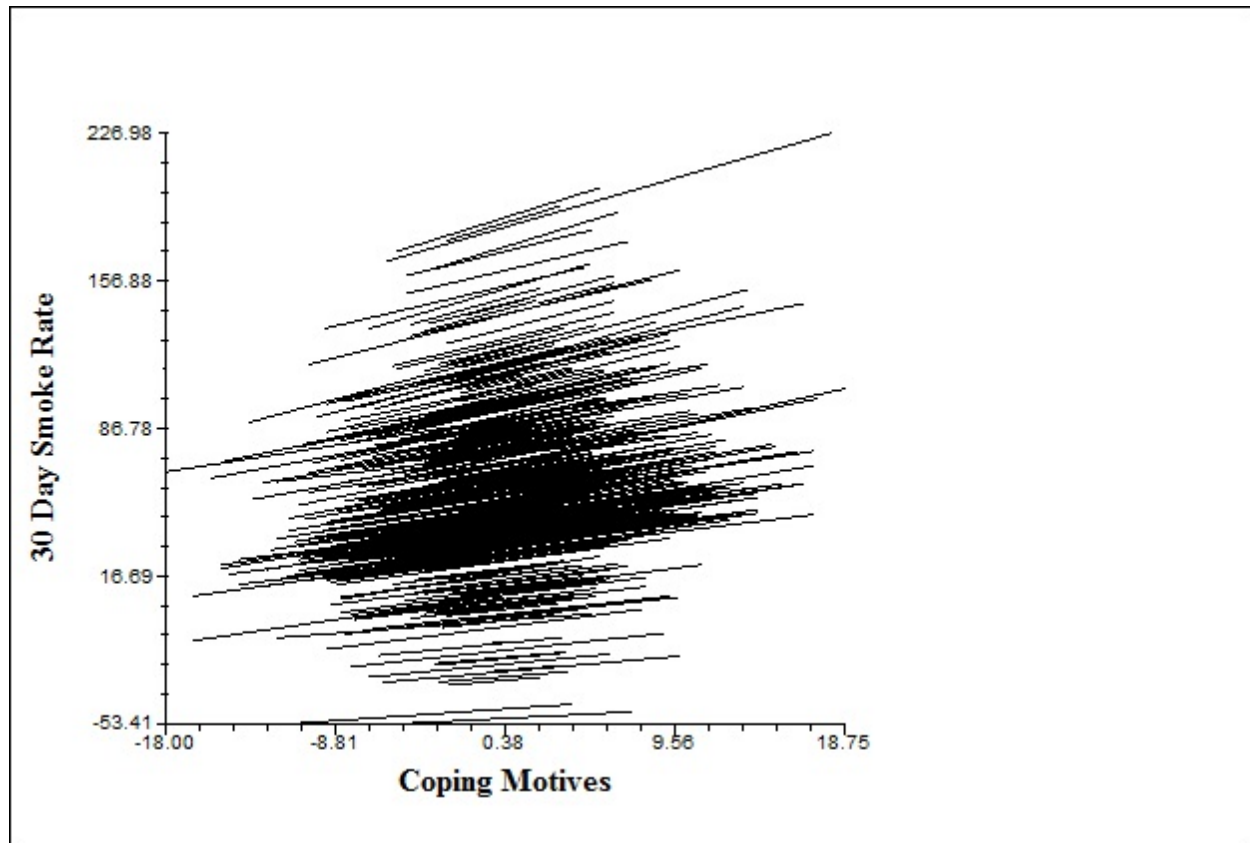


Figure 11.

Participant-level slopes for individual mean-centered social smoking motives association with past month smoking behavior.

