

IMPLICIT AND EXPLICIT PREDICTORS OF SMOKING CESSATION BEHAVIOR

by

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A rectangular box containing four handwritten signatures, each on a horizontal line. The signatures are: Barbara McCrady, Alan Stein, Elizabeth J. Pote, and Daniel J. [unclear].

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ABSTRACT OF THE DISSERTATION

Implicit and Explicit Predictors of Smoking Cessation Behavior

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The current study drew on the Theory of Planned Behavior (TPB) to model self-change behavior in a sample of self-defined smokers over a 6 month follow-up period. The study tested the validity of the TPB model and the validity of the Expanded Model which proposed the addition of Impulsivity and Implicit Smoking Self-Identity as predictors of smoking outcome. The sample was recruited via an online advertisement and consisted of current smokers over 18 years of age reporting no terminal illness. The baseline sample consisted of 81 female and 49 male participants and the follow-up sample consisted of 28 female and 14 male participants. The study was administered online. Data consisted of demographic variables, dependence severity, and perceived stress. The TPB model variables were Smoking Attitude, as measured by Semantic Differential scales, Social Norm and Intent to Quit, measured using item ratings, and Self-Efficacy. Smoking outcome was measured as time to first quit attempt, number of quit attempts in the last 6 months, and longest period of abstinence in the last 6 months (dichotomized into high and low abstinence groups because of severe skew). A linear regression was run to test the first step of the TPB, predicting Intent to Quit from Personal Attitude, Social Norm, and Self-Efficacy. The current study found support for the first step of the

TPB model- Personal Attitude and Social Norm predicted Intent to Quit. A series of regressions were performed to test the second step of the model, predicting Smoking Outcome from Intent to Quit, Self-Efficacy, Impulsivity, and Smoking Self-Concept. Partial support was found for the second step of the model, with Intent to Quit and Impulsivity predicting smoking outcome. Smoking Self-Concept was found to be predictive at a trend. Self-efficacy was not found to be predictive of either Intent to Quit or smoking outcome. An attrition analysis was performed to investigate predictors of study participation at follow-up. Support for the construct validity of the Smoking Self-Identity IAT was found; it was uncorrelated with Explicit Attitude and Social Desirability Bias and negatively correlated with smoking outcome. Limitations of the sample and implications for future research are discussed.

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Implicit and Explicit Predictors of Smoking Cessation Behavior

Tobacco use in the US is associated with 1 in 6 deaths every year (NIDA, 2006). Fortunately, smoking prevalence has dropped considerably, falling from a peak of 50% in 1965 to 24.9% in 2004. However, there is evidence to suggest that the remaining smokers represent people who are harder to treat or more resistant to anti-smoking interventions - the so-called Hardening Hypothesis (Burns & Warner, 2002; Irvin & Brandon, 2002; Warner & Burns, 2003). Whatever the explanation may be for the recent deterioration in treatment outcomes, the consensus among researchers is that more needs to be done to improve smoking cessation success rates. The current study attempted to more completely model self-change efforts among current smokers to identify variables affecting smoking cessation that might suggest future intervention efforts that would improve treatment efficacy.

Smoking Research

Treatment Outcome

Clinical research in the smoking literature is largely dominated by studies of treatment outcome. The studies have established a number of treatments as efficacious in smoking cessation. Treatments that have significant efficacy include behavioral interventions, nicotine replacement therapy, non-nicotine pharmacotherapy, and combinations of behavioral and pharmaceutical interventions.

Behavioral Treatments. Behavioral interventions studied range from brief, three-minute interventions by physicians to more intensive counseling, involving multiple sessions (Rigotti, 2002). These treatments have demonstrated efficacy over control treatment conditions regardless of treatment intensity, but some studies have reported a

dose dependent response (Lerman, Patterson, & Berrettini, 2005). A meta-analytic review of treatment outcome studies found odds ratios of 1.48-1.52 for brief interventions such that participants receiving treatment were 1.48-1.52 times more likely to quit than controls who received no treatment (Baillie, Mattick, Hall, & Webster, 1994). More intense behavioral interventions (3 to 4 times the length of brief interventions) demonstrated an odds ratio of 2.23 for quit rates.

Nicotine Replacement Therapy (NRT). Interventions that rely on nicotine replacement aid smokers by reducing the symptoms of physiological withdrawal associated with smoking cessation. They provide a relatively safe and lower dose of nicotine than cigarettes. The dose of nicotine is faded after a period of abstinence from smoking. Currently, smokers can choose among a number of routes of nicotine delivery including the gum, the transdermal patch, the inhaler, the nasal spray, and the lozenge. A review of smoking interventions found a 1.5 to 2 times greater likelihood of abstinence at 6-month follow-up for those on NRT compared to placebo conditions (Lerman et al., 2005).

Non-Nicotine Pharmacotherapy. A number of medications have been found to be effective as smoking cessation aids. Bupropion is an antidepressant whose mode of action is thought to be through the inhibition of reuptake of dopamine and norepinephrine. Recent findings suggest that it is also a nicotinic receptor antagonist that may reduce the reinforcing effects of smoking (Lerman et al., 2005). It has been demonstrated to be superior in efficacy to both placebo and the transdermal nicotine patch in terms of quit rates. At 12-month follow-up, bupropion doubled quit rates relative to placebo (Lerman et al., 2005).

Varenicline is a recently approved smoking cessation aid. It is thought to be a nicotinic receptor partial agonist. It inhibits nicotine from binding to these receptors and mildly stimulates dopamine release, reducing reinforcement from smoking. Early studies revealed quit rates of 4 times that of placebo and twice that of bupropion and the transdermal nicotine patch (Wardhan, Chopra, & Rehan, 2007). Varenicline also demonstrated significantly higher cessation rates after 40 weeks of follow-up and significantly reduced rates of relapse at 1-year follow-up compared to placebo.

Standard of Care and Clinical Guidelines. The current standard of care is to combine a behavioral treatment with a pharmacologic treatment. Studies consistently find significantly greater efficacy for combinations of behavioral and pharmacologic treatments than for either alone (Lerman et al., 2005).

Despite the improvements in outcome over placebo that the above interventions demonstrate, there is still room for improvement. Six-month abstinence rates for the various treatments are as follows: 7-19% for behavioral treatments (Niaura et al., 2002; Prochaska, DiClemente, Velicer, & Rossi, 1993), 17-63% for NRT, 18-27% for bupropion, and 25-35% for varenicline (Lerman et al., 2005; Wardhan, Chopra, & Rehan, 2007). Clearly, current treatments do not provide optimal outcomes and, looking forward, a deterioration in efficacy is predicted by the Hardening Hypothesis.

Mechanisms Research

Parallel to treatment efficacy studies are studies of models of behavior change that attempt to identify the mechanisms involved in change. This research promises to elucidate how current treatments work, for whom they work best, and suggest potential improvements that would increase the efficacy of treatments. A number of theories have

been put forth and have gained substantial empirical support demonstrating significant predictive validity. Among the theories that have found wide appeal in research are Bandura's Social learning theory, Prochaska and DiClemente's Stages of Change theory, and Ajzen's Theory of Planned Behavior.

Social Learning Theory. Bandura's social learning theory posits that cognitive processes mediate behavior change (Bandura, 1977). According to the theory, learning is not solely the result of contingent shaping; it also can occur through observation via cognitive intermediaries as is suggested by vicarious learning. The theory also introduced the concept of self-efficacy. Bandura suggested that outcome expectancies are not sufficient in determining behavior but that self-efficacy, a belief in one's ability to successfully execute a behavior, is a necessary precursor. It is not sufficient that an individual have positive expectations about the consequences of executing a behavior. The individual must also reasonably expect that he/she would be successful at executing the behavior.

Perceived self-efficacy partially determines whether an individual initiates a behavior and persists in it. Perceived self-efficacy also partially determines the choice of behavioral settings; situations that exceed coping skills are avoided and those commensurate with them are chosen. Also, perceived self-efficacy affects coping efforts once a behavior is initiated. Persistence leads to corrective experiences, which in turn reinforce an individual's sense of efficacy. However, Bandura emphasized that the appropriate skills and incentives are necessary prerequisites for expectations to result in performance success. Thus cognitions, behavior, and environment influence one another in a reciprocal fashion.

In most studies, self-efficacy is measured by simply asking participants to judge the likelihood of their being able to sustain a behavior, such as abstinence, in various situations. Research with clinical samples has demonstrated associations between self-efficacy and depression and between self-efficacy and anxiety symptoms, and also has established the mediating role of self-efficacy in the development of depressive symptoms in response to stressors over time (Maciejewski, Prigerson, & Mazure, 2000; Muris, 2002). In the area of health psychology, research has demonstrated the importance of the role of self-efficacy in treatment adherence and the management of chronic conditions (Belanger, Morin, Bastien, & Ladouceur, 2005; Scherer & Bruce, 2001).

The role of self-efficacy is no less important in the field of substance use treatments (Heather, 2005). A recent trend in treatment outcome studies is a greater focus on mechanisms that facilitate therapeutic change. Most consistent and significant of these findings has been the role of self-efficacy as the main and, for the most part, only empirically established mediator of change (Longabaugh et al., 2005; Morgenstern & Longabaugh, 2000). Other mechanisms will surely be identified with improved designs (Doss, 2004; Kazdin, 2005; Kazdin & Nock, 2003) but, for now, there is good evidence pointing to self-efficacy as an important change mechanism.

In the smoking cessation literature, self-efficacy features extensively. Smoking outcomes have been found to correlate significantly with self-efficacy, with reported explained variances ranging from 14 % to 47% (Condiotte & Lichtenstein, 1981; de Vries & Backbier, 1994; Lipkus, Lyna, & Rimer, 1999). Self-efficacy also has been demonstrated to mediate the protective effect of cultural norms on smoking outcomes

(Morgan-Lopez, Gonzalez Castro, Chassin, & MacKinnon, 2003). These findings are not limited to the short term. Self-efficacy at baseline was found to be predictive of smoking outcomes at 1 and 2-year follow-up (Abrams, 2000), and in a longitudinal study of adolescent smokers, self-efficacy and attitude about smoking were predictive of smoking status 3 years later (Engels, Knibbe, de Vries, & Drop, 1998).

A more fine-grained analysis of self-efficacy over time using Ecological Momentary Assessment (EMA) also revealed baseline self-efficacy to be predictive of initial lapse. Additionally, daily self-efficacy, measured after the quit date, was found to be predictive of relapse (smoking at least 5 cigarettes for 3 consecutive days) (Shiffman, et al., 2000). Finally, urge intensity, another predictor of relapse, was found to be associated with self-efficacy (Gwaltney, Shiffman, & Sayette, 2005).

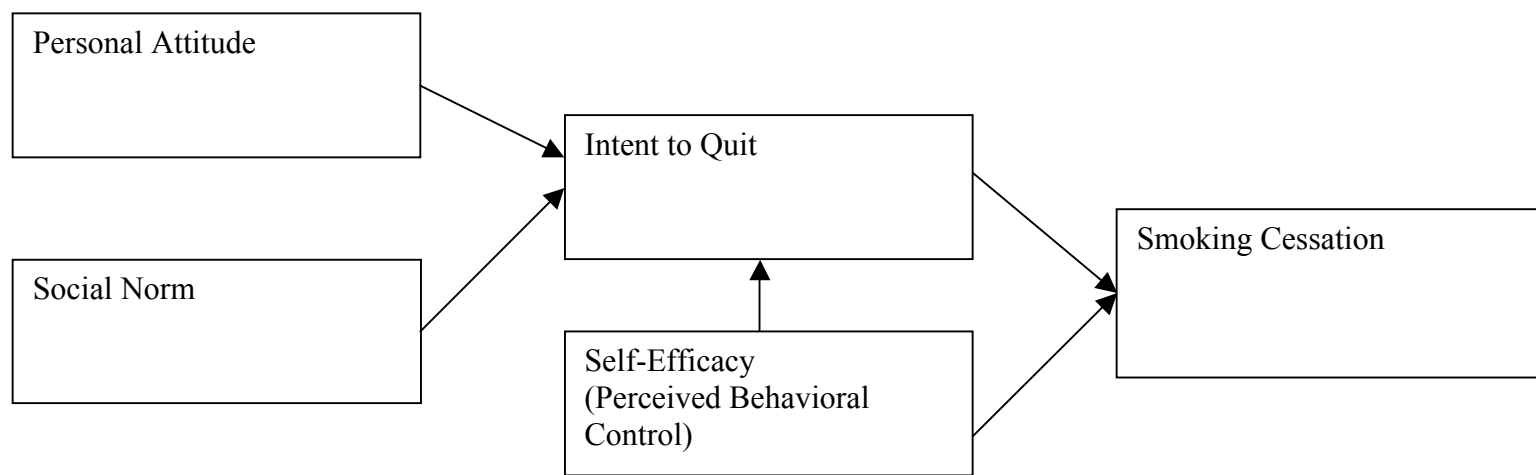
The Stages of Change. The Stages of Change model, part of the Transtheoretical Model, is a model of behavior change that attempts to account for varying degrees of motivation and readiness to change problem behaviors. The theory was first used to understand smoking cessation behavior among self-changers. It suggests that individuals can be understood as belonging to five stages of behavior change: precontemplation, contemplation, preparation, action, and maintenance (DiClemente et al., 1991). In the precontemplation stage, an individual is not considering changing within the next 6 months. In the contemplation stage, an individual is considering changing in 1 to 6 months or less than a month if no attempts to change have been made in the last year that lasted at least a day. In the preparation stage, the individual has tried to change for at least 24 hours within the last year and is planning to change within the next month. In the action stage, the individual has successfully changed for anywhere from 0 to 6

months. Beyond 6 months of successful change, the individual is considered to be in the maintenance stage. The model suggests that individuals progress sequentially through the stages but that slipping backwards is common. Cycling through the stages a number of times is expected before change becomes permanent.

Stage membership consistently has been found to be associated with self-efficacy. Among smokers, individuals classified into the more advanced stages reported higher levels of self-efficacy than individuals classified into the earlier stages (DiClemente et al., 1991; DiClemente, Prochaska, & Gibertini, 1985; Velicer, Redding, Sun, & Prochaska, 2007). Also, quit attempts and point prevalence abstinence were greater at 6 month follow-up among participants in the more advanced stages than those in the earlier stages (DiClemente et al., 1991).

Theory of Planned Behavior. The Theory of Planned Behavior (TPB) is an elaboration of the Theory of Reasoned Action (TRA). The TRA states that behavioral intentions are the best predictors of behavior (Sheppard, Hartwick, & Warshaw, 1988). The determinants of behavioral intentions are personal attitudes about the behavior and perceived social norms regarding the behavior. TPB (Figure 1) extends TRA to include perceived behavioral control as an additional determinant of behavioral intentions as well as a direct determinant of the behavior itself (Ajzen, 1991). This extension overcame the limitation of TRA as applicable only to behaviors over which an individual has complete volitional control. Perceived behavioral control encompasses an assessment of the requisite resources available to an individual to execute a behavior. As such, it has been deemed to be equivalent to perceived self-efficacy (Ajzen, 1991).

Figure 1. Theory of Planned Behavior



With self-efficacy as a determinant of behavioral intent, the overlap of the TPB with Bandura's Social Learning theory becomes apparent. The TPB takes the view that intention is a more immediate predictor of behavior than personal attitudes and social norms related to the behavior and that self-efficacy is in turn a determinant of intention along with attitudes about the behavior and social norms. Social learning theory (SLT) is silent on intention. It states that self-efficacy is predictive of the likelihood of initiating and maintaining a behavior, or performance success. The TPB is silent on the success of executing a behavior, focusing solely on its initiation.

The TPB has found support in the areas of consumer behavior and health psychology (Hardeman et al., 2002). A meta-analysis across health-related behaviors including smoking cessation revealed that, on average, attitude, social norms, and perceived behavioral control explained 41% of the variance in intention, and intention explained 34% of the variance in behavior (as cited in Hardemen et al., 2002). Perceived behavioral control, or self-efficacy, was found to explain 11.5% of the variance in behavior beyond that of behavioral intention. Efficacious interventions based on the TPB were found for behaviors as diverse as drunk driving, weight loss, and condom use. Calculable effect sizes ranged from 3.7% to 50%.

A number of studies have applied the TPB to smoking cessation. They consistently find support for the TPB (Conner, Sandberg, Higgins, & McMillan, 2006; Godin, Valois, Lepage, & Desharnais, 1992; McMillan, Higgins, & Conner, 2005). The explained variance for predicting intent to quit ranged from 1 to 54% and for predicting smoking outcome was 27 to 46%. Unfortunately, these studies are not consistent in how they measure the various constructs and a large portion of them rely on single-item

measures for some of the constructs. This inconsistency in methodology may be the reason for the wide divergence in findings. Another reason is suggested by a study that investigated the TPB in different racial groups, finding social norms predictive of intent among Black youth but not among Hispanic and White youth (Hanson, 1997).

Gaps in the Smoking Literature

The above theories of behavior change share a bias that characterizes much of psychological research. They have overlooked implicit and automatic influences on behavior, relying solely on explicit processes. Technological, as well as conceptual, barriers to the reliable and valid measurement of such constructs probably have been a major impediment to their incorporation into research efforts. Yet, few scientists today would argue for the absolute dominance of either implicit or explicit processes. Recent innovations in the measurement of implicit cognitions have reduced technological barriers substantially. However, the conceptual integration of implicit processes within explicit theories of behavior change has lagged although work on such ‘dual-process’ models is starting to emerge (Tiffany, 1990; Wiers & Stacy, 2006). The current study proposed to extend one of the current theories by incorporating implicit predictors into its model.

In treatment outcome research, implicit processes are beginning to be targeted directly (Wiers & de Jong, 2006). A promising intervention is ‘attentional retraining,’ which attempts to remedy the attentional biases that individuals with substance dependence develop towards stimuli related to their substance of choice. Early findings are promising, demonstrating significant reductions in cravings and consumption in a sample of alcoholics (Wiers, van de Luitgaarden, van den Wildenberg, & Smulders,

2005). However, adoption of such interventions is still in its infancy. Development and validation of models of behavior change that include implicit mechanisms will likely speed up their adoption. But which of the above explicit models of behavior change should be used as the basis of the elaborated model?

