Title
A DUAL-PROCESSING APPROACH TO ASSESSING AND CHANGING SMOKING ATTITUDES

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A DUAL-PROCESSING APPROACH TO ASSESSING AND CHANGING SMOKING ATTITUDES

by

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Psychological Sciences Group

University of California, Merced

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Abstract

Despite widespread knowledge as to the dangers associated with smoking behavior, 20% of the United States population continues to smoke (Center for disease control, 2011). Novel intervention techniques need to be developed for those who continue to smoke despite awareness of the associated health risks. This dissertation explores the possibility that implicit cognitions that occur automatically and outside of conscious awareness might be specifically targeted for the purpose of behavior change. Two research questions (RQ) have guided the theory and methodology used in these two studies: RQ 1) can smoking related implicit attitudes be delineated into subdomains that mirror domains of explicit smoking attitudes?, & RQ 2) can interventions that tap into smoking related implicit associations produce changes in implicit and explicit attitudes? Study 1 assessed multiple implicit measures of cognition, each designed to tap into a unique domain of implicit smoking attitudes. The results of a factor analysis conducted on the Implicit Association Test (IAT; Greenwald & Banaji, 1995) in study 1 suggest that all four IATs tap into the same basic construct. Thus the answer to RQ 1 appears to be negative: smoking related implicit attitudes cannot be delineated into distinct domains. Study 2 assesses a novel interactive intervention that utilizes implicit methods of message delivery in hopes of impacting implicit and explicit smoking attitudes. The results of this study suggest that explicit, but not implicit, attitude change occurred, providing partial support for RQ 2. Additional research in the area of implicit cognition of smoking behavior is necessary to build upon these findings and explore the plausibility of an implicit intervention as a means to help reduce smoking behavior. Future directions and implications for policy are discussed.

Introduction

Over 440,000 people die as a result of smoking-related complications every year. Prominent models of health behavior change, such as the health belief model (Janz & Becker, 1984) suggest that knowledge as to the dangers of smoking should contribute to an appropriately healthy decision to quit. Thus, the current prominent paradigm is to disseminate information as to the dangers of tobacco use with expectation that this should curb smoking behavior. These efforts have occurred at the population level in the form of public campaigns, as well as the individual level in the form of interventions. These efforts seem to have been largely successful; according to one survey 89% of the population believed smoking to be harmful to one's health (Brownson et al 1992). These numbers are in contrast to the 66% of individuals that had knowledge that smoking caused cancer in 1964 as reported by Brownson and colleagues. In addition, over 80 percent of then-current smokers reported knowledge of the addictive nature of smoking and the benefits of quitting. These numbers coincide with the Center of Disease Control and Prevention's (CDC) findings that a decline in smoking from 41.9 percent in 1965 to 19.3 percent in 2010 (Center for disease control, 2011). Thus, national trends in smoking seem to have declined in the same time that knowledge of the dangers of smoking has increased.

Although smoking rates have declined, 20 % of individuals in the United States continue to smoke despite widespread knowledge as to the dangers of smoking. In general, research has been slow to recognize that traditional methods of smoking intervention might not be appropriate for heavy smokers; however, more recently researchers have begun to focus on these recalcitrant smokers who do not react to more traditional anti-smoking campaigns

(Goldenberg & Arndt, 2008). The purpose of this dissertation is to explore how the behavior of these recalcitrant smokers might be targeted in an intervention designed to avoid common mistakes when addressing this population.

Two theories in particular provide insight as how to address the 20% that do not seem to be influenced by explicit knowledge of the dangers of smoking. First, dual-processing models of smoking attitudes suggest that smokers have conflicting implicit associations concerning smoking that might act as a barrier to behavior change. Past research has provided evidence that implicit attitudes toward smoking may vary by domain; for example, a sample of smokers showed negative implicit affect when the health-related aspects of smoking were highlighted, but relatively positive affect when social-related aspects of smoking were highlighted (Hansen, Winzeler, & Topolinski, 2010). In contrast, non-smokers have consistently congruent negative attitudes related to smoking. Thus, an intervention must take care to directly address the domains of implicit smoking attitude that will maximize reduction of smoking behavior among heavy smokers, and avoid crafting the message in a way that might inadvertently activate positive implicit attitudes.

This leads to a second important theory that might shed light on how to best address the behavior of recalcitrant smokers: terror management theory (TMT; Solomon, Greenberg, & Pyszczynski, 1991). TMT provides a useful theoretical groundwork to address implicit smoking attitudes given its focus upon automatic unconscious reactions that individuals have in response to reminders of death and mortality. Given the nature of smoking and its consequences for health, the terror management health model suggests smoking research

might benefit from assessing how messages that make death salient might influence the implicit attitudes and behavior of heavy smokers. The basic premise of TMT theory casts doubt on the effectiveness of the current technique of bombarding heavy smokers with the health risks of smoking. That is, because reminders of death lead to an unconscious bolstering of important aspects of the self, reminders of death might actually lead to a bolstering of the exact aspect of identity that is intended to be weakened—the smoking identity (Goldenberg & Arndt, 2008). The fact that this process appears to be automatic and unconscious, and thus occurs without any knowledge on the part of the smoker, only further complicates matters. This automatic cognitive response influences behavior as well. The terror management health model (TMHM) suggests that highly identified smokers often react against explicit messages that convey health risks (such as cancer and death) associated with smoking such that smoking behavior actually increases rather than decreases (Goldenberg & Arndt, 2008). Empirical research supports the notion that heavy smokers often increase smoking behavior when faced with anti-smoking campaigns that emphasize the health risks of smoking (Hansen, Winzeler, & Topolinski, 2010). These results suggest that strong explicit messages conveying the health related consequences of smoking, such as death and cancer, might be hindering many smokers' attempts at quitting.

Taken together, the dual processing approach to attitudes and terror management health model provide a plausible account for a major barrier that recalcitrant smokers face in quitting. That is, explicit messages emphasizing the health risks associated with smoking, though highly effective for a majority of the population, may ironically increase smoking among the 20 percent of the population that continue to smoke. It is clear that novel intervention

methods are now necessary to specifically address the ambivalent attitudes fostered among recalcitrant smokers. Anti-smoking messages must be designed to influence smoking attitudes without inducing the negative reaction that is common among highly identified smokers.

The ambivalence of implicit smoking attitudes among smokers may be the result of conflicting implicit attitude domains. Researchers have used IATs in order to target specific implicit attitudes including health (Hansen, Winzeler, & Topolinski, 2010), identity (Dal Cin, Gibson, Zanna, Shumate, & Fong, 2007; Swanson, Rudman, and Greenwald, 2001), and social (Hansen, Winzeler, & Topolinski, 2010; Kahler, Daughters, Leventhal, Gwaltney, & Palfei, 2007) domains of smoking attitudes. While heavy smokers (similar to non-smokers) implicitly associate smoking with poor health (Hansen, Winzeler, & Topolinski, 2010), they also (unlike non-smokers) implicitly treat smoking as socially positive (Kahler et al. 2007; Vahey, Boles, & Barnes-holmes 2010) and implicitly identify as a smoker (Dal Cin, Gibson, Zanna, Shumate, & Fong, 2007). An intervention that can influence smoking attitudes over a wide variety of contexts such that a habitually negative association (i.e. across domains) is established will be important if stable *long-term* attitude change is to occur. To date, the vast majority of smoking interventions that target implicit attitudes provide evidence for only short term attitude change (Rooke, Hine, Thorsteinsson, 2008). A method must be developed that can ensure repeated exposure to an anti-smoking message such that attitudes toward smoking become habitually negative across time and context.

Developing an Implicit Intervention

Two theories in particular provide the background for how an implicit message can be crafted for the purpose of disrupting smoking behavior and positive attitudes associated with smoking. A large body of research on cognitive metaphor suggests that much of our understanding of the world is dictated by the metaphors we use in language (Lakoff & Johnson, 1980). For example, it is common for personality to be described using a temperature metaphor: that is, friendly people are generally described as warm, while unfriendly is described as cold (Williams & Bargh, 2008). Therefore, a potentially powerful method for smoking attitude change is the use of implicit metaphor in order to convey the message.

Until recently, attitudes and mental representations, including metaphors, have been conceptualized largely as a product of language and ultimately considered to be merely 'things in our head'; however, recent work of cognitive psychologists and scientists is suggesting that this is an oversimplification. Lower-order processes such as motor functioning and the senses are much more important to our understanding of concepts than once commonly accepted (Lakoff & Johnson, 1980). Returning to the warm/cold personality trait metaphor, Williams and Bargh (2008) have demonstrated that this metaphor is partially embodied by providing participants with either warm or cold coffee influenced ratings of a fictitious individual. This provides evidence that the physical sensation of warm or cold (a lower-level cognitive process) is intimately connected to our more abstract concepts of warm and cold as personality traits. Similarly, the message that smoking is deteriorating to health or social life might also be conveyed 'iconically' or visually (i.e. through a non-linguistic, lower-level process) if the stimuli are carefully crafted.

Taken together, theories of cognitive metaphor and embodied cognition suggest that a simple anti-smoking message might be conveyed visually by activating a cognitive metaphor that highlights the risks of smoking. Given the importance of fire in the cigarette smoking process, a cultural metaphor that might be exploited for the purpose of an implicit intervention is fire as destruction and consumption. For example, the statement 'Los Angeles is burning' conveys the idea of the city of Los Angeles burning in the literal sense, as well as the idea of the city's demise in a more symbolic sense. The common cultural metaphor of 'fire as consumption' (Princen, 2010; Radway 1986) is the basis for our understanding of this metaphor, and will be the basis for a novel implicit smoking intervention.

Research Aims

Given that some individuals persist in smoking despite having explicit knowledge as to the dangers of tobacco use, public campaigns that continue to dedicate resources toward educating individuals as to the dangers of smoking seem to be experiencing diminishing returns. It has been suggested that interventions that directly target unconscious implicit attitudes might be more effective for those that are not influenced to quit by explicit knowledge of the dangers to health (Goldenberg & Arndt, 2008). An intervention that ensures repeated exposure of a subtle anti-smoking message and directly targets implicit smoking attitudes is the ultimate purpose of this dissertation. Two specific aims have guided the research performed for this dissertation in effort to create an intervention that relies upon implicit methods of message delivery.

Aim 1: To determine if implicit attitudes can be delineated into domains that mirror domains of explicit smoking attitudes (i.e. social attitudes, health attitudes, self attitudes, etc.).

Past research has identified health and social attitudes as important domains in explicit attitudes relevant to smoking. The first aim to of this study is to determine if implicit associations can similarly be partitioned into unique domains. Four implicit attitude measures were designed for this study in order to tap into implicit domains of: health, social, self-identification, and general valance. By addressing four implicit attitude domains simultaneously in the same study, we can determine if these measures are truly tapping in to four distinct domains or if these measures are merely tapping into the same network of associations. The answer to this issue will help inform whether an intervention ought to target specific implicit domain, or if it is safe to treat implicit associations as all part of the same associative system.

Aim 2**:** To develop smoking primes that can be repeatedly administered and are context specific to implicit attitude subtypes (i.e. social attitudes, health attitudes, self attitudes, etc.) for the purpose of implicit and explicit smoking attitude change.

Interventions that attempt to curb smoking behavior by explicitly conveying information about the dangers associated with smoking are ineffective for recalcitrant smokers. Even more, reminding recalcitrant smokers of the life-threatening aspects of smoking is not only ineffective, but can sometimes result in a boomerang effect in which smoking behavior actually increases after such a message. The second aim of this study is to develop a brief intervention that can influence implicit and explicit attitudes using an implicit method of message delivery.

An implicit intervention might potentially avoid the pitfalls of explicit interventions and campaigns that might lead to ironic increase in smoking behaviors among recalcitrant smokers. The design of this intervention was informed by several prominent theories including: dual-processing theory, terror management theory, embodied cognition, and cognitive metaphor.

Background theory

Implicit cognition and smoking. A wide body of research has explored the idea that behavior can be altered and explained not only by explicitly held conscious cognitions (e.g. skills, perceptions, and beliefs) but also by implicit automatic cognitions that operate effortlessly and outside of conscious awareness (Bargh & Chartland 1999; Baumeister, Masicampo, & Vohs, 2010). Chassin and colleagues (2010) found evidence that implicit attitudes (measured by the implicit association test (IAT; Greenwald and Banaji, 1995)) and explicit attitudes (measured by questionnaire responses) each explain unique aspects of smoking cessation. Specifically, explicit attitudes were a better predictor of smoking cessation for those who had only a few previous failed attempts to quit smoking, while implicit attitudes were a better predictor of smoking cessation for those who have tried to quit unsuccessfully many times in the past. Repeated failure to quit smoking appears to deplete explicit controlled processes involved in cessation of smoking behavior, thus implicit automatic processes are more likely to influence smoking behavior among those who have continuously attempted (yet failed) to quit smoking (Chassin et al, 2010). Thus, the distinction between implicit and explicit smoking attitudes is not a trivial one, and it will be particularly important to gain a more

complete understanding of how implicit attitudes influence behavior above and beyond explicit attitudes.

Focusing specifically on implicit attitudes, non-smokers have been found to have stronger implicit negative attitudes toward smoking than smokers (Sherman, Rose, & Koch, 2003). This suggests that smokers show relatively more positive implicit associations with tobacco use than non-smokers; however, as suggested in the introduction, it would be an over-simplification to suggest that attitudes toward smoking are either strictly positive or strictly negative. The attitude domain being assessed appears to be important: thus when measuring implicit attitudes without any attempt to control for the domain of interest (e.g. via experimental manipulation), researchers cannot be certain what specific smoking related attitude is being assessed. This may be a problem for any study that purports to measure a general, as opposed to domain specific, smoking attitude. A few studies have started targeting specific domains, rather than attempting to assess general attitudes. For example, Kahler and colleagues (2007) found that when individuals unconsciously associated smoking with negative social consequences they were more likely to maintain smoking abstinence than when they associated smoking with negative health consequences. Thus, implicit *social* attitudes associated with smoking may have a substantial impact upon smoking behavior among those who have a particularly hard time quitting. Not surprisingly, this is precisely the population that current smoking interventions seem to fail.

In addition to positive or negative associations with a particular domain of smoking attitudes, implicit associations of smoking with the *self* are associated with intentions to smoke.

Researchers have shown that images in the media have an influence upon implicit self-identification as a smoker, such that images of movie stars smoking, increases self-identification of smokers (Dal Cin, Gibson, Zanna, Shumate, & Fong, 2007). Furthering our understanding of how implicit attitudes influence smoking behavior as a function of the domain of interest (e.g. health, social, self, etc.) will be informative for researchers and clinicians who are interested in the design of interventions that aid in attempts to quit smoking. Aim 1 of this dissertation is to determine if implicit associations indeed meaningfully cluster into multiple distinct domains, or if implicit associations ought to be treated as single construct.

The presence of multiple implicit smoking domains has yet to be empirically investigated. If evidence is found in favor of multiple implicit domains, it will be important to target the implicit domain that best predict smoking behavior and explicit smoking attitudes. There is some evidence from past research that addressing some specific topics while avoiding others might be fruitful when trying to change the attitudes and behavior of recalcitrant smokers. As we will now see, focusing on the social aspects of smoking (perceptions of self and social relationships) or of youthful physical appearance might be more fruitful than the common approach of emphasizing the health risks associated with smoking.

Smoking, Terror Management Theory, and Identity. The terror management health model (TMHM; Goldenburg & Ardnt, 2008) is a useful model to explain why many smokers have a difficult time quitting despite knowledge of the health risks. The TMHM is an application of the terror management model to health decision research (TMT; Solomon, Greenberg, & Pyszczynski, 1991). This theory suggests that, as human beings, knowledge of our own

mortality is a threat to one's sense of self-meaning. Death signals the end of one's life, thus the saliency of one's own mortality puts an individual's sense of self-meaning in jeopardy. Terror management theory proposes that individuals will sometimes bolster aspects of the self that bring meaning to an individual's life in order to relieve the threat to meaning brought on by reminders of mortality. For example, social group memberships are often important for an individual's sense of identity (Tajfel & Turner, 1969). Researchers have found that participants bolstered important group memberships, such that they preferred their own group more and felt more negatively toward the out-group, when mortality threat was made salient (Greenberg, Pyszczynski, Solomon, Simon, & Breus, 1994; Harmon-Jones, Greenberg, Solomon, & Simon, 1995). Mortality threat not only increases in-group preference, but also promotes thinking about social groups in terms of stereotypes (Schimel et al, 1999). Further, when mortality is salient individuals tend to act more aggressively following a challenge to their ideological worldview than when mortality is not salient (McGregor et al, 1998). Thus we find that mortality threat tends to lead individuals to bolster important social group memberships and worldviews in order to reaffirm the meaning that has been threatened as a result of mortality salience (Solomon, Greenberg, & Pyszczynski, 1991). The terror management health model suggests that this process may have implications for smokers and explicit health messages that emphasize the risk of death associated with smoking.

Public campaigns and other smoking interventions largely rely on explicit delivery of information when conveying messages about the dangers of smoking to the public. Based in-part upon this knowledge, many smokers have decided to quit and many others have refrained from initiating smoking in the first place (Thrasher et al, 2004). This is consistent with the

health belief model (Janz & Becker, 1984), the theory of planned behavior (Ajzen, 1991), protection motivation theory (Norman, Boer, & Seydel, 2005), and extended parallel process model (Witte 1992) that each describe how health decisions are made following conscious deliberation. This is a process in which smokers and potential smokers consider the dangers of tobacco use, and ultimately make a decision about whether or not to smoke. According to terror management theory when an individual quits smoking it removes the threat of mortality by removing the source of the physical threat. In this case, the decision to cease smoking is in harmony with the rational decision making process as described by the health belief model where behavior change occurs in response to explicit knowledge as to the dangers of smoking. According to the terror management health model, smokers can also alleviate the mortality threat associated with smoking by ignoring the dangers of smoking and instead pushing thoughts about the dangers outside of conscious awareness. That is, rather than quitting in order to remove the actual threat, people can instead reduce the mortality threat associated with smoking by either dismissing the health claims as bogus or refusing to consider the consequences of smoking. In either case the threat is dealt with in a logical manner, even if the ultimate health decision turns out to be detrimental.

According to terror management theory, once the cognitive dissonance associated with smoking is removed from consciousness, *unconscious* associations are activated that can lead to surprising behavioral and attitudinal outcomes. Mortality threat only activates abstract concepts related to the self when the threat is pushed outside of conscious awareness, as research suggests bolstering of important self-concepts only occurs after death related thoughts were either primed subliminally or after enough time had passed for death thoughts

to no longer be conscious (Solomon, Greenberg, & Pyszczynski, 1991). Terror management at an implicit level is not bound by logic as is true for terror management at the explicit level (Pyszczynski, Greenberg, & Solomon, 1999). Instead, implicit mortality threat is alleviated by activating other cognitive systems of meaning such as worldviews or group memberships. By activating other implicit systems of meaning, the threat to self-meaning associated with death is alleviated (Solomon, Greenberg, & Pyszczynski, 1991).