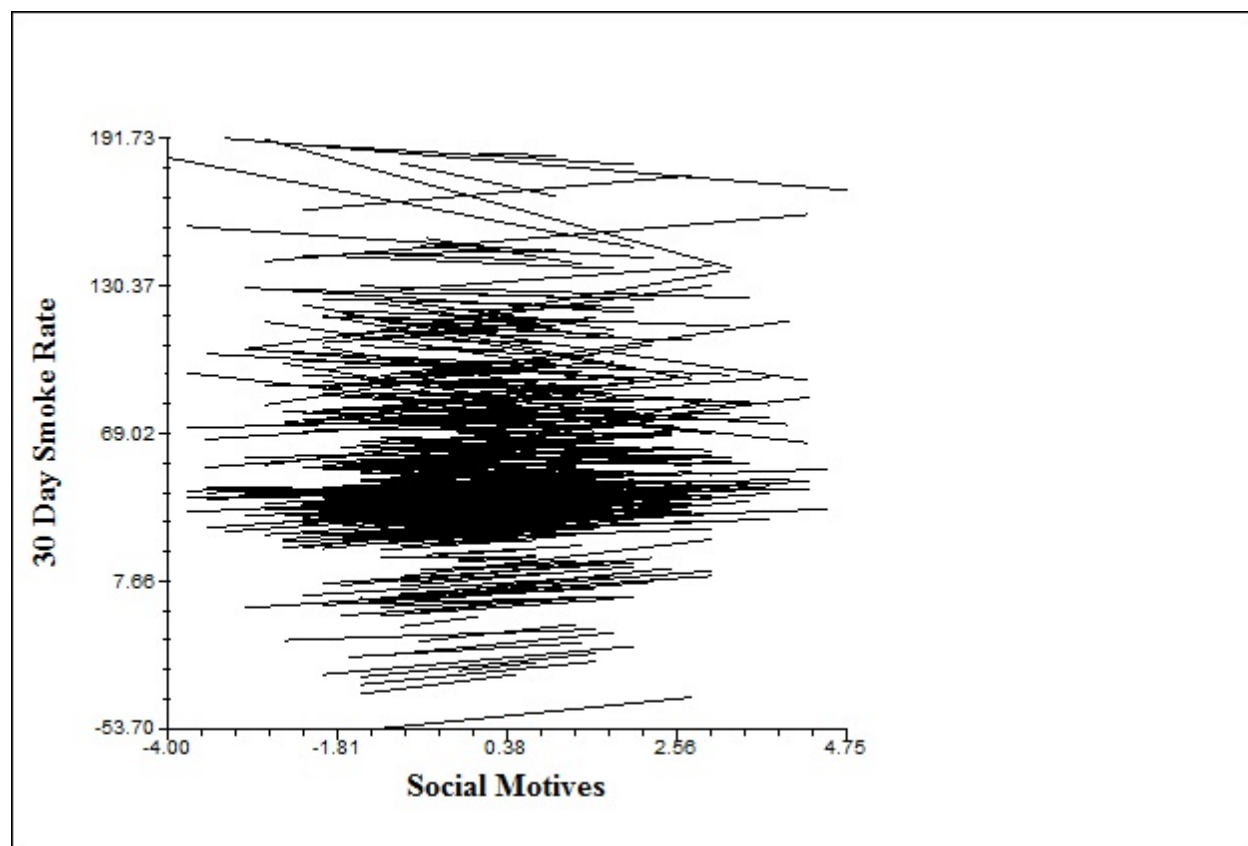


Figure 12.

Participant-level slopes for individual mean-centered expectancy association with past month smoking behavior.