The Theory of Planned Behavior and Smoking. In a study of the TPB applied to smoking behavior, Norman, Conner, and Bell (1999) investigated the validity of the TPB in modeling smoking cessation behavior. The authors recruited 115 participants from a health promotion clinic. The clinics covered a wide range of health issues including smoking. The health promotion sessions lasted 30 minutes and provided information on the benefits of smoking cessation and encouraged attendees to quit. Questionnaires at baseline were administered that included measures of the TPB variables. Attitude about smoking was measured using 3 sets of semantic differential scales (bad-good, beneficial-harmful, foolish-wise). Subjective norms were measured using a single semantic differential scale that asked participants to rate on a likert scale (likely-unlikely) how strongly they believed that people important to them thought they should quit smoking in the next 6 months. Perceived behavioral control was measured using 3 items, e.g., “How much control do you feel you have over not smoking over the next 6 months?” Behavioral intention was measured using 4 items, e.g., “How likely is it that you will not be smoking in the next 6 months?” The purpose of the study was to explore the validity of including a measure of perceived susceptibility to negative consequences associated with smoking (the authors asked about seven smoking-related health problems, such as lung cancer, bronchitis: “How likely do you think it might be that you will develop any of the following problems in the future if you continue to smoke?”) and a measure of past

behavior. Previous quit attempts were measured using a single item that asked participants to indicate the number of times they had attempted to quit smoking in the past 5 years. The longest recent quit attempt was determined by asking participants to report the length of their longest quit attempt in the last 5 years. Six months later, a second questionnaire was mailed to participants. It consisted of two questions: whether or not an attempt to quit smoking was made in the last 6 months, and if a quit attempt had been made, the length of the period of abstinence. Eighty-four participants responded to the second questionnaire.

The analyses revealed that attitude, subjective norm, and perceived behavioral control combined were highly predictive of intent to quit, explaining 49% of the variance in behavioral intent. However, only the behavioral control variable emerged as a significant predictor. The addition of the perceived susceptibility variable to the model made a significant contribution to explained variance in behavioral intent, raising it to 56%. The addition of the previous behavior variable to the model did not contribute significantly to explained variance.

As for actual quit attempts made (or behavior initiation), coded as a dichotomous variable, the TPB variables led to a significant improvement in explained variance with the behavioral intent variable emerging as a significant predictor. The addition of the perceived susceptibility variable failed to improve the model, but the addition of the past behavior variable led to an improvement in the prediction of an attempt to quit.

Finally, the above analysis was repeated with length of abstinence entered as the outcome variable. The addition of both the past behavior variable and the longest recent quit attempt variable contributed 16% of the 25% explained variance of the model as a

whole. However, only the longest recent quit attempt variable emerged as a significant predictor of length of abstinence.

Norman et al. (1999) concluded that the TPB was predictive of intent to quit smoking with perceived control being the most important predictor. The TPB also was found to be predictive of the likelihood of making a quit attempt over a 6 month period. However, intent to quit smoking was a significant predictor while behavioral control was not. Finally, the TPB was not predictive of quitting success (length of abstinence). These findings suggest that the TPB is suitable for predicting intent to quit smoking but is not useful for predicting success of quitting effort. The authors also concluded that the addition of perceived susceptibility improved the TPB model by significantly enhancing its ability to predict quitting intention.

Addressing Gaps in the Smoking Literature

Implicit Attitudes. The fields of social and personality psychology offer clues to potential implicit mechanisms. In a review of the literature on attitude research, Greenwald and Banji (1995) made a strong case for the presence of implicit social cognitions, such as implicit attitudes and stereotypes, and the significance of their role in judgment and behavior. The authors noted that past research on attitudes had found weak correlations between attitudes and observable behavior, undermining the predictive validity of the construct. Subsequent research has found strong correlations only in situations where the attitude is strongly activated or where the link between attitude and behavior is clearly perceived by the actor. It seems that explicit attitudes predict behavior only when one is made conscious of them. Greenwald and Banaji argued that implicit attitudes also are strongly predictive of behavior. They defined implicit attitudes as:

“introspectively unidentified (or inaccurately identified) traces of past experience that mediate favorable or unfavorable feeling, thought, or action toward social objects” (p. 8).

As evidence of the predictive validity of implicit attitudes, Greenwald and Banaji (1995) reinterpreted findings of studies that supported the existence of previously unexplainable phenomena. Among such phenomena is the ‘halo’ effect. The authors regarded the ‘halo’ effect as the tendency to judge a person as possessing one attribute that is influenced by knowledge of the person possessing another known but unrelated attribute. In the literature, the known attribute most often studied has been physical attractiveness and it has been found that people tend to view others who are physically attractive as being “kinder, more interesting, more sociable, happier, stronger, of better character, and more likely to hold prestigious jobs” (p. 9). The association between attractiveness and the other attributes is implicit.

The authors point to the literature on the ‘mere exposure’ effect for another example of implicit attitude effects. The ‘mere exposure’ effect refers to the phenomenon in which increased familiarity with a stimulus leads to an increased positive evaluation of it. Similarly, implicit attitude effects can be found in context effects in survey research, such as those in a study where participants who were interviewed by phone on sunny days reporting greater quality-of-life than participants interviewed on rainy days. When participants were asked to describe the weather at the beginning of the interview, the effect of the weather on their quality of life response disappeared. These findings support the notion that peripheral information implicitly influences evaluative judgments.

The Implicit Association Test (IAT) was first introduced by Greenwald et al. (1998). It is used to infer the strength of association between two concepts by measuring the latency to respond when stimuli are presented that represent the combination of the two concepts. Participants are asked to discriminate between two categories of object words (e.g. flower and insect names) presented in the middle of the screen by pressing, using the left hand, a key on the left end of the keyboard ('A') that represents one category and pressing, using the right hand, a key on the right end of the keyboard ('L') that represents the other category. Then they are asked to discriminate between words that represent evaluation attributes (e.g. pleasant and unpleasant words). Finally, they are asked to respond to word stimuli drawn from a combination of both an object name and an attribute such that the response keys represent combinations of words and attributes (stimuli are presented randomly and balanced between the juxtaposed categories). When these combinations are of categories that are associated (e.g. flower names and pleasant words, insect names and unpleasant words), the latency to respond is shorter than when they are not associated (e.g. flower names and unpleasant words, insect names and pleasant words). The IAT effect is defined as the difference in latency between the incompatible association and the compatible association.

Greenwald et al. (1998) varied procedural variables in the administration of the IAT. They demonstrated that there was no significant moderating effect for variations in category set size (5 to 25 items), inter-trial interval (100, 400, or 700ms), or the assignment of response key (left or right). Only the order in which the combined tasks was presented had a moderate impact, such that the IAT effect was larger when the

compatible task was performed first. This effect was later found to be diminished by reducing the number of trials in each step of the IAT.

Additionally, the authors compared the outcome of the IAT to results from explicit measures of attitudes, such as the feeling thermometer and semantic differentials. For the feeling thermometer, participants were asked to indicate on an illustration of a thermometer their general level of warmth or coolness toward the target concepts. The thermometer was graduated in ten-degree intervals and labeled at the 0, 50 and 99 points with the words cold or unfavorable, neutral, and warm or favorable, respectively. For the semantic differentials, participants were asked to complete, for each target concept, five 7-point scales that were labeled at either end with opposite adjective pairs such as beautiful-ugly, good-bad, pleasant-unpleasant, honest-dishonest, and nice-awful. If a scale was irrelevant, participants were asked to mark the middle of it. Correlations between explicit and implicit measures were low, suggesting a divergence in the constructs measured by the two methods.

To comment on the resistance of the IAT to self-presentational forces, the authors devised IATs that contrasted socially consistent target concepts, such as flower names-insect names and musical instruments-weapons, with pleasant-unpleasant words, as well as IATs that tapped into more socially sensitive domains such as attitudes toward ethnic groups by contrasting Japanese-Korean names (for Japanese and Korean participants) and Black-White names with pleasant-unpleasant words (White American participants). They found that the variation in effect sizes for explicit measures of attitude was greater than the variation in the effect size of the IAT, suggesting that explicit measures were more susceptible to self-presentational forces. Also, given the anonymous conditions

under which the tests were administered, the authors concluded that the self-presentational forces were of the category of private self-presentation, i.e. presentation to self, rather than the category of impression management, i.e. presentation of self to others.

Convergent validity for the IAT was demonstrated by the fact that it correlated expectedly with common views regarding target concepts, i.e. that musical instruments and flowers are more pleasant than weapons and insects. Also, in the Korean-Japanese task, IAT results were moderated by measures of immersion in Asian culture. Additionally, preference for in-group members was demonstrated by the results of the IAT in the White-Black task.

Discriminant validity was demonstrated by the fact that for each target concept, explicit measures of attitude correlated better with one another than with the IAT measures. A possible confound with the IAT results may be familiarity with the target concept. White participants responding faster to White names than to Black names may be because of their greater familiarity with White names relative to Black names. However, familiarity alone cannot explain the results for the flower-insect and musical instrument-weapons tasks because the negative target concept words (weapons and insects) have substantially higher frequency in the language than the positive concept words (flowers and musical instruments) (Greenwald et al., 1998).

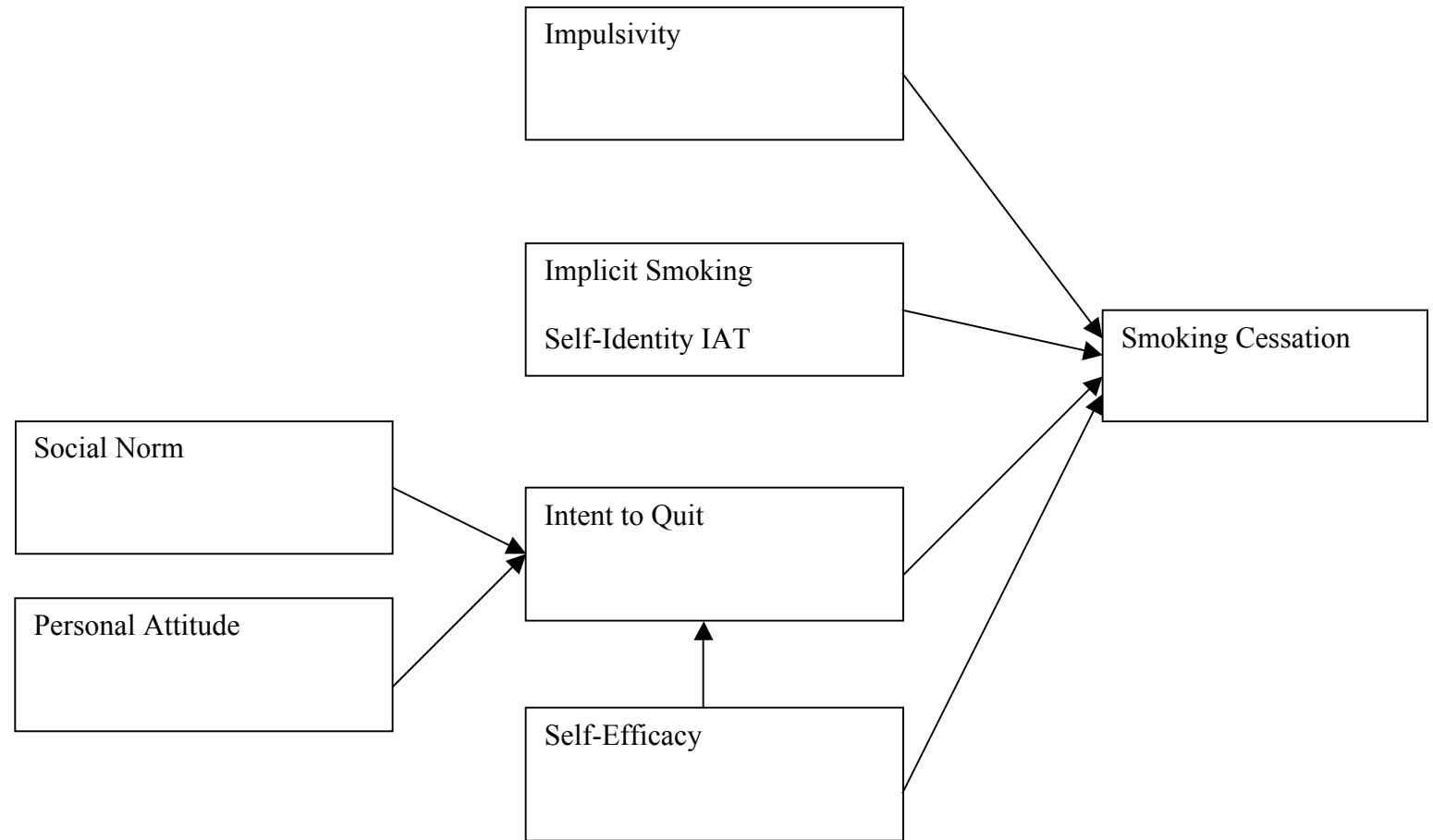
The IAT also has been used to measure self-esteem and identity (Greenwald et al., 2002; Greenwald & Farnham, 2000), and stereotypes (Banaji & Greenwald, 1995; Rudman et al., 1999). It also is growing in prominence in research on psychopathology such as depression (Friedman, 2004; Gemar, 2001), phobias (Teachman, 2002), and

addictive behaviors (Swanson et al., 2001). Published details on a revised scoring algorithm for the IAT that outperforms earlier conventions also can be found (Greenwald et al., 2003). The current study utilized the IAT (Greenwald et al., 1998) to measure smoking Self-Identity, using the IAT as a proxy for the combined effect of social norms about smoking and the importance of social norms to the individual (conformity) (Terry & Hogg, 1996).

Implicit Attitudes and the Theory of Planned Behavior. A consensus emerging in the social psychology field is that implicit and explicit attitudes are “related but distinct concepts” (Rudman, 2004). The extent to which explicit and implicit attitudes correspond with one another is moderated by a number of potential variables such as social desirability concerns and accessibility. As long as such potential moderators are suspected to influence the relationship between implicit and explicit attitudes, both must be taken into consideration as potential determinants of the relevant behavior. In other words, implicit and explicit attitudes may have independent and uncorrelated influences on decisions and behavior. Therefore, theories like the TPB that rely on explicit attitudes about a target behavior as a determinant of behavioral intent must also consider their implicit counterparts to completely account for the role of the attitude of interest.

The current study extended the TPB by including an implicit measure of smoking self-identity as an independent predictor of behavior that is not mediated by behavioral intent (Figure 2). It was hypothesized that doing so would significantly improve the predictive power of the model. Implicit smoking self-identity is a sufficient implicit analog of the combination of explicit personal attitude and social norms because, as suggested earlier by Social Identity theory and Self-Categorization theory, an individual’s

Figure 2. The Elaborated Model



self-identity consists of both a personal and social identity, the importance of which is determined by the individual's relative strength of identification with both (Terry & Hogg, 1996). The influence of implicit personal attitude is incorporated into the cognitive triad as suggested by the Unified Theory.

Personality and Smoking. Personality research has uncovered a number of factors related to substance use. According to a recent meta-analysis of studies of personality and smoking, smokers consistently score higher than non-smokers on Extraversion and Neuroticism (Munafo, 2007). Also, smokers are not homogenous; heavy smokers scored significantly higher than light smokers on Psychoticism, as did smokers who started smoking at earlier ages (Arai, Hosokawa, Fukao, Izumi, & Hisamichi, 1997).

Another personality construct that has been investigated in the smoking literature is Impulsivity. Impulsivity is broadly defined as action without foresight (Winstanley, Eagle, & Robbins, 2006). It has been found to be associated with smoking and, in a longitudinal study, was found to be associated with an increase in the number of cigarettes smoked, but only among women (GranÖ, Virtanen, Vahtera, Elovainio, & KivimÄKi, 2004). As for success at maintaining abstinence, more impulsive smokers were found to relapse faster than less impulsive smokers, even after controlling for baseline dependence severity (Doran, Spring, McChargue, Pergadia, & Richmond, 2004). Furthermore, mediational analyses revealed that this association was not explained by declines in positive affect, increases in negative affect, or craving intensity. Finally, impulsivity was found to predict a heightened craving response to a smoking cue (Doran, McChargue, & Cohen, 2007). The above findings suggest that Impulsivity warrants consideration in models of behavior change for smokers.

The current study incorporated a measure of impulsivity as a predictor of smoking cessation outcomes. It was hypothesized that impulsivity would have a direct effect on behavior without being mediated by behavioral intent (Figure 2). As discussed above, impulsivity consistently has been found to be both a determinant and a consequence of smoking behavior (Bickel & Marsch, 2001; Dom, D'Haene, Hulstijn, & Sabbe, 2006; Field, Santarcangelo, Sumnall, Goudie, & Cole, 2006; Giordano et al., 2002; Perry, Larson, German, Madden, & Carroll, 2005; B. Reynolds, 2004).

There are a number of methods to measure impulsivity. Self-report personality inventories and questionnaires, and behavioral tasks such as the Go/NoGo Task and the Stop Task have been used (B. Reynolds, Ortengren, Richards, & De Wit, 2006). Of late, the field of behavioral economics has offered delay discounting as a measure of impulsivity. Delay discounting refers to the phenomena that people discount the value of a reward expected after a time delay relative to an immediate reward (B. Reynolds, Richards, Horn, & Karraker, 2004). In other words, individuals prefer to have a reward now rather than later and if they have to accept a delay in receiving a reward, then they perceive it as less valuable. So ten dollars now is worth more to a person than ten dollars next week. To measure the extent to which someone might discount delayed rewards, the Delay Discounting Task (DD) is used. The DD presents a series of choices to participants who select which of two options they prefer. The choice typically is between \$10 after delays of 1, 2, 30, 180, and 365 days and a smaller amount available immediately. The smaller amount is increased by \$.50 increments on successive trials until the participant chooses equally the delayed versus the immediate option. This is considered to be the participant's indifference point for a particular time delay. Five

indifference points are determined that correspond to the five time delays used. The indifference points are plotted and a discount function is determined by fitting a curve to the points. The curve-fitting analysis results in a k-value, which is a quantitative index of the steepness of the curve. Higher k-values correspond to greater discounting of delay such that more immediate rewards are valued as much greater than delayed rewards. Greater delay discounting indicates greater impulsivity.

The DD offers a number of advantages over other methods for measuring impulsivity among smokers. First, the DD has been researched extensively among substance users and has been found to have significant validity as a measure of impulsivity (Bickel & Marsch, 2001; Dom et al., 2006; Field et al., 2006; Giordano et al., 2002; Perry et al., 2005; B. Reynolds, 2004). Second, impulsivity as measured by the DD has been demonstrated to be uniquely sensitive to the number of cigarettes smoked (B. Reynolds, 2004; B. Reynolds et al., 2004). Finally, the DD is resistant to social desirability biases because none of its items hint at the underlying construct that is being measured, namely impulsivity; there is no mention of substance use, loss of control, or impulsive behavior. For all the above reasons, the current study utilized the Delay Discounting task to measure impulsivity.

The DD k-value has been found to be negatively associated with grade point average (Kirby, Winston, & Santiesteban, 2002), and positively correlated with alcohol abuse, opioid dependence (Allen, Moeller, Rhoades, & Cherek, 1998), borderline personality disorder and bipolar disorder (Allen et al., 1998; Crean, de Wit, & Richards, 2000). More delay discounting was found among smokers experiencing nicotine deprivation relative to those allowed to smoke ad libitum (Field et al., 2006). Also,

active smokers discount more on average than those who never smoked or those who have quit smoking (Bickel, Odum, & Madden, 1999).