The notion that mortality threat might cause a smoker to bolster an identity that they feel closely associated with presents a dilemma for highly identified smokers. That is, the terror management health model suggests that one unconscious strategy that highly identified smokers might use when confronted with the health risks associated with smoking is to bolster their smoking identity, leading to an ironic increase in tobacco use. Indeed, the results of one experimental study suggest that health related smoking threat actually increased positive attitudes toward smoking amongst smokers that were highly identified (Hansen, Winzeler, & Topolinski, 2010). Thus anti-smoking messages that focus on the risk of death associated with smoking might actually have a 'boomerang' effect whereby smokers actually bolster the smoking aspect of the self, and thus smoke more than they would have otherwise. This same research suggests that the emphasizing the social risks associated with smoking can be quite effective for the highly identified smokers: social related smoking threat, such as smelling bad or stained teeth and the smokers' cough, did reduce positive attitudes toward smoking amongst highly identified smokers (Hansen, Winzeler, & Topolinski, 2010). This suggests that perhaps rather than focusing upon the risk of death associated with smoking, interventions

might benefit by focusing upon the social risks associated with smoking (Goldenberg & Ardnt, 2008).

Despite all the health dangers associated with tobacco use, many are drawn to smoking in part because of the perceived social benefits associated with the behavior. For instance, smokers are more likely than adolescent non-smokers to believe tobacco use will produce positive social outcomes such as making them appear older, increasing popularity, and making them look 'cool' (Halpern-Felsher, Biehl, Kropp, & Rubinstein, 2004). Thus those who smoke might do so in part because they believe that it increases their social status. In addition, smokers are less likely to maintain smoking abstinence when their implicit attitudes suggest positivity toward the social aspects of smoking (Kahler, Daughters, Leventhal, Gwaltney, & Palfai, 2007). The implicit belief that smoking brings about social benefits seems to be a barrier when one attempts to quit, perhaps because smokers perceive quitting will be associated with a loss of those benefits. Taken as a whole, this research suggests that for some individuals smoking is an important part of how they fit in with their peers and develop a sense of self-esteem. In other words, smoking can be an important part of one's identity.

Working from the framework of identity theory (Hogg, Terry, & White, 1995; Stets & Burke, 2000) and social identity theory (Tajfel & Turner, 1979), researchers have provided additional support for the hypothesis that one's identity plays an important role in smoking cessation. Before smokers show any intention to quit they must first develop 'quitting' identity; that is, smokers must envision a future self that is compatible with smoking cessation before any intention to quit will surface (van den Putte, Yzer, Willemsen, de Bruijn, 2009).

Once a quitting identity is established and intentions to quit smoking emerge, the extent to which smokers' actually identity as a 'smoker' is inversely related to the actual number of times they attempt to quit (van den Putte et al, 2009). In other words, someone who is highly identified as a smoker is likely to be less persistent in their attempts to quit smoking than someone who does not strongly identify as a smoker. Part of the difficulty associated with getting people to stop smoking is that it seems to require a change in the individual's self concept from the self as a 'smoker' to 'quitter' (van den Putte et al, 2009) and perhaps ultimately 'non-smoker' or 'ex-smoker' (Vangeli & West, 2011).

Research on reactance to explicit messages also suggest that one's sense of self identity is important to understanding why, for some individuals, explicit messages have ironic or boomerang effects that actually increase intentions to smoke (Grandpre, Alvaro, Burgoon, Miller, and Hall, 2003). According to reactance theory (Grandpre et al, 2003) some individuals will react negatively to advertisements they perceive to be persuasive (e.g. advertisements designed to convince people not to smoke), because this persuasion is interpreted in part as a *threat to freedom*. Not only will they feel more negative toward the advertisement, they might more strongly adhere to the behavior (e.g. smoking) because it reaffirms the freedom of decision. This finding is compatible with a general underlying assumption of terror management theory as it relates to smoking: when a message (e.g. advertisement, anti-smoking interventions, etc.) is perceived as posing a threat to an aspect of the self (e.g. mortality salience, challenges to freedom, etc.), it will sometimes result in reactance to the message such that more, rather than less, smoking will result. Thus the terror management health model (Goldenberg & Arndt, 2008) and reactance theory (Grandpre et al, 2003) are

independent theories that jointly corroborate the notion that anti-smoking messages might lead to the ironic boosting of smoking behaviors if the message acts as a threat (even inadvertently) to the self-identity of message recipients.

In addition to the importance of mortality threat and identity, the TMHM posits a second important prediction specific to health behaviors: that knowledge of one's own corporealness (physical body) can undermine bodily-oriented health promoting activities (Goldenberg & Ardnt, 2008). Thoughts of our own physicality, as opposed to spirituality or soul, are a reminder that we are merely human and thus present a threat to one's sense of self-meaning. Research suggests that individuals might be less inclined to get invasive, yet beneficial, procedures when reminded of the physicality of the body. For example, attitudes toward both breastfeeding (Cox, Goldenberg, Arndt, and Pyszczynski, 2007) as well as pregnancy (Goldenberg, Cox, Arndt, & Goplen, 2007) have been found to be more negative after a reminder of corporeality. In addition, women were found to perform shorter breast self-examinations when reminded of their own physicality (Goldenberg, Ardnt, Hart, & Routledge, 2008). Reminders of corporeality also make physical aspects of sex, but not the romantic aspects of sex, less appealing (Goldenberg, Cox, Pyszczynski, Greenberg, & Solomon, 2002). In each of these previous studies, reminders of corporeality have been presented as barriers to healthy behaviors. There might be, however, reason to believe that in the case of smoking, reminders of corporeality might promote health behavior rather than act as a barrier to it. Smoking is a cancer-causing behavior that is corporeal in nature— the cigarette is brought to the smoker's mouth and smoke is inhaled to the lungs. In this sense smoking is quite invasive to the body. If indeed reminders of corporeality decrease the odds of engaging in

behaviors that are invasive to the body, it stands to logic that bodily invasive behaviors that are health harming should also be discouraged by reminders of corporeality.

Implications of terror management and identity for smoking intervention design. The terror management health model, paired with studies addressing the social identity value of smoking, provides some guidelines for determining where efforts should be directed in order to reduce smoking behavior of highly smoking-identified smokers. An intervention designed to influence the smoking behavior of highly identified smokers should have at least three components. The intervention should be implicit so that the message is unlikely to be explicitly rejected.

Terror management theory suggests that those who persist in smoking despite knowledge of the risks of smoking do so in part because they either reject the anti-smoking message as bogus, or choose to consciously ignore the risks (Goldenberg & Arndt, 2008). Overall, explicit campaigns that convey of the dangers of tobacco use have been effective in convincing a majority of the population to refrain from smoking, yet explicit campaigns have proved ineffective for many whom continue to smoke (Grandpre et al 2003). Interventions should be tailored to address the specific needs of those who persist in smoking. With this in mind, the second key component to reduce smoking behavior among highly identified smokers is to avoid using heavy handed reminders of death. This second point is to ensure that, as terror management theory would hypothesize, mortality salience does not activate an urge to bolster the 'smoker' identity. Third, the terror management health model suggests that reminders of corporeality of the body should act as a barrier to smoking because reminders of corporeality

tend to decrease behaviors that are invasive to the body. I have argued previously, smoking should be perceived as invasive and thus reminders of corporeality should impede desire to smoke. Thus, an intervention at the implicit level might benefit by making the invasive nature of smoking salient, for instance by emphasizing the damage smoking does to the teeth and gums. These three components can be exploited to develop novel techniques for manipulating attitudes toward smoking, and ultimately reducing smoking behavior. The basic premises of terror management theory and identity theory have provided some guidelines for how to craft the content of an implicit anti-smoking message: that is, stimuli ought to avoid inciting reminders of death and should focus primarily upon the social risks associated with smoking. We will now turn to background research in cognitive metaphor and embodied cognition in order to gain insight as to how one might effectively deliver an implicit anti-smoking message.

Cognitive metaphor

Until fairly recently, metaphor was viewed by the scientific community as a relatively uninteresting aspect of language (Lakoff & Johnson, 1980). Lakoff and Johnson were among the first to recognize that much of our understanding of the world is derived from our understanding of other, more simple, aspects of experience: that is, by metaphor. For example, many cultures have 'orientational' metaphors that attach meaning related to wellbeing and health to spatial relationships, presumably because some health experiences correlate with orientation and spatial experiences (Lakoff & Johnson, 1980). For example, there is a common metaphor in western cultures of 'up' associated with positive health and 'down' with ill health. For instance, those whom are healthy are generally on their feet and active (up), while those whom are ill are generally bedridden and inactive (down). Similarly, people talk about 'feeling

down' when sad and depressed; however, people start to talk about things as 'looking up' or 'lifted spirits' when they eventually feel better. The importance of metaphor for our understanding of personal well-being extends beyond these simple orientational metaphors.

Researchers have argued that metaphors influence meaning by framing meaning in such a way that certain aspects of the world are emphasized while other aspects are deemphasized, so that attention is drawn toward or detracted from specific aspects of the world as intended by the person conveying the message. For example, a wide variety of metaphors are utilized by cancer patients, doctors, and popular media when discussing issues related to cancer. A recent article describes some notable popular metaphors such as 'cancer as war' and 'cancer as a puzzle/riddle', and explores how various metaphors frame meaning of cancer and the treatment of cancer (Camus, 2009). For example, in the case of the metaphor 'cancer as war', the metaphor frames the understanding of cancer as a collective enemy that willfully and maliciously attacks our bodies. In this metaphor, cancer cells are often referred to as invaders to the body, while the human body is described as having its own defenses. It is only given this kind of understanding of cancer that the phrase 'lost her battle with cancer' can have meaning. This cancer as war metaphor is quite different from the metaphor of 'cancer as a riddle', and can lead to vastly different understandings of cancer. While 'cancer as war' emphasizes the struggle that the cancer patient will need to fight in order to 'defeat' cancer; 'cancer as a puzzle' emphasizes a search for the correct 'solution' to the problem posed by cancer. In the case of 'cancer as a puzzle', rather than cancer being an enemy that ought to be defeated, cancer is a problem to be solved. Adopting one metaphor over another emphasizes certain

aspects while masking others, which has the potential to influence what kind of cancer treatment might be sought after by patients or recommended by physicians (Camus, 2009).

Past research has shown that even simple visual metaphors based upon shades of color can influence judgments formed about a stimuli. For example, when participants were presented with a variety of words in an affective decision task the shade of word-primes influenced the affect that was activated: light colored words more likely to prime positive affect than negative affect, and dark words more likely to prime negative affect than positive affect (Meier, Robinson, Clore, 2004). These researchers argued that the shade of the word influenced affect because it taps into a metaphor that exists in many world cultures where light is equated with good and dark is equated with bad (Meier, Robinson, Clore, 2004). This past work provides evidence that even subtle characteristics of the attitude object (e.g. color of the stimulus) can influence judgments about the object. The purpose of the intervention being proposed is to exploit the use of a common cultural metaphor in order to convey an anti-smoking message without the use of explicit language to convey the message.

Embodied cognition

Meier and colleagues (2004) argue that their findings demonstrate that metaphors are not a mere aspect of language, and that cognitive metaphors are 'embodied' within the sensory/motor systems. That is, as Lakoff and Johnson (1980) suggest, our understanding of metaphors are often dependent upon information supplied by the sensory and motor systems. In the case of Meier and colleagues, the visual brightness of the stimuli presented to participants influenced the valence of the attitude that is primed. This falls in line with the

basic premise of research in embodied cognition that views thought as more than just concepts in our head (i.e. semantic knowledge), but also as representations that require integration with 'lower-level' sensory and motor systems to account for a full understanding of a concept. For example, a cognitive metaphor such as 'cancer is war' should induce explicit thoughts and attitudes about war, but also should induce mental imagery that relies upon sensory and motor experiences that are associated in memory with the concepts of war and battle (Camus, 2009). In the view of researchers emphasizing the importance of embodied cognition, a model of cognition that does not take into account the integration of higher and lower level processes fails to fully account for the phenomenon of cognition.

Implicit Smoking Intervention

This dissertation introduces and explores the possibility of developing an implicit intervention that delivers a subtle anti-smoking message by activating an implicit metaphor. Terror management theory would suggest that such a message will be most effective when they emphasize the threat of smoking to social relationships or physical appearance instead of emphasizing the threat of death associated with smoking (Goldenberg & Arndt, 2008). If stimuli are carefully crafted, an intervention might be designed that directly influences implicit smoking attitudes (and ultimately behavior) by framing the smoking behavior as the consumption and decay of social relationships or youthful physical appearance. Few interventions have been designed in attempt to reduce smoking by directly influencing implicit cognitions; there is, however, one notable exception. One intervention utilized a virtual reality (VR) environment in which participants were tasked to navigate the virtual world and either

crush (with virtual hands) cigarettes or neutral stimuli (Girard, Turcotte, Bouchard, and Girard, 2009). Participants who crushed cigarettes in the VR environment showed signs of reduced nicotine addiction as well as higher rates of smoking abstinence compared to participants who crushed the neutral stimuli.

One explanation for this finding provided by Girard and colleagues (2009) is that the act of symbolically crushing cigarettes repeatedly led to a newly conditioned negative response toward smoking. This explanation is rooted in the theory of embodied cognition (for review see: Anderson, 2003) that posits cognition is represented not only in the conscious mind, but also in motor action and behavior. Thus the symbolic motor action of crushing the virtual cigarettes led to both behavior change and change in implicit attitude. Despite the plausibility of this explanation grounded in embodied cognition, Girard and colleagues (2009) did admit the exact mechanism for behavior change in the VR study is unknown. A major goal of the current study is to investigate how the symbolic destruction of an object (for example, crushing of cigarettes in VR environment) can lead to changes in implicit and explicit attitudes. A practical limitation of this VR study is that it is not realistic to expect smokers to consistently attend lab or clinical settings in order to participate in VR interventions. Aim 2 of this study is geared toward crafting an implicit intervention that can be administered outside the laboratory setting. The logic of the intervention designed for this dissertation is analogous to the work of Girard and colleagues (2009) VR paradigm in which symbolically crushing virtual cigarettes leads to reduced smoking behavior.

Research Questions

The purpose of this dissertation is to learn more about the structure of implicit smoking attitudes (aim 1) and to use this information to inform the development an implicit intervention (aim 2). Two research questions have been derived from these study aims, and will serve to guide the design and procedures for the two studies in presented in this dissertation.

RQ 1: Can smoking related implicit attitudes be delineated into subdomains that mirror domains of explicit smoking attitudes (i.e. social attitudes, health attitudes, self-attitudes, etc.)?

To date, much of the literature treats implicit smoking attitudes as a general valence assessment without taking a more nuanced approach that disentangles the influence of various attitude domains on smoking behavior. However, no study has yet looked at social, health, and identity domains of implicit smoking attitudes within in the same study to see if these truly represent unique implicit smoking attitude domains. Factor analyses will be conducted in both study 1 and study 2 in order to assess the structure of implicit smoking associations.

RQ 2: Can primes/prompts/interventions that specifically tap in to subdomains of smoking related implicit attitudes (versus general positive or negative affect) produce changes in implicit and explicit attitudes?

The ultimate goal of this dissertation is to explore a new paradigm of smoking intervention in which smoking attitudes and behaviors are addressed using an implicit intervention that does not rely upon explicit knowledge conveyance. A variety of theories have been discussed in the introduction that helped to guide the creation of this implicit intervention.

The implicit intervention that will be addressed in study 2 operates on the basic premise that metaphors can be powerful conveyers of information if carefully crafted. The intervention will rely upon the implicit metaphor of 'fire as consumption' as a method of message delivery. There is reason to believe that the metaphor will be more impactful if it can be conveyed using visual imagery instead of with the use of written language. Several researchers have found that the use of imagery increases incidental learning (Butter, 1970; Sheehan, 1972). By using imagery as a method of message delivery, it is more likely that the message will be impactful even without willful effort on the part of the participant. Further, processing of imagery is more likely to evoke a sensory experience relevant to the imagery, while written language is more detached from sensory experience (MacInnis & Price, 1987).

The use of graphic imagery as a method to convey the dangers associated with smoking has already been demonstrated to increase the effectiveness of anti-smoking messages. Through the use of semi-structured focus group interviews, participants reported that graphic warning labels bolstered their interest and attention to anti-smoking messages (McCool, Webb, Cameron, & Hoek, 2012). McCool and colleagues suggest that graphic warning labels appear to provide 'shock value' that helps to reinforce text based anti-smoking messages. Results from an additional study utilizing survey data suggest that young adults perceive graphic warning labels to be more effective in raising concern about the health effects of smoking, encouraging one to quit smoking, and to retain smoking abstinence (O'Hegarty, Pederson, Nelson, Mowery, Gable, & Wortley, 2006). Finally, a within-subject experimental design demonstrated that graphic warning labels had greater impact upon the perceived health consequences associated

with smoking and were more discouraging to smoking behavior compared to text only messaging (Cameron, Pepper, & Brewer, 2012).

Given these findings in support of the effectiveness of invoking visual imagery to convey anti-smoking messages, the fire as consumption metaphor will be more vivid and impactful if conveyed visually rather than verbally. Given that many of the stimuli in this intervention were selected to tap into aspects of health and physical appearance, sensory experience of the decay of health and physical appearance might be particularly impactful for smokers. Positive images representing social relationships, as well as images of youthful healthy skin and teeth, will be presented to participants in a computerized task one at a time. Participants will be presented with a mouse cursor that takes on the image of cigarette. Participants will be instructed to click on the image and observe the resulting animation of the image burning away in a fire.

This study will seek evidence for the effectiveness of such a technique to curb smoking behavior in the short-term. Some researchers have abandoned hope for curbing the smoking behavior of recalcitrant smokers, and suggested instead that efforts should be dedicated to stop younger individuals from initiating smoking to begin with. Ultimately, this novel approach to smoking intervention is an attempt to pave the way for new insights as to how we might help heavy smokers to quit and reverse years of damage to their hearts and lungs.

Methods Study 1

Participants

Recruitment. Participant responses were gathered online via Mechanical Turk (Mturk) during the Fall semester of 2013. Mturk is a crowd sourcing website in which tasks can be posted for Mturk users to complete and receive pay for their work. This website is increasingly being used by social science researchers to post studies that can be completed by Mturk users for compensation. Anyone 18 years of age or older who have a computer with internet connection are eligible to complete work as an Mturk user.

Using Mturk for data collection holds a number of advantages over data collection in the lab setting. First, it has a wider age range and is at least as ethnically diverse as the university undergraduate population (Buhrmester, Kwang, & Gosling, 2011). Second, Mturk allows for data to be collected across the United States in the privacy of the users own homes—there is no need bring participants into the lab. Finally, a benefit of Mturk over the undergraduate population at UC Merced is that smokers are more readily accessible in the Mturk population. The undergraduate population at UC Merced lacks a sufficient number of smokers, making research in smoking behavior at UC Merced a serious challenge. Data collection via Mturk allows access to a population that is better representative of smoking behavior within the United States.

The study was posted to Mturk under the project name 'Research study on attitudes toward smoking and cigarette use'. The study was described as *"…an academic survey about attitudes toward cigarettes and tobacco smoke. You will also participate in four categorization*

tasks. Select the link below to complete the survey. At the end of the survey, you will receive a code to paste into the box below to receive credit for taking our survey. The task should take approximately 40 minutes; however, you are allotted 2 hours to complete the task."
Participants were informed that they will be compensated 50 cents for their participation in the study—this level of compensation is standard for Mturk tasks that require approximately the same amount of time.