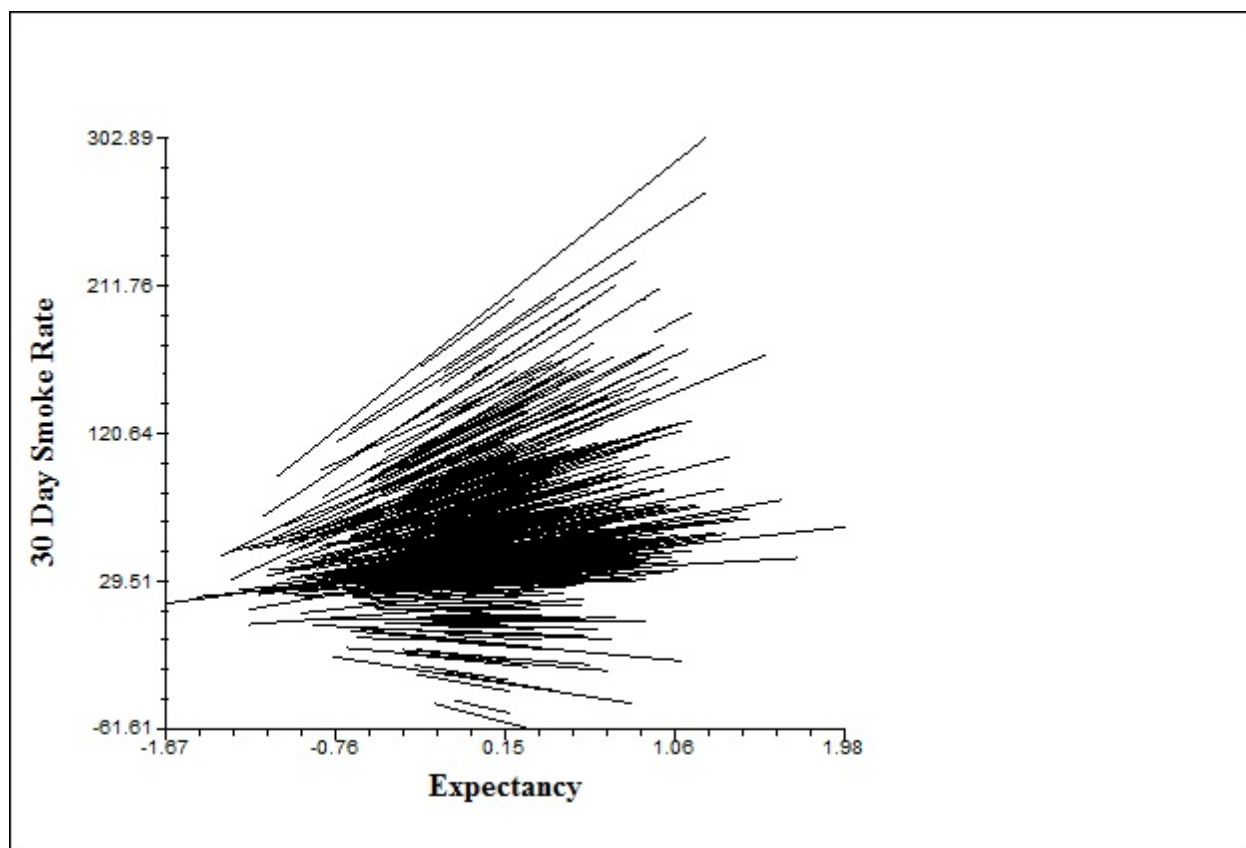
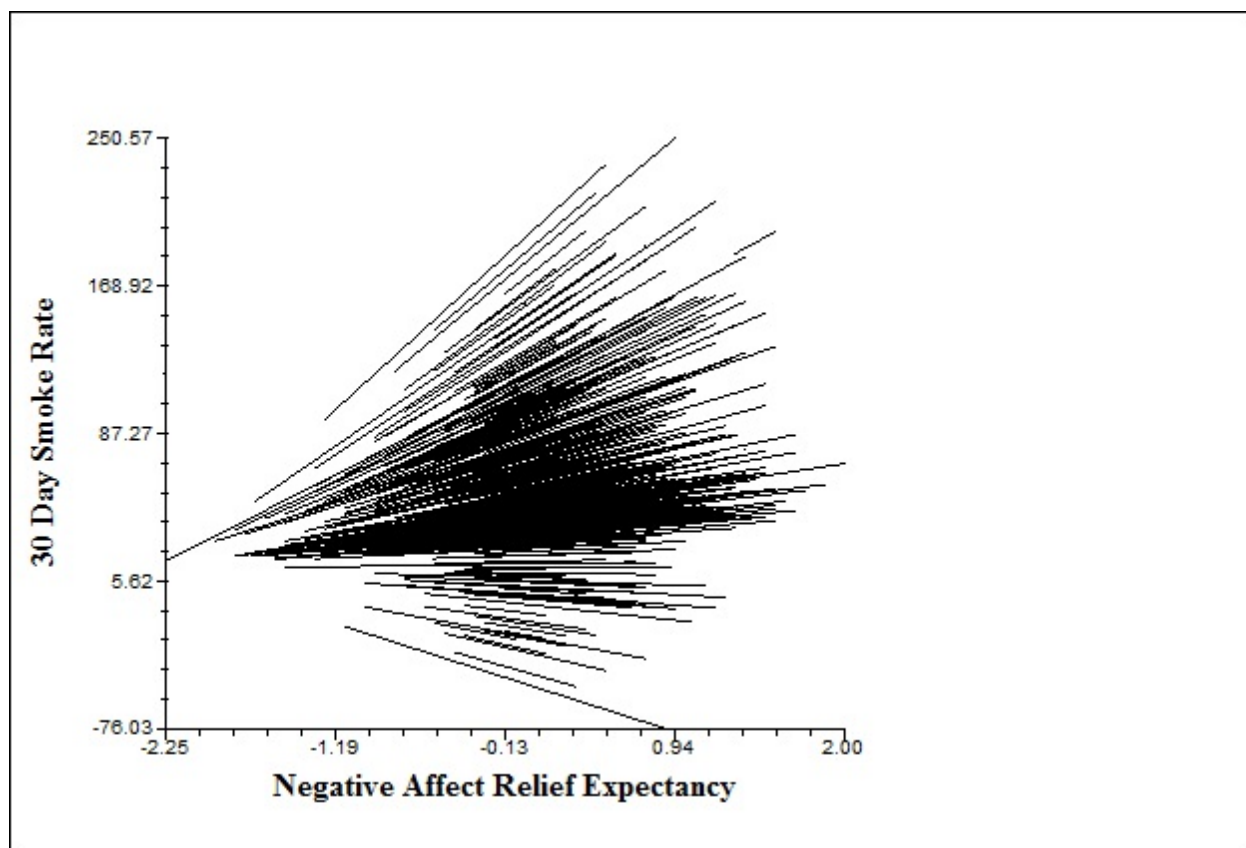