The current study employed the DD k-value as a measure of impulsivity. It was hypothesized that the DD k-value would be significantly and positively correlated with dependence severity and the average number of cigarettes smoked per day. Also, it was hypothesized that the DD k-value would be predictive of smoking cessation outcomes such that it would be significantly associated with a shorter latency to quit attempt, greater number of quit attempts and a lower success rate.

Comparison of Current Models

Shortcomings of the models of behavior change. A criticism of social learning theory is that it overlooks behavioral intentions or an individual's willingness to act. While one may feel able to successfully execute a behavior and believe that the behavior has rewarding consequences, one may not necessarily have the intention to initiate the behavior. At any one time, individuals are faced with many choices of possible behaviors that meet Bandura's stipulations. The Stages of Change model and the Theory of Planned Behavior acknowledge the role of intention in the decision to perform a behavior.

Despite the intuitive appeal of the Stages of Change model, it has come under considerable criticism due to a lack of unequivocal empirical research supporting it and the seemingly arbitrary boundaries it places between stages (Littell & Girvin, 2002; West, 2005; Whitelaw, Baldwin, Bunton, & Flynn, 2000). The model also assumes that people make stable and coherent plans to change. In fact, there is empirical evidence for the instability of intent to change over periods of time as short as a week (Hughes, Keely,

Fagerstrom, & Callas, 2005). Furthermore, a plan is not a necessary prerequisite for change. Recent findings suggest that more than half of smokers in a sample drawn from a family medicine practice setting reported attempting to quit without planning to do so (Larabie, 2005). Another study found that individuals who reported unplanned quit attempts demonstrated greater success at 6 months than those who reported planned quit attempts (West & Sohal, 2006). It appears that even in the absence of an explicit intent to quit, some smokers are able to achieve behavior change and they may even be better off not planning to quit.

Another criticism of the Stages of Change model is that the criteria used to classify participants appear to confound readiness to change with constructs such as dependence severity (Velicer et al., 2007), intent, self-efficacy, and history of prior change attempts (Littell & Girvin, 2002; West, 2005). It is perhaps for this reason that the readiness to change construct has found limited utility in research and weak support as a mechanism of change in treatment (Heather, 2005). Furthermore, a simple rating of desire to quit was found to be a superior predictor of behavior than stage membership in a sample of smokers (Pisinger, Vestbo, Borch-Johnsen, & Jorgensen, 2005).

The TPB addresses two of the criticisms raised about the Stages of Change model. The TPB specifies multiple determinants of behavioral intent and two determinants of behavior (Figure 1). The Stages of Change model relies on a seemingly continuous latent construct to categorize individuals into its discrete stages (Littell & Girvin, 2002). Also, the TPB is a linear model of behavior change that does not make any assumptions about the nature of behavior change over time. The Stages of Change model, on the other hand, views change as a phenomenon that is necessarily characterized by multiple stages.

For all the above reasons, the current study relied on the Theory of Planned Behavior to model the explicit determinants of behavior. However, the TPB itself is not free of criticism. There is a lack of consistent support for the role of social norms in determining behavioral intent (Ajzen, 1991; Donald & Cooper, 2001). This led Ajzen (1991) to conclude that personal factors are the primary determinants of intention relative to social norms. Terry and Hogg (1996) argued that attempts to measure perceived social norms failed in the past because they involved asking participants to report their perception of the extent to which others think the participants should perform the behavior in question. Rather, social norms should be assessed by asking participants about their perception of the *behavior* of others; for example, for a smoker considering quitting, the questions would be: “How many of your friends and peers think that quitting smoking is a good thing to do?”, and “To what extent do people in your social network agree that quitting smoking is a good thing to do?” The authors found empirical support for their arguments (Terry & Hogg, 1996). Social norms, measured as suggested by Terry and Hogg (1996), were found to be significant determinants of behavioral intent. Also, the relevant contributions of perceived social norms and personal attitude to behavioral intent were found to be significantly higher for high group identifiers (determined using a median split) and the reverse was found to be true for low group identifiers. This finding is consistent with Social Identity theory and Self-Categorization theory, which state that an individual’s self-identity consists of both a personal identity and a social identity. The salience of either identity is context-dependent and relies on the individual’s strength of identification with a reference group. The current study measured social norms as suggested by Terry and Hogg.

Another criticism of the TPB is that it ignores the role of implicit cognitions in determining behavior. Most theories of behavior change have ignored implicit and automatic influences on behavior (Tiffany, 1990). The TPB is no different. Yet, in a discussion of the theory's potential contribution to CBT, the authors have acknowledged that the TPB does not address more automatic and unconscious attitudes and personality factors, which they referred to as 'background factors' (Fishbein & Ajzen, 2005). They argue that these 'background factors' indirectly influence behavioral intent and so targeting behavioral attitudes directly is sufficient to facilitate changes in behavior without expending effort on changing the more 'deep-seated' attitudes. However, our understanding of behavior change is far from complete, so potential determinants that may improve models and suggest improvements in treatment cannot be overlooked. Furthermore, implicit and automatic forces may not necessarily influence behavioral intent but may directly influence behavior (Bargh & Chartrand, 1999; Bargh & Ferguson, 2000). The current study investigated the potential role of implicit attitudes in determining smoking cessation behavior, along with the explicit self-report measures suggested by the TPB.

Methodological issues in testing the TPB. There are a number of issues regarding the methodology in prior research that the current study attempted to address. Norman et al.'s (1999) application of the TPB used a three item set to measure perceived control without establishing its validity. It is generally agreed in the literature that, in the context of the TPB, self-efficacy should be treated as synonymous with perceived control (Ajzen, 1991). Self-efficacy to abstain from smoking might be a better choice than the three-item measure for two reasons. First, there are a number of established measures of self-

efficacy to quit smoking with good reliability and validity. Second, self-efficacy is a concept with a wider scope than would be suggested by the 3 items representing behavioral control. Self-efficacy measures specific situations and asks participants about their confidence to resist smoking in them. The items themselves serve as prompts that allow for a more accurate assessment of self-efficacy than is likely possible by relying on participants' own memory to assess a general sense of confidence to abstain. In fact, conceptually, self-efficacy should encompass an assessment of perceived control and perceived susceptibility as well as capture an element of past behavior. The above study chose to treat these constructs as separate. The current study attempted to replicate the above study but instead of the measures used by Norman et al. (1999), an established measure of self-efficacy was used. The current study did not introduce an intervention to avoid biasing findings towards one determinant or another.

The current study investigated the predictions made by both SLT and the TPB for a sample of smokers. Personal attitude and social norm regarding smoking, and self-efficacy were hypothesized to be predictive of intent to quit. Intent to quit was hypothesized to be predictive of latency to first quit attempt (behavior initiation) and the number of quit attempts made. Self-efficacy also was hypothesized to be predictive of latency to first quit attempt and the number of quit attempts but it was hypothesized that intent to quit would be the significantly superior predictor. Finally, self-efficacy was hypothesized to be predictive of success of quit attempts (behavior maintenance) as measured by the percentage of days abstinent and cigarette consumption. Intent to quit was not hypothesized to be predictive of success of quit attempts.

A 6-month follow-up period was proposed for the current study because one of the conditions of TPB is that behavioral intent and perceived control (self-efficacy) remain stable during the assessment and observation period. The time between assessments was kept to a 6 month period to reduce the likelihood of intervening influences affecting the variables of interest. While this window may still seem to be too large, it is an improvement over past studies, which have investigated follow-up windows greater than 6 months. The current author was not aware of any TPB studies of smoking self-change behavior that have employed follow-up periods briefer than 6 months. Moreover, reducing the length of the follow-up period any further could have led to a greatly reduced number of participants who attempted to quit, preventing an investigation of how they might differ from those who do not attempt to quit. A prior study of smoking self-change with no intervention demonstrated a quit rate of 7.7% after a 1 month interval and 56% over a 6 month interval (DiClemente et al., 1991). Therefore, the current study incorporated a follow-up at 6 months to attempt to model the shorter time period suggested to test the TPB and allow for the assessment of the temporal reliability of the variables. Finally, no intervention that might influence any of the variables was introduced between assessments. However, participants were free to seek treatment should they have desired it; no attempt was made to constrain their behavior during follow-up.

Another condition of the TPB is that self-assessments of perceived behavioral control be accurate and close to actual behavioral control. While misinformation and naiveté can be sources of inaccuracy in self-assessments, social desirability forces are just as likely to inflate self-efficacy assessments. This is especially true of stigmatized

behaviors such as smoking (Swanson, Rudman, & Greenwald, 2001). The current study was administered via the internet in an attempt to reduce the influence of social desirability forces and improve the predictive validity of smoking cessation self-efficacy.

Self-Change Behavior in a Community Sample. Self-change behavior in community samples is a useful target of research for a number of reasons. A considerable percentage of smokers will not attempt to quit smoking while being studied (approximately 50% are expected to attempt to quit over a 6 month period, DiClemente et al., 1991). Among those who attempt to quit, the majority will not seek help (DiClemente et al., 1991). If research were conducted only among those recruited for a clinical trial, then a large population of smokers that successfully change without clinical intervention would be overlooked. Clinical trial participants may be deficient in a skill or differ systematically from successful self-changers in other ways. Studying self-changers makes it possible to identify how they differ from treatment-seekers and perhaps suggest ways to bolster treatment-seekers' efforts to change. Furthermore, there is evidence suggesting that self-changers themselves are in need of effective interventions because their rates of cessation are no greater than those of treatment-seekers (Sobell, Sobell, & Agrawal, 2002). Studying self-change behavior also may lead to more effective public campaigns aimed at the general population of smokers.

Finally, community samples are more representative of smokers in general and allow for the study of processes of change that precede change efforts. Some theories of behavior change, such as the Stages of Change model (Prochaska & DiClemente, 1983) and the Theory of Planned Behavior (Ajzen, 1991), encompass concepts of intention and readiness to change that are presumed precursors to the decision to change. Studying

self-changers becomes a necessity to avoid artificially constraining these variables and allow for the inclusion of a broader array of change processes than seen in treatment.

In summary, the extant smoking cessation literature often relies on inconsistent and single-item measures, overlooks implicit attitudes and personality as predictors of behavior, and does not account for the role of social desirability bias in assessing participants. The current study attempted to model smoking self-change behavior using an Elaborated model that incorporates variables suggested by the Theory of Planned Behavior with the addition of a measure of implicit smoking Self-Identity and a measure of impulsivity as suggested by the literature on Delay Discounting among substance users. These additional variables were integrated as direct predictors of smoking behavior. It was hypothesized that the Elaborated model would be significantly more predictive of smoking outcomes than the TPB model. Implicit smoking Self-Identity and impulsivity were predicted to be significant and unique predictors of quit attempts and smoking behavior. Secondary analyses explored the role of implicit smoking Self-Identity as a possible determinant of impulsivity. Also, secondary investigations were carried out of possible significant interactions between implicit Self-Identity and behavioral intent, and between impulsivity and behavioral intent. Finally, the potential impact of Social Desirability Bias was investigated.

The Current Study

Rationale and Purpose

The current study investigated the integration of implicit constructs into an explicit theory of behavior change, the Theory of Planned Behavior. The implicit constructs included Implicit Smoking Self-Identity as well as a personality factor, Impulsivity. The Elaborated model was hypothesized to be significantly more predictive of smoking outcomes than the original theory.

A significant shortfall in follow-up participation at 6 months post baseline is likely to have introduced significant selection bias into the sample findings. Therefore, in addition to the original test of the above hypotheses, the following analyses were added in response to the limitations of the found dataset. The analyses included: a cross-sectional test of the validity of the proposed model; a thorough examination of the implicit construct, implicit smoking self-identity, to comment on the construct validity and reliability of the IAT; and finally, an analysis of predictors of study attrition. A further discussion of the challenges that were faced in data collection and proposed remedies for future efforts is included in the discussion section.

Hypotheses

- 1) a. Smoking Abstinence Self-Efficacy, Smoking Attitude and Social Norm are associated with Intent to Quit.
- b. Intent to Quit and Smoking Abstinence Self-Efficacy are predictive of latency to first quit attempt and the number of quit attempts.
- 2) a. Intent to Quit is significantly more predictive of latency to first quit attempt and the number of quit attempts than Smoking Abstinence Self-Efficacy.

- b. Intent to quit is significantly more predictive of the longest period of abstinence than of the latency to first quit attempt.
- 3) Impulsivity and Implicit Smoking Self-Identity, the additional variables of the Elaborated Model of Behavior Change beyond those of the Theory of Planned Behavior, add significant predictive power to the model across all outcome measures.

Revised Hypotheses

Cross-Sectional Analysis of the Elaborated Model

- 1) Intent to Quit and Smoking Abstinence Self-Efficacy are associated with latency to first quit attempt and the number of quit attempts.
- 2) a. Intent to Quit is significantly more strongly associated with latency to first quit attempt and the number of quit attempts than Smoking Abstinence Self-Efficacy.
- b. Intent to quit is significantly more associated with the longest period of abstinence than of the latency to first quit attempt.
- 3) Impulsivity and Implicit Smoking Self-Identity, the additional variables of the Elaborated Model of Behavior Change beyond those of the Theory of Planned Behavior, add significant predictive power to the model across all outcome measures.

Construct Validity of Implicit Smoking Self-Identity. The following hypotheses explore the construct validity of the Smoking Self-Identity IAT as a measure of Implicit Smoking Self-Identity. The first hypothesis was based on the consistent finding that implicit attitudes are constructs that are related to their corresponding explicit attitude

counterparts, as suggested by their face validity, but otherwise uncorrelated to them. The second hypothesis was derived from the assumption that Implicit Attitudes are resistant to social desirability forces. This feature has been argued to be a strength of the implicit attitude construct that often has been overlooked in research relying on explicit measures of attitude. The third hypothesis was based on the assumption that current smokers with less implicit smoking identity will be more likely to intend to quit smoking. This assumption was derived from the theory of Cognitive Dissonance, which suggests that people have a fundamental cognitive drive to reduce dissonance from holding contradictory beliefs (Spangenberg et al., 2003). Similarly, the fourth hypothesis was based on the assumption that current smokers with less implicit smoking identity would be more likely to make attempts to quit smoking as suggested by the theory of Cognitive Dissonance. The fifth hypothesis was based on the assumption that smokers with less implicit smoking identity identify are more likely to perceive themselves as capable of efficacious change. The hypotheses were:

- 1) Implicit Smoking Self-Identity is not significantly correlated with Explicit Smoking Attitude.
- 2) Implicit Smoking Self-Identity is not significantly correlated with Social Desirability Bias.
- 3) Implicit Smoking Self-Identity is significantly negatively correlated with Intent to Quit.
- 4) Implicit Smoking Self-Identity is significantly negatively correlated with number of quit attempts.

- 5) Implicit Smoking Self-Identity is significantly negatively correlated with Smoking Abstinence Self-Efficacy.

Predictors of Study Attrition. The following hypotheses explore potential predictors of attrition. The first hypothesis was based on the assumption that smokers who scored higher on the Social Desirability scale would be more likely to overestimate their readiness to quit smoking and thus would be more likely to avoid further participation as a way to avoid having to report behavior contradictory with their initial reports. The second hypothesis was based on the assumption that participants who were more impulsive would be less likely to follow through with a decision to participate again in the future. The third hypothesis was based on the assumption that smokers who reported greater Smoking Abstinence Self-Efficacy would be more likely to have positive smoking outcomes at 6 months and thus have less reason to avoid participating again than smokers who had negative outcomes to report. The fourth hypothesis was based on the assumption that participants who perceived greater everyday stress in their lives would be more likely to feel too overwhelmed to take the time to participate again at 6 months.

The hypotheses were:

- 1) Study participation at follow-up is significantly negatively correlated with social desirability bias.
- 2) Study participation at follow-up is significantly negatively correlated with impulsivity.
- 3) Study participation at follow-up is significantly positively correlated with smoking abstinence self-efficacy.

- 4) Study participation at follow-up is significantly negatively correlated with perceived stress.

Method

Participants

Participants were recruited using the Google search engine via online advertising targeted at US smokers. Participants came across an online advertisement when searching for certain keywords using the Google search engine. The advertisement invited them to participate in an online study concerning adults who were current smokers. The smoking literature is inconsistent in what it considers to be sufficient smoking to confer the status of ‘smoker’. The current study relied on participants to define themselves as daily smokers. Participants were led to a website via a hyperlink and self-screened for appropriate age (over 18), and having a terminal illness. Subsequently, they were invited to begin the study. No other inclusion or exclusion criteria were used. Participant recruitment via university listserves and smoking clinics also was explored but the response from the Google advertisement was so overwhelmingly strong that it was used as the sole method of participant recruitment.

The most constraining of the original hypotheses demanded a sample size of 97. Assuming an attrition rate of 20% (Borland, Segan, Livingston, & Owen, 2001) over the follow-up horizon, the target sample size at baseline had been set at 122. Greater attrition was expected for an online study than for an in-person lab study. However, avoiding the use of an intervention, providing an attractive reimbursement schedule, and limiting the length of the study had been expected to be effective measures to remedy any anticipated deterioration in the attrition rate.

The final recruited sample included 130 adults, 81 women and 49 men, who were smoking on a daily basis. To avoid artificially constraining any of the variables, no

exclusion criteria regarding readiness to quit smoking were used. The resulting sample allowed for a fairer test of the predictions of the TPB. However, the recruitment strategy used may have biased the sample towards smokers who were considering quitting. The limitations of the current recruitment procedure are discussed later.

The mean and median age of the baseline sample was 38 years and the mode was 48. The minimum age was 18 years old and the maximum age was 74. The sample was predominantly White (78%), followed by Black, Latino, Native American and South Asian (Table 1). The sample was predominantly Christian (56%) followed by Jewish and Atheist. Thirty-eight percent of participants reported living in the South, 28% reported living in the Midwest and the remainder were almost equally split between the Northeast and West (18% and 16%, respectively).

The Fagerstrom Test of Nicotine Dependence (FTND; Heatherton, Kozlowski, & Frecker, 1991) categorizes respondents into six levels of dependence severity; Very Low Dependence, Low Dependence, Medium Dependence, High Dependence, and Very High Dependence. The majority of participants (34%) scored in the High Dependence range. The next largest category of nicotine dependence was the Low Dependence group (22%). The remaining dependence categories were represented equally (14-15%). Participants who completed the study at follow-up ($n = 41$) did not differ significantly from those who dropped out in terms of demographic variables, including: age, sex, race, location, income, and education level.

