2013

The Impact of Warning Label Exposure on Attentional Bias to Smoking Cues in Smokers and Nonsmokers

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https://dx.doi.org/10.21220/s2-xxjg-hy94

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The Impact of Warning Label Exposure on Attentional Bias to Smoking Cues in Smokers and Nonsmokers

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A Thesis presented to the Graduate Faculty of the College of William and Mary in Candidacy for the Degree of Master of Arts

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The College of William and Mary
August, 2013
This Thesis is submitted in partial fulfillment of the requirements for the degree of

Master of Arts

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Approved by the Committee, June 2013

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Protocol number(s): PHSC-2012-09-10-8109-caforestell

Date(s) of approval: 9/28/2012
Abstract

Research on graphic warning labels used on cigarette packages suggests they are more effective than text labels at reducing smoking behavior. However, it is possible that text labels that challenge social- and coping-related outcome expectancies associated with smoking could be more effective than those that rely on health-related threats. Whether warning labels lead to cognitive changes in attention to cigarette-related cues has not yet been tested, but is important to study, as implicit attentional bias toward smoking-related images has been implicated in nicotine addiction and is related to addiction severity as well as difficulty quitting and relapse. The current study sought to measure participants’ implicit attention toward smoking-related images using a Dot Probe task. Eighty-eight nonsmokers and 111 smokers completed the Dot Probe before and after viewing graphic labels, text health labels, text social/coping labels, or control labels. Results showed that only graphic warning labels affected smokers’ attention, such that attentional bias toward the control images was increased after viewing the graphic labels. These results suggest that graphic labels are more likely to affect attention in smokers than text-only labels, which may lead to reductions in smoking behavior. Given that attentional bias toward smoking-related cues is associated with addiction-related cognitive changes in smokers that have been linked to difficulty with quitting smoking, the current findings support the efficacy of the graphic warning labels.
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ACKNOWLEDGEMENTS

This writer wishes to express her appreciation to her advisors, Professor Cheryl Dickter and Professor Cathy Forestell, for their guidance, support, and criticism throughout this thesis project and throughout her career in the graduate program. She wishes to thank them as well for fostering her interest in research and for their enthusiasm for her ideas. She would also like to thank Professor Josh Burk for his thoughtful questions and feedback on the project.

The writer also wishes to acknowledge her family and friends, her fiancé, and particularly her fellow psychology graduate students for their love and support during her time at William and Mary. She would like to thank them all for bringing laughter and joy to even the most difficult days of this thesis project.
The Impact of Warning Label Exposure on Attentional Bias toward Smoking Images in Smokers and Nonsmokers

One of the most serious public health issues in the United States is the continued prevalence of cigarette smoking. Approximately