Demographics. The age of participants ranged from 18-73; the average age in the sample is 34.93. Our sample included 225 females and 204 males. The majority of participants in this sample self-identified as White (77%). In addition, 7% identified as African-American, 8% identified as Asian, 3% identified as Hispanic or Latino, and 3% identified as 'other'. Given the low percentage of African-Americans, Asians, Hispanic/Latino, and other ethnicities in this sample, these social categories were collapsed so that they could be compared to White participants.

Measures

Implicit associations. The Implicit association test (Greenwald & Banaji, 1995) is a timed categorization task in which participants must place words and/ or pictures that appear at the center of a computer screen into their appropriate categories using a keyboard press of either the left ('e' key) or right ('i' key). For instance, in a standard IAT participants might be instructed to sort images of flowers to the category on the left with an 'e' key press and images of insects to the category on the right with an 'i' key press. Once familiar with categorizing insects and flowers in this way, a new categorization task is introduced: participants must also

sort any words of positive valance to the left and words of negative valance on the right. After practice trials sorting words of positive and negative valance, the tasks are combined so that participants must now sort any positive words or flower images to the left, and sort and negative words or insect images to the right. This initial combined categorization task is the first critical block of the IAT.

Upon completion of the first critical block, the insect and flower categories switch sides so that participants must now sort positive words and insects on the left, while sorting negative words or flowers on the right. This portion of the task with the insect and flower categories flipped represents the second and final critical block. The two critical blocks are then compared by researchers to determine which categorization combination was easier for participants to complete. For instance, participants generally find it easy to categorize flowers with positive words like 'sweet' and 'kind' and to categorize insects along with negative words like 'gross' and 'creepy', while it is relatively harder to categorize flowers with negative words and insects with positive ones (Greenwald, McGhee, & Schwartz, 1998). The logic of the IAT lies in that if it is easier to categorize some categories with others (i.e. flowers with positivity and insects with negativity), than these concepts are likely to be more closely linked in a network of semantic associations.

The standard IAT was modified to capture implicit attitudes related to smoking in each of the domains of interest including health, social, self/other, and general valence. The attributes used to represent each of these categories are reported in appendix A. Smoking stimuli include images of cigarettes, lighters, and ash trays (see appendix B for smoking images).

Smoking stimuli were selected from Google images using search terms ‘smoking’ and ‘cigarettes’. Shapes were used as a neutral contrast category (see appendix C for neutral images). Neutral stimuli were selected from Google images using the search terms ‘shapes’ and ‘geometric shapes’.

Explicit Smoking Attitudes

We assessed explicit attitudes toward smoking using 12 semantic differential scale items that were modified to address a range of relevant attitudes directed toward smoking and cigarette use (Bradley & Lang, 1994). Responses to the semantic differential occurred on a 7-point bipolar scale that assessed the extent to which smoking is associated with various adjectives of interest. For instance, two items tapped into social related attitudes by asking whether smoking is ‘cool’ versus ‘uncool’ and ‘popular’ versus ‘unpopular’. See Appendix D for a complete listing of semantic differential ratings and anchors for each scale; reliability analysis of these items yielded an alpha of .867.

Table 1

Category/ attributes	Stimuli
Good	Excellent, Good, Great, Pleasant
Bad	Awful, Bad, Dreadful, Horrible
Healthy	Fitness, Fresh, Health, Healthy
Unhealthy	Cough, Disease, Illness, Unhealthy
Social	Cool, Friendly, Popular, Social
Unsocial	Loner, Rejected, Unpopular, Unsocial
Self	Me, Mine, Self, Us
Other	Other, Their, Them, They
Smoking	Four images depicting cigarettes, lighters, and ash trays*
Shapes	Four images depicting geometric shapes*

* See appendices B & C for images used in the IAT

Additional outcomes

Risk assessment. Perceived risk and consequences associated with smoking were assessed using a modified version of a measure by Halpern-Felsher, Biehl, Kropp, & Rubinstein (2004). The measure has previously been found to tap into the perception of health and social related risks associated with smoking (Halpern-Felschner et al, 2004) and has been adapted to investigate the attitudes toward the dangers of second hand smoke (Song, Glantz, & Halpern-Felshner, 2009). While this measure was originally designed to measure adolescents' perceptions of risks associated with smoking, this measure has been adapted for use with adults in the current study (see appendix E). These 20 items were subjected to a reliability analysis yielding an alpha of .928.

More detail was gathered about perceived risks associated with smoking by asking participants the extent to which they believe they will encounter various consequences associated with smoking a pack of cigarettes a week. Participants were posed with the scenario: 'Imagine that you smoke, on average, a pack a week. What is the chance (0%-100%)…'. Participants were then presented with 18 potential consequences associated with smoking. For example, participants were asked about the likelihood of getting lung cancer, becoming addicted, and losing weight. See appendix F for the measure in its entirety; reliability analysis for these 18 items yielded an alpha of .894.

An additional measure of perceived smoking risks was obtained using a single-item measure designed to assess general perceptions of the risks versus benefits associated with smoking. Participants were asked to: 'Think about the potential risks and benefits associated

with smoking cigarettes. Weigh the benefits against the risks. On the scale below, where do your overall feelings about smoking fall. Please provide the number where your judgment falls _____.' Participants were provided with a 21-point scale with anchors starting at 'Sure risk' (-10) and ending at 'Sure benefit' (+10). On this item a high score indicates that the participant believes that smoking brings about more benefits than risks, and low scores indicate smoking brings about more risks than benefits.

Graphic warning label rating task. Past research has demonstrated that 8 of the 9 graphic warning labels selected by the FDA were effective at inducing fear and reducing intentions to smoking (Cameron, Pepper, and Brewer, in press). While Cameron and colleagues presented 18 graphic labels to participants, we presented to participants the nine graphic warning labels previously approved for use by the FDA. The same questions used in this past work will be utilized in the current study including: the understandability, confusion caused by the image, worry, fear, and discouragement from smoking. Please see appendix G for images and items used on the graphic warning label task. A reliability analysis was conducted for the five ratings for each of the nine graphic warning images yielding an alpha of .937.

Smoking behavior questionnaire. In order to measure smoking behavior among our sample of our participants, participants were asked a set of questions commonly used by large, epidemiological surveys deployed by the Centers for Disease Control (e.g. Schoenborn, Vickerie, Barnes, 2003) designed to assess smoking history and current smoking status of participants. Participants were asked if they have smoked 100 cigarettes in a lifetime. If participants indicated that they have smoked 100 or more cigarettes in their lifetime, additional questions about their smoking behavior and history were asked including: when they initiated smoking, if

they quit or have attempted to quit, number of cigarettes smoked in the past month, and current number of cigarettes smoked per day. See appendix H for a complete listing of smoking behavior items.

Demographics. Participants were asked to provide some basic demographic information including: gender, age, ethnicity, and country of residence. Participation in this study was limited to those living within the United States, thus information about country of residence was collected in effort to identify anyone who gained access to this survey who lives outside the United States.

Procedures.

Instructions, consent forms, and explicit measures were presented to participants using Survey Monkey (surveymonkey.com). Survey Monkey is an online service that allows researchers or business to collect data online using survey creation software provided by the website. Survey Monkey provides more features and flexibility compared survey software provided by Mturk. For instance, Survey Monkey provides randomization of the order of items within a page to help eliminate order effects that might confound responses to survey items. Survey Monkey also allows for skip logic, so that portions of the task can be skipped given specific conditions; for example, those participants who reported smoking fewer than 100 cigarettes in their lifetime were allowed to skip items concerning specific smoking history (e.g. quit attempts, cigarettes smoked per day, etc.).

The four implicit association tests (IATs) were programmed in Adobe Flash so that implicit data could be collected online, eliminating the need to bring participants into the lab. Survey Monkey allows for Flash and other media files to be displayed within surveys, but does not allow for the ability to directly upload files to their servers and host these files. Thus, the implicit measures were uploaded to Bluehost and embedded within Survey Monkey. Likewise, Survey Monkey does not have any means to collect or store reaction time data from the implicit measures. Data from implicit measures were collected and stored on password protected Bluehost servers. The IATs were embedded within Survey Monkey along with the explicit measures so that participants experienced a streamlined experience without the need to follow multiple web links.

This study was advertised on Amazon's Mechanical Turk as '*Attitudes toward smoking*'. In the study description participants were told that if they decided to participate: '*You will be asked questions concerning your attitudes toward smoking and complete several interactive computerized tasks. The study is expected to take approximately 40 minutes of your time.*' Mturk users who decided to volunteer were provided with a link to Survey Monkey. Clicking on the link provided sent participants to the first page of Survey Monkey containing consent materials. Participants provided their consent to participate by clicking '*Yes - I have decided to participate in this study as a research subject. I have read and understand the information above. I may print out a copy of this consent form.*' Participants that declined participation were directed to a screen thanking them for their interest in the study.

The order of presentation of implicit and explicit measures were counterbalanced so that roughly half of participants received the four implicit measures (presented in random order) followed by the explicit attitude measures, while the other half received each of the explicit attitude measures followed the four implicit attitudes. Upon completion of the implicit and explicit measures, participants responded to the graphic warning label ratings task, followed by demographic questions, and finally the smoking behavior questionnaire. Each measure and implicit task was presented on its own dedicated survey monkey page. After each measure or task was completed, participants advanced to the next screen by clicking the '*Next*' button at the bottom of the screen. Participants were not allowed to return to a previous screen once they advanced to the next Survey Monkey page.

Upon completion of smoking behavior questionnaire, participants were directed to a debriefing page where they were thanked for their participation and given instructions to obtain their payment via Mturk. Participants were provided with a participant code '*No smoking1'* during debriefing in order to confirm that the participant saw the study through to the end. Payment was released to participants within 8 hours of completion of the study.

Analysis

RQ 1: Can smoking related implicit attitudes be delineated into subdomains that mirror domains of explicit smoking attitudes (i.e. social attitudes, health attitudes, self-attitudes, etc.)?

The purpose of aim 1 is to determine if implicit associations related to smoking share a structure similar to that of explicit attitudes. In order to address the structure of implicit attitudes, an exploratory factor analysis was conducted on the four versions of the IAT along

with the 12 semantic differential items measuring explicit attitudes toward smoking. An additional factor analysis was conducted on the four IATs alone. The 12 explicit smoking attitude items (i.e. semantic differential scores) and 4 implicit measures (i.e. implicit association test) were all entered into an exploratory factor analysis using principle components extraction and Promax rotation.

RQ 2: Can primes/prompts/interventions that specifically tap in to subdomains of smoking related implicit attitudes (versus general positive or negative affect) produce changes in implicit and explicit attitudes?

The ultimate goal of aim 2 is to identify which smoking attitude domains ought to be targeted when trying to initiate changes in implicit associations. If any particular smoking attitude domain emerges as an especially strong predictor of smoking behavior, risk estimates, or graphic warning label ratings, this domain ought to be targeted in any future attempts at smoking intervention. To this end, regression analysis will be used to determine the extent to which explicit attitudes (as measured by semantic differential scales) and implicit associations (as measured by IATs) predict smoking behavior. In addition, structural equation modeling (utilizing Mplus) will be used as a more in-depth exploration of the joint influence of implicit associations and explicit attitudes in prediction of smoking behavior. All analyses, with the exception of structural equation modeling, were conducted using Statistical Package for the Social Sciences (SPSS).

Results study 1

Sample characteristics

Descriptive statistics for the sample are reported below in table 2.

Table 2

Sample characteristics

Variable	N	%
Gender		
Male	204	48
Female	225	52
Age		
18-25	107	25
26-35	169	39
36-45	58	14
46-55	49	11
56 +	46	11
Ethnicity		
African-American	31	7
Asian	35	8
Hispanic/ Latino	18	4
White	332	77
Other	14	4
Smoked 100 cigarettes in lifetime?		
Yes	206	48
No	226	52
Smoking status (among those who reported smoking 100 cigarettes in their lifetime)		
Former smoker	96	47
Daily smoker	68	33
Non-daily smoker	41	20

RQ 1: Can smoking related implicit attitudes be delineated into subdomains that mirror domains of explicit smoking attitudes (i.e. social attitudes, health attitudes, self-attitudes, etc.)?

Factor analyses

The factor analysis suggested a three-factor solution to smoking attitudes. These three factors together account for 58% of the total variance explained; individually, factor 1 explained 38% of the variance, factor 2 explained 10% of the variance, and factor 3 explained an additional 10% of the variance. The first factor included perceptions of the extent to which smoking is: sexy, pleasant, sociable, glamorous, calming, relevant to the self, & important. This factor is characterized by items pertaining to some of the specific consequences associated with smoking. A second factor included items pertaining to the extent to which smoking is viewed as: good, positive, healthy, harmful, and pertaining to life/death. This factor appears to be dominated by more general attitudes associated with smoking. Finally, the third factor included each of the four implicit measures. Each of the four implicit measures, despite being crafted to tap different implicit attitude domains, all clustered together. This factor structure suggests that explicit attitudes can clearly be broken into two domains (which are referred to here as general attitudes and specific consequences), while implicit attitudes appear to be best represented by a single factor. The three-factor solution reported here has a high degree of theoretical coherence (see discussion section) and is supported by evidence that our three factor solution satisfies the criterion of including only those factors with an associated eigen-value of 1 or greater. See table 3 below for factor loadings and communalities.

Table 3

Loadings and communalities based upon a principle component factor analysis using Promax rotation

Item	Specific risks	General attitudes	Implicit attitudes	Communalities
SD- Good/Bad	.564	**.903**		.820
SD- Negative/Positive	.571	**.895**		.810
SD- Unhealthy/Healthy		**.861**		.765
SD- Life/Death		**.601**		.366
SD- Unsexy/Sexy	**.829**	.517		.692
SD- Unpleasant/ Pleasant	**.819**	.647		.723
SD- Harmless/Harmful		**.815**		.684
SD- Unsociable/Sociable	**.690**			.491
SD- Ugly/ Glamorous	**.819**	.567		.687
SD- Calming/ Stressful	**.698**			.523
SD- Unlike you/ Like you	**.759**	.457		.587
SD- Unimportant/ Important	**.507**			.346
IAT- Good/Bad			**.719**	.540
IAT- Social/Unsocial			**.645**	.424
IAT- Healthy/Unhealthy			**.688**	.488
IAT- Self/other			**.606**	.376

Note: Only factor loadings above .45 were included in this table. Loadings on each factor are emboldened.

RQ 2: Can primes/prompts/interventions that specifically tap in to subdomains of smoking related implicit attitudes (versus general positive or negative affect) produce changes in implicit and explicit attitudes?

Relationship between Factors

During factor analysis procedures, a factor score was derived for each of the three factors. Promax (an oblique rotation method) was utilized so that factors were allowed to correlate with one-another. General attitudes and perceptions of risks were significantly correlated at .56 ($p<.05$). Perceptions of risks and implicit associations were significantly correlated at .31 ($p<.05$). The general attitudes were significantly correlated with implicit associations at .29 ($p<.05$). Correlations between factor scores, the four IATs, and perceived risks/ benefits are displayed in table 4 below. In addition, correlations between the implicit factor and individual items of the explicit semantic differential scale (items that comprise general attitudes and perceptions of risks) are reported in appendix I.

Relationship between factors and additional outcome measures

To further explore implicit associations and explicit smoking attitudes (i.e. perceived consequences and specific risks), correlations between these factors and additional outcome measures of interest were assessed. Patterns of correlations between the three factors of interest and the measure adopted from Halpern-Felshner and colleagues (2004) indicate that the two explicit factors (perceived consequences and general attitudes) are consistent predictors of risk assessment in various scenarios (see appendix E for scenarios and items). Implicit associations were inconsistently related to risk assessment as measured by this questionnaire; however, implicit associations indicate a pattern of predicting the likelihood of

having trouble breathing and developing asthma. See appendix J for correlations between each of the three factors and items of the adapted Halpern-Felshner scale.

Each of the three factors were consistent predictors of the 18-item risk assessment questionnaire (see appendix F for the measure in its entirety). Correlations between the three factors and risk assessment questionnaire can be found in appendix K. In addition, the three factor scores were correlated with the single-item measure of perceived risks versus benefits associated with smoking. The single-item risk/benefit measure correlated with perceived consequences at .59 ($p < .05$), with general attitudes at .68 ($p<.05$), and with implicit associations at .27 ($p < .05$).

Finally, correlations between the three factors of interest and items assessing the graphic warning labels were addressed. Perceived consequences and general attitudes were consistently correlated with nearly all the items addressing each graphic warning label. Implicit associations were not a consistent a predictor of responses to the warning labels, with the exception of one item—as implicit associations became more negative, each of the graphic warning labels became increasingly more effective in discouraging one from smoking. See appendix L for correlations between the three factors and the graphic warning label task.

Regression analyses of smoking behavior outcome

Factor scores derived from the above factor analysis were entered into regression analyses to determine the extent to which our primary predictor variables (implicit associations, general smoking attitudes, perceptions of specific consequences) are related to smoking behavior.

A logistic regression analysis was performed in order to assess the likelihood of smoking status statistically predicted by general attitudes, specific consequences, and implicit smoking attitudes. Logistic regression was necessary to address this binary outcome measure (i.e. current smoker or non-smoker). The overall model was significant, [-2 Log likelihood = 190.403, $p<.05$ N=275]. Both specific consequences (B=1.52, $p<.001$) and the implicit associations (B=.535, $p<.01$) each explained unique variation in smoking status. General smoking attitudes were not a significant predictor of smoking status.

Table 4 **Study 1 correlations**

	Perceived consequences	General attitude	Implicit factor	IAT-Good/Bad	IAT-Health	IAT-Self/other	IAT-Social	Cigarettes per day
Perceived consequences	1	.564**	.307**	.316**	.206**	.215**	.120*	.009
General attitude	.564**	1	.292**	.165**	.298**	.265**	.118	.154
Implicit factor	.307**	.292**	1	.719**	.688**	.606**	.645**	.391*
IAT- Good/Bad	.316**	.165**	.719**	1	.305**	.221**	.307**	.263
IAT- Health	.206**	.298**	.688**	.305**	1	.252**	.296**	.315*
IAT- Self/other	.215**	.265**	.606**	.221**	.252**	1	.178**	.262
IAT- Social	.120*	.118	.645**	.307**	.296**	.178**	1	.021
Cigarettes smoked per day	.009	.154	.391*	.263	.315*	.262	.021	1

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

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

As an additional measure of smoking behavior, the average number of cigarettes smoked per day was regressed on the three factor scores; this analysis was limited to individuals who indicated that they were a current smoker. The overall model was not significant, ($p=.073$); however, a closer look at the non-significant model shows that the implicit factor ($B=.376$, $p<.01$) alone was a significant predictor of the average number of cigarettes smoked per day.