Table 1. Summary of Demographics and FTND classification

		Baseline (n = 130)			Follow-Up (n = 40)		
		Male	Female	Total	Male	Female	Total
Age	-mean(SD)	39(16.4)	38(13.0)	38(14.3)	41(4.1)	39(2.5)	40(13.6)
Ethnicity	White	41	60	78%	13	22	85%
	Black	2	9	8%	0	2	5%
	Latino/Hispanic	3	3	5%	0	0	0%
	Native American	0	3	2%	0	0	0%
	South Asian	0	3	2%	0	1	2%
	Other	3	3	5%	1	2	7%
Religion**	Christian	27	46	56%	7	15	54%
	Jewish	3	3	5%	2	2	10%
	Atheist	2	4	5%	1	2	7%
	Other	17	28	34%	4	8	29%
Geographic	Northeast	13	11	18%	6	6	29%
Region	Midwest	12	24	28%	4	8	29%
	South	11	38	38%	3	11	34%
	West	13	8	16%	1	2	7%
FTND*- mean(SD)		5(2.2)	5(2.2)	5(2.2)	5(2.5)	5(2.3)	5(2.4)
	Very Low Dependence	7	12	15%	5	5	24%
	Low	13	16	22%	0	8	20%

Dependence						
Medium Dependence	6	12	14%	2	2	10%
High Dependence	16	28	34%	6	9	37%
Very High Dependence	7	13	15%	1	3	10%
Total	49	81	130	14	27	41

*** Fagerstrom Test of Nicotine Dependence; **All Christian denominations were collapsed into a single category. Also, all other religions were collapsed into a single category because they were represented by only 1 participant.**

Procedure

When participants followed the link to the study website they were directed to a consent webpage containing a detailed description of the study and the requirements for participation. In lieu of written consent, participants were asked to submit an email address as indication of their informed consent. This email address was saved to a password protected directory on an external thumb drive that was separate from the data that were collected. Next, participants were directed to the study webpage to begin the study. No identifying information was collected or linked to the data at any time. Data collected via the Millisecond website were downloaded periodically and saved to a password protected database on another external thumb drive.

All measures were programmed electronically and administered singly via Inquisit 2.0 software (Inquisit, 2006) through the maker's website. Participants were instructed to follow the directions to complete the IAT and questionnaires. Participants performed the IAT first to avoid any unintentional priming effects. Priming effects are

the unconscious activation of associations and they have been demonstrated to influence performance on various tasks (Greenwald, Klinger & Schuh; Greenwald, Draine & Abrams, 1995). Participants were then asked to complete the Delay Discounting task, the Personal Attitude, Social Norm, and Intent to Quit scales, the Smoking Abstinence Self-Efficacy Questionnaire (SASE), the Fagerstrom Test for Nicotine Dependence (FTND), the Marlowe-Crowne Social Desirability Scale (MCSD), Barratt's Impulsiveness Scale (BIS) and the Perceived Stress Scale (PSS). Finally, participants were asked to complete a demographic and smoking history questionnaire. This questionnaire asked participants to report demographic data including age, gender, education and income, smoking history, including age of first use, number and length of previous quit attempts, and current level of smoking. Participants were then thanked for their participation and received an electronic Amazon.com coupon worth \$10. After six months, participants were contacted via email and invited to participate again. They were asked to repeat the above battery of assessments online. The Smoking History questionnaire included a question that asked participants to specify when they attempted to quit smoking in the past 6 months and what, if any, resources they used to help them quit. After completing the battery, participants were thanked for their participation and they received an electronic Amazon.com coupon worth \$20. The maximum expected length of time for administering each assessment was approximately 15 minutes. To link the data from the two sessions, participants were asked to generate a unique code before each session consisting of the last 4 digits of their phone number and their 6 digit birth date (MM/DD/YY). After each assessment, participants were referred to the following online quitting resources: www.quitnet.com, www.smokefree.gov, www.becomeanex.org .

Also, every 8 weeks over the 6 month follow-up period, participants received the same blind-copied group email encouraging them to quit and/or to remain abstinent with links to the aforementioned online quitting resources.

An anticipated challenge was encouraging participants to participate at follow-up. Participants who failed to respond within a week of their first invitation to participate at follow-up were reminded repeatedly to participate. Reminder emails were sent regularly on varying days of the week for up to 4 weeks after the last follow-up due date. During the final two weeks of data collection, the incentive offered was increased to \$40. Subsequently data collection was halted to preserve the validity of the final dataset and to allow the experimenter to proceed to its analysis.

Internet research poses some unique challenges (Nosek, Banaji, & Greenwald, 2002). To facilitate follow-up, participants provided an email address as a result of their consenting to the study. One of the challenges to internet research is obtaining multiple data points from the same participant. To prevent this problem, participants were sent another email to the address they provided indicating study consent, which linked them to the start of the actual study. This precaution also ensured that the email address was a functioning one and prevented the same individual from using false email addresses to participate multiple times. Multiple data points originating from the same email address were screened out. Furthermore, the IP address of the machine used by participants was recorded as an added precautionary measure and multiple data points from the same IP address were screened out. There were 3 cases of participants attempting to participate multiple times at baseline. Their data were excluded from the final dataset.

Also, it is difficult to ensure that participants are sufficiently debriefed in internet studies. A number of unforeseen occurrences could disrupt the process without the experimenter's awareness that debriefing was not complete. To safeguard against inadequate debriefing, at the end of each participation session and along with their coupon, participants received an email with a debriefing note and anticipated Frequently Asked Questions.

Another challenge to internet research is the lack of experimenter control over the time the participant takes to complete a study. In the current study, participants were reminded that the time available to participate was limited. Also, they were asked to ensure that they would not be disturbed for the duration of the expected participation time. The IAT is a time-sensitive task, the scoring of which screens out latencies that are inordinately long and latencies that are unreasonably short. To ensure that all other measures were completed at the same time, each webpage displayed a time limit after which participation was terminated and the individual was invited to restart their participation. Data from interrupted sessions were disregarded.

A limitation of internet research that is difficult to address is the threat to generalizability of findings to the broader population. An online sample is likely to under-represent ethnic minorities and individuals of low socio-economic status and necessarily includes those who are computer-savvy enough to navigate the web. Although it is a major shortcoming of internet research, it is likely to diminish with time as barriers to online access continue to decline. The limits of the generalizability of the current findings will be discussed further in the discussion section.

Measures

The IAT. The IAT is an implicit cognitive measure of the strength of association between two concepts (Greenwald et al., 1998). Participants are instructed to respond to word stimuli presented on a computer screen by pressing a key on either the left or the right side of the keyboard. Above both keys, on the top corners of the screen, the category labels for the stimuli being represented are shown throughout the test. The shorter their latency to respond to stimuli from a combination of categories, the more closely associated the categories are to the participants. The IAT has demonstrated adequate internal consistency (.6) and good construct and predictive validity ($r = .27$) (Greenwald, Nosek, & Sriram, 2006; Poehlman, Uhlmann, Greenwald, & Banaji, 2003). The stimulus words for the smoking Self-Identity IAT were 5 smoking words (cigarette, tobacco, nicotine, smoke, ashtray) and 5 neutral words (neutral, historical, brown, steep, sandy) to represent smoking and nonsmoking concepts, respectively, and 5 ‘self’ words (I, me, my, mine, self) and 5 ‘other’ words (others, they, them, their, theirs) to represent self and other concepts, respectively. The choice of stimuli was made based on studies that revealed neutral words to be superior to ‘non stimuli,’ which tend to lead to a latency bias because non stimuli take longer to process cognitively (McCarthy & Thompson, 2006).

The IAT effect, or IAT D , is arrived at by a scoring algorithm suggested by Greenwald et al. (2003). The smoking self-identity IAT consists of 7 blocks of trials. The first two blocks consisted of presentations of items representing the smoking/neutral words and self/other words, respectively. Block 3 was considered a practice block of presentations of the combination of the two categories. Block 4 was also a combination of the two categories except that participants were informed that it was no longer for

practice and that their results would be recorded. Block 5 was similar to block 2 except that the response keys were reversed. Blocks 6 and 7 were similar to blocks 3 and 4, except the response keys were reversed. The position of presentations of the combined categories (blocks 3, 4, 6 and 7) was counterbalanced so that for half of the participants the initial combination was the hypothesized compatible combination (self + smoking/other + neutral), which was reversed in blocks 6 and 7, and for the remainder the initial combination was the incompatible one (self+ neutral/other + smoking).

Scoring of the IAT involved data collected from blocks 3, 4, 6, and 7 as stipulated in Greenwald et al. (2003). Trials with latencies greater than 10,000 ms were eliminated. Data were eliminated from participants for whom more than 10% of trials had a latency less than 300ms ($n = 0$). The mean of correct latencies for each block was calculated and one pooled standard deviation for all trials in blocks 3 and 6 and another for all trials in blocks 4 and 7 was calculated. Each error latency was then replaced with the block mean + 600ms. The average of latencies for each block was calculated and the differences between the averages of blocks 6 and 3, and blocks 7 and 4, were divided by the corresponding pooled standard deviations. Finally, the average of the prior two quotients was computed and the sign of the results from participants who were presented with the compatible combinations first was reversed. This algorithm provided a computation of D , which is a standardized measure of the difference in latencies between the hypothesized compatible and non-compatible block presentations.

Delay Discounting Task (B. Reynolds, 2004). The Delay Discounting Task determined indifference points for five delay intervals: 1, 2, 30, 180, and 365 days. The indifference points were determined by asking the participant to choose between

receiving a hypothetical \$10 after one of the delay intervals or a hypothetical \$1 immediately. The smaller amount was increased by increments of \$.50 until the participant was indifferent about the two choices. This procedure was repeated for each delay interval. The indifference point for each interval was the smallest amount of money the participant chose to receive immediately. The indifference points were plotted on a graph against the delay interval to which they corresponded. A curve-fitting program (SigmaPlot) was used to determine a measure of the steepness of the curve, the k-value, for each participant. The Delay Discounting k-value has demonstrated good reliability (.99) (Richards, Zhang, Mitchell, & de Wit, 1999) and good construct validity (.35-.45 correlations with established measures of impulsivity) (Richards et al., 1999).

Barratt Impulsiveness Scale (Patton, Stanford, & Barratt, 1995). The Barratt Impulsiveness Scale consists of 30 items that measure impulsivity. The scale has demonstrated good reliability (.79-.83). The scale has demonstrated good validity by correlating significantly with an established measure of impulsivity, the Sensation-Seeking Scale, and by discriminating between more and less severely dependent participants along with an established measure of impulsivity from Eysenck's Personality Questionnaire (O'Boyle & Barratt, 1993).

Personal Attitude scale (Terry & Hogg, 1996). The Personal Attitude scale is a set of semantic differentials consisting of the following adjective pairs: unpleasant-pleasant, favorable-unfavorable, awful-nice, and good-bad as suggested by Terry and Hogg (1996). Each adjective pair corresponds to either extreme of a 7-point Likert scale, labeled, consecutively, 'extremely,' 'moderately,' 'slightly,' 'neutral,' 'slightly,' 'moderately,' and 'extremely.' Participants were asked to rate 'smoking' on these scales.

Their responses were reverse-scored, such that a high score was indicative of a more positive attitude towards smoking, and then averaged to obtain a Personal Attitude score. The semantic differential scales have demonstrated very high reliability (.95-.99) and validity as measures of explicit attitude (ratings of negatively valenced concepts are in the expected direction) (Link, Yang, Phelan, & Collins, 2004).

Social Norm scale (Terry & Hogg, 1996). The Social Norm scale consisted of the following questions to which participants responded on a 7-point Likert scale, where 1 corresponded to ‘none’ and 7 corresponded to ‘all’: “How many of your friends and peers at work would think that quitting smoking is a good thing to do?”, and “Think about your friends and peers. How much would they agree that quitting smoking is a good thing to do?” A third question to which participants responded on a 7-point Likert scale where 1 corresponded to ‘undesirable’ and 7 corresponded to ‘desirable,’ is: “Most of my friends and peers think that my quitting smoking would be...”. The responses to the 3 items were averaged to obtain a Social Norm score, which represented the Social Norm construct in the Theory of Planned Behavior model. The Social Norm scale has demonstrated adequate reliability (.71-.74) and good validity as indicated by it being a greater predictor of intent for individuals who are relatively higher in group identification (Terry & Hogg, 1996).

Intent to Quit scale (Terry & Hogg, 1996). The Intent to Quit scale consists of the following questions: “I intend to quit smoking in the next 6 months,” and, “How likely is it that you will quit smoking in the next 6 months?” Participants indicate their response to both on a 7-point Likert scale, where 1 corresponds to ‘extremely unlikely; and 7 corresponds to ‘extremely likely.’ The ratings are averaged to obtain an Intent to Quit

score, which represents the Intent to Quit (or Behavioral Intent/Intention) construct in the Theory of Planned Behavior model. The Intent to Quit scale has demonstrated good reliability (.85-.94) and good predictive validity (explaining 34% of the variance in behavior) (Terry & Hogg, 1996).

Smoking Abstinence Self-Efficacy (SASE) (DiClemente et al., 1985). The SASE asks participants to indicate their confidence on a 5-point Likert scale from (1) 'not at all' to (5) 'extremely' that they would be able to resist smoking in 20 high risk situations. The scale for smoking demonstrates good internal consistency (.88 to .92) and good construct and predictive validity ($r = .72$ between self-efficacy and length of abstinence period) (Condiotte & Lichtenstein, 1981).

Fagerstrom Test for Nicotine Dependence (FTND) (Heatherton, Kozlowski, & Frecker, 1991). The FTND is a 6-item scale designed to measure physical dependence on nicotine. The questionnaire combines responses about the smoking habit (number of cigarettes smoked, minutes to first morning cigarette, smoking while ill, etc.) to create a measure of dependence severity ($\alpha = .61$). The FTND has been used to discriminate level of addiction using biochemical markers, withdrawal responses, heart rate, and past smoking behavior.

Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983). The PSS is designed to tap how unpredictable, uncontrollable, and overloaded participants find their lives. It is considered a global measure of how much perceived stress subjects have experienced within the past month. The scale consists of 10 items (Cohen & Williamson, 1988). The PSS has high reported reliability (.85) and correlates significantly both with

life event scales and with perception of life events scales, but more so with the latter (a difference of .18-.36) (Cohen & Williamson, 1988).

Marlowe-Crowne Social Desirability Scale (MCSD), short form (W. M. Reynolds, 1982). The short form of the MCSD is a 12 item scale designed to detect social desirability set responding. The original version consists of 33 items. The short form possesses adequate reliability (.75) and correlates significantly with the established 33 item version (.92).

Demographic and Smoking History questionnaire. This questionnaire included questions about demographic data including age, gender, education and income, and smoking history, including age of acquisition, number of serious quit attempts made (as defined by participants), length of longest period of abstinence in the last 6 months, time since the last quit attempt, and current level of smoking.

Smoking Outcome Measures. At baseline and follow-up, participants were asked to provide the following information about the previous 6 months: the number of serious quit attempts made, if any, the longest period of abstinence achieved (not a single puff), how soon after the previous assessment they made their first quit attempt if any, and current level of smoking. Additionally, participants were asked to report whether they were abstinent during the 7 days prior to their 6 month assessment to arrive at 7-day abstinence point prevalence.

Data Preparation and Analysis

Each variable was plotted and inspected for any skewed distributions as well as curvilinearity and potential influential outliers. To test for normality, the w/s (Kanji, 1993) test for normality was employed. The q test statistic must fall between 4.31 and

5.90 for the samples to be considered normally distributed. Any distributions that deviated significantly from normality were subjected to either a power or logarithmic transformation or a median split if transformations failed to achieve normality. To test for homogeneity of variances, the Fmax test (Kanji, 1993) was employed. To eliminate the effect of suspiciously extreme values on the distribution of the samples and the correlation calculation, data points that fell 1.5 interquartile ranges below the first quartile or above the third quartile were deemed to be outliers. If significant outliers were found, they were excluded from further analysis. To be consistent with the literature the FTND, and PSS were investigated as possible significant covariates across all models. If the FTND or PSS correlated significantly with the dependent variable in question, the variable was included in the analysis as a covariate to be controlled for before considering the role of the main predictors. Sex also was investigated as a potential covariate because there was a large imbalance in the final sample with almost twice as many women as men. Furthermore, all IVs were assessed for vulnerability to social desirability by examining their correlations with MCSD scores. The BIS was utilized as the measure of impulsivity across all analyses instead of the DD k-value due to a lack of valid DD data in the current sample.

Testing the Hypotheses

- 1) a. *Smoking Self-Efficacy, Smoking Attitudes and Social Norms are predictive of Intent to Quit.*

The null hypothesis was that the model does not provide significant fit to the data. The alternate hypothesis was that the model does provide significant fit to the data. The appropriate test was the F-test and the critical value was 3.20. The independent

variables (IV) were Smoking Abstinence Self-Efficacy, Smoking Attitude score, and Social Norm score; the dependent variable (DV) was the Intent to Quit score. A linear regression was run.

Past findings indicate that a meaningful effect size would be $R^2=.41$ (Hardeman et al., 2002). A regression analysis with 3 predictors at a .80 level of power and an alpha level of .05 demands an n of 21.

b. Intent to Quit and Smoking Self-Efficacy are predictive of latency to first quit attempt and the number of quit attempts made.

The null hypothesis was that the model does not provide significant fit to the data. The alternate hypothesis was that the model does provide significant fit to the data. The appropriate test was the F-test and the critical value is 3.52. The IVs were Intent to Quit and Smoking Self-Efficacy; the DVs were latency to first quit attempt and the number of quit attempts. A Cox regression was run for the latency to first quit attempt DV and a linear regression was run for the number of quit attempts DV.

Past findings indicate that a meaningful effect size would be .34 (Hardeman et al., 2002). A Bonferroni correction was applied to the alpha level because the analysis was repeated for 2 DVs. The alpha level was set at .025. Unfortunately, no previous study applied a survival analysis to the TPB in the context of smoking. A simulation comparing R^2 for linear models to those from Cox models revealed them to be similar (Gillespie, 2006). However, heavy censoring (50%) can decrease R^2 by as much as 20%. The current study expected censoring of up to 80%; only 20% of participants were expected to attempt to quit by follow-up due to the brief time horizon and lack of intervention. To be conservative, an exponential relationship was assumed between

percentage of data censored and decreases in R^2 . This assumption suggested a reduction of up to 64% in R^2 for data that are 80% censored. The expected R^2 for the current hypothesis came to .12. A linear regression analysis with 2 predictors at a .80 power level and an alpha level of .025 demands an n of 89.

- 2) a. *Intent to Quit is significantly more predictive of latency to first quit attempt and the number of quit attempts made than Smoking Abstinence Self-efficacy.*

The above hypothesis was directional. The null hypothesis was that the difference between the standardized regression coefficients of Intent to Quit and Smoking Abstinence Self-Efficacy is equal to or less than zero. The alternate hypothesis was that the difference between the standardized regression coefficients of Intent to Quit and Smoking Abstinence Self-Efficacy would be greater than zero. The IVs were Intent to Quit and Smoking Abstinence Self-Efficacy. The DVs were latency to first quit attempt and the number of quit attempts. Two linear regressions would have been run, one for each DV.