Figure 13.

Participant-level equations for individual mean-centered negative affect relief expectancy association with past month smoking behavior



APPENDIX A

Subjective Smoking Experiences-Current Questionnaire

1. When you smoke now, how much of a pleasurable sensation do you feel?

1 – None 2 – Some 3 – Moderate 4 – Intense 5 – I don't smoke now

2. When you smoke now, how much of an unpleasurable sensation do you feel?

1 – None 2 – Some 3 – Moderate 4 – Intense 5 – I don't smoke now

3. When you smoke now, do you experience a pleasurable rush or buzz?

1 – None 2 – Some 3 – Moderate 4 – Intense 5 – I don't smoke now

4. When you smoke now, does it make you feel more relaxed?

1 – Not at all 2 – Somewhat 3 – Moderately 4 – Very much 5 – I don't smoke now

5. When you smoke now, do you feel sick or nauseous?

1 – Not at all 2 – Somewhat 3 – Moderately 4 – Very much 5 – I don't smoke now

6. When you smoke now, do you feel dizzy?

1 – Not at all 2 – Somewhat 3 – Moderately 4 – Very much 5 – I don't smoke now

7. When you smoke now, do you cough?

1 – Not at all 2 – Somewhat 3 – Moderately 4 – Very much 5 – I don't smoke now

APPENDIX B

Smoking Expectancy Scale

1. When I'm angry, a cigarette can calm me down.
1 – Disagree 2 – Disagree a little 3 – Agree a little 4 – Agree
2. Cigarettes are good for dealing with boredom.
1 – Disagree 2 – Disagree a little 3 – Agree a little 4 - Agree
3. Smoking keeps my weight down.
1 – Disagree 2 – Disagree a little 3 – Agree a little 4 - Agree
4. When I'm upset with someone, a cigarette helps me cope.
1 – Disagree 2 – Disagree a little 3 – Agree a little 4 – Agree
5. If I have nothing to do, a smoke can kill time.
1 – Disagree 2 – Disagree a little 3 – Agree a little 4 - Agree
6. When I'm feeling down, a cigarette can really make me feel good.
1 – Disagree 2 – Disagree a little 3 – Agree a little 4 - Agree
7. Cigarettes keep me from eating more than I should.
1 – Disagree 2 – Disagree a little 3 – Agree a little 4 - Agree
8. When I'm alone, a cigarette can help me pass the time.
1 – Disagree 2 – Disagree a little 3 – Agree a little 4 - Agree
9. Smoking calms me down when I feel nervous.
1 – Disagree 2 – Disagree a little 3 – Agree a little 4 - Agree
10. Smoking helps me control my weight.
1 – Disagree 2 – Disagree a little 3 – Agree a little 4 - Agree