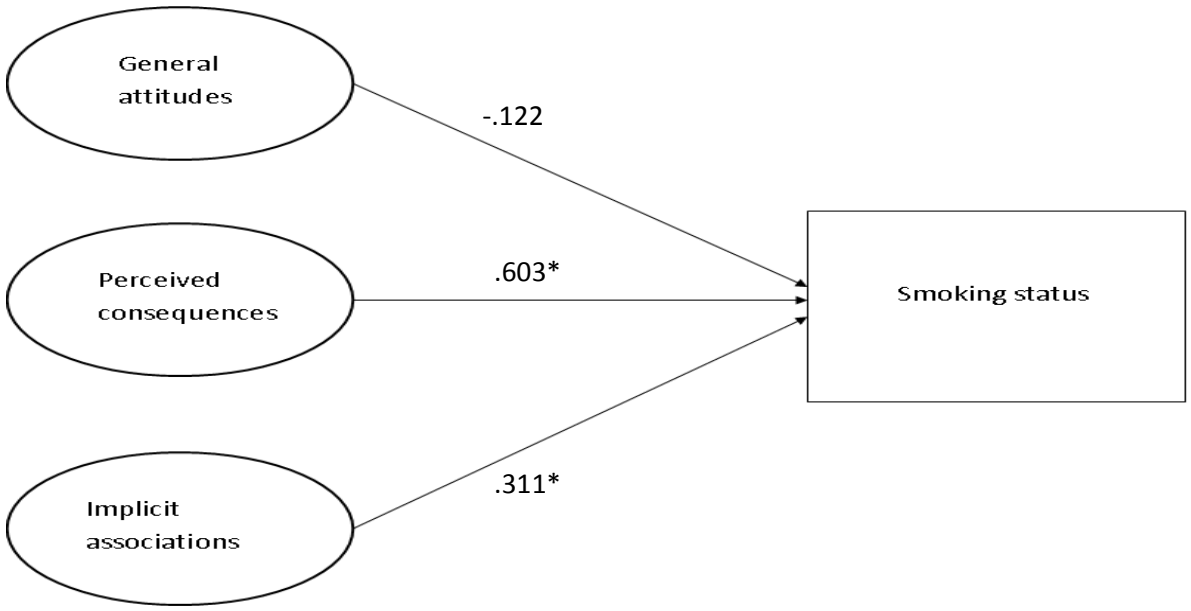
Structural Equation Modeling

Researchers have discussed a variety of ways in which implicit associations and explicit attitudes jointly influence behavior (Evans, 2008; Perugini, 2005). The relationship between implicit and explicit processes in prediction of behavior differs by the specific behavior being addressed (Peruguini, 2005). Thus, three variants on predictive models of smoking behavior (i.e. smoking status) were considered, each utilizing implicit associations, general attitudes, and specific consequences as predictors. Age and ethnicity served as covariates in each model. Theoretical rationale and statistical fit for each model configuration is discussed here. Smoking status was the only behavioral outcome assessed via structural equation modeling. The other behavioral outcome measure (i.e. cigarettes smoked per day) was limited to current smokers, and thus had an insufficient number of responses in order to be addressed via SEM.

Model 1: Implicit and explicit factors direct effects only. Model 1 pits implicit associations, perceptions of specific risks, and general attitudes toward smoking as direct predictors of smoking behavior (see figure 1 below). Model 1 is an additive model of smoking

behavior in which explicit attitudes (represented by specific risks and general attitudes) and implicit associations each predict unique variation in smoking behavior (Perugini, 2005). This model is a pure parallel process in which explicit and implicit cognitive systems are independent of one another in their prediction of behavior (Evans, 2008).

Figure 1



* indicates significant standardized estimates for each pathway

Fit Model 1:

The hypothesized model achieved adequate fit when analyzed using structural equation modeling. The CFI for the model is .908, while the TLI is .893. The root mean square error of approximation (RMSEA) estimate was .049, with 90% confidence interval ranging between .041 and .057.

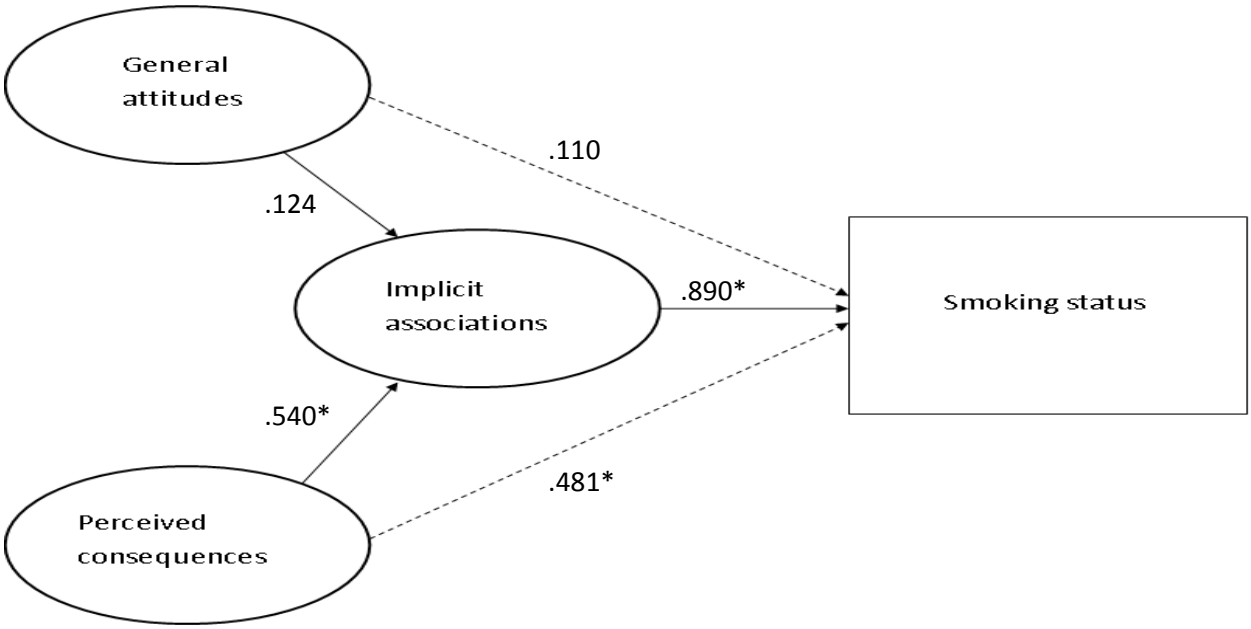
Direct effects:

Smoking behavior was significantly predicted by risk / benefit perception (standardized estimate = .603). Smoking behavior was also significantly predicted by the implicit association factor (standardized estimate = .311). The direct effect between global smoking attitudes and smoking behavior was non-significant.

Covariates age and ethnicity were also controlled for in the model, both of which were non-significant.

Model 2: Implicit associations directly related to outcome/ Explicit attitudes indirectly related to smoking behavior outcome. Model 2 pits implicit associations as a direct predictor of smoking status, while general attitudes and perceptions of consequences are indirectly related to smoking status via implicit associations (see figure 2 below). Model 2 best fits theoretical models of implicit attitude change that suggest implicit attitudes can be developed or changed by explicit effort on the part of the individual. Support for this model would suggest that implicit associations are essentially well entrenched explicit attitudes.

Figure 2



* indicates significant standardized estimates for each pathway

Fit model 2:

The hypothesized model did not achieve adequate fit when analyzed using structural equation modeling. The CFI for the model is .885, while the TLI is .868. The root mean square error of approximation (RMSEA) estimate was .055, with 90% confidence interval ranging between .047 and .062.

Direct effects:

Implicit associations were a significant predictor of the smoking behavior outcome measure (standardized estimate= .890).

Implicit associations were significantly predicted by risk perceptions (standardized estimate = .540). The direct effect between global smoking attitudes and implicit associations was non-significant.

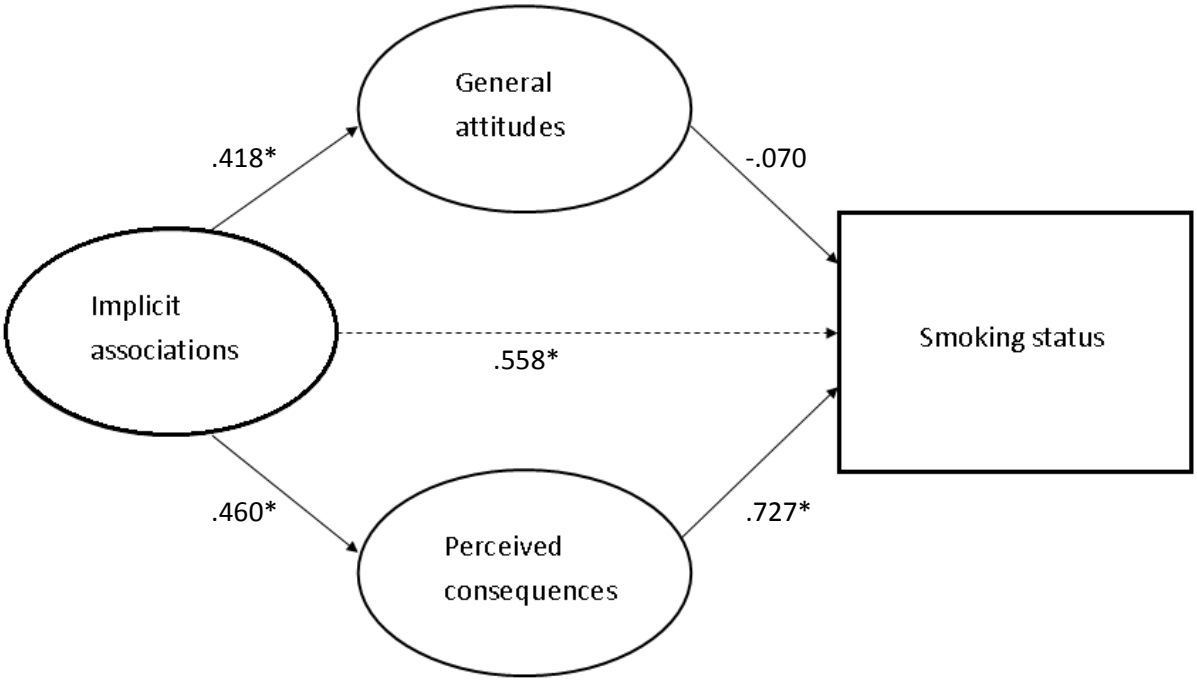
Covariates age and ethnicity were also controlled for in the model, both of which were non-significant.

Indirect effects:

Both of the explicit factors (global attitudes and specific risks/benefits) were tested for their indirect effects via implicit associations. The indirect effect between specific risks and smoking behavior was significant (total indirect= .481; $p<.05$). The indirect effect between global smoking attitudes and smoking behavior was non-significant ($p=.075$).

Model 3: Implicit attitudes indirectly related to smoking behavior outcome/ explicit associations directly related to outcome. Model 3 pits general attitudes and perceived consequences as direct predictors of smoking status, while implicit attitudes predict behavior indirectly via general attitudes and perceived consequences (see figure 5 below). Model 3 was motivated by Evans' (2008) description of the dual-processing accounts of cognition in which implicit processes contextualize and shape the expression of explicit attitudes in the immediate situation. In the case of smoking, when smokers come into contact with smoking stimuli in a given situation (or feel the urge to smoke due to nicotine addiction), a set of pre-established implicit associations are automatically activated that will have an influence upon explicit reasoning and beliefs, which in turn ultimately has influence upon explicit behavioral decisions.

Figure 3



* indicates significant standardized estimates for each pathway

Fit model 3:

The hypothesized model achieved adequate fit when analyzed using structural equation modeling. The CFI for the model is .902, while the TLI is .887. The root mean square error of approximation (RMSEA) estimate was .051, with 90% confidence interval ranging between .043 and .058. The weighted root mean square residual value was 1.051.

Direct effects:

Smoking behavior was significantly predicted by risk perception (standardized estimate = .727). The direct effect between global smoking attitudes and smoking behavior was non-significant.

Global smoking attitudes and perceptions of risks both significantly predicted the implicit factor (.418 and .460 standardized estimates respectively).

Covariates age and ethnicity were also controlled for in the model, both of which were non-significant.

Indirect effects:

The indirect effect of implicit associations on smoking behavior via the two explicit factors (global attitudes and specific risks) was tested here. The indirect effect of implicit associations through risk perceptions was significant (total indirect= .305; $p<.05$). The indirect effect between global smoking attitudes and smoking behavior was non-significant ($p=.257$).

SEM model comparison

Model 2 was eliminated from further analysis due to inadequate model fit based upon rule of thumb criteria. Fit indices for both model 1 and model 3 indicated adequate model fit. A significant indirect effect of implicit associations via perceptions of specific risks was identified in model 3, and thus is the target of focused attention in the discussion section (see appendix M for the detailed model).

Table 5:

	RMSEA	CFI	TLI	WRMR
Model 1	0.049	0.908	0.893	1.026
Model 2	0.055	0.885	0.868	1.116
Model 3	0.051	0.902	0.887	1.051

Note: RMSEA= Root mean square error approximation. CFI= Confirmatory fit index. TLI= Tucker-Lewis index. WRMR= Weighted root mean square error.

Discussion Study 1

RQ 1: Can smoking related implicit attitudes be delineated into subdomains that mirror domains of explicit smoking attitudes (i.e. social attitudes, health attitudes, self-attitudes, etc.)?

An exploratory factor analysis of the 12 explicit smoking attitude items and four IATs revealed a three factor solution—one factor representing general attitudes toward smoking, one factor representing perceptions of specific consequences associated with smoking, and an implicit factor comprised of all four IATs. This analysis fails to support a structure in which implicit attitudes mirror explicit attitude domains. Instead, implicit associations appear to represent a single factor, while explicit attitude measures loaded onto two unique factors: one representing the general attitudes toward smoking (e.g. is smoking good or bad, positive or negative, etc.), and one representing perceptions of specific consequences associated with smoking (e.g. is smoking cool, sexy, calming, etc.). In addition, all four IATs were entered into a second exploratory factor analysis revealing a single-factor solution. This finding provides

additional evidence that implicit attitudes are best represented as a single construct instead of multiple domains. Despite that each IAT was designed to tap into distinct implicit domains (i.e. general valance, health, social, and identity), results from two factor analyses suggest that all four IATs belong to the same factor— Thus, the four implicit association tests used here appear to be tapping in to a single underlying network of associations.

The conclusion that implicit smoking associations are best represented as a single factor is further supported by a consistent pattern of correlations observed among the implicit measures and other measures obtained in this study. First, each implicit measure is positively correlated with each other implicit measure. Second, there is a consistent pattern in the correlations between the four implicit measures and other measures of interest. While these two findings are not sufficient in themselves to draw conclusions concerning the structure of implicit attitudes, the correlations are consistent with the notion that these measures belong to the same construct.

The overall pattern of results failed to provide support for the hypothesis that implicit associations with smoking can be neatly delineated into distinct domains. This conclusion is buttressed by two exploratory factor analyses indicating each IAT measure belongs to a common factor, and additionally supported by a consistent pattern of correlations among the four IAT measures. Instead, these results suggest that the four IATs were tapping into the same set of semantic associations. This conclusion has implications for the second research question concerning whether or not distinct implicit domains can be tapped for the purpose of changing both implicit and explicit attitudes. The answer appears to be negative: because implicit

associations do not appear to be separable into distinct domains, implicit associations should instead be treated as a single construct to be targeted for the purpose of behavior change.

RQ 2: Can primes/prompts/interventions that specifically tap in to subdomains of smoking related implicit attitudes (versus general positive or negative affect) produce changes in implicit and explicit attitudes?

The implicit factor was significantly correlated with cigarettes smoked per day among current smokers. Neither general smoking attitudes, nor perceived consequences associated with smoking, were significantly correlated with cigarettes smoked per day among current smokers. A regression analysis predicting number of cigarettes smoked per day among current smokers—with implicit associations, general attitudes, and perceived consequences as predictors— suggest that implicit associations alone were a significant predictor of smoking behavior.

As an additional measure of smoking behavior, logistic regression was used to predict smoking status (i.e. smoker or non-smoker), with implicit associations, general attitudes, and perceived risks again serving as predictor variables. Results suggest that implicit attitudes and perceptions of specific risks (but not general attitudes) predicted unique variance in smoking status.

To more fully address the predictive value of implicit attitudes, general attitudes, and perceived consequences on smoking status, these three factors were entered into structural equation analysis. Structural equation modeling was performed in order to better assess the relationship between implicit attitudes, general attitudes, and perceptions of specific risks in

prediction of smoking status. Three SEM variants were compared for model fit to the data. Model 1 pit general attitudes, specific risks, and implicit attitudes as direct predictors of smoking status. Model 2 pit implicit associations as a direct predictor of smoking status, while general attitudes and specific risks were indirectly related to smoking status via implicit associations. Model 3 pit general attitudes and specific risks as direct predictors of smoking status, while implicit attitudes were indirectly related to smoking status via general attitudes and specific risks.

SEM model 2 was immediately ruled out due to inadequate model fit. Model 1 and model 3 had comparable model fit, thus were compared for theoretical coherence. The two remaining models considered represent two common dual-processing models described by Evans (2008). Model 1 represents a pure parallel process, in which implicit associations are presented on equal footing with the two explicit attitude measures (i.e. general attitudes and specific risks). Model 1 is an additive model (Peruigini, 2005), in which implicit associations and explicit attitudes (here represented by general attitudes and specific risks) predict unique variance in smoking behavior. Model 3 best represents a different kind of dual processing model in which implicit associations provide a context in which general attitudes and perceptions of specific risks are expressed. The presence of significant indirect effects of implicit associations via general attitudes and specific risks indicates that a simple parallel process (i.e. SEM model 1), in which implicit associations and explicit attitudes independently predict unique variance in smoking status, is insufficient to capture the complexity of the predictive relationship.

Implications of Study 1 for Design of an Implicit Intervention

Taken together, the results discussed here suggest that 1) implicit associations related to smoking are best described as a single construct to be targeted in intervention and 2) that implicit associations are indeed a significant predictor of smoking behavior. These findings suggest that any future interventions need not specifically target any particular implicit attitude domain (e.g. health, social, self, etc.) in order to impact implicit associations. However, it should be noted that so far the findings that speak to research question 2 (i.e. can implicit associations be targeted for the purpose of attitude change?) are correlational. Correlation, regression, and SEM analyses presented here suggest that implicit associations are indeed predictive of smoking behavior, yet a causal relationship has yet to be established. The purpose of study 2 is to experimentally manipulate implicit associations and explicit attitudes using an implicit intervention.

Implications for Study 2

Results from study 1 provide some clues as to how one ought to design and implement an implicit intervention. First, implicit associations were identified as an important predictor of smoking behavior and self-reported explicit smoking attitudes. This makes the prospect of an intervention that disrupts positive implicit associations for the purpose of reduction in explicit attitude change and smoking behavior a plausible scenario. Second, factor analyses indicate that implicit associations ought to be treated as part of a single cohesive system, instead of an assortment of distinct domains. Thus, an intervention designed with the intention of directly targeting implicit associations would likely be best served by addressing a broad range of

stimuli, instead of directly targeting any particular smoking domains (e.g. health, social, self, etc.). An important aspect of the original version of RQ 2 concerned whether or not specific subdomains of implicit associations could be directly targeted to enact attitude change. Given that the answer appears to be negative—directly targeting specific domains is unnecessary—RQ 2 has been altered to account for this conclusion:

RQ 2: *Can primes/prompts/interventions that tap in to smoking related implicit associations produce changes in implicit and explicit attitudes?*

Methods Study 2

Participants

Recruitment. Participant responses were again gathered online via Mechanical Turk (Mturk) during the Winter and of 2013 through the Spring of 2014. Mturk users who are 18 years of age or older and have to a computer with internet connection are eligible to complete the study.