Past findings indicate that a meaningful effect size would be $R^2 = .34$ (Hardeman et al., 2002), which comes to .12 for an equivalent Cox analysis with 80% censored data. Two Cox regression analyses with 2 predictors at a .80 power level and an alpha level of .025 demands an n of 89.

- b. *Intent to quit is significantly more predictive of the latency to first quit attempt than the longest period of abstinence achieved.*

The above hypothesis was directional. The null hypothesis was that the standardized beta coefficient of Intent to Quit as a predictor of latency to first quit

attempt would be greater than the standardized beta coefficient of Intent to Quit as a predictor of the longest period of abstinence achieved. The alternate hypothesis was that the standardized beta coefficient of Intent to Quit as a predictor of latency to first quit attempt would be less than or equal to the standardized beta coefficient of Intent to Quit as a predictor of the longest period of abstinence achieved. The IV was Intent to Quit; the DVs were latency to first quit attempt, and the percentage days abstinent. Two regression analyses were run, one for each DV. A Bonferroni correction was applied to the alpha level to account for repeating the analyses for each of the 2 DVs.

A meaningful discrepancy in effect size between the DVs being compared would be $d = .10$, which corresponds to finding at minimum one of the additional variables to be significantly predictive. Two regression analyses with 1 predictor at a .80 power level and an alpha level of .025 demand an n of 89.

- 3) *Impulsivity and Implicit Smoking Self-Identity, the additional variables of the Elaborated Model of Behavior Change beyond those of the Theory of Planned Behavior, add significant predictive power to the model across all outcome measures.*

The above hypothesis was directional. The null hypothesis was that the explained variance of the Elaborated Model is less than or equal to the explained variance of the Theory of Planned Behavior model. The alternate hypothesis was that the explained variance of the Elaborated Model is greater than the explained variance of the Theory of Planned Behavior. The IVs were Intent to Quit, Smoking Abstinence Self-Efficacy, Implicit Smoking Self-Identity, and Impulsivity; the DVs were latency to first quit attempt, the number of quit attempts made, and the longest period of abstinence. Three

analyses were run. A survival analysis using a Cox regression was run for the latency to first quit attempt DV and a two-step hierarchical linear regression was run for the number of quit attempts made and the longest period of abstinence DVs. A Bonferroni correction was applied to the alpha level to account for the 3 regression analyses.

A meaningful change in explained variance would be $R^2 = .10$, which is equivalent to a linear R^2 of .04% with heavy censoring. A Cox regression analysis with 4 IVs, a power level of .80, and an alpha level of .017(alpha of .05 divided across 3 regressions) demands an n of 97.

Cross-Sectional Analysis of the Elaborated Model

One method to test the proposed model within the limitations of the current dataset was to substitute longitudinal analyses with cross-sectional analyses that focused on data collected at baseline. For these analyses, outcome variables measured at follow-up were replaced with the equivalent variable gathered at baseline. While such a strategy cannot be relied upon to definitively assess the performance of the model in a longitudinal sample, it is a useful initial step. Inherent in this strategy is the assumption that past behavior is indicative of future behavior. The limitations of this strategy are discussed further in the discussion section. The hypotheses that relied on follow-up outcome data that were re-examined cross-sectionally were hypotheses 1b, 2a, 2b and 3. Predictions made were the same as those made for the original hypotheses above.

Construct Validity of Implicit Smoking Self-Identity

The large baseline dataset provided sufficient power to conduct correlational analyses that may be used to inform the construct validity of the Smoking Self-Identity measure and the Implicit Association Test as a whole. The following hypotheses were tested:

1) Implicit Smoking Self-Identity is not significantly correlated with Explicit Smoking Attitude.

The above hypothesis was directional. The null hypothesis was that the absolute value of the correlation between Implicit Smoking Self-Identity and Explicit Smoking Attitude would be greater than zero. The alternate hypothesis was that the correlation between Implicit Smoking Self-Identity and Explicit Smoking Attitude would be equal to zero.

The IV was Implicit Smoking Self-Identity and the DV was Explicit Smoking Attitude. The appropriate test was the t-test. A meaningful effect size (coefficient of determination) would be .25. A t-test at a .80 power level and an alpha level of .05 demands an n of 120.

2) Implicit Smoking Self-Identity is not significantly correlated with Social Desirability Bias.

The above hypothesis was directional. The null hypothesis was that the absolute value of the correlation between Implicit Smoking Self-Identity and Social Desirability Bias would be greater than zero. The alternate hypothesis was that the correlation between Implicit Smoking Self-Identity and Social Desirability Bias would be equal to zero.

The IV was Implicit Smoking Self-Identity and the DV was Social Desirability Bias. The appropriate test was the t-test. A meaningful effect size (coefficient of determination) would be .25. A t-test at a .80 power level and an alpha level of .05 demands an n of 120.

- 3) *Implicit Smoking Self-Identity is significantly negatively correlated with Intent to Quit.*

The above hypothesis was directional. The null hypothesis was that the correlation between Implicit Smoking Self-Identity and Intent to Quit would be greater than or equal to zero. The alternate hypothesis was that the correlation between Implicit Smoking Self-Identity and Intent to Quit would be less than zero.

The IV was Implicit Smoking Self-Identity and the DV was Intent to Quit. The appropriate test was the t-test. A meaningful effect size (coefficient of determination) would be .25. A t-test at a .80 power level and an alpha level of .05 demands an n of 95.

- 4) *Implicit Smoking Self-Identity is significantly negatively correlated with number of quit attempts.*

The above hypothesis was directional. The null hypothesis was that the correlation between Implicit Smoking Self-Identity and number of quit attempts would be greater than or equal to zero. The alternate hypothesis was that the correlation between Implicit Smoking Self-Identity and number of quit attempts would be less than zero.

The IV was Implicit Smoking Self-Identity and the DV was number of quit attempts. The appropriate test is the t-test. A meaningful effect size (coefficient of determination) would be .25. A t-test at a .80 power level and an alpha level of .05 demands an n of 95.

- 5) *Implicit Smoking Self-Identity is significantly negatively correlated with Smoking Abstinence Self-Efficacy.*

The above hypothesis was directional. The null hypothesis was that the correlation between Implicit Smoking Self-Identity and Smoking Abstinence Self-Efficacy would be

greater than or equal to zero. The alternate hypothesis was that the correlation between Implicit Smoking Self-Identity and Smoking Abstinence Self-Efficacy would be less than zero.

The IV was Implicit Smoking Self-Identity and the DV was Smoking Abstinence Self-Efficacy. The appropriate test was the t-test. A meaningful effect size (coefficient of determination) would be .25. A t-test at a .80 power level and an alpha level of .05 demands an n of 95.

Predictors of Study Attrition

To investigate potential variables that might have predicted study attrition, an analysis of the mean differences between participants who participated at follow-up and those who did not was run. The hypothesized predictors of study retention were Social Desirability Bias, Impulsivity, Smoking Abstinence Self-Efficacy, and Perceived Stress Level. The hypotheses were as follows:

- 1) *Study participation at follow-up is significantly negatively correlated with Social Desirability Bias.*

The above hypothesis was directional. The null hypothesis was that the Social Desirability Bias mean difference between participants who participated at follow-up and those who did not would be less than zero. The alternate hypothesis was that the Social Desirability Bias mean difference between participants who participated at follow-up and those who did not would be greater than or equal to zero. The appropriate test was the independent samples t-test. The minimum effect size (d) that the current dataset can support, with sample sizes of 40 and 135, at an .80 power level and an alpha level of .05 is .47, a medium effect size.

- 2) *Study participation at follow-up is significantly negatively correlated with Impulsivity.*

The above hypothesis was directional. The null hypothesis was that the Impulsivity mean difference between participants who participated at follow-up and those who did not would be less than zero. The alternate hypothesis was that the Impulsivity mean difference between participants who participated at follow-up and those who did not would be greater than or equal to zero. The appropriate test was the independent samples t-test. The minimum effect size (d) that the current dataset can support, with sample sizes of 40 and 135, at a .80 power level and an alpha level of .05 is .47, a medium effect size.

- 3) *Study participation at follow-up is significantly positively correlated with Smoking Abstinence Self-Efficacy.*

The above hypothesis was directional. The null hypothesis was that the Smoking Abstinence Self-Efficacy mean difference between participants who participated at follow-up and those who did not would be greater than zero. The alternate hypothesis was that the Smoking Abstinence Self-Efficacy mean difference between participants who participated at follow-up and those who did not would be less than or equal to zero. The appropriate test was the independent samples t-test. The minimum effect size (d) that the current dataset can support, with sample sizes of 40 and 135, at a .80 power level and an alpha level of .05 is .47, a medium effect size.

- 4) *Study participation at follow-up is significantly negatively correlated with Perceived Stress*

The above hypothesis was directional. The null hypothesis was that the Perceived Stress mean difference between participants who participated at follow-up and those who did not would be less than zero. The alternate hypothesis is that the Perceived Stress mean difference between participants who participated at follow-up and those who did not would be greater than or equal to zero. The appropriate test was the independent samples t-test. The minimum effect size (d) that the current dataset can support, with sample sizes of 40 and 135, at a .80 power level and an alpha level of .05 is .47, a medium effect size.

To further explore the explanatory power of the above variables in determining study attrition, significant predictors were entered into a logistic regression model with study participation at follow-up as the DV. Before entering predictors into the model, they were tested for multicollinearity. Had predictors been found to be highly correlated, those that had demonstrated a smaller effect size in determining participation status at follow-up would have been dropped from the model.

Secondary analyses investigated possible significant interactions between Implicit Smoking Self-Identity and Intent to Quit, and between Impulsivity and Intent to Quit. It was predicted that being more impulsive or having a stronger implicit smoking identity (greater Smoking Self-Identity) would interact with Intent to Quit to lead to worse outcomes. Also, secondary analyses investigated the relationship between Implicit Smoking Self-Identity and Impulsivity. It was predicted that Implicit Smoking Self-Identity would be significantly correlated with Impulsivity.

Results

Preliminary Analyses and Data Reduction.

Frequency distributions were generated for all variables to examine them for violations of normality. All variables were found to be normally distributed except for the baseline and follow-up Social Norm scales, which were found to be significantly skewed. Various transformations failed to correct for the skewed distribution. A median split was performed and the variable was recoded into a categorical variable with two values denoting a low social norm group and high social norm group. Problems with the Delay Discounting data disallowed the valid use of the data to ascertain impulsivity. Only the data from 14 participants were valid at baseline. The rest of the data consisted of indifference points that were the same across all time delays, or indifference points that were irrational, in that they fell in value and then increased, or increased as the delay period increased, suggesting that participants preferred to be compensated less for greater delay periods. A large number of participants' responses suggested that they were attempting to speed through the task. Also, a number of participants appeared to have lost interest halfway through the task. The BIS score was used as a measure of impulsivity instead of the DD k-value.

A greater number of women than men participated in the current study (see Table 1). To explore the significance of this disparity, a thorough analysis of sex differences in all the variables of interest was conducted. Among the demographic variables, significant differences emerged in terms of income earned, $F(1,120)=12.523, p<.01$, and geographic location, $X^2(3, N=130)=13.16, p<.01$. The mean income earned in thousands of dollars by male participants ($M=70.6, SD=58.64$) was greater than the mean income

earned in thousands by female participants ($M=40.3$, $SD=36.00$). Male participants from the 4 major US regions were almost equally represented with 13 participants from the Eastern and Western regions each and 12 from the Midwest and 11 from the South. Female participants from the South (38) and the Midwest (24) were overrepresented relative to participants from the Eastern (11) and Western (8) regions.

A series of t-tests were conducted to determine the significance of the difference between women and men across all the variables of interest at baseline and follow-up (Table 2 and Table 3). Significant sex differences were found on the baseline score on the Intent to Quit scale ($t(128)=-2.77$, $p<.01$), the baseline score on the Explicit Attitude scale ($t(128)=-2.11$, $p=.04$), and the follow-up score on the Perceived Stress Scale ($t(39)=2.37$, $p=.02$). The sex difference in terms of the baseline score on the Perceived Stress Scale was significant at a trend level ($t(128)=1.86$, $p=.07$). Male participants scored significantly higher on the Intent to Quit scale than female participants at baseline. Male participants also scored higher on the Explicit Attitude scale than female participants at baseline indicating a more positive attitude about smoking. Female participants scored higher on the PSS at baseline and follow-up than male participants.

Table 2. *Baseline Sex Differences Analysis of Variance*

Variable		<i>N</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
FTND ¹	Women	81	5.30	2.20	0.80	0.43
	Men	49	4.98	2.20		
PSS ²	Women	81	21.32	7.88	1.86	0.07
	Men	49	18.76	7.15		
Intent to Quit	Women	81	3.42	1.61	-2.77	0.01
	Men	49	4.30	1.96		

Social Norm	Women	81	5.98	1.37	0.23	0.82
	Men	49	5.93	1.11		
Explicit Attitude	Women	81	3.35	1.51	-2.11	0.04
	Men	49	3.93	1.52		
Self-Efficacy	Women	81	3.90	0.67	0.95	0.34
	Men	49	3.78	0.69		
Social Desirability	Women	81	6.47	2.75	0.32	0.76
	Men	49	6.33	2.26		
Impulsivity	Women	81	39.59	8.36	-0.52	0.62
	Men	49	40.31	7.06		
IAT D^3	Women	77	0.26	0.72	-0.53	0.60
	Men	48	0.33	0.72		
Income ('000s)	Women	77	40.33	36.00	-3.54	0.00
	Men	45	70.63	58.64		
Education	Women	81	13.30	1.84	-1.32	0.19
	Men	48	13.80	2.29		
Age	Women	81	38.20	13.02	-0.28	0.77
	Men	49	38.97	16.37		

¹Fagerstrom Test of Nicotine Dependence; ²Perceived Stress Scale; ³Implicit Association Test D

Table 3. *Follow-Up Sex Differences Analysis of Variance*

Variable		<i>N</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
FTND¹	Women	28	4.68	2.33	0.05	0.96
	Men	14	4.64	2.50		
PSS²	Women	27	22.33	6.46	2.37	0.02
	Men	14	16.64	8.68		
Intent to Quit	Women	27	3.41	1.58	-0.31	0.76
	Men	14	3.57	1.65		

Social Norm	Women	27	6.19	1.08	1.30	0.2
	Men	14	5.69	1.30		
Explicit Attitude	Women	27	3.29	1.41	-1.38	0.17
	Men	14	3.96	1.63		
Self-Efficacy	Women	27	3.80	0.64	0.22	0.83
	Men	14	3.75	0.79		
Social Desirability	Women	27	6.59	3.35	1.62	0.11
	Men	14	4.93	2.56		
Impulsivity	Women	27	39.70	7.10	0.46	0.65
	Men	14	38.64	6.98		
IAT <i>D</i>³	Women	26	0.32	0.66	0.03	0.87
	Men	14	0.35	0.48		

¹Fagerstrom Test of Nicotine Dependence; ²Perceived Stress Scale; ³Implicit Association Test *D*

The results from the IAT paradigm were scored according to the improved algorithm suggested by Greenwald et al. (2003). Scoring of the IAT involved data collected from blocks 3, 4, 6, and 7 as stipulated in Greenwald et al. (2003). Data were eliminated from participants for whom more than 10% of trials had a latency of less than 300ms ($n = 4$). The mean of correct latencies for each block was calculated and one pooled standard deviation for all trials in blocks 3 and 6 and another for all trials in blocks 4 and 7 was calculated. Each error latency was then replaced with the block mean of + 600ms. The average of latencies for each block was calculated and the differences between the averages of blocks 6 and 3, and blocks 7 and 4, were divided by the corresponding pooled standard deviations. Finally, the average of the prior two quotients was computed and the sign of the results from participants who were presented with the compatible combinations first were reversed. This algorithm provides a computation of

D , which is a standardized measure of the difference in latencies between the hypothesized compatible and non-compatible block presentations. D is analogous to measures of effect size, such as d , in that it is a standardized measure of difference.

To test whether the IAT scores were significantly positive and therefore indicative of the presence of a smoking self-concept among participants as expected, the baseline and follow-up IAT D s were subjected to a one-sample t-test (Table 4). The baseline IAT D was significant, $t(124)=4.54$, $p<.001$, as was the follow-up IAT D , $t(39)=3.48$, $p<.01$. Both the baseline IAT D ($M=.29$, $SD=.72$) and the follow-up IAT D ($M=.33$, $SD=.60$) were greater than zero. These findings suggest that, on average, participants reacted faster to presentations of combinations of smoking and self stimuli (and necessarily non-smoking and other stimuli) than to combinations of smoking and other stimuli (and necessarily non-smoking and self stimuli). The IAT D can be interpreted as indicating on average the presence of an implicit smoking self-identity among the participants.

Table 4. *Mean IAT D^1 and t-test*

	Mean(SD)	t	df	sig. (2-tailed)
Baseline	0.29 (0.72)	4.54	124	0.00
Follow-up	0.33 (0.60)	3.48	39	0.00

¹Implicit Association Test D

Reliability of Measures

Two sets of analyses were conducted to assess the reliability of study measures (Table 5). To assess internal consistency, Cronbach alphas were calculated for

appropriate multi-item measures. To assess the temporal reliability of the measures, t-tests were conducted to compare variables at baseline to the same variables at follow-up.

The internal consistency as demonstrated by Cronbach's alpha was good for the SASE, the BIS, Intent to Quit, and Social Norm. It was acceptable, for the PSS, Explicit Attitude, and the MCSD. The internal consistency of the FTND was poor. The FTND has consistently demonstrated poor internal consistency in the literature (Colby, Tiffany, Shiffman, & Niaura, 2000). The reasons suggested for its poor performance are that the measure provides fewer response choices for each item than a likert scale, the measure items vary in the number of response choices they provide (either 4 or 2 choices), and the measure may be capturing a multi-dimensional construct as a single score. Clearly, more efforts need to be made to come to a consensus about the nature of the nicotine dependence construct and to design measures of it that are valid and reliable. The MCSD, the BIS, and the PSS demonstrated high temporal reliability. The SASE and Social Norm demonstrated moderate temporal reliability. The FTND, Intent to Quit, and Explicit Attitude demonstrated low temporal reliability. The IAT effect at baseline was not correlated to the IAT effect at follow-up.