APPENDIX C

Wills Tobacco Motives Inventory

1. Smoking helps you fit with other people.

1 – Not at all true 2 – A little true 3 – Somewhat true 4 – Pretty true 5 – Very true

2. Smoking makes it easier to be sociable with others.

1 – Not at all true 2 – A little true 3 – Somewhat true 4 – Pretty true 5 – Very true

3. Smoking makes you feel more energetic.

1 – Not at all true 2 – A little true 3 – Somewhat true 4 – Pretty true 5 – Very true

4. Smoking helps you concentrate on things.

1 – Not at all true 2 – A little true 3 – Somewhat true 4 – Pretty true 5 – Very true

5. Smoking makes you feel more sure of yourself.

1 – Not at all true 2 – A little true 3 – Somewhat true 4 – Pretty true 5 – Very true

6. You smoke when there's nothing better to do.

1 – Not at all true 2 – A little true 3 – Somewhat true 4 – Pretty true 5 – Very true

7. Smoking helps you forget your worries.

1 – Not at all true 2 – A little true 3 – Somewhat true 4 – Pretty true 5 – Very true

8. Smoking helps you calm down when you're feeling tense and nervous.

1 – Not at all true 2 – A little true 3 – Somewhat true 4 – Pretty true 5 – Very true

9. Smoking helps you when you're feeling angry.

1 – Not at all true 2 – A little true 3 – Somewhat true 4 – Pretty true 5 – Very true

10. Smoking makes you feel more relaxed.

1 – Not at all true 2 – A little true 3 – Somewhat true 4 – Pretty true 5 – Very true

11. Smoking cheers you up when you're in a bad mood.

1 – Not at all true 2 – A little true 3 – Somewhat true 4 – Pretty true 5 – Very true

APPENDIX D

Nicotine Dependence Syndrome Scales

1. Compared to when I first started smoking, I need to smoke a lot more now in order to be satisfied.

1 – Not at all true 2 – Not very true 3 – Fairly true 4 – Very true

2. Since I started smoking, I have increased how much I smoke.

1 – Not at all true 2 – Not very true 3 – Fairly true 4 – Very true

3. After not smoking for awhile, I need to smoke to relieve feelings of restlessness and irritability.

1 – Not at all true 2 – Not very true 3 – Fairly true 4 – Very true

4. After not smoking for awhile, I need to smoke in order to keep myself from experiencing any discomfort.

1 – Not at all true 2 – Not very true 3 – Fairly true 4 – Very true

5. I can function much better in the morning after I've had a cigarette.

1 – Not at all true 2 – Not very true 3 – Fairly true 4 – Very true

6. When I go without a smoke for a few hours, I experience craving.

1 – Not at all true 2 – Not very true 3 – Fairly true 4 – Very true

7. When I'm craving a cigarette it feels like I'm in the grip of some unknown force that I can't control.

1 – Not at all true 2 – Not very true 3 – Fairly true 4 – Very true

8. If there were no cigarettes in the house and there was a big rainstorm, I would still go out of the house and find a cigarette.

1 – Not at all true 2 – Not very true 3 – Fairly true 4 – Very true

9. In situations where I need to go outside to smoke (e.g. home if your parents don't know you smoke, at school during lunch), it's worth it to be able to smoke a cigarette, even in cold or rainy weather.

1 – Not at all true 2 – Not very true 3 – Fairly true 4 – Very true

10. If I'm low on money, I'll spend it on buying cigarettes instead of buying lunch.

1 – Not at all true 2 – Not very true 3 – Fairly true 4 – Very true

APPENDIX E*Quantity/Frequency Measures of Cigarette Smoking Behavior*

During the last 7 days, how many days did you smoke cigarettes?