The study was posted to Mturk under the project name 'Research study on attitudes toward smoking and cigarette use'. The study was described as "…an academic survey about attitudes toward cigarettes and tobacco smoke. You will also participate in two categorization tasks. Select the link below to complete the survey. At the end of the survey, you will receive a code to paste into the box below to receive credit for taking our survey. The task should take approximately 40 minutes; however, you are alloted 2 hours to complete the task." Participants were instructed that they will be compensated 50 cents for their participation in the study.

Demographics. The age of participants ranged from 18-71; the average age in the sample is 33.44. Our sample included 548 females and 406 males. The majority of participants in this sample self-identified as White (83%). In addition, 6% identified as African-American, 6% identified as Asian, 4% identified as Hispanic or Latino, and 1% identified as 'other'. Given the low percentage of African-Americans, Asians, Hispanic/Latino, and other ethnicities in this sample, these social categories were collapsed so that they could be compared to White participants.

Materials and Measures

Experimental Manipulation. An interactive computerized task was programmed using Adobe Flash for the purpose of the implicit intervention. Two separate conditions were created, each with a different set of 30 images. In the experimental condition, participants were presented with 30 positive images such as smiling families, friends, and healthy looking skin (see appendix N for experimental stimuli). As a control condition, a separate set of participants were presented with 30 images of various shapes such as squares, circles, and various 3 dimensional objects (see appendix O for control stimuli). Some participants were assigned to a third condition in which participants did not participate in the burning image task—this third condition acted as an additional control. See appendix P for an illustration of the fire animation.

Upon beginning the task, participants were presented with instructions and informed about what to expect. To advance each slide and move on to the next image, participants were instructed to click on each image with a customized mouse cursor designed to take on the appearance of a cigarette cursor. Once participants click on to the image with the cigarette cursor, a burning animation is activated that engulfs the image until it disappears. Once the animation has completed, participants are presented with a 'next' button in order to advance to the next image. Once participants have completed this process with each of the 30 images, participants are instructed to move on to the remainder of the study.

Implicit smoking associations. Two versions of the IAT that were used in study 1 were also used in study 2. The two versions of the IAT retained for study 2 were health associations

and self/other associations. The attributes used to represent these two categories are reported in appendix Q Smoking stimuli include images of cigarettes, lighters, and ash trays (see appendix B for smoking images). Shapes were used as a neutral contrast category (see appendix C for neutral images).

Table 6

Category/ attributes	Stimuli
Good	Excellent, Good, Great, Pleasant
Bad	Awful, Bad, Dreadful, Horrible
Healthy	Fitness, Fresh, Health, Healthy
Unhealthy	Cough, Disease, Illness, Unhealthy
Social	Cool, Friendly, Popular, Social
Unsocial	Loner, Rejected, Unpopular, Unsocial
Self	Me, Mine, Self, Us
Other	Other, Their, Them, They
Smoking	Four images depicting cigarettes, lighters, and ash trays*
Shapes	Four images depicting geometric shapes*

* See appendices B & C for images used in the IAT

Explicit smoking attitudes. We assessed explicit attitudes toward smoking using 12 semantic differential scale items that were modified to address a range of relevant attitudes directed toward smoking and cigarette use (Bradley & Lang, 1994). Responses to the semantic differential occurred on a 7-point bipolar scale that assessed the extent to which smoking is associated with various adjectives of interest. For instance, two items tapped into social related attitudes by asking whether smoking is 'cool' versus 'uncool' and 'popular' versus 'unpopular'. See Appendix D for a complete listing of semantic differential ratings and anchors for each scale; reliability analysis of these items yielded an alpha of .877

Risk assessment. Perceived risk and consequences associated with smoking were assessed using a modified version of a measure by Halpern-Felsher, Biehl, Kropp, & Rubinstein (2004). The measure has previously been found to tap into the perception of health and social related risks associated with smoking (Halpern-Felschner et al, 2004) and has been adapted to investigate the attitudes toward the dangers of second hand smoke (Song, Glantz, & Halpern-Felshner, 2009). While this measure was originally designed to measure adolescents' perceptions of risks associated with smoking, this measure has been adapted for use with adults in the current study (see appendix E for the measure). These 20 items were subjected to a reliability analysis yielding an alpha of .667.

More detail was gathered about perceived risks associated with smoking by asking participants the extent to which they believe they will encounter various consequences associated with smoking a pack of cigarettes a week. Participants were posed with the scenario: 'Imagine that you smoke, on average, a pack a week. What is the chance (0%-

100%)…'. Participants were then presented with 18 potential consequences associated with smoking. For example, participants were asked about the likelihood of getting lung cancer, becoming addicted, and losing weight. See appendix F for the measure in its entirety; reliability analysis for these 18 items yielded an alpha of .890.

An additional measure of perceived smoking risks was obtained using a single-item measure designed to assess general perceptions of the risks versus benefits associated with smoking. Participants were asked to: 'Think about the potential risks and benefits associated with smoking cigarettes. Weigh the benefits against the risks. On the scale below, where do your overall feelings about smoking fall. Please provide the number where your judgment falls _____.' Participants were provided with a 21-point scale with anchors starting at 'Sure risk' (-10) and ending at 'Sure benefit' (+10). On this item a high score indicates that the participant believes that smoking brings about more benefits than risks, and low scores indicate smoking brings about more risks than benefits.

Graphic warning label rating task. As was the case in study 1, nine graphic warning labels previously approved for use by the FDA were rated by participants. Participants rated each of graphic warning labels for: understandability, confusion caused by the image, worry, fear, and discouragement from smoking. Please see appendix G for images and items used on the graphic warning label task. A reliability analysis was conducted for the five ratings for each of the nine graphic warning images yielding an alpha of .947.

Smoking behavior questionnaire. In order to measure smoking behavior among our sample of our participants, participants were asked a set of questions commonly used by large,

epidemiological surveys deployed by the Centers for Disease Control (e.g. Schoenborn, Vickerie, Barnes, 2003) designed to assess smoking history and current smoking status of participants. Participants were asked if they have smoked 100 cigarettes in a lifetime. If participants indicated that they have smoked 100 or more cigarettes in their lifetime, additional questions about their smoking behavior and history were asked including: when they initiated smoking, if they quit or have attempted to quit, number of cigarettes smoked in the past month, and current number of cigarettes smoked per day. See appendix H for a complete listing of smoking behavior items.

Demographics. Participants were asked to provide some basic demographic information including: gender, age, ethnicity, and country of residence. Participation in this study was limited to those living within the United States, thus information about country of residence was collected in effort to identify anyone who gained access to this survey who lives outside the United States.

Procedures

Instructions, consent forms, implicit and explicit measures were presented to participants using Survey Monkey (surveymonkey.com). The two implicit association tests (IATs) were programmed in Adobe Flash so that implicit data could be collected online, eliminating the need to bring participants into the lab.

This study was advertised on Amazon's Mechanical Turk as '*Attitudes toward smoking*'. In the study description participants were told that if they decided to participate: '*You will be*

asked questions concerning your attitudes toward smoking and complete several interactive computerized tasks. The study is expected to take approximately 40 minutes of your time.' Mturk users who decided to volunteer were provided with a link to Survey Monkey. Clicking on the link provided sent participants to the first page of Survey Monkey containing consent materials. Participants provided their consent to participate by clicking '*Yes - I have decided to participate in this study as a research subject. I have read and understand the information above. I may print out a copy of this consent form.*' Participants that declined participation were directed to a screen thanking them for their interest in the study.

After providing their consent, participants were directed to the intervention task. Participants completed either the experimental condition with burning positive images, the control condition with the burning neutral shape condition, or skipped the task all together for the purpose of an additional control condition. Upon completion of the task, participants were directed to the remainder of the study. The order of presentation of implicit and explicit measures were counterbalanced so that roughly half of participants received the two implicit measures (presented in random order) followed by the explicit attitude measures, while the other half received each of the explicit attitude measures followed the two implicit attitudes. Upon completion of the implicit and explicit measures, participants responded to the graphic warning label ratings task, followed by demographic questions, and finally the smoking behavior questionnaire. Each measure and implicit task was presented on its own dedicated survey monkey page. After each measure or task was completed, participants advanced to the next screen by clicking the '*Next*' button at the bottom of the screen. Participants were not allowed to return to a previous screen once they advanced to the next Survey Monkey page.

Upon completion of smoking behavior questionnaire, participants were directed to a debriefing page where they were thanked for their participation and given instructions to obtain their payment via Mturk. Participants were provided with a participant code '*No smoking1'* during debriefing in order to confirm that the participant saw the study through to the end. Payment was released to participants within 8 hours of completion of the study.

Analysis.

RQ 1: Can smoking related implicit attitudes be delineated into subdomains that mirror domains of explicit smoking attitudes (i.e. social attitudes, health attitudes, self-attitudes, etc.)?

In order to replicate study 1 results concerning the structure of implicit attitudes, an exploratory factor analysis was again conducted, this time on the two versions of the IAT along with the same 12 semantic differential items measuring explicit attitudes toward smoking. The 12 explicit smoking attitude items (i.e. semantic differential scores) and 2 implicit measures (i.e. implicit association test) were all entered into an exploratory factor analysis using principle components extraction and Promax rotation.

RQ 2: Can primes/prompts/interventions that tap in to smoking related implicit associations produce changes in implicit and explicit attitudes?

A 2 (smoker/ non-smoker) x 3(experimental, neutral burn, no burn) Analysis of Variance (ANOVA) will be conducted in order to detect main effects of these two factors, and interactions between them, upon the outcome measures including both implicit associations

and explicit attitudes. Upon reviewing the results from these ANOVAs, additional tests of equivalency of means were conducted using t-tests.

Results Study 2

Sample characteristics

Descriptive statistics for the sample are reported below in table 7 below.

Table 7

Sample characteristics

Variable	N	%
Gender		
Male	406	43
Female	548	57
Age		
18-25	260	27
26-35	382	40
36-45	144	16
46-55	94	10
56 +	67	7
Ethnicity		
African-American	60	6
Asian	51	5
Hispanic/ Latino	40	5
White	790	83
Other	12	1
Smoked 100 cigarettes in lifetime?		
Yes	501	52
No	455	48
Smoking status (among those who reported smoking 100 cigarettes in their lifetime)		
Former smoker	196	39
Daily smoker	214	43
Non-daily smoker	91	18

RQ 1: Can smoking related implicit attitudes be delineated into subdomains that mirror domains of explicit smoking attitudes (i.e. social attitudes, health attitudes, self-attitudes, etc.)?

Factor analyses

The 12 explicit smoking attitude items (i.e. semantic differential scores) and 2 implicit measures (i.e. implicit association test) were all entered into an exploratory factor analysis using principle components extraction and Promax rotation. This analysis suggests a three-factor solution to smoking attitudes consisting of three dimensions. These three factors together account for 62% of the total variance explained; individually, factor 1 explained 41% of the variance, factor 2 explained 13% of the variance, and factor 3 explained an additional 8% of the variance. The three-factor solution reported here is practically identical to the factor analysis results reported in study 1. See table 8 for factor loadings and communalities.

Factor scores

A factor score was derived for each of the three factors. Promax (an oblique rotation method) was utilized so that factors were allowed to correlate with one-another. The explicit social attitude factor and explicit health attitude factor were significantly correlated at .51 ($p<.05$). The explicit social factor and implicit attitude factor were significantly correlated at .17 ($p<.05$). The explicit health factor was significantly correlated with implicit attitude factor at .11 ($p<.05$). Correlations between factor scores, the two IATs, and perceived risks/ benefits are displayed in table 9 below. In addition, correlations between the implicit factor and individual Items of the explicit semantic differential scale (items that comprise general attitudes and perceptions of risks) are reported in appendix R.

Table 8

Loadings and communalities based upon a principle component factor analysis using Promax rotation

Item	Risk perception	General attitudes	Implicit attitudes	Communalities
SD- Good/Bad		**.877**		.768
SD- Negative/Positive		**.825**		.755
SD- Unhealthy/Healthy		**.945**		.745
SD- Life/Death		**.608**		.484
SD- Unsexy/Sexy	**.743**			.682
SD- Unpleasant/ Pleasant	**.711**			.713
SD- Harmless/Harmful		**.767**		.549
SD- Unsociable/Sociable	**.744**			.533
SD- Ugly/ Glamorous	**.754**			.736
SD- Calming/ Stressful	**.852**			.569
SD- Unlike you/ Like you	**.769**			.625
SD- Unimportant/ Important	**.649**			.362
IAT- Healthy/Unhealthy			**.759**	.576
IAT- Self/other			**.764**	.588

Note: Only factor loadings above .45 were included in this table. Loadings on each factor are emboldened.

Table 9

	Perceived risks	General attitude	Implicit factor	IAT- Health	IAT- Self/other	Cigarettes per day	Expected risks	Expected benefits
Perceived risks	1	.508**	.167**	.101**	.139**	-.056	-.424**	.503**
General attitude	.508**	1	.107**	.120**	.046	.115	-.362**	.233**
Implicit	.167**	.107**	1	.756**	.765**	.222*	-.101**	.079*
IAT- Health	.101**	.120**	.756**	1	.180**	.207*	-.098**	.072*
IAT- Self/other	.139**	.046	.765**	.180**	1	.085	-.040	.075*
Average cigarettes smoked per day	-.056	.115	.222*	.207*	.085	1	-.095	-.025
Expected risks	-.424**	-.362**	-.101**	-.098**	-.040	-.095	1	.094**
Expected benefits	.503**	.233**	.079*	.072*	.075*	-.025	.094**	1

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Relationship between factors and additional outcome measures

The relationship between the three factors of interest and risk assessment/ graphic warning label measures were assessed in order to determine the stability of patterns of correlations observed in study 1. Patterns of correlations between the three factors of interest and the measure adopted from Halpern-Felshner and colleagues (2004) indicate that the two explicit factors (perceived consequences and general attitudes) are consistent predictors of risk assessment in various scenarios (see appendix E for scenarios and items). Implicit associations were inconsistently related to risk assessment as measured by this questionnaire. See

appendix S for correlations between each of the three factors and items of the adapted Halpern-Felshner scale.

Specific risks and general attitudes were both consistent predictors of the 18-item risk assessment questionnaire (see appendix F for the measure in its entirety). Implicit associations were inconsistently correlated to the 18-item measures. Correlations between the three factors and risk assessment questionnaire can be found in appendix T. In addition, the three factor scores were correlated with the single-item measure of perceived risks versus benefits associated with smoking. The single-item risk/benefit measure correlated with perceived consequences at .52 ($p < .05$), with general attitudes at .50 ($p<.05$), and with implicit associations at .17 ($p < .05$).

Finally, correlations between the three factors of interest and items assessing the graphic warning labels were addressed. Perceived consequences and general attitudes were consistently correlated with nearly all the items addressing each graphic warning label. Implicit associations were not a consistent a predictor of responses to the warning labels; no discernible pattern emerged for implicit associations. See appendix U for correlations between the three factors and the graphic warning label task.

Study 2 manipulation

RQ 2: Can primes/prompts/interventions that specifically tap in to subdomains of smoking related implicit attitudes (versus general positive or negative affect) produce changes in implicit and explicit attitudes?

Analysis of variance

ANOVAs were used to investigate the presence of main effects of condition (experimental, neutral-burn, no-burn) and smoking status of the participant (smoker or non-smoker). Investigating the presence of an interaction effect between the two factors (i.e. smoking status and condition) was of particular interest in this analysis.

Implicit measure. The overall corrected model predicting general smoking attitudes was significant $F(5, 713)= 8.01$, $p<.01$; however, only smoking status served as a significant main effect $(1, 713)= 37.48$, $P<.01$. No interaction effect was found between smoking status and experimental condition.

General attitude. The overall correct model predicting general smoking attitudes was significant $F(5, 713)= 8.35$, $p<.01$; however, only smoking status served as a significant main effect $(1, 713)= 33.23$, $P<.01$. No interaction effect was found between smoking status and experimental condition.

Specific risks. The overall corrected model predicting implicit associations was significant $F(5, 713)= 222.62$, $p<.01$. Smoking status served as a significant main effect $F(1, 713)= 306.62$, $P<.01$, as did condition $F(2, 713)= 3.24$, $p<.05$. No interaction effect was found between smoking status and experimental condition. Post-hoc tests reveal that those in the experimental condition perceived more greater risks than those in the neutral-burn (but not the no-burn) condition.

T-tests

T-tests were used to compare composite scores for implicit associations, general smoking attitudes, and perceptions of specific risks. Given the non-significant difference between the no-burn and neutral-burn conditions found in each of the ANOVAs reported above, these two conditions were collapsed so that they can be compared to the experimental condition. General smoking attitudes were significantly more negative in the experimental than control conditions $t(522)= 2.136$, $p<.05$. Likewise, perceptions of specific risks associated with smoking were significantly more negative in the experimental than control conditions $t(716)= 2.644$, $p<.01$. Implicit associations were not influenced by the experimental condition compared to controls $t(716)= .643$, $p=.520$.

Discussion Study 2

RQ 1: Can smoking related implicit attitudes be delineated into subdomains that mirror domains of explicit smoking attitudes (i.e. social attitudes, health attitudes, self-attitudes, etc.)?

Factor analyses were conducted on the explicit attitude items and the IATs effort to replicate the results presented in study 1. The only difference between the factor analysis in study 1 and study 2 is that the social IAT and general IAT were not included in this analysis, because these measures were not assessed in study 2. Despite this minor difference once again three factors emerged, representing: general attitudes toward smoking, perceptions of specific

risks, and implicit attitudes (see table 8). This factor structure has been found to be consistent across two unique sets of participants.

In addition, the pattern of correlations between the factor scores (derived from the study 2 factor analysis) and other measures of interest are quite similar to those found in study 1 (see table 4 from study 1). Again, the two implicit measures were positively correlated with one-another, and always correlated with other variables of interest in the same direction. Again we find that patterns of correlations are consistent with the notion (though not alone conclusive) that implicit associations belong to a common underlying construct. Taken together, these findings provide additional confidence in the results obtained in study 1 pertaining to research question 1: can smoking related implicit attitudes be delineated into subdomains that mirror domains of explicit smoking attitudes? The again answer appears to be no—implicit associations do not appear to be separable into distinct domains.

RQ 2: *Can primes/prompts/interventions that tap in to smoking related implicit associations produce changes in implicit and explicit attitudes?*

Three ANOVA models were assessed to explore the influence of experimental condition and smoking status on implicit associations, specific risks, and general attitudes associated with smoking. A main effect of smoking status was identified in each of the three models, indicating smokers had more positive implicit associations, general attitudes, and perceptions of specific risks associated with smoking. However, only in the case of specific risks was a significant main effect found. Post-hoc analysis suggests the control and experimental conditions were

significantly different from one another. Those in the experimental condition reported greater perceptions of specific risks than those in the neutral-burn control condition.

Given that in no case did the no-burn and control conditions differ in these ANOVAs, these two conditions were collapsed so that they could be compared to the experimental condition using t-tests. Both general attitudes and specific consequences were significantly more negative in the experimental compared to the combined control conditions. Implicit associations were not significantly impacted by condition.