Table 5. *Internal Consistency and Temporal Reliability of Measures*

		<i>N</i>	# of items	Cronbach's Alpha	Temporal Reliability, <i>r</i>	<i>p</i>
SASE ¹	Baseline	130	20	0.91	0.65	0.00
	Follow-Up	42		0.92		
BIS ²	Baseline	130	30	0.85	0.82	0.00
	Follow-Up	42		0.82		
PSS ³	Baseline	130	10	0.67	0.65	0.00
	Follow-Up	42		0.70		

Intent to Quit	Baseline	130	2	0.85	0.35	0.03
	Follow-Up	42		0.84		
Social Norm	Baseline	130	3	0.81	0.40	0.01
	Follow-Up	42		0.85		
Explicit Attitude	Baseline	130	4	0.75	0.32	0.04
	Follow-Up	42		0.73		
MCSD⁴	Baseline	130	12	0.62	0.87	0.00
	Follow-Up	42		0.79		
FTND⁵	Baseline	130	6	0.46	0.38	0.01
	Follow-Up			0.50		
IAT⁶	-	-	-	-	0.15	0.35
	-			-		

¹Smoking Abstinence Self-Efficacy; ²Barratt Impulsiveness Scale; ³Perceived Stress Scale; ⁴Marlowe-Crowne Social Desirability scale; ⁵Fagerstrom Test of Nicotine Dependence; ⁶Implicit Association Test

Susceptibility to Social Desirability Bias

All study variables were investigated for susceptibility to social desirability bias by exploring their relationships with the MCSD score measured at the same time point. The correlations between the MCSD and the following variables were significant: the baseline BIS ($r=-.42$, $p<.001$), the follow-up BIS ($r=-.38$, $p=.02$), the follow-up Negative Affect subscale of the SASE ($r=.34$, $p=.03$), baseline PSS ($r=-.21$, $p=.02$), baseline Explicit Attitude ($r=-.23$, $p=.01$). Participants who scored higher on the MCSD scale and therefore were more likely to exhibit Social Desirability bias were more likely to report lower BIS scores, Explicit Attitude scores, and PSS scores and higher Negative Affect Smoking Abstinence Self-Efficacy. These findings suggest that further studies to investigate the use of indirect measures of Impulsivity and implicit measures of attitude may be fruitful.

Predictors of Follow-Up Attrition

A one way ANOVA with follow-up participation as the between subjects factor and PSS, Social Desirability, SASE, the Habitual craving subscale of SASE, and Impulsivity as the within subjects factors was run (Table 6). The Habitual Craving subscale of the SASE was significant, $F(1,128)=5.34, p=.02$. Those who participated at follow-up scored higher at baseline on the Habitual Craving subscale ($M=3.78, SD=.73$) than those who did not ($M=3.42, SD=.87$). The SASE score was significant at a trend level, $F(1,128)=2.98, p=.09$. Those who participated at follow-up scored higher on the SASE scale ($M=4.00, SD=.55$) than those who did not ($M=3.79, SD=.72$). The groups did not differ on other variables tested.

Table 6. *Analysis of Variance of Follow-Up Participation*

Variable		<i>N</i>	<i>M</i>	<i>SD</i>	<i>F</i>	<i>p</i>
PSS¹	Retained	41	20.20	7.27	0.03	0.87
	Dropped Out	89	20.43	7.91		
Social Desirability	Retained	41	6.24	2.73	0.27	0.61
	Dropped Out	89	6.49	2.50		
Habitual Craving	Retained	41	3.78	0.73	5.34	0.02
	Dropped Out	89	3.42	0.87		
SASE²	Retained	41	4.00	0.55	2.98	0.09
	Dropped Out	89	3.79	0.72		
Impulsivity	Retained	41	39.02	6.73	0.68	0.41
	Dropped Out	89	40.25	8.36		

¹Perceived Stress Scale; ²Smoking Abstinence Self-Efficacy

A logistic regression was run with the Habitual Craving score as the IV and Follow-up Participation as the DV (Table 7). The model provided an acceptable fit to the

data, $\chi^2(1, N=130) = 5.44, p = .02$. The explained variance of the model was 5.8%. The Habitual Craving score was a significant predictor, $B = .55, \chi^2(1, N=130) = 5.01, p = .03$. A unit increase in the Habitual Craving score increased the odds of follow-up participation by 74.1%.

Table 7. *Summary of Logistic Regression Analysis for Variables Predicting Participation at Follow-Up*

	Variable	B	SE	Exp(B)
Step 1				
	Habitual Craving	0.55	0.25	1.74*

Note: $R^2 = .06$ for Step 1 ($p < .05$)

* $p < .05$

Hypothesis 1a - Predicting Intent to Quit

The first step of the Theory of Planned Behavior model is cross-sectional and attempts to predict Intent to Quit from Smoking Abstinence Self-Efficacy, Smoking Attitude, and Social Norm. Two linear regressions were run to test the hypothesis generated by the first step. The first regression relied on measurements of the variables at baseline and the second regression relied on measurements of the variables at follow-up. Significant covariates were controlled for before the inclusion of the model variables.

All variables were examined for outliers. For the baseline analysis, two data points were removed as univariate outliers for having extreme values for the Explicit Attitude variable. No data points were deemed to be multivariate outliers due to a large Mahalanobis Distance. For the follow-up analysis, no data points were found to be univariate or multivariate outliers. For both baseline and follow-up analyses, none of the IVs demonstrated significant collinearity. Residual plots for both analyses were sufficiently normal to meet the homoscedasticity assumption.

For the baseline regression analysis, only Sex was found to be a significant covariate and it was entered into the first step of the regression (Table 8). The explained variance for the first step was 5.0%, $F(1,126)=6.64$, $p=.01$. The explained variance for the second step was 11.1%, $F(3,123)=5.45$, $p<.01$. Explicit Attitude was found to be a significant predictor, $B=.25$, $t(123)=2.39$, $p=.02$. For every unit increase in Explicit Attitude, Intent to Quit increased by .25 units while accounting for the effects of all other model variables. Social Norm was found to be a significant predictor, $B=-.75$, $t(123)=-2.37$, $p=.02$. On average, those who scored high on Social Norm scored .75 units less in terms of Intent to Quit than those who scored low on Social Norm, while accounting for all other model variables. Sex was significant at a trend, $B=-.59$, $t(123)=-1.89$, $p=.06$. On average, men scored .59 units more than women on Intent to Quit, while accounting for all other model variables. SASE was not found to be a significant predictor of Intent to Quit.

Table 8. *Summary of Hierarchical Regression Analysis for Baseline Variables Associated with Intent to Quit at Baseline*

	Variable	<i>B</i>	<i>SE</i>	β
Step 1				
	Sex	-0.82	0.32	-0.22*
Step 2				
	Sex	-0.59	0.31	-0.16'
	SASE ¹	0.03	0.22	0.01
	Explicit Attitude	0.25	0.11	0.21*
	Social Norm	-0.75	0.32	-0.21*

Note: $R^2 = .05$ for Step 1 ($p<.05$); $\Delta R^2 = .11$ for Step 2 ($p<.01$)

¹Smoking Abstinence Self-Efficacy

' $p<.10$, * $p<.05$

For the follow-up regression analysis, only FTND was found to be a significant covariate and it was entered into the first step of the regression (Table 9). The explained variance for the first step was 14.7%, $F(1,39)=6.70$, $p=.01$. The explained variance for the second step was 14.7%, $F(3,36)=2.51$, $p=.07$. Only Explicit Attitude was found to be significant at a trend, $B=.30$, $t(36)=1.77$, $p=.09$. For every unit increase in Explicit Attitude, Intent to Quit increased by .30 units while accounting for the effects of all other model variables. No other model predictors were found to be significant. After accounting for the model IVs, FTND was no longer significant.

Table 9. *Summary of Hierarchical Regression Analysis for Follow-Up Variables Associated with Intent to Quit at Follow-Up*

	Variable	B	SE	β
Step 1				
	FTND¹	0.26	0.10	0.38*
Step 2				
	FTND	0.16	0.11	0.23
	SASE²	0.11	0.36	0.05
	Explicit Attitude	0.30	0.17	0.29'
	Social Norm	-0.62	0.50	-0.20

Note: $R^2 = .15$ for Step 1 ($p<.05$); $\Delta R^2 = .15$ for Step 2 ($p<.1$)

¹Fagerstrom Test of Nicotine Dependence; ²Smoking Abstinence Self-Efficacy

' $p<.10$, * $p<.05$

Hypothesis 1b and Hypothesis 3- Predicting Smoking Outcomes

The second step of the TPB model is longitudinal and it attempts to predict smoking outcomes at follow-up using Intent to Quit and Smoking Abstinence Self-Efficacy at baseline (Hypothesis 1b). The Elaborated model adds Implicit Smoking Self-Identity and Impulsivity as predictors of smoking outcomes (Hypothesis 3). The findings from these hypotheses must be viewed as tentative, affected by the small follow-up

sample size and probable biases in the sample. The current longitudinal sample is less than half the ideal size suggested by the power analysis as necessary to detect significant results.

A two step Cox regression survival analysis was run with SASE score and Intent to Quit score entered into the first step, and the IAT *D* and BIS score entered into the second step. None of the potential covariates were found to be significantly correlated with the DV so they were excluded from the analyses. All IVs were measured at baseline. All variables met the normality assumption. There were no univariate or multivariate outliers found. None of the covariates interacted significantly with time so the assumption of proportionality of hazards was deemed met. None of the IVs demonstrated significant collinearity.

Ninety-two cases were missing, 14 cases were censored and 24 cases experienced the event (quitting) in the time period under consideration. The mean time to first quit attempt was 44 days. None of the steps of the proposed model were found to provide an acceptable fit to the data (Table 10). None of the covariates were found to be significant.

Table 10. *Summary of Sequential Cox Regression Analysis for Baseline Variables Predicting Time to First Quit Attempt at Follow-Up*

	Variable	<i>B</i>	<i>SE B</i>	Exp(<i>B</i>)
Step 1				
	SASE ¹	-0.12	0.37	0.89
	Intent to Quit	-0.21	0.15	0.81
Step 2				
	SASE	-0.09	0.39	0.91
	Intent to Quit	-0.27	0.17	0.76
	IAT <i>D</i> ²	0.16	0.35	1.18
	BIS ³	-0.03	0.03	0.97

Note: $R^2 = .06$ for Step 1 (ns); $\Delta R^2 = .03$ for Step 2 (ns)

¹Smoking Abstinence Self-Efficacy; ²Implicit Association Test *D*; ³Barratt Impulsiveness Scale

Secondary analyses were conducted to explore the significance of the interaction between Intent to Quit and BIS, and between Intent to Quit and the IAT effect. All variables were centered for ease of interpretation. The Cox regression analysis was rerun with an extra step including the higher order terms of the interactions. None of the higher order terms were found to be significant predictors of the DV.

The Cox regression was rerun with Time since the last quit attempt measured at baseline as the DV. There were no univariate or multivariate outliers found. None of the covariates interacted significantly with time so the assumption of proportionality of hazards was deemed met. None of the IVs demonstrated significant collinearity. Twenty-one cases were missing, 75 cases were censored, and 34 cases experienced the event in the time period under consideration. The mean time since last quit attempt was 86 days. None of the steps of the proposed model were found to provide an acceptable fit to the data (Table 11). None of the covariates were found to be significant.

Table 11. *Summary of Sequential Cox Regression Analysis for Baseline Variables Associated with Time since Last Quit Attempt at Baseline*

	Variable	<i>B</i>	<i>SE B</i>	<i>Exp(B)</i>
Step 1				
	SASE¹	0.13	0.26	1.14
	Intent to Quit	-0.15	0.10	0.86
Step 2				
	SASE	0.21	0.27	1.24
	Intent to Quit	-0.15	0.10	0.86
	IAT <i>D</i>²	-0.42	0.26	0.66
	BIS³	-0.01	0.02	0.99

Note: $R^2 = .02$ for Step 1 (ns); $\Delta R^2 = .02$ for Step 2 (ns)

¹Smoking Abstinence Self-Efficacy; ²Implicit Association Test *D*; ³Barratt Impulsiveness Scale

Secondary analyses were conducted to test the interaction between Intent to Quit and BIS, and between Intent to Quit and the IAT effect. The Cox regression analysis was rerun with an extra step including the higher order terms of the interactions. None of the higher order terms were found to be significant predictors of the DV.

To test the TPB model with the Number of Quit Attempts made in the 6 months following baseline as the smoking outcome, a linear regression analysis was conducted. A three step linear regression was run with significant covariates entered into the first step, SASE score and Intent to Quit score entered into the second step, and the IAT *D* and BIS score entered into the third step. All IVs were measured at baseline. All variables met the normality assumption. One data point was found to be a univariate outlier in terms of BIS and it was eliminated. No multivariate outliers were found. None of the IVs demonstrated significant collinearity and residual plots were sufficiently normal to meet the homoscedasticity assumption.

Explained variance for the first step was 10.9%, $F(1,37)=4.53, p=.04$ (Table 12). The second step did not contribute significant explained variance. The third step contributed 15.7% in explained variance, $F(2,33)=4.02, p=.03$. FTND was found to be a significant predictor, $B=-.29, t(33)=-2.68, p=.01$. For every unit increase in FTND, the Number of Quit Attempts decreased by -.29 attempts, while adjusting for all other IVs. BIS was also found to be a significant predictor, $B=.10, t(33)=2.77, p<.01$. For every unit increase in BIS, the Number of Quit Attempts increased by .10 attempts, while adjusting for all other IVs. No other model IVs were found to be significant predictors.

Table 12. *Summary of Hierarchical Regression Analysis for Baseline Variables Predicting Number of Quit Attempts at Follow-Up*

Variable	<i>B</i>	<i>SE B</i>	β
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Step 1				
	FTND¹	-0.21	0.10	-0.33*
Step 2				
	FTND	-0.19	0.11	-0.31
	SASE²	0.03	0.42	0.01
	Intent to Quit	-0.27	0.14	-0.30'
Step 3				
	FTND	-0.28	0.11	-0.47*
	SASE	0.46	0.41	0.19
	Intent to Quit	-0.21	0.13	-0.23
	IAT <i>D</i>³	-0.33	0.28	-0.18
	BIS⁴	0.10	0.03	0.43**
Step 4				
	FTND	-0.28	0.10	-0.45**
	SASE	0.53	0.38	0.23
	Intent to Quit	-0.38	0.14	-0.42*
	IAT <i>D</i>	-0.41	0.26	-0.23
	BIS	0.08	0.03	0.34**
	IAT x Intent⁵	0.20	0.17	0.45
	BIS x Intent⁶	-0.07	0.03	-3.02*

Note: $R^2 = .11$ for Step 1 ($p < .05$); $\Delta R^2 = .09$ for Step 2 (ns); $\Delta R^2 = .16$ for Step 3 ($p < .05$); $\Delta R^2 = .14$ for Step 4 ($p < .05$); $p < .1$, * $p < .05$, ** $p < .01$

¹Fagerstrom Test of Nicotine Dependence; ²Smoking Abstinence Self-Efficacy; ³Implicit Association Test *D*; ⁴Barratt Impulsiveness Scale; ⁵Interaction between IAT *D* and Intent to Quit; ⁶Interaction between BIS and Intent to Quit

Secondary analyses to explore the significance of the interaction between Intent to Quit and BIS, and between Intent to Quit and the IAT effect were conducted. The regression analysis was rerun with a fourth step including the higher order terms of the interactions. The additional step in the regression was significant providing additional explained variance of 13.6%, $F(2,31)=4.16$, $p=.03$. In the final model, FTND was found to be a significant predictor, $B=-.28$, $t(31)=-2.80$, $p=.01$. For every unit increase in FTND, the number of quit attempts made increased by .3 attempts, while accounting for all other model variables. Intent to Quit was found to be a significant predictor, $B=-.38$, $t(31)=-2.74$, $p=.01$. For every unit increase in Intent to Quit, the number of quit attempts

made decreased by .38 attempts at the mean value of all other model IVs. BIS was found to be a significant predictor, $B=.08$, $t(31)=2.22$, $p=.03$. For every unit increase in BIS, the number of quit attempts made increased by .08 attempts, at the mean value of all other model IVs. The interaction effect between Intent to Quit and BIS was found to be significant, $B=-.07$, $t(31)=-2.58$, $p=.02$. The increase in the number of quit attempts associated with an increase in BIS is almost entirely buffered by a fall in Intent to Quit. Similarly, the decrease in the number of quit attempts associated with an increase in Intent to Quit was enhanced by a higher baseline BIS (Figure 3).

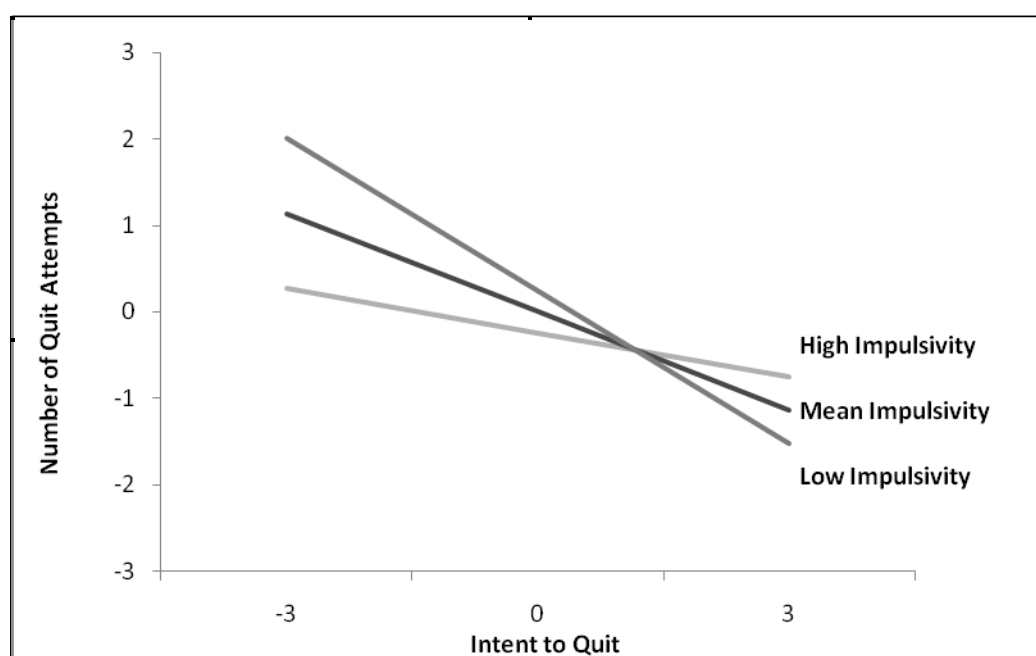


Figure 3. Graph of the relationship between the standardized values of Baseline Intent to Quit and the number of Quit Attempts Made for different levels of Baseline Impulsivity

The linear regression was rerun with the Number of Quit Attempts made in the 6 months prior to baseline as the DV. Three data points were found to be univariate outliers and they were eliminated: one because of the BIS score and two because of the

DV. No multivariate outliers were found. None of the IVs demonstrated significant collinearity and residual plots were sufficiently normal to meet the homoscedasticity assumption.

None of the steps contributed significant explained variance (Table 13). The IAT effect was found to be significant at a trend, $B = -1.29$, $t(108) = -1.70$, $p = .09$. For every unit increase in IAT effect, the Number of Past Quit Attempts made decreased by 1.29 attempts, while adjusting for all other IVs.