0 days 1 day 2 days 3 days 4 days 5 days 6 days 7 days

During the last 7 days, about how many cigarettes did you smoke on each of these days?
(Write in)

On how many days did you smoke in the past 30 days?

0 days 1 day 2 to 3 days 4 to 5 days 6 to 7 days 8 to 10 days
11 to 20 days 21 to 29 days all 30 days

Think about the past 30 days. On the days you smoked cigarettes, about how many cigarettes did you smoke each day?

Did not smoke	less than 1	1 cig	2 cigs	3 cigs	4 cigs
5 cigs	6 – 10 cigs	11-19 cigs	20 cigs	20+ cigs	

CURRICULUM VITAE

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2006-2010**Honors/Awards:**

- Cum Laude 2010
- Presidential Scholarship 2006-2010
- Chicago Catholic Heritage Award 2006-2010
- Loyola Grant 2009-2010
- Dean's List 2006-2010

Research Interests:

- Substance use
- Courses of addiction
- Antecedents of cessation

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Substance Use Research Laboratory (SURL)
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Principal Investigator: Andrea King, PhD
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Research Assistant
Self & Social Interaction Lab
Principal Investigator: Tracy DeHart, PhD
 Department of Psychology
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August 2009-May 2010

Peer Reviewed Journal Articles:

1. Rueger, S.Y., Trela, C.J., **Palmeri, M.D.**, & King, A.C. (2012). Self-administered web-based timeline followback procedure for drinking and smoking behaviors in young adults. *Journal of Studies on Alcohol and Drugs*, 73, 829-833. PMID: 22846247
2. Roche, D. J. O., **Palmeri, M. D.** & King, A. C. (2013), Acute Alcohol Response Phenotype in Heavy Social Drinkers is Robust and Reproducible. *Alcoholism: Clinical and Experimental Research*. doi: 10.1111/acer.12280

Articles in Preparation

1. **Palmeri, M.D.** & Grant, J.E. (2015 in preparation). Moderators of trait and cognitive impulsivity in unipolar depression: An RDoC perspective.
2. **Palmeri, M.D.**, Trela, C.J., Piessecki, T., Mermelstein, R. (2015 in preparation). Antecedents to smoking cessation in adolescents: Results from a longitudinal ecological momentary assessment study.
3. **Palmeri, M.D.**, Giedgowd, G., Espitia, J., Kassel, J.D. (2016 in preparation). Nicotine withdrawal effects on selected attention.

Published Abstracts:

1. **Palmeri, M.D.**, Rueger, S.Y., Trela, C.J., McNamara, P.J., & King, A.C. (2012). Utilizing web-based technology in the assessment of alcohol and cigarette use via the Timeline Follow Back [Abstract]. *Alcoholism: Clinical and Experimental Research*, 36 (suppl: 1), 170A.
2. King, A.C., McNamara, P.J., **Palmeri, M.D.**, & Trela, C.J. (2012). Integrating laboratory and brief intervention methods to enhance behavioral change in drinker-smokers [Abstract]. *Alcoholism: Clinical and Experimental Research*, 36 (suppl: 1), 220A.
3. Roche, D.J.O., Claus, E.D., **Palmeri, M.D.**, Hutchinson, K.E., & King, A.C. (2012). A polymorphism of a ferrochelatase gene is related to neurobiological response to alcohol cues, subjective response to alcohol, and drinking behavior [Abstract]. *Alcoholism: Clinical and Experimental Research*, 36 (suppl: 1), 174A.
4. **Palmeri, M.D.**, McNamara, P.J., & King, A.C. (2013). Reproducibility of acute alcohol responses in young adult heavy social drinkers: Wave 2 of the Chicago Social Drinking Project [Abstract]. *Alcoholism: Clinical and Experimental Research*, 37 (suppl: 2)

Presentations at Scientific Meetings:

1. **Palmeri, M.D.**, Rueger, S.Y., Trela, C.J., McNamara, P.J., & King, A.C. (2012). Utilizing web-based technology in the assessment of alcohol and cigarette use via the Timeline Follow Back. Poster presented at the 35th annual meeting of the Research Society on Alcoholism, San Francisco, CA.
2. King, A.C., McNamara, P.J., **Palmeri, M.D.**, & Trela, C.J. (2012). Integrating laboratory and brief intervention methods to enhance behavioral change in drinker-smokers. Poster presented at the 35th annual meeting of the Research Society on Alcoholism, San Francisco, CA.
3. Roche, D.J.O., Claus, E.D., **Palmeri, M.D.**, Hutchison, K.E., & King, A.C. (2012). A polymorphism of a ferrochelatase gene is related to neurobiological response to alcohol cues, subjective response to alcohol, and drinking behavior. Poster presented at the 35th annual meeting of the Research Society on Alcoholism, San Francisco, CA.
4. **Palmeri, M.D.**, Grant, J.E. (2013). Impulsivity in young adults with a history of affective disorder without manic episodes. Poster presented at the 168th annual meeting of the American Psychiatric Association, San Francisco, CA.
5. King, A.C., **Palmeri, M.D.**, & McNamara, P.J. (2013). Alcohol's effect on smoking urge during the BrAC in heavy drinking co-users with light, moderate, and heavy smoking. Symposium presented at the 19th annual meeting of the Society for Research on Nicotine and Tobacco, Boston, MA.

6. **Palmeri, M.D.**, McNamara, P.J., & King, A.C. (2013). Reproducibility of acute alcohol responses in young adult heavy social drinkers: Wave 2 of the Chicago Social Drinking Project. Poster presented at the 36th annual meeting of the Research Society on Alcoholism, Orlando, FL.
7. **Palmeri, M.D.**, Giedgowd, G., Conrad, M.F., Kassel, J.D., Mermelstein, R. (2015). Initial evidence for the Incentive-Sensitization theory of addiction in adolescent smokers. Poster presented at the 21st annual meeting of the Society for Research on Nicotine and Tobacco, Philadelphia, PA.
8. **Palmeri, M.D.**, Giedgowd, G., Conrad, M.F., Espitia, J., Parkison, E., Kassel, J.D. (2015). Avoidance coping partially mediates coping motivated drinking in young adults. Poster presented at the 87th annual meeting of the Midwestern Psychological Association, Chicago, IL.

Campus Talks

1. **Palmeri, M.D.** (2014). Motivational Interviewing: What it is, why it's important and how to do it. Lecture presented during Psch 333, Clinical Psychology Laboratory, University of Illinois-Chicago.
2. **Palmeri, M.D.** (2015). Basic Statistics Primer. Lecture presented during Psch 333, Clinical Psychology Laboratory, University of Illinois-Chicago.
3. **Palmeri, M.D.** (2015). Firearm Law and Clinical Psychologists. Lecture presented during Psch 340, Psychological Assessment, University of Illinois-Chicago.

Teaching Experience

Fall 2013-Spring 2014

Teaching Assistant for Introduction to Psychology

- Lead weekly discussion sections to review course material.
- Provided guidance for students midterm and final papers
- Graded midterm and final papers

Fall 2014-Present

Teaching Assistant for Laboratory in Clinical Psychology

- Attend weekly lectures
- Grade assignments and papers
- Lecture on various topics related to clinical psychology

Summer 2015

Teaching Assistant for Abnormal Psychology

- Graded assignments and papers

- Proctored Exams

Summer 2015

Teaching Assistant for Psychological Assessment

- Lectured on topics related to assessment
- Graded exams and assignments

Clinical Experience

- Deliver weekly evidence-based treatments to clients from all backgrounds and age groups.
- Administered psychological testing for clients with difficulties ranging from intellectual disabilities to attention deficit hyperactivity disorder

Clinical Certifications

Spring 2014

- Motivational Interviewing from the Motivational Interviewing Training Network

Fall 2014

- CBT for Trichotillomania from the Professional Training Institute of the Trichotillomania Learning Center

Fall 2015

- Cognitive Processing Therapy for PTSD from the Medical University of South Carolina