Observing animations of cigarette use resulting in the burning away of positive images appears to have at least a short term influence upon explicit attitudes related to smoking behavior; however, no significant difference was found in implicit associations as a result of the manipulation. Several explanations as to why this task was found to be ineffective in impacting implicit associations are explored in the general discussion. Avenues of future research will also be discussed in hope of improving the methods used to assess the effectiveness of the implicit task. With additional assessment of the effectiveness of the implicit intervention task in disrupting positive implicit smoking associations, we will be better equipped to design effective implicit interventions in the future. Ultimately, the goal of this dissertation has been to inspire novel and unique ways of delivering anti-smoking messages by relying upon implicit methods of message delivery. With this ultimate goal in mind, a novel intervention is proposed that builds upon the basic logic of the implicit intervention introduced in this dissertation. Implications for cognition and public policy are also explored in the general discussion.

General Discussion

Summary of Findings

The first research question (RQ 1) addressed in this dissertation was concerned with the structure of implicit smoking associations and whether implicit associations cluster into multiple distinct domains that mirror those commonly found in explicit smoking attitude research (e.g. social, health, etc.). Four IATs were designed to tap into four distinct implicit domains: general valance, health, social, and self/other. I hypothesized that these measures would load onto distinct factors, indicating they are truly tapping into unique implicit domains. Contrary to this hypothesis, results from two factor analyses in study 1 provide evidence that each of these four measures appear to tap into the same basic construct. These findings were replicated in study 2 with a distinct sample of participants.

RQ 2 was amended to account for findings from RQ 1 in support of implicit smoking associations as part of a single coherent set of associations as opposed to unique and distinct domains. With this addendum, the second research question asked whether an intervention could be developed that relied upon implicit methods of message delivery for the purpose of implicit and explicit attitude change. Study 1 investigated the predictive value of implicit associations for actual smoking behavior. Because factor analyses suggest that implicit associations are part of the same associative system, implicit associations were treated as a single construct that could act as a predictor of smoking behavior. Results from correlation, regression, and SEM analyses all corroborate that implicit associations are a unique significant predictor of smoking behavior above and beyond explicit attitudes.

Three 2 x 3 ANOVAs were conducted in order to determine the influence of smoking status (smoker or non-smoker) and condition (experimental, neutral- burn, no-burn) on implicit attitude, general attitude, and perceived risk factors. I hypothesized a main effect of smoking status and experimental condition for implicit attitudes, general attitudes, and perceived risks. Smokers were expected to be relatively more positive than non-smokers on all three outcome variables. Those in the experimental condition were expected to have more negative implicit associations with smoking, more general negative attitudes, and greater perception of risks associated with smoking.

Initial ANOVA results suggested a main effect of smoking status on implicit attitudes, general valance, and perceptions of specific risks. Smokers tended to rate smoking more favorably on each of these outcomes. Results were mixed on the main effect of experimental condition. A main effect of condition was found only for perceptions of specific risks, where participants were more likely to perceive higher risks in the experimental condition compared to the neutral-burn control. Due to these mixed results of the influence of condition, additional analyses were conducted in order to more fully explore the impact of condition. In no case did the ANOVAs indicate that the two control conditions (neutral-burn and no-burn) were significantly different, so these conditions were collapsed so that they could be collectively compared against the experimental condition using t-tests. T-tests indicated that both general attitudes and perceptions of risks were significantly more negative in the experimental versus the control conditions. Implicit associations were not impacted by condition.

Results from study 2 partially support the hypothesis that an implicit intervention could produce attitude change without conveying explicit information about the dangers of smoking. Explicit attitudes in the form of general attitudes and specific risks were impacted by the intervention, but no evidence was found that would indicate implicit associations were impacted by the intervention. However, more research needs to be conducting before ruling out the effectiveness of this intervention on disrupting positive implicit associations. It is possible the lack of an observed impact of the intervention on implicit associations could be due to the overall study design and techniques of measurement, instead of the intervention per se. Suggestions for how to address this issue are offered below. In addition, while the findings from study 2 provide some indication of the effectiveness of this intervention for change in explicit attitudes, more research is needed in order to better determine exactly how this procedure is effective in changing explicit attitudes. By understanding more about the mechanism(s) that drove explicit attitude change in the computerized intervention, similar intervention designs might be developed that can improve upon the design tested here and adapted to better address implicit associations. Unanswered questions and directions for future research to build a better implicit intervention will now be discussed.

Implications and Future Directions

Structure of implicit attitudes. The four IATs that were developed for the purpose of measuring four distinct implicit attitude domains in this study (i.e. general valance, health, social, self/other) have instead been demonstrated to all tap into the same common network of associations as evidenced by factor analyses in both study 1 and 2. However, it is still possible

that other networks of implicit associations not yet discussed might be identified that operate relatively independent of the associative network identified here. For instance, researchers have assessed implicit approach and avoidance responses in various contexts, including smoking behavior. Because implicit approach/avoidance is meant to tap implicit behavioral tendencies, this particular measure of implicit smoking cognition may not be so closely tied to the set of associations measured by the four IATs addressed in this dissertation. Of course, implicit approach/ avoidance might very well turn out to be tied into the same associative network identified in the current dissertation—however, this is an issue for future investigation. In either case, future research ought to explore the link between implicit semantic associations addressed in the current study and implicit behavioral measures of approach and avoid tendency.

In addition to including implicit measures of approach and avoidance, a more comprehensive investigation of how uncontrolled automatic cognitive systems work in concert to support smoking behavior is necessary. For instance, past research in implicit attention using eye tracking methods have identified that heavy smokers are generally quicker to attend to smoking stimuli and slower to disengage from the stimuli than non-smokers (Baschnagel, 2013). Semantic associations (the implicit system addressed here) may interact with other aspects of automatic cognition such as implicit attention or implicit behavioral tendency (i.e. approach/avoid). It is likely that these three aspects of automatic smoking behavior—implicit associations, implicit behavioral tendency, and implicit attention—are tied together and supportive of each other. For example, positive implicit associations with smoking would likely make smoking stimuli rewarding for an individual, and thus more tempting as a target of

attention. Further, if a person has positive implicit associations with smoking, and is automatically geared toward paying attention to smoking stimuli, it is likely that implicit behavioral approach tendency would be supported as well. The link between implicit semantic associations and implicit behavioral tendencies may be key in determining the exact mechanism for translating changes in implicit associations to changes in actual smoking behavior. Understanding the dynamics of these three implicit systems would be a great next step toward understanding how implicit cognitive systems influence smoking behavior.

Implicit associations and explicit attitudes in prediction of smoking behavior. Implicit associations were found to uniquely predict smoking status above and beyond explicitly held attitudes (i.e. general attitudes and perceptions of specific risks). This finding is in contention with the findings from a study that used very similar methods to address the joint influence of implicit associations and explicit attitudes in the prediction of smoking behavior (Peruigini, 2005). Explicit attitudes were measured using the same methods in this dissertation: the semantic differential scale with similar adjectives (e.g. cool-uncool, good-bad, sexy-unsexy). Implicit associations were assessed using a general valance IAT (i.e. pleasant/unpleasant) with exercise acting as the contrast category to smoking. A hierarchical logistic regression analysis suggested that while explicit attitudes were a uniquely significant predictor of smoking status, implicit attitudes were not, although an interaction between implicit associations and explicit attitudes was significant.

So while Peruigini concluded implicit associations do play a role in smoking behavior, the role is only evident in its interaction with explicit attitudes—a direct effect was not found

between implicit associations and smoking behavior in his study. Despite the use of similar methods and measures, results from the studies conducted for this dissertation diverge from those found by Parugini (2005); both study 1 and study 2 provide evidence in support of implicit associations serving as a unique predictor of smoking behavior. While the methods are very similar, a minor difference in the IAT procedure could have led to diverging findings.

The IAT utilized by Paruigini (2005) to assess implicit attitudes with smoking used 'exercise' as the contrast category to 'smoking', while research for this dissertation used the neutral category 'shapes'. Using a neutral category such as shapes may be preferable to using an activity such as exercise. The standard IAT is a relative measure where associations of the target category (in this case smoking) are assessed relative to the contrast category. A smoking IAT that utilizes exercise as a contrast category is likely measuring associations with exercise as much as they are measuring associations with smoking. Researchers have demonstrated that the contrast category used as a comparison to the target can impact the outcome of IAT scores (Robinson , Meier, Zetocha, & Kevin D. McCaul, 2010). An IAT that uses a neutral contrast category is likely better equipped to directly tap into smoking associations without risking conflation with associations to exercise.

Implicit attitude change. Contrary to the initial hypothesis, implicit associations were not found to have been impacted by the intervention in study 2. There are several possibilities that ought to be explored as to why there was no evidence of implicit associations being impacted by the experimental procedure. Implicit associations are generally believed to develop over time and are not as malleable as explicit attitudes. One possibility to explore is

that the intervention task was not long enough in duration or did not have enough trials to allow for the implicit associations to be impacted.

We can look to research outside of the realm of smoking for examples of success in retraining implicit biases; two studies may provide insight as to how the procedures can be altered to better disrupt positive implicit smoking associations. In a study designed to retrain implicit biases held toward social groups, participants were instructed to respond negatively when presented with an image of the target group (e.g. African-Americans) and an affiliated stereotype of that group, as if to deny endorsement of the stereotype (Kawakami, Dovidio, Moll, Hermsen, and Russin, 2000). Participants completed 480 trails of this process, which led to reduced activation of stereotypes associated with the social group. This could be an indication that the study 2 lacked the appropriate number of trails to change implicit associations. In contrast, other researchers have demonstrated a reduction in prejudice among participants who engaged in an evaluative conditioning task with fewer trials (Olson & Fazio, 2006). Prejudice reduction was observed after only 24 trials of stereotype incongruent pairings—images of black individuals were paired with positive traits, while images of white individuals were paired with negative traits. This conditioning is counter to common cultural stereotypes, as IATs regularly find white targets to be more often associated with positivity than black targets. Despite that the task had only 24 critical pairing trials, evidence of the conditioning was found two days after the original task.

It is also possible that the IAT measures used here were not sensitive enough to detect any changes in implicit cognition. Dense sampling techniques such as eye tracking or mouse

tracking provide a richer set of data to analyze, and thus may be more sensitive to subtle changes in implicit cognition than the IAT. Reduction in automatic attention paid toward smoking stimuli may be an additional indication of the effectiveness of an implicit intervention. Future research should considering implementing these measures of implicit cognition that might be more sensitive to changes in implicit associations. Similarly, a longitudinal study in which outcome measures are assessed repeatedly over an extended period of time may provide a better test for the effectiveness of this intervention on implicit associations, which may require extended repeated exposure of this intervention procedure in order to enact observable changes in implicit associations.

Finally, it could be that this kind of intervention simply does not tap in to implicit associations regardless of the duration of the study and amount of repeated exposure. This does not necessarily rule out the potential effectiveness of the intervention as a means of smoking behavior change, as study 2 did provide evidence that at least explicit general attitudes and perceptions of specific risks were impacted by experimental condition. Additional research is needed to clarify if the study 2 intervention failed to influence implicit associations due to issues of measurement (e.g. measures not sensitive enough, too few measures) or if implicit associations are truly not impacted by this intervention.

Behavior Change. While more research needs to be performed concerning the impact of this intervention upon implicit associations, study 2 did provide evidence that this intervention may at least impact explicit smoking attitudes. Evidence from regression analyses, correlations, and SEM suggests that explicit attitudes (in addition to implicit attitudes) are

predictive of smoking behavior—however it was not within the scope of this study to determine if the intervention had an impact upon actual smoking behavior. It is unlikely that any effect of the computerized intervention would persist long after participants completed study 2 given the short duration of the intervention procedure. The next iteration of this study should focus upon determining if this change in explicit attitudes brought on by the intervention does in fact lead to a reduction in smoking behavior.

Given the ambivalent attitudes that smokers seem to have, and a desire to enact lasting changes in attitude, a single measurement of attitude change might be less than optimal. As suggested by a recent conceptual review of attitude change (Gawronski & Bodenhausen, 2006), implicit associations elicited via intervention might represent newly formed implicit attitudes, however changes observed in response to experimental manipulations could represent primed associations that were already present in memory. Thus, a single measurement using the IAT cannot distinguish between whether an intervention is successful in appropriately influencing attitude, or whether the intervention simply primed a pre-existing (if rarely activated) association. Thus, determining whether an intervention has created new associations or has simply primed a previously existing association in memory might be impossible to determine based upon a post-test only design. The claim that attitude change has occurred in response to an intervention should be suspect if evidence for attitude change is supported by a single measurement of implicit attitudes. This seems to be a particularly important dilemma given the ambivalent attitudes found in heavy smokers: a single measurement is not sufficient to determine if any lasting attitude change has occurred. Given findings from past research that

implicit attitudes vary for smokers by context, a smoking intervention should only be considered truly successful if the attitude remains relatively stable over time and context.

A longitudinal study using the same procedures as study 2 over the course of three months would be ideal to assess this intervention, as such as design would allow for more opportunities for repeated exposure to the intervention as well as more opportunities to assess the participant on implicit and explicit measures. This would not only allow time for data to be collected on actual smoking behavior; in addition, obtaining multiple IAT measurements over the course of three months would be a good test of the impact of repeated exposure of the intervention upon implicit associations. Participants could complete all implicit and explicit outcome measures at the start of participation and again at the end of the three months for a thorough pre-test / post-test measurement. Participants would be assigned to either the experimental condition or the neutral-burn control, and instructed to intermittently complete the intervention task throughout the week. Participants should also be asked to complete an IAT several times a week for the duration of the study in order to determine if any changes in implicit associations occur as a result of repeated exposure to the intervention. These procedures would allow for us to determine if the explicit attitude change observed as a result of the intervention in study 2 can translate to change in actual smoking behavior.

A New Paradigm in Smoking Intervention. One of the main issues with this method is the difficulty in repeatedly and consistently delivering the message in a way that will allow for long-term attitude change to occur. Even the longitudinal version of the intervention described in the discussion above is limited in several ways. The most striking way in which such an

intervention would be limited is that the reliance on a computerized task as a method of disseminating an implicit intervention is problematic. Such an approach is limited because the intervention requires access to a computer and internet connection, or participants would need to come in to the lab repeatedly throughout the process. Even with internet access as ubiquitous as it is in current times, participants might simply choose not log on and complete the intention procedures as often as is necessary to ensure appropriate repeated exposure. Researchers need to develop novel methods of intervention delivery that can alleviate the concerns of non-compliance to the intervention.

One potentially novel way of addressing this issue is to apply an anti-smoking message to the cigarette itself, thereby guaranteeing repeated exposure to the message at least as often as a person smokes. Given that implicit attitudes appear to provide a contextual background by which explicit attitudes express themselves in any given situation, it would also be optimal to deliver an implicit anti-smoking message exactly when positive implicit associations ought to be disrupted— that is, when people are engaging (or about to engage) in smoking behavior. A clearly articulated explicit message that conveys the dangers of smoking might be impossible to apply to a cigarette; however, a *subtle* message that is designed to address implicit attitudes toward smoking is much more plausible.

Placing positive stimuli on the very tip of the cigarette would force smokers to burn that positive stimulus every time they light up. As the stimulus literally burns, it is expected that the smoker's interaction with the modified cigarette will activate a representation of the symbolic destruction of the attitude object represented by the stimulus. This proposed intervention

relies upon the same logic that motivated the intervention in study 2; however, in that case the fire was an animation burning up a digital image, while this version would place images on cigarettes to be burned by actual flame. For example, placing tiny image of an American flag at the end of a cigarette is expected to prime the symbolic destruction of America (a presumably positive social affiliation) when flame is applied. Over repeated experience lighting the positive stimulus on fire, an implicit association is expected to be fostered between the physical act of smoking with the destruction of concepts that are meaningful to all humans such as life and social relationships. Thus, attitudes toward smoking should slowly become more negative as the metaphor of destruction of a positive stimulus is repeatedly activated each time an individual smokes.

There will be challenges associated with implementing this intervention, though none are insurmountable. Perhaps most obvious is how the stimuli will be applied to cigarettes. Will the stimuli be stamped? Written in pen? Applied as a decal? For ethical reasons, whatever is added to the cigarette would need to refrain from adding any toxins to the already highly toxic product. Careful consideration would need to be conducted in order ensure the product is no more harmful than the smoking behavior alone.

A practical question about this procedure is how these modified cigarettes will be distributed to participants for the purpose of the intervention? One option is for participants to bring in their own pack of cigarettes for researchers to manipulate and stamp on the stimuli while the participant completes pre-test measures. This then would require participants to come into the lab regularly, especially if the participant is a heavy smoker. Alternately,

researchers might purchase cartons of cigarettes and manipulate them to distribute to participants as they arrive to the lab. This comes with its own set of problems as it would be very costly, researchers would risk distributing cigarettes that participants do not like, and dealing out free cigarettes in a study designed to curb smoking behavior may be ethically questionable. In either case, an additional concern remains: how many manipulated cigarettes should be provided to participants? Because individuals vary in their amount of cigarette use, it is difficult to know how many packs of cigarettes should be given to each participant. Giving participants too many modified cigarettes may be unethical because it may cause them to smoke more than they would have otherwise, giving participants too few modified cigarettes might cause participants to go out and buy unmodified cigarettes when they run out. These challenges raised concerning the proposed intervention will need to be addressed before spending the time and resources toward testing this novel intervention. The hope is that the results of the two studies reported in this dissertation will provide the catalyst for the creation of a variety of novel interventions that rely upon subtle implicit messaging as a means to reduce smoking behavior.

Public Policy. Public policy might be informed by a better understanding of how implicit associations impact smoking behavior. For instance, public anti-smoking campaigns might start to integrate graphic imagery in with explicit messages as to the dangers of smoking. Such campaigns might be more effective if the threats to physical health associated with smoking were conveyed using an implicit message (e.g. through use of a visual metaphor), while the social threats that smoking poses might be more explicitly detailed—thus explicitly drawing attention to the social consequences, while also subtly reminding participants that smoking is

also a danger to their well being. Anti-smoking commercials and printed advertising can be improved upon using implicit techniques such as the use of subtle imagery. The intervention assessed in study 2 provides support for the plausibility of creating online anti-smoking interventions that users can interact with. Active engagement in an intervention is likely preferable to interventions in which participants passively observe.

With the help of the internet it is now possible to make such interactive interventions widely available, whether in the form of a dedicated website or pop-up advertisement. One possibility is to require that cigarette companies to allow government sponsored pop-ups that require interaction on the part of the user for the message to disappear. Pop-ups might prove to be a unique way to ensure repeated exposure. The use of targeted advertisements based upon browsing history is now common on the internet, so those who show a pattern of browsing that indicates interest in tobacco might be directly targeted for these advertisements. A systematic investigation of the interrelation between browsing history and tobacco use might eventually lead to pop-up interventions that are tailored to the individual based upon the kinds of websites they visit. Implementing such research may be tricky in the current political landscape however, as privacy rights over internet usage is now hotly debated in public discourse.