Table 13. *Summary of Hierarchical Regression Analysis for Baseline Variables Associated with the Number of Quit Attempts at Baseline*

	Variable	<i>B</i>	<i>SE B</i>	β
Step 1				
	SASE¹	0.93	0.84	0.11
	Intent to Quit	-0.10	0.30	-0.03
Step 2				
	SASE	1.13	0.84	0.13
	Intent to Quit	-0.11	0.30	-0.04
	IAT <i>D</i>²	-1.29	0.76	-0.16'
	BIS³	-0.01	0.07	-0.01

Note: $R^2 = .01$ for Step 1 (ns); $\Delta R^2 = .03$ for Step 2 (ns)

¹Smoking Abstinence Self-Efficacy; ²Implicit Association Test *D*; ³Barratt Impulsiveness Scale
' $p < .10$

The Longest Period of Abstinence variables were severely skewed at both baseline and follow-up. They were dichotomized using a median split after failed attempts at transforming them. The resulting Abstinence Group variables classified participants into one of two groups: High or Low Abstinence. To test the TPB model with Abstinence Group at 6 months as the smoking outcome, a logistic regression was run. A three step logistic regression was run with the significant covariates entered in the first step, the SASE score and Intent to Quit score entered in the second step, and the IAT

D and BIS score entered in the third step. All IVs were measured at baseline. All IVs met the normality assumption. One data point was found to be a univariate outlier in terms of BIS and was eliminated. Also, a multivariate outlier was determined and it was eliminated.

None of the steps contributed significant explained variance. IAT *D* was found to be significant at a trend, $B=-1.1$, $X^2(1, N=38)=-1.77$, $p=.09$ (Table 14). For every unit increase in IAT *D*, the likelihood of belonging to the high abstinence group fell by 67%, while accounting for all other model variables. None of the other IVs were significant model predictors.

Table 14. *Summary of Sequential Logistic Regression Analysis for Baseline Variables Predicting Abstinence Group at Follow-Up*

	Variable	<i>B</i>	<i>SE B</i>	Exp(<i>B</i>)
Step 1				
	SASE ¹	-0.71	0.66	0.49
	Intent to Quit	-0.51	0.27	0.60'
Step 2				
	SASE	-0.42	0.69	0.66
	Intent to Quit	-0.43	0.28	0.65
	IAT <i>D</i> ²	-1.10	0.63	0.33'
	BIS ³	0.06	0.06	1.06

Note: $R^2 = .16$ for Step 1 ($p<.1$); $\Delta R^2 = .10$ for Step 2 (ns)

¹Smoking Abstinence Self-Efficacy; ²Implicit Association Test *D*; ³Barratt Impulsiveness Scale

' $p<.10$

Secondary analyses to explore the significance of the interaction between Intent to Quit and BIS, and between Intent to Quit and the IAT effect were conducted. The above analysis was run with an extra step including the higher order terms of the interactions. None of the higher order terms were found to be significant predictors of Abstinence Group.

The logistic regression was rerun with Abstinence Group at baseline as the DV. One data point was found to be a univariate outlier in terms of BIS and was eliminated. A multivariate outlier was determined and it was eliminated. Only FTND was found to be a significant covariate, contributing the equivalent of 13% of explained variance. The addition of the model IVs did not significantly improve the fit of the model to the data. The FTND covariate was found to be significant $B=-.31$, $X^2(1, N=113) = 7.24$, $p<.01$. For every unit increase in FTND, the likelihood of belonging to the High Abstinence group fell by 26%, while accounting for all other model variables. Intent to Quit was found to be significant, $B=-.27$, $X^2(1, N=113)= 4.81$, $p=.03$. For every unit increase in Intent to Quit, the likelihood of belonging to the High Abstinence group decreased by 24%, while accounting for all other model variables. BIS also was found to be significant $B= -.06$, $X^2(1, N=113) = 4.37$, $p= .04$. For every unit increase in BIS, the likelihood of belonging to the High Abstinence group increased by 6.2%, while accounting for all other model variables.

Table 15. Summary of Sequential Logistic Regression Analysis for Baseline Variables Associated with Abstinence Group at Baseline

	Variable	<i>B</i>	<i>SE B</i>	<i>Exp(B)</i>
Step 1				
	FTND¹	-0.30	0.10	0.74**
Step 2				
	FTND	-0.29	0.11	0.75**
	SASE²	-0.15	0.36	0.86
	Intent to Quit	-0.25	0.12	0.78*
Step 3				
	FTND	-0.31	0.12	0.73**
	SASE	-0.18	0.38	0.84
	Intent to Quit	-0.27	0.13	0.76*
	IAT <i>D</i>³	-0.15	0.30	0.86
	BIS⁴	0.06	0.03	1.06*
Step 4				

FTND	-0.39	0.13	0.68**
SASE	-0.11	0.37	0.89
Intent to Quit	-0.42	0.16	0.66**
IAT <i>D</i>	-0.07	0.32	0.93
BIS	0.06	0.03	1.07'
Intent x IAT⁵	-0.12	0.21	0.88
Intent x BIS⁶	-0.06	0.03	0.94*

Note: $R^2 = .13$ for Step 1 ($p < .01$); $\Delta R^2 = .05$ for Step 2 ($p < .1$); $\Delta R^2 = .05$ for Step 3 ($p < .1$); $\Delta R^2 = .08$ for Step 4 ($p < .05$);

¹Fagerstrom Test of Nicotine Dependence; ²Smoking Abstinence Self-Efficacy; ³Implicit Association Test *D*; ⁴Barratt Impulsiveness Scale; ⁵Interaction between IAT *D* and Intent to Quit; ⁶Interaction between BIS and Intent to Quit

' $p < .10$; * $p < .05$; ** $p < .01$

Secondary analyses to explore the significance of the interaction between Intent to Quit and BIS, and between Intent to Quit and the IAT effect were conducted. The logistic regression was rerun with a fourth step including the higher order terms of the interactions. FTND was found to be significantly associated with baseline Abstinence Group, $B = -.39$, $X^2(1, N=113) = 9.09$, $p < .01$. For every unit increase in FTND, the likelihood of belonging to the High Abstinence group fell by 32%. Intent to Quit was found to be significantly associated with, $B = -.42$, $X^2(1, N=113) = 7.06$, $p < .01$. For every unit increase in Intent to Quit, the likelihood of belonging to the High Abstinence group decreased by 6.9% at the mean value of all other model IVs. BIS was found to be significant at a trend level, $B = -.059$, $X^2(1, N=113) = 3.50$, $p = .06$. For every unit increase in BIS, the likelihood of belonging to the High Abstinence group increased by 6.6% at the mean value of all other model IVs. The interaction effect between Intent to Quit and BIS was found to be significant, $B = -.06$, $X^2(1, N=113) = 2.20$, $p = .02$. The increase in the likelihood of belonging to the High Abstinence group with an increase in BIS is almost entirely buffered by a fall in Intent to Quit.

Hypothesis 2.- Predicting Initiation versus Maintenance of Change

The second hypothesis addressed the relative applicability of the TPB in predicting the two aspects of behavior change, change initiation and change maintenance, in response to the findings of Norman et al. (1999). The first part of the hypothesis examined the relative strength of Intent to Quit and SASE to predict change initiation. Norman et al. (1999) found Intent to Quit to be a significant predictor of change initiation but behavioral control was not significant. Testing this part of the hypothesis relied on first establishing Intent to Quit and SASE as significant predictors of both Time to first quit attempt and the Number of Quit Attempts made. In fact, Intent to Quit was not found to be a significant predictor of either Time to first quit attempt or the Number of Quit Attempts made. Therefore, it was not possible to test the first part of the hypothesis.

The second part of the hypothesis examined the relative strength of Intent to Quit as a predictor of change initiation and change maintenance. Norman et al. (1999) found Intent to Quit as a significant predictor of change initiation and not a significant predictor of change maintenance. Testing this part of the hypothesis relied on first establishing Intent to Quit to be a significant predictor of both the Time to first quit attempt (change initiation) and Abstinence Group (change maintenance). In fact, Intent to Quit was found only to be significant as a predictor of Abstinence Group at baseline. Therefore, it was not possible to test the second part of the hypothesis.

Validity of the Implicit Smoking Self-Identity Construct

Five hypotheses were proposed to examine the construct validity of the Implicit Smoking Self-Identity measure. Each hypothesis suggested a relationship between Implicit Smoking Self-Identity and another study variable. t-tests were performed to test

the significance of the correlation between the Implicit Smoking Self-Identity and the variables of interest, at baseline (Table 16) and at follow-up (Table 17). The first hypothesis predicted that there would be no relationship between Implicit Smoking Self-Identity and Explicit Smoking Attitude. IAT *D* did not correlate significantly with Explicit Attitude, either at baseline or at follow-up. This finding supports the first hypothesis.

The second hypothesis predicted that there would be no relationship between Implicit Smoking Self-Identity and Social Desirability Bias. IAT *D* did not correlate significantly with Social Desirability Bias, either at baseline or at follow-up. This finding supports the second hypothesis.

The third hypothesis predicted that there would be a significant negative relationship between Implicit Smoking Self-Identity and Intent to Quit. IAT *D* did not correlate significantly with Intent to Quit at baseline. At follow-up, the correlation between IAT *D* and Intent to Quit was significant at a trend, $r(38)=-.28, p=.09$. This finding does not support the third hypothesis.

Table 16. *Correlation between IAT D and Explicit Attitude, Social Desirability, Intent to Quit, # of Quit Attempts, SASE, and Habitual Craving at Baseline*

	IAT <i>D</i> ¹	Explicit Attitude	Social Desirability	Intent to Quit	# of Quit Attempts	SASE ²	Habitual Craving ³
IAT <i>D</i>	-	0.03	-0.02	-0.05	-0.15	0.13	.16'
Explicit Attitude		-	-0.23	0.32	-0.07	0.05	0.06
Social Desirability			-	-0.09	-0.02	-0.13	-0.12
Intent to				-	-0.03	-0.01	0.00

Quit**# of Quit Attempts**

- 0.10 0.15

SASE

- .87***

Habitual Craving

-

¹Implicit Association Test *D*; ²Smoking Abstinence Self-Efficacy; ³Habitual Craving is a subscale of the SASE
¹*p*<.10, **p*<.05, ***p*<.01, ****p*<.001

The fourth hypothesis predicted that there would be a significant negative relationship between Implicit Smoking Self-Identity and the number of quit attempts made. IAT *D* was significantly negatively correlated with the number of quit attempts at follow-up, $r(38)=-.41, p<.01$ (Table 17). This correlation corresponds to an effect size of 17%. At baseline, the correlation was not significant. This finding partially supports the fourth hypothesis.

Table 17. *Correlation between IAT D and Explicit Attitude, Social Desirability, Intent to Quit, # of Quit Attempts, SASE, and Habitual Craving at Follow-Up*

	IAT <i>D</i> ¹	Explicit Attitude	Social Desirability	Intent to Quit	# of Quit Attempts	SASE ²	Habitual Craving
IAT <i>D</i>	-	0.04	0.00	.28'	-.41**	0.00	0.09
Explicit Attitude		-	-0.21	.44**	-.32*	-0.02	0.04
Social Desirability			-		0.03	0.21	0.05
Intent to Quit				-		0.12	0.13

# of Quit Attempts	-	-0.26	-0.20
SASE		-	0.88***
Habitual Craving			-

¹Implicit Association Test *D*; ²Smoking Abstinence Self-Efficacy
[†]*p*<.10, **p*<.05, ***p*<.01, ****p*<.001

The fifth hypothesis predicted that there would be a significant negative relationship between Implicit Smoking Self-Identity and Smoking Abstinence Self-Efficacy. IAT *D* did not correlate significantly with SASE, either at baseline or follow-up. The Habitual Craving subscale correlated positively at a trend level, $r(124)=.16$, $p=.08$. This finding does not support the fifth hypothesis.

Secondary analyses were conducted to explore the relationship between IAT *D* and Impulsivity. The two variables were not found to be significantly correlated with each other.

Discussion

The current study proposed to expand the Theory of Planned Behavior by the inclusion of two additional variables in its model: impulsivity and implicit self-identity. An online study was conducted to test the hypotheses generated by both the TPB and the Elaborated TPB models in a sample of smokers. Participants were US residents who were recruited online and assessed at baseline and again 6 months later. The final sample differed from smokers in the general population in a number of ways. At baseline, the majority of smokers in the current sample were female (62%) while in the general population 46% of smokers are female (CDC, 2008). The percentage of White smokers in the current sample was greater than the percentage of White smokers in the general population of smokers in the US (78% versus 38%, respectively). These differences must be taken into account when generalizing the current findings. The follow-up sample did not differ significantly from the baseline sample in terms of demographics.

The First Step of the Theory of Planned Behavior- Predicting Intent to Quit

The TPB model consists of two steps. The first step predicts Intent to Quit from Personal Attitude, Social Norm, and Self-Efficacy. The first step is cross-sectional and thus it was possible to test it twice using the current sample, once at baseline and again at follow-up. However, due to the stark shortfall in follow-up participation, significant bias was likely to have been introduced into the follow-up analysis.

Findings at baseline provided support for the first step of the TPB. Both Personal Attitude and Social Norm were significantly associated with Intent to Quit. Stronger negative attitudes about smoking were associated with greater intention to quit smoking.

Also, participants who reported greater negative attitudes about smoking among their peers reported less intent to quit than participants who reported less negative attitudes about smoking among their peers. Together, the main independent variables provided 11.2% explained variance of the total 16% provided by the model as a whole. Self-Efficacy was not found to be a significant predictor of Intent to Quit.

Findings at follow-up provided partial support for the first step of the TPB. Only Personal Attitude was significant at a trend level. Together, the model predictors provided 15% explained variance (significant at a trend level) of the total 30% provided by the model as a whole. Again, Self-Efficacy was not found to be a significant predictor of Intent to Quit.

Given the shortcomings of the follow-up dataset, the baseline results should be given greater weight. At the same time, the follow-up results trend toward being aligned with the baseline findings. Taken together, the findings provide partial support for the first step of the TPB model in predicting Intent to Quit.

The Social Norm variable was problematic because of its strongly skewed distribution. Almost all participants reported strong pressure to quit smoking from their social networks. This finding is likely to persist, given the growing negative sentiment about smoking. A measure of Social Norm that is more sensitive to negative pressure to quit smoking would avoid the trade-off in power that comes with dichotomizing a continuous variable.

Also, findings for the Social Norm variable suggested a relationship to Intent to Quit that seems paradoxical. Greater social pressure to quit was associated with less intention to do so. Extreme social pressure might become discouraging and actually elicit

resistance to change. This finding warrants a closer look because of the clinical implications. If greater social pressure discourages smokers from quitting then perhaps effort should be expended to reduce perceived social pressure, provide guidance for families on more effective to discuss smoking, and/or reduce resistance to change. However, the causal relationship between social norms and intent to quit is equally likely be in the other direction; having less intention to quit smoking may elicit greater pressure to quit from others. Replication of this finding is necessary to confirm its significance and rule out the possibility that it might be entirely spurious. The literature is inconsistent in findings for the relationship between social norm and intent to quit when the TPB is applied to smoking cessation. Echoing the current study, Norman et al (1999) found a negative relationship between social norm and intent to quit. On the other hand, Godin et al. (1992) found a positive relationship between social norm and intent to quit in one sample, and no significant relationship between the variables in another. The disparity in findings may be the result of the studies using different measures of social norm. Also, the disparity may be the result of variations in propensities to resist or conform to prevalent norms in different samples, something that is not accounted for by the TPB.

The Second Step of the Theory of Planned Behavior - Predicting Smoking Outcome

The second step of the TPB predicts behavior change from Intention and Self-Efficacy. Three sets of analyses were run to address the second step of the TPB, one for each outcome variable investigated: time to first quit attempt, number of quit attempts, and Abstinence Group, defined as those with longer and shorter periods of prior abstinence. The second step of the TPB model is longitudinal and thus investigating it

using the current sample necessarily introduced bias into the findings. An additional cross-sectional investigation of this part of the model was conducted using baseline outcome measures. Such a strategy was less vulnerable to sampling bias but less valid to directly test the hypothesis.

Using the longitudinal data, the model with time to first quit attempt as the outcome variable was not supported. None of the model IVs were found to be significant predictors of the likelihood to quit within the period under consideration. This comes as no surprise given the poor participation at follow-up; only 38 participants had valid data at follow-up. Also, Cox regressions and logistic regressions in general demand larger samples for the same level of power than linear regressions due to the DV being dichotomized. As a result, there was an even greater reduction in the likelihood of finding significant results with the current sample. The additional analysis of baseline data with time since last quit attempt as the outcome variable also failed to find the model to be a good fit to the data. None of the model IVs were found to be significantly associated with the time since quitting in the past 6 months. Although the sample was larger at baseline, 69% of the data were censored because the participants had not attempted to quit in the 6 months prior. Furthermore, past behavior may not be associated with hypothesized predictors of future behavior. In fact, it may be argued that the goal of modeling behavior change is to identify variables that facilitate a discrepancy between past and future behavior. Therefore, testing this part of the model cross-sectionally may have been less likely to yield significant findings.

With the number of quit attempts as the dependent variable, of the potential covariates, only Dependence Severity was found to be significant. Greater dependence

severity was associated with fewer quit attempts. However, after the inclusion of Intent to Quit and Self-Efficacy, the main model independent variables, Dependence Severity was no longer significant. None of the main model IVs were found to be significant. Only Intent to Quit was found to be significant at a trend level. Greater Intent to Quit was associated with a fewer Quit Attempts made. This finding may seem paradoxical at first, but greater intent to quit may lead to participants making fewer but more serious attempts to quit rather than many impulsive but less serious attempts. The interpretation of greater quit attempts as indicative of impulsive behavior is supported by the finding that inclusion of impulsivity as a model IV made a significant contribution to its explanatory power. It is difficult to make comparisons to published results regarding this finding. Godin et al (1992) failed to find a significant relationship between intent and behavioral outcome. However, the authors measured outcome using a discrete variable with three possible values indicating daily smoking, occasional smoking or at least one quit attempt made, and no smoking. Such an outcome variable demands more power to find significant results than a continuous variable for the same sample size. In another study, intent to quit was found to be predictive of a dichotomous outcome variable indicating whether at least one quit attempt had been made or not (Norman et al, 1999). The relationship was positive such that greater intent was associated with a greater likelihood of making a quit attempt. All-in-all, the additional cross-sectional analysis with the number of quit attempts made in the last 6 months found little evidence to support the second step of the TPB. None of the predictors were found to be significant.