Research that highlights the importance of accounting for implicit cognition in smoking behavior might also inform policy as to what kinds of images cigarette companies ought to be able to use to advertise their product. Cigarette advertisements often include images of attractive and healthy-looking individuals having a good time while smoking cigarettes. While

no explicit information is provided by these messages to suggest that smoking is healthy, these advertisements are designed to ensure an implicit link is made between smoking and a fun healthy lifestyle. As we learn more about the influence of implicit associations on smoking behavior and explicit attitudes, it will be important to revisit cigarette advertising laws. If cigarette advertisements are truly effective in generating positive health and social associations with smoking, we might consider adapting policy to limit big tobacco's ability to do so. Additional research is needed in order to assess the impact of tobacco advertisements on implicit associations.

Conclusion

It is important to recognize that automatic cognitions that operate outside of conscious awareness are essential to better understand the link between smoking attitudes and behavior. Public anti-smoking campaigns have long operated primarily by conveying explicit information about the health risks associated with smoking. Despite a steep decline in smoking rates over the last 40 years, rates have currently reached a plateau; approximately 20% of Americans continue to smoke despite knowledge concerning the dangers of smoke to overall health. Given stagnant smoking rates, it appears to be time to investigate novel approaches to smoking intervention. I have argued that developing implicit methods of smoking intervention will be one fruitful approach to addressing the needs of recalcitrant smokers. The implicit intervention procedure assessed in study 2 was successful in reducing positive explicit attitudes, but failed to impact implicit associations. While it is encouraging that this implicit intervention appears to have influenced explicit attitudes, replication with a much greater number of experimental

trials is necessary to better assess the effectiveness of this intervention in reducing implicit associations. Of course, ultimately this intervention must do more than impact attitudes and cognitive associations; an intervention is only truly effective if it also helps to reduce smoking behavior. With additional research exploring the plausibility of implicit interventions as a means of smoking cessation, the health field might supplement current efforts that rely upon explicit conveyance of knowledge as a means of smoking cessation.

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Appendix A: IAT attributes

Self	Other
me, mine, us, self ;	them, they, their, other

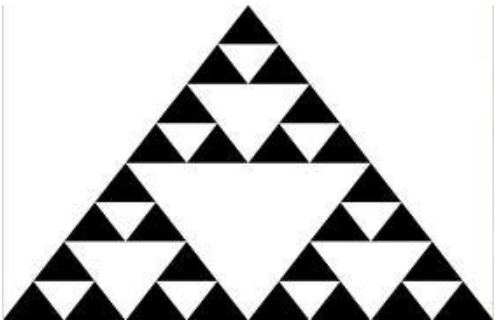
Pleasant	Unpleasant
good, pleasant, great, excellent, terrific, and fabulous	bad, awful, dreadful, nasty, and horrible, unpleasant

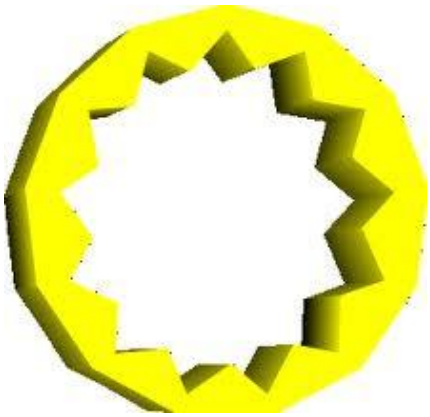
Healthy	Unhealthy
healthy, fitness, clean, fresh, energy, health;	unhealthy, disease, illness, sickness, cough, nausea

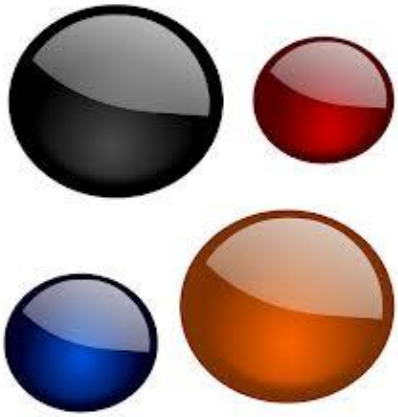
Social	Unsocial
social, cool, fun, friendly, popular, attractive	unsocial, loner, uncool, ugly, unpopular, rejected

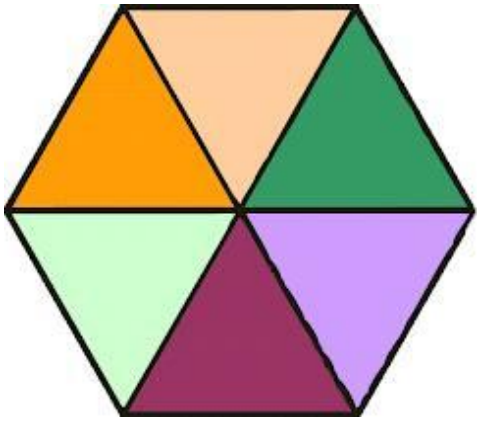
Appendix B: IAT smoking images

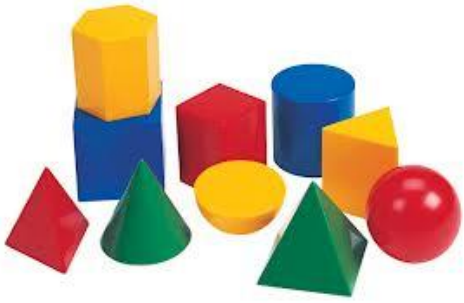
Appendix C: IAT neutral shapes











Appendix D: Semantic differential scale items (7-point scale; scale anchors are highlighted)

1. Please rate the extent to which you believe smoking is either **bad** or **good**.
2. Please rate the extent to which you believe smoking is either **negative** or **positive**.
3. Please rate the extent to which you believe smoking is either **unhealthy** or **healthy**.
4. Please rate the extent to which you believe smoking is related to **life** or **death**.
5. Please rate the extent to which you believe smoking is either **unsexy** or **sexy**.
6. Please rate the extent to which you believe smoking is either **unpleasant** or **pleasant**.
7. Please rate the extent to which you believe smoking is either **harmless** or **harmful**.
8. Please rate the extent to which you believe smoking is either **unsociable** or **sociable**.
9. Please rate the extent to which you believe smoking is either **ugly** or **glamorous**.
10. Please rate the extent to which you believe smoking is either **calming** or **stressful**.
11. Please rate the extent to which you believe smoking is either **unlike** you or **like you**.
12. Please rate the extent to which you believe smoking is either **unimportant** or **important**.

Appendix E: Halpern-Felsher, Biehl, Kropp, & Rubinstein (2004);

Song, Glantz, & Halpern-Felshner, 2009

Questions:

A) Imagine your best friend smokes 1 pack of cigarettes each day. They often smoke in front of you, but you don't smoke. What is the chance that you (the nonsmoker) will _____ from your best friend's smoking (0%-100%)?

B) Imagine you smoke 1 pack of cigarettes each day. You often smoke in front of your best friend, but your best friend doesn't smoke. What is the chance your best friend (the nonsmoker) will _____from your smoking (0%-100%)?

C) Imagine you smoke 1 pack of cigarettes each day. What is the chance that you will _____from your smoking (0%-100%)?

D) Imagine that you smoke cigarettes infrequently. For instance, you tend to smoke only at parties or when having a few drinks with friends. What is the chance that you will _____ from your occasional smoking (0%-100%)?

Responses

….get asthma?

…get lung cancer?

…have a heart attack?

…have a lot of trouble breathing?

…start smoking?

Appendix F: 18 item risk assessment

Item instructions:

Imagine that you smoke, on average, a pack a week. What is the chance (0%-100%)…

Responses:

you will get wrinkles on your face

you will have emphysema

you will still be smoking in 5 years

you will have really bad colds

you will feel relaxed

you will put other people at risk because of your cigarette smoke

you will become addicted

you will have a heart problems

you will lose weight

you will look cool

you will have bad breath

you will feel less bored

you will get lung cancer

you will feel less anxious

you will have an easier time talking to people

you will get a bad cough

you will smell like an ashtray

you will have a lot of trouble catching your breath

Appendix G: Graphic warning label tasks

1

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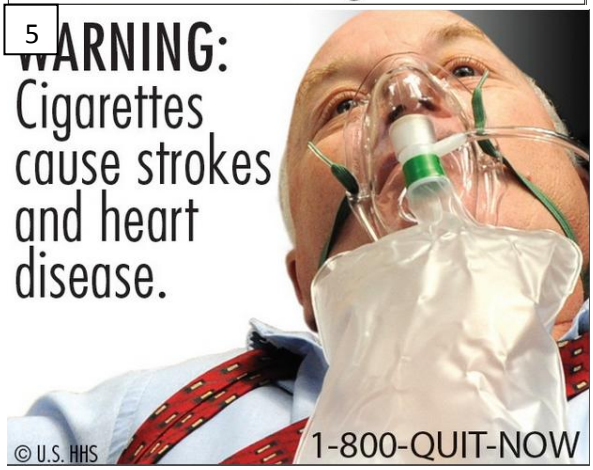

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Appendix G: Graphic warning label tasks

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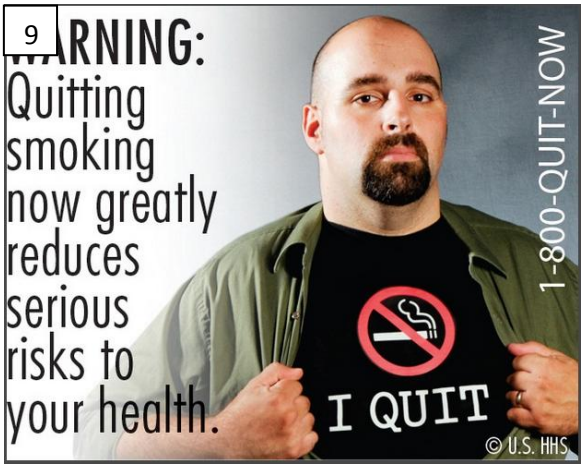


Appendix H: Smoking behavior questionnaire

1) Have you smoked at least 100 cigarettes in your ENTIRE LIFE?
2) How old were you when you FIRST started to smoke fairly regularly?
3) Do you NOW smoke every day, some days, or not at all?
4) How long has it been since you quit smoking cigarettes? **(for former smokers)**
5) On the average, how many cigarettes do you now smoke a day? **(for current smokers)**
6) On how many of the past 30 days did you smoke a cigarette? **(for current smokers)**
7) During the PAST 12 MONTHS, have you stopped smoking for more than one day BECAUSE YOU WERE TRYING TO QUIT SMOKING? **(for current smokers)**

Appendix I: Study 1 semantic differential correlations

Study 1 correlations between implicit associations and individual semantic differential items

	Implicit associations
Good-Bad	.284**
Pleasant-unpleasant	.309**
Health	.166**
Life-death	.144*
Sexy	.232**
Pleasant-unpleasant	.251**
Harmful	.363**
Social	.308**
Ugly	.240**
Calming	.294**
Identification	.331**
Important	-.128*

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Appendix J: Halpern-Felshner scale correlations

Study 1 Correlations between Halpern-Felshner, Biehl, Kropp, & Rubinstein (2004) and perceived consequences, general attitudes, and implicit associations

	Perceived consequences	General attitude	Implicit associations
A_asthma	-.212**	-.265**	-.118
A_lung cancer	-.269**	-.240**	-.070
A_heart attack	-.235**	-.212**	-.093
A_trouble breathing	-.326**	-.279**	-.124*
A_start smoking	-.025	-.135*	.027
B_asthma	-.218**	-.275**	-.120*
B_lung cancer	-.242**	-.232**	-.055
B_heart attack	-.204**	-.201**	-.069
B_trouble breathing	-.336**	-.288**	-.147*
B_start smoking	.248**	.054	.084
C_asthma	-.174**	-.268**	-.148*
C_lung cancer	-.186**	-.303**	-.116
C_heart attack	-.154*	-.270**	-.101
C_trouble breathing	-.133*	-.307**	-.169**
C_start smoking	.067	-.048	-.032
D_asthma	-.196**	-.203**	-.093
D_lung cancer	-.221**	-.264**	-.109
D_heart attack	-.209**	-.224**	-.106
D_trouble breathing	-.245**	-.268**	-.152*
D_start smoking	-.043	-.272**	-.150*

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

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

Appendix K: Study 1 risk perception correlations

Study 1 Correlations of 18-item risk perception scale with perceived consequences, general attitudes, and implicit associations

	Perceived consequences	General attitudes	Implicit associations
smell like an ashtray	-.307**	-.384**	-.146*
cough	-.238**	-.387**	-.234**
trouble breathing	-.233**	-.331**	-.164**
bad colds	-.283**	-.323**	-.184**
bad breath	-.318**	-.419**	-.153*
lung cancer	-.200**	-.313**	-.158**
heart disease	-.191**	-.266**	-.105
emphasema	-.208**	-.315**	-.150*
wrinkles	-.221**	-.312**	-.069
addicted	-.065	-.367**	-.123*
will still smoke in 5 years	-.074	-.201**	-.057
will look cool	.448**	.200**	.264**
feel relaxed	.503**	.205**	.205**
lose weight	.098	-.056	.031
less anxiety	.464**	.196**	.185**
will be less bored	.435**	.225**	.187**
be more talkative	.447**	.144*	.109
put others at risk	-.385**	-.409**	-.210**

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

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

Appendix L: Study 1 graphic warning label correlations

Study 1 correlations between graphic warning label (GWL) ratings and perceived consequences, general attitudes, and implicit associations

	Perceived consequences	General attitudes	Implicit associations
GWL1 _understandable	-.152*	-.312**	-.061
GWL1 _confuse	.208**	.233**	.048
GWL1 _worried	-.083	-.180**	-.042
GWL1 _scared	-.105	-.185**	-.077
GWL1 _discourage	-.528**	-.525**	-.264**
GWL2 _understandable	-.119	-.353**	-.110
GWL2 _confuse	.132*	.237**	.079
GWL2 _worried	-.232**	-.269**	-.055
GWL2 _scared	-.238**	-.258**	-.047
GWL2 _discourage	-.475**	-.458**	-.154*
GWL3 _understandable	-.166**	-.373**	-.060
GWL3 _confuse	.120*	.284**	.059
GWL3 _worried	-.138*	-.237**	-.053
GWL3 _scared	-.177**	-.247**	-.072
GWL3 _discourage	-.485**	-.546**	-.186**
GWL4 _understandable	-.171**	-.324**	-.109
GWL4 _confuse	.140*	.281**	.098
GWL4 _worried	-.124*	-.215**	-.088
GWL4 _scared	-.176**	-.227**	-.074
GWL4 _discourage	-.474**	-.490**	-.227**
GWL5 _understandable	-.241**	-.373**	-.076
GWL5 _confuse	.132*	.249**	.091
GWL5 _worried	-.198**	-.238**	-.087
GWL5 _scared	-.188**	-.244**	-.076
GWL5 _discourage	-.519**	-.515**	-.243**
GWL6_understandable	-.107	-.243**	.024
GWL6 _confuse	.096	.201**	.010
GWL6 _worried	-.191**	-.118	-.072
GWL6 _scared	-.203**	-.117	-.103
GWL6 _discourage	-.466**	-.367**	-.194**
GWL7 _understandable	-.187**	-.315**	-.086
GWL7 _confuse	.153*	.258**	.024
GWL7_worried	-.239**	-.277**	-.112
GWL7 _scared	-.239**	-.274**	-.094
GWL7 _discourage	-.517**	-.540**	-.224**

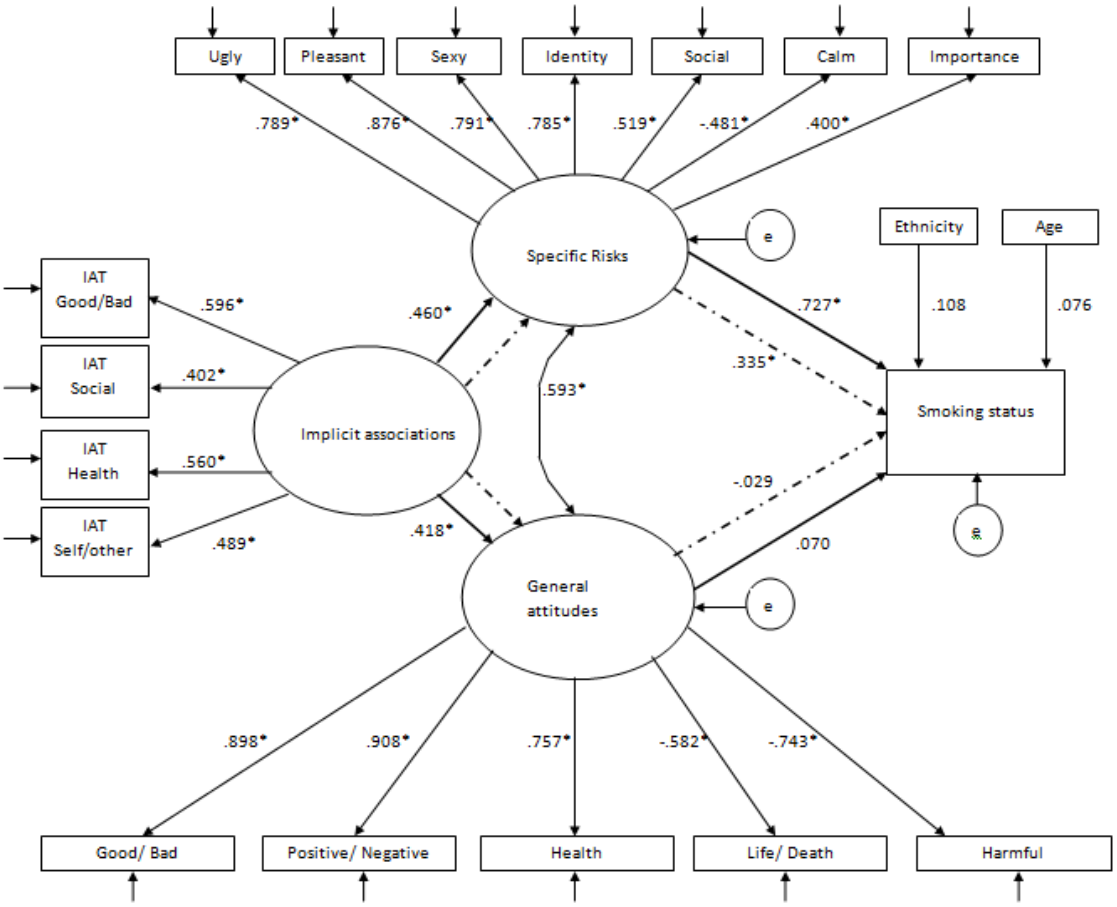
Appendix L: Study 1 graphic warning label correlations (continued)

GWL8 _confuse	.116	.181**	.027
GWL8 _worried	-.377**	-.287**	-.203**
GWL8 _scared	-.382**	-.281**	-.198**
GWL8 _discourage	-.506**	-.389**	-.229**
GWL9 _understandable	-.165**	-.339**	-.067
GWL9 _confuse	.159**	.274**	.051
GWL9 _worried	-.193**	-.054	-.031
GWL9 _scared	-.206**	-.058	.019
GWL9 _discourage	-.482**	-.354**	-.186**

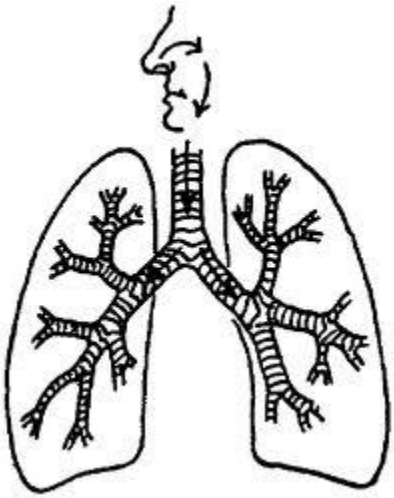
**. Correlation is significant at the 0.01 level (2-tailed).