The longest prior period of abstinence achieved by participants in the last 6 months was used to separate them at the median into two groups: High and Low

Abstinence. With abstinence group at follow-up as the outcome variable, the model demonstrated a fit to the data that was significant at a trend level. Total explained variance was 15.9%. Only Intent to Quit was significant at a trend level. Greater intent to quit at baseline was associated with a reduction in the likelihood of belonging to the High Abstinence group in 6 months' time. This finding suggests that smokers who were more intent on quitting were more likely to be among those who were less able to sustain abstinence 6 months later. This finding suggests that greater intention to change is associated with less successful attempts to sustain change, despite its association with greater number of attempts at initiating change. Perhaps the majority of smokers make half-hearted attempts to quit? The additional cross-sectional analysis with Abstinence Group at baseline as the dependent variable revealed the model to be a significant fit to the data. Dependence Severity was found to be a significant predictor and was associated with a reduction in the likelihood of belonging to the High Abstinence group. Intent to Quit also was a significant predictor and was associated with a reduction in the likelihood of belonging to the High Abstinence group. This finding suggests that participants who were among the High Abstinence group at baseline were less likely to have the intention to quit in the next 6 months. Perhaps participants who failed after achieving significant periods of abstinence became more demoralized than those who failed after achieving briefer periods of abstinence, which influenced their reported future intent to attempt quitting again.

Together, the above findings provide some support for the second step of the TPB. There is evidence to suggest the inclusion of Intent to Quit as a model variable. However, none of the analyses found Self-Efficacy to be a significant model predictor.

Thus, there is no evidence to support its role in the current model. Norman et al (1999) found that behavioral control was not predictive of change initiation or change maintenance. However, Godin et al (1992) found behavioral control to be a significant change outcome in two different samples of smokers. Again, the studies relied on different measures of behavioral control, making it difficult to draw unequivocal conclusions.

The Elaborated Model

The Elaborated Model introduced the Implicit Smoking Self-Identity and Impulsivity constructs to the TPB as predictors of outcome. With the number of quit attempts as the outcome variable, only Impulsivity was a significant predictor. Greater Impulsivity was associated with more quit attempts made after 6 months. This finding suggests that more impulsive smokers were more likely to initiate quit attempts than less impulsive smokers. Also, Dependence Severity was a significant covariate. Greater Dependence Severity was associated with fewer quit attempts made after 6 months. This finding suggests that smokers who were more dependent are less likely to attempt quitting than smokers who were less dependent on nicotine. The additional cross-sectional analysis with the number of quit attempts made in the last 6 months was not significant. Only Implicit Smoking Self-Identity was significant at a trend. Greater Implicit Smoking Self-identity was associated with fewer quit attempts in the last 6 months, suggesting that a stronger identification with smoking might discourage attempts to initiate change.

With abstinence group at follow-up as the outcome variable, the additional personality and implicit variables did not contribute significantly to the model. Only

Implicit Smoking Self-Identity was significant at a trend level and was associated with a reduction in the likelihood of belonging to the High Abstinence group. This finding suggests that smokers who implicitly identified more with smoking were less likely to be among those who were able to abstain for relatively longer periods of time. With abstinence group at baseline as the dependent variable, the additional personality and implicit variables contributed to the model at a trend level. Impulsivity was found to be significant; greater impulsivity was associated with an increased likelihood of having belonged to the High Abstinence group in the previous 6 months. This finding suggests that greater impulsivity was associated with a history of greater success at sustained change efforts that ultimately failed. All participants were current smokers at baseline so any reported abstinence was necessarily followed by relapse. Perhaps, failures after sustaining abstinence for longer periods of time loom larger than failures at sustaining abstinence for shorter periods of time and thus are more likely to influence smokers' perception of their own behavior as being more impulsive.

Together, the above findings provide some support for the inclusion of Implicit Smoking Self-Concept and Impulsivity as model variables in the TPB. Each of the variables was found to be a significant model predictor in two tests of the Elaborated model. However, replication using a longitudinal sample with an acceptable follow-up rate is necessary to substantiate the validity of the Elaborated model.

Secondary Analyses of Interaction Effects within the Elaborated Model

Further analysis was carried out to explore the possibility that the additional variables of the Elaborated model, Impulsivity and Implicit Smoking Self-Identity, were moderators of the relationship between Intent to Quit and smoking outcome. Evidence

to support significant interactions was found with the Number of Quit Attempts at follow-up and Abstinence Group at baseline as the outcome variables.

With the number of quit attempts at follow-up as the dependent variable, the interaction terms contributed significant explained variance to the model. The interaction between Intent to Quit and Impulsivity was found to be significant. The interaction term suggests that Intent to Quit moderated the relationship between Impulsivity and the number of quit attempts made such that for participants with greater reported intent to quit, impulsivity was less predictive of the number of quit attempts made than for participants with lower intent to quit.

The above findings were very similar to the findings with Abstinence Group at *baseline* as the DV. The interaction terms contributed significantly to the model. Intent to Quit was a significant predictor while Impulsivity was significant at a trend level. The interaction term between Intent to Quit and Impulsivity was significant. The interaction term suggests that Intent to Quit moderated the relationship between Impulsivity and the likelihood of having belonged to the High Abstinence group such that for participants with greater reported intent to quit, impulsivity was less predictive of prior Abstinence Group membership than for participants with lower intent to quit. . Among smokers with low Intent to Quit, impulsivity was associated with their past experiences of sustaining behavior change (and necessarily failing). Together, the above findings provide support for the inclusion of interaction terms, namely the interaction between Impulsivity and intent to quit, in the Elaborated model of the TPB.

Pattern of Significant Model Predictors for Different Smoking Outcome Variables

The pattern of findings was similar for the model with *baseline* Abstinence Group as the DV (Table 15) and the model with *follow-up* Number of Quit Attempts as the DV (Table 12), as well as for the model with *follow-up* Abstinence Group as the DV (Table 14) and the model with *baseline* Number of Quit Attempt as the DV (Table 13). This observation suggests an interesting relationship between the outcome variables that is ‘mediated’ by the TPB model: there appears to be an association between past Abstinence Group membership and future number of quit attempts made, as well as between future Abstinence Group membership and past number of quit attempts made. The t-tests of the correlations between the DVs with similar patterns of significant IVs that were conducted revealed a significant positive correlation between baseline Number of Quit Attempts and follow-up Abstinence Group suggesting that smokers who had made multiple quit attempts at baseline were more likely to belong to the high abstinence group at follow-up. Similarly, a significant positive correlation was found between baseline Abstinence Group and follow-up Number of Quit Attempts, suggesting that smokers who had belonged to the high abstinence group at baseline were more likely to make more quit attempts by follow-up. Furthermore, the number of quit attempts made at baseline and at follow-up were significantly correlated, suggesting that change behavior of participants remained consistent. Similarly, high abstinence group members at baseline were more likely to remain high abstinence group members at follow-up.

The Problem of Self-Efficacy

There was no evidence to suggest that Self-Efficacy was a significant predictor of Intent to Change or any of the smoking outcome variables. The shortfall in sample size at follow-up may have been the reason for this finding. However, inadequate sample size

was not a problem for the baseline test of the first step of the TPB. The lack of evidence for self-efficacy as a predictor is surprising, given the consistent and widespread finding for its validity and utility in the literature.

Perhaps self-efficacy does not fit in the TPB, particularly as a predictor of Intent to Change. Self-efficacy captures a person's confidence to resist smoking in various situations (change maintenance). It may be unrelated to the likelihood that the person will attempt to quit smoking (change initiation) in a given time period; intention to change may be completely divorced from ability to successfully maintain change and therefore unrelated to it.

Alternatively, perhaps self-efficacy is a poor proxy for perceived behavioral control and therefore not a suitable predictor of behavioral intention. In fact, some of the questions that are used to measure perceived control appear to necessarily tap into intent by the inclusion of a time period in its items e.g. "How much confidence do you have that you can quit within 6 months?" and "How much effort will it take to for you to quit in the next 6 months?" Measures of self-efficacy utilize similar items but do not specify a time period, merely a general confidence to perform a behavior. In the current study, the SASE only measured anticipated success in performing a behavior and was entirely devoid of the intention to do so. The current study did not include a measure of perceived control to permit comparison.

Perhaps self-efficacy is a good proxy for perceived behavioral control but the SASE is a poor measure of self-efficacy. By relying on the assessment of many situations without including an assessment of the frequency that they might be encountered, the SASE may not be appropriate for smokers who limit their smoking to a

few specific situations. Also, recent changes in legislation in many states may have reduced the scope of contexts where smokers are permitted to smoke, further reducing the utility of the SASE and similar measures. An overall confidence rating of ability to change a behavior may be a better measure of self-efficacy. Alternatively, ideographic measures that allow smokers to specify or rank their most challenging triggers may be more appropriate.

Finally, perhaps current smokers are very different from smokers who have already quit, as suggested by the Hardening Hypothesis. Perhaps, for current smokers, self-efficacy is a poor predictor of outcome especially if they are naïve to quitting and thus unable to assess their true ability to resist smoking in the face of various triggers. Alternatively, current smokers may be smokers who lack insight into their own behavior and so measures that rely on self-report are less useful. Whatever the case may be, before self-efficacy is discounted entirely, replication is necessary, especially given the high attrition in the current sample.

The Smoking Self-Identity IAT

A thorough set of analyses was run to explore the construct validity of the Smoking Identity IAT. A measure of Implicit Smoking Self-Identity is expected to detect significant smoking self-identity among individuals who choose to smoke. In the current sample, the IAT D was found to be significantly positive, suggesting a significant implicit smoking self-identity among smokers.

IAT measures are not expected to correlate significantly with their explicit counterparts, especially in socially-sensitive domains (Poehlman et al., 2003). In the current study, Smoking Self-Identity IAT did not correlate significantly with Explicit

Smoking Attitude, either at baseline or follow-up. While attitude about smoking is conceptually different from smoking self-identity, it is related. The lack of correlation between two related measures that rely on different methods of measurement provides divergent validity (Campbell & Fiske, 1959) for the implicit smoking self-identity construct.

A proposed advantage of implicit measures is their resistance to self-presentational forces. This characteristic can be assessed by investigating correlations between the IAT measure and the Marlowe-Crown Social Desirability scale. As expected, the MCSD scale did not correlate significantly with the Smoking Self-Identity IAT, either at baseline or follow-up. In contrast, the MCSD correlated significantly with the Explicit Smoking Attitude measure at baseline and at a trend level at follow-up. The negative correlations between social desirability and explicit smoking attitudes suggest that smokers who were more vulnerable to social desirability bias were less likely to report negative attitudes about smoking than their less vulnerable counterparts. This finding supports the notion that relying on explicit measures of attitude alone leaves research vulnerable to social desirability bias, especially in cases where the subject of study involves behavior that is stigmatized such as smoking.

As far as smoking behavior is concerned, the smoking self-identity IAT effect was found to correlate significantly and negatively with the number of quit attempts made, but only at follow-up. As expected, greater implicit smoking self-identity was associated with fewer attempts made to quit. This finding provides convergent validity for the Smoking Self-Identity IAT by revealing an association between it and a behavioral measure. However, the association was not significant at baseline.

The expected negative correlation between the smoking self-identity IAT effect and Intent to Quit was not found at baseline. At follow-up, the correlation was significant at a trend level. Greater smoking self-identity was associated with greater intent to quit. Perhaps a positive smoking self-identity is stigmatizing in the current social climate and it may encourage smokers to express greater intent to quit.

The expected correlation between the IAT effect and Smoking Abstinence Self-Efficacy was not found, although there was a trend level correlation between the Habitual Craving subscale of the SASE and the IAT effect. The prediction was based on an expected greater difficulty among those who have a greater smoking self-identity to resist smoking in various situations. Social desirability bias may have interfered with the expected association because the SASE is an explicit self-report measure. In fact, the Negative Affect subscale was found to correlate with the MCSD. Perhaps an implicit measure of Smoking Abstinence Self-Efficacy would be a more appropriate measure for comparison.

All of the above evidence appears to contribute to the validity of the Implicit Smoking Self-Identity as measured by the IAT. The problems with data collection at follow-up did not allow for a comprehensive assessment of the predictive validity of the smoking self-identity IAT, although there was some indication for the validity of its inclusion as a predictor in the Elaborated model of the TPB. Finally, the Implicit Smoking Self-Identity measure demonstrated poor temporal reliability, a consistent finding in the IAT literature. Poor temporal reliability is likely to undermine the predictive validity of a measure and limits its utility in research. Nevertheless, a recent meta-analytic review of the use of the IAT paradigm in the substance use literature points

to its growing use in the field, especially as greater consideration is being given to dual-process models, and the consistent finding that it correlates with the expected behavioral outcomes (Rooke, Hine & Thorsteinsson, 2008).

Study Attrition

None of the expected predictors of study attrition were found to be significant. However, Smoking Abstinence Self-Efficacy was found to be a significant predictor at a trend level. The Habitual Craving subscale alone was found to be significant predictor. A unit increase in reported Habitual Craving self-efficacy subscale score increased the odds of participating at follow-up by about 74%. This finding suggests that participants with little confidence in their ability to resist habitual triggers were more likely to drop out of the study. To avoid high attrition rates in future research, greater efforts could be made to retain smokers with low-self-efficacy. Alternatively, if greater efforts to retain smokers with low self-efficacy fail, then perhaps they should be over-sampled with the expectation that they will demonstrate greater attrition than the rest of the sample. However, with only 6% of the variance in study attrition explained by the Habitual Craving subscale, there is much more to be understood about what led to dropout. Attrition may have been due to other factors that were not measured as part of the current study. A major consideration is the study design, which was entirely administered over the Internet. Perhaps the anonymity that can be so valuable in reducing bias may in fact discourage conscientiousness. Furthermore, dropout may have been random and unintentional if participants never received the invitation to participate again, as is discussed in the limitations section below.

The Delay Discounting Task

With only 14 valid data points at baseline in the current dataset, it was not possible to conduct a fair assessment of the Delay Discounting task as a measure of impulsivity. The current study was limited by the features of the software used to administer the Delay Discounting task. The most recent upgrade of the Inquisit software to version 3.0 (Inquisit, 2008) brings a host of promising improvements that may be useful in the administration of the Delay Discounting task. Some of the new features allow participants to move back and forth through the test, more sophisticated real time data validation, and generally a more visually appealing presentation that may alleviate some of the tedium that comes with performing a monotonous task. Alternatively, other measures of impulsivity may be used that also are resistant to social desirability bias such as the Go/No Go Task. In the current study, the BIS correlated significantly with the MCSD, supporting the argument that indirect methods may be more valid.

Limitations

The current study relied on the Internet to recruit participants and to administer the measures. A major advantage of the Internet is that it can be used to reach populations that typically are underserved by research. Also, the Internet can provide a greater sense of anonymity to participants than an in-person study, even with the customary assurances. This feature is especially important for areas of research where the behavior of interest is stigmatized, as is the case with addictive behaviors.

However, Internet research is not without its pitfalls, many of which became evident in the current study. A major concern with longitudinal research is participant retention. In the current study, a great amount of control was sacrificed to preserve participant anonymity, which limited what the investigator could do to minimize drop

out. The result was an extremely poor retention rate, 31%, that was much lower than the expected and acceptable 70%. The resultant sample was too small to address the more power-demanding longitudinal analyses and the longitudinal results must be interpreted with considerable caution.

An unanticipated obstacle was that the experimenter's email address was flagged by a number of Internet service providers as a spammer and so all communications originating from it were automatically filed as spam or blocked. A number of factors led to this situation. Spam filters are programmed to be suspect of email messages that are addressed to a large number of people. On a number of occasions the experimenter contacted participants en masse to send them messages of encouragement to quit and links to online resources, as well as to invite them to participate at follow-up. All of these communication attempts were likely instances that spam filters flagged as being indicative of spamming behavior. To overcome this obstacle, the experimenter created new email accounts and used them to contact each participant with a separate email message. This strategy was met with limited success. However, the changing email address may have aroused suspicion in some participants or simply been ignored as being unfamiliar.

Another challenge that spam filters present is that they are programmed to flag emails with certain keywords in their subject fields. These keywords are usually indicative of a spammer or marketer suggesting a limited time offer. To overcome this aspect of spam filters the experimenter used restrained language devoid of colorful or urgent language, or promises of reimbursements to invite participants to participate at follow-up. This strategy may have increased the likelihood that the email messages

reached participants' inboxes. Nevertheless, the messages have to compete for attention with all other email messages that also made it past the spam filters. The milder language may have made them easier to overlook.

Another major problem was that a number of email addresses were no longer valid by follow-up. It appears that participants may have created email accounts that remained idle for too long and were inactivated by their service providers. These participants may have changed Internet service providers over the follow-up period or they may have been inconsistent Internet users who did not use email consistently enough to care to preserve an address. Alternatively, they may have been participants who created the address solely for the purpose of the study as a measure of protection until the study proved to be legitimate but then lost track of the address or failed to check it regularly or they may have forgotten the password associated with it.

Also, anonymity is a double-edged sword. The anonymity of the Internet may have made it harder for participants to take the study seriously or to adhere strictly to instructions. There is no guarantee that participants followed through with instructions to ensure that they were in an environment ideally suited for research. Also, it was impossible to definitively ascertain whether or not email messages were actually received, read, and/or ignored by participants. One way to remedy this problem would be to collect participant phone numbers as a prerequisite to participation. Brief phone contact with participants would be much more informative to the experimenter and perhaps more persuasive to the participant to participate at follow-up than an email message.

Finally, the current findings must be replicated in a longitudinal sample that meets the requirements suggested by the power analysis that was performed originally. The attrition rate was greater than expected. Some of the variables were not normally distributed as expected, namely Social Norm and Abstinence Group. Also, the author interpreted findings significant at a trend level and very small interaction terms, a fairly liberal stance especially given that r is a positively biased predictor of effect size. Finally, a larger total number of statistical tests was run than originally planned, which increases the likelihood of finding a significant result when there is none (Type I error).

Conclusion and Future Directions

The current study found partial support for the Theory of Planned Behavior. The final sample was more suitable to address the first step of the TPB, predicting behavioral intent from social norm, personal attitude, and self-efficacy, for which it found support. Both Social Norm and Explicit Attitude were significant predictors of Intent to Quit. The second step relied on longitudinal data, which suffered from poor participant retention. Various analyses found support for some of the predictors some of the time. There was some evidence that Impulsivity and Implicit Smoking Self-Identity, as well as their interactions with Intent to Quit, may be useful additions to the model, but such a conclusion must only be made after findings are replicated with a more appropriate longitudinal sample. Impulsivity is a broad construct, so future research efforts should investigate the various kinds of impulsivity that may be at play in various contexts. Also, greater efforts need to be made by researchers to maintain consistency in measuring model variables. Until then, only tenuous comparisons can be made.

The current study encountered some unexpected obstacles that must be heeded in future Internet research. Supplementing email communication with telephone contact may be an effective remedy to dropout. Furthermore, the widespread negative sentiment about smoking in the population at large led to the severely skewed distribution of the Social Norm measure, which had to be dichotomized for the purposes of the current study. A different measure that is more sensitive on the negative end of the scale would allow future research efforts to study perceptions of social norms as a continuous variable.

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