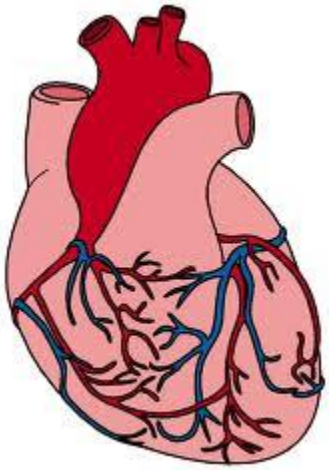
*. Correlation is significant at the 0.05 level (2-tailed).

Appendix M: SEM final model



Appendix N: Experimental condition stimuli





Appendix N: Experimental condition stimuli

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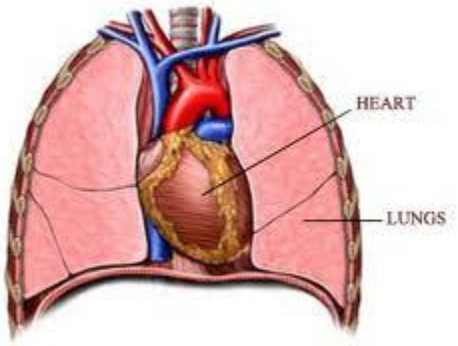
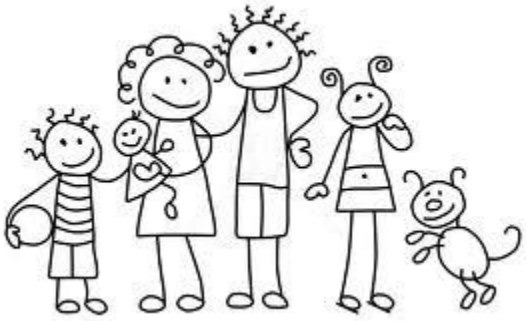
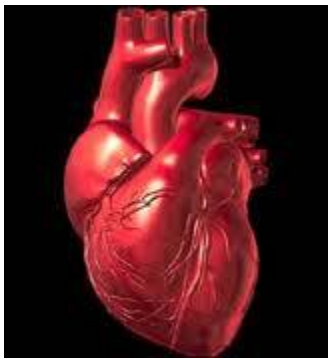
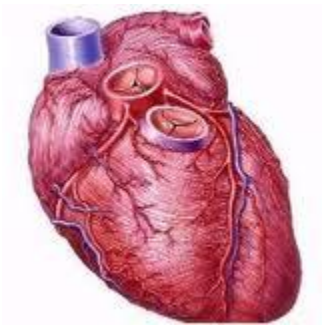
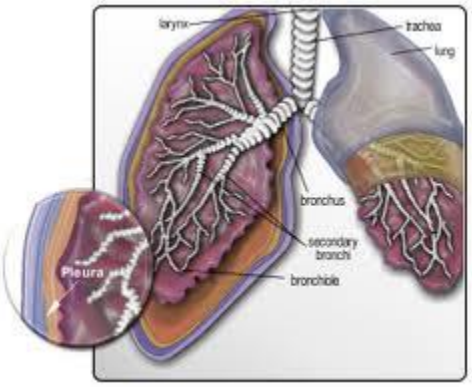


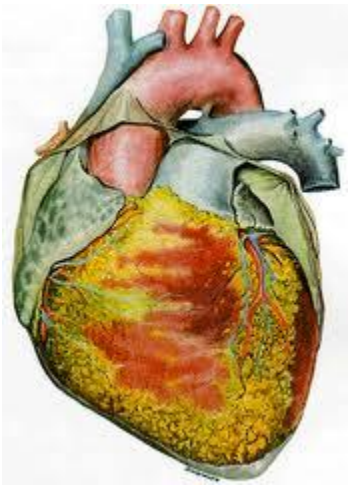




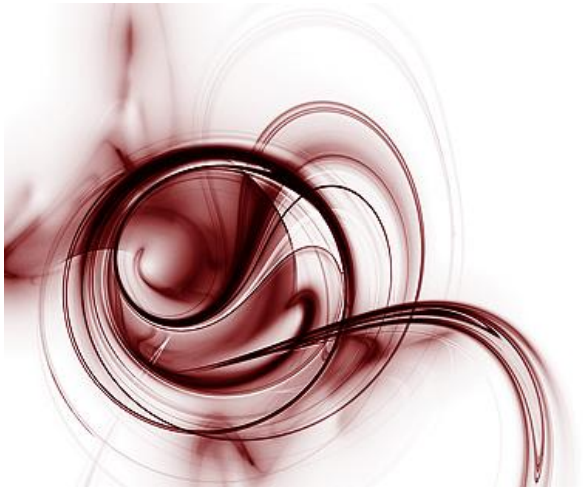




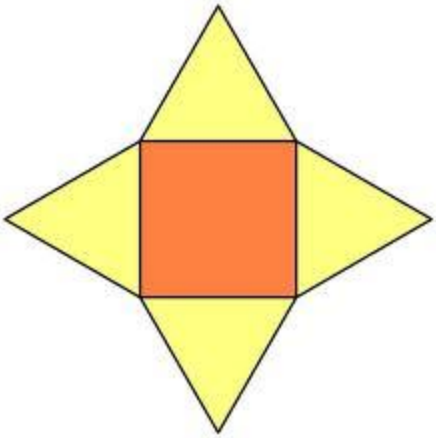
Appendix N: Experimental condition stimuli

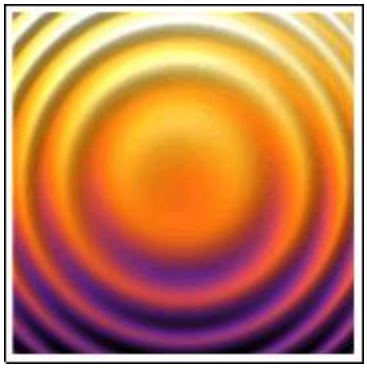


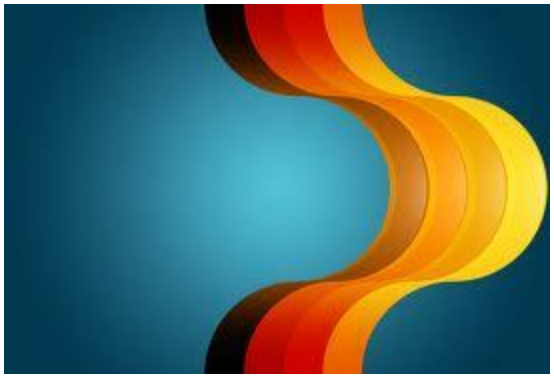
Appendix O: Control Stimuli



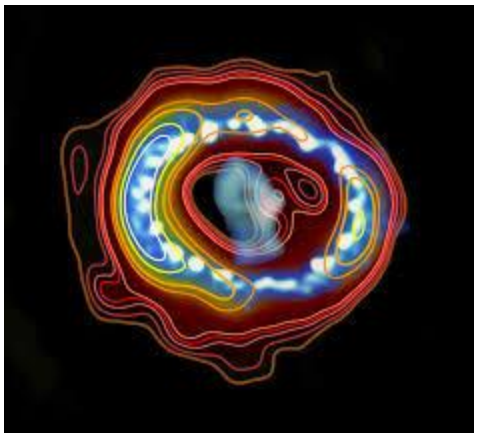
Appendix O: Control stimuli

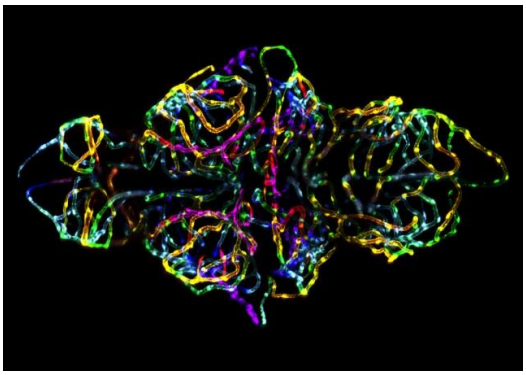


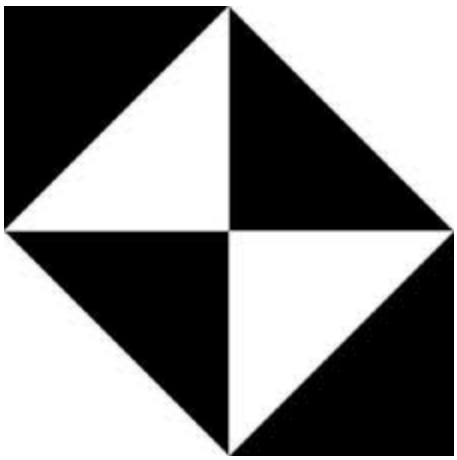




Appendix O: Control stimuli







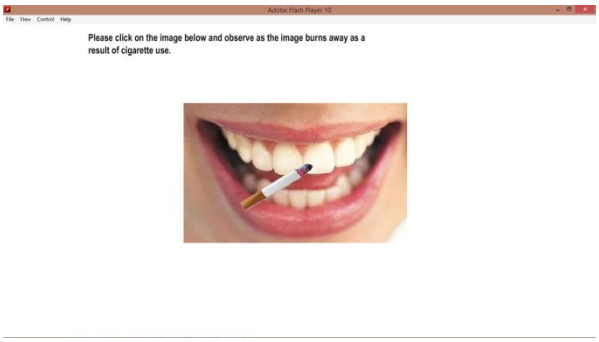
Appendix O: Control stimuli

Appendix P


Adobe Flash Player 10
File View Control Help


Adobe Flash Player 10
File View Control Help

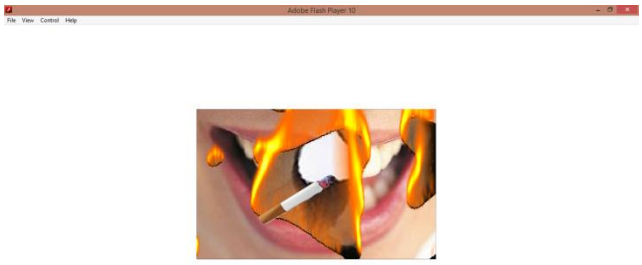

Adobe Flash Player 10
File View Control Help
Please click on the image below and observe as the image burns away as a result of cigarette use.

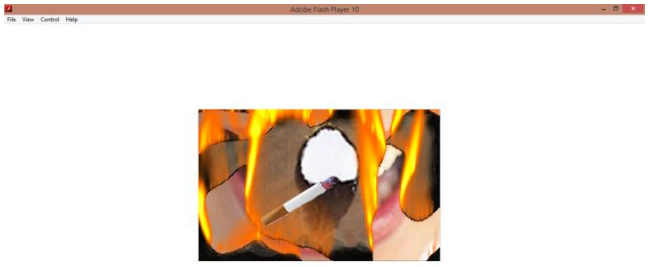

Adobe Flash Player 10
File View Control Help
Please click on the image below and observe as the image burns away as a result of cigarette use.

Appendix P

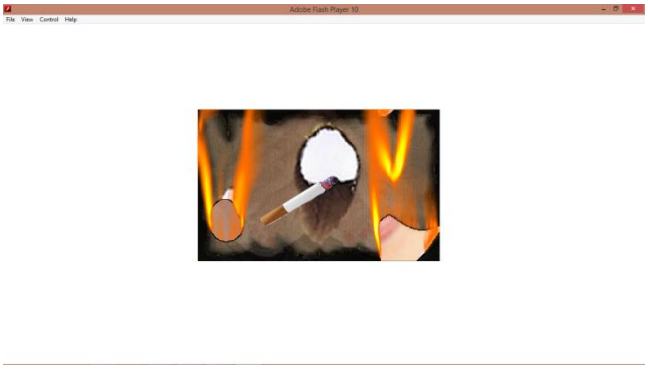

Adobe Flash Player 10
File View Control Help


Adobe Flash Player 10
File View Control Help

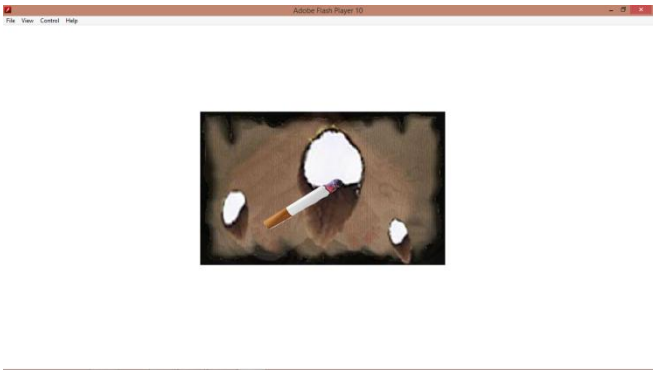

Adobe Flash Player 10
File View Control Help


Adobe Flash Player 10
File View Control Help

Appendix P


Adobe Flash Player 10
File View Control Help


Adobe Flash Player 10
File View Control Help


Adobe Flash Player 10
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File View Control Help

Appendix Q: Study 2 IAT attributes

Self	Other
me, mine, us, self ;	them, they, their, other

Healthy	Unhealthy
healthy, fitness, clean, fresh, energy, health;	unhealthy, disease, illness, sickness, cough, nausea

Appendix R: Study 2 semantic differential correlations

Study 2 correlations between implicit associations and individual semantic differential items

	Implicit Associations
Good-Bad	.076*
Pleasant-unpleasant	.093*
Health	.066
Life-death	.048
Sexy	.114**
Pleasant-unpleasant	.179**
Harmful	.140**
Social	.052
Ugly	.118**
Calming	.122**
Identification	.274**
Important	.033

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Appendix S: Study 2 Halpern-Felshner scale correlations

Study 2 correlations between Halpern-Felshner, Biehl, Kropp, & Rubinstein (2004) and perceived consequences, general attitudes, and implicit associations

	Perceived consequences	General attitudes	Implicit associations
A_asthma	-.052	-.036	.015
A_lung cancer	-.313**	-.155**	-.087*
A_heart attack	-.267**	-.098**	-.054
A_trouble breathing	-.263**	-.165**	-.099**
A_start smoking	-.074*	-.063	-.040
B_asthma	-.300**	-.138**	-.075*
B_lung cancer	-.303**	-.152**	-.106**
B_heart attack	-.274**	-.086*	-.072
B_trouble breathing	-.313**	-.195**	-.125**
B_start smoking	.027	-.020	.028
C_asthma	-.352**	-.230**	-.105**
C_lung cancer	-.357**	-.301**	-.065
C_heart attack	-.277**	-.262**	-.093*
C_trouble breathing	-.290**	-.317**	-.128**
C_start smoking	.002	-.120**	-.048
D_asthma	-.329**	-.189**	-.077*
D_lung cancer	-.308**	-.228**	-.045
D_heart attack	-.260**	-.196**	-.044
D_trouble breathing	-.310**	-.249**	-.107**
D_start smoking	-.014	-.179**	.012

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

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

Appendix S: Study 2 risk perception correlations

Study 2 correlations of 18-item risk perception scale with perceived consequences, general attitudes, and implicit associations

	Perceived consequences	General attitudes	Implicit associations
smell like an ashtray	-.301**	-.349**	-.086*
cough	-.341**	-.348**	-.088*
trouble breathing	-.302**	-.303**	-.074*
bad colds	-.361**	-.265**	-.074*
bad breath	-.341**	-.379**	-.098**
lung cancer	-.336**	-.304**	-.044
heart disease	-.300**	-.275**	-.057
emphasema	-.340**	-.299**	-.066
wrinkles	-.308**	-.294**	-.105**
addicted	-.164**	-.356**	-.006
will still smoke in 5 years	-.146**	-.244**	-.030
will look cool	.400**	.277**	.052
feel relaxed	.499**	.183**	.100**
lose weight	.053	.032	-.036
less anxiety	.427**	.150**	.047
will be less bored	.366**	.143**	.052
be more talkative	.302**	.156**	.074*
put others at risk	-.419**	-.346**	-.126**

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

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

Appendix T: Study 2 graphic warning label correlations

Study 2 correlations between graphic warning label (GWL) ratings and perceived consequences, general attitudes, and implicit associations

	Perceived consequences	General attitudes	Implicit associations
GWL1 _understandable	-.097**	-.248**	.071
GWL1 _confuse	.047	.211**	-.024
GWL1 _worried	-.155**	-.203**	.025
GWL1 _scared	-.167**	-.195**	-.008
GWL1 _discourage	-.525**	-.429**	-.112**
GWL2 _understandable	-.094*	-.263**	.023
GWL2 _confuse	.048	.192**	-.051
GWL2 _worried	-.279**	-.243**	-.065
GWL2 _scared	-.285**	-.246**	-.027
GWL2 _discourage	-.456**	-.364**	-.098**
GWL3 _understandable	-.086*	-.222**	.006
GWL3 _confuse	.043	.238**	-.028
GWL3 _worried	-.138**	-.238**	-.016
GWL3 _scared	-.153**	-.239**	-.014
GWL3 _discourage	-.436**	-.431**	-.140**
GWL4 _understandable	-.128**	-.251**	-.010
GWL4 _confuse	.122**	.249**	-.024
GWL4 _worried	-.201**	-.245**	.001
GWL4 _scared	-.206**	-.249**	-.012
GWL4 _discourage	-.506**	-.467**	-.111**
GWL5 _understandable	-.102**	-.200**	.032
GWL5 _confuse	.089*	.209**	-.052
GWL5 _worried	-.202**	-.221**	.025
GWL5 _scared	-.206**	-.215**	.030
GWL5 _discourage	-.471**	-.380**	-.097**
GWL6_understandable	-.098**	-.165**	.053
GWL6 _confuse	.039	.135**	-.066
GWL6 _worried	-.278**	-.227**	-.014
GWL6 _scared	-.288**	-.222**	-.009
GWL6 _discourage	-.464**	-.324**	-.069
GWL7 _understandable	-.117**	-.254**	-.004
GWL7 _confuse	.154**	.273**	-.041
GWL7_worried	-.244**	-.240**	-.013
GWL7 _scared	-.236**	-.235**	-.014
GWL7 _discourage	-.483**	-.392**	-.090*

Appendix T: Study 2 graphic warning label correlations (continued)

GWL8_understandable	-.140**	-.240**	.081*
GWL8 _confuse	.162**	.233**	-.097**
GWL8 _worried	-.368**	-.267**	-.011
GWL8 _scared	-.363**	-.257**	.013
GWL8 _discourage	-.501**	-.347**	-.065
GWL9 _understandable	-.098**	-.215**	.013
GWL9 _confuse	.069	.241**	-.043
GWL9 _worried	-.182**	-.059	.051
GWL9 _scared	-.184**	-.025	.053
GWL9 _discourage	-.401**	-.304**	-.052

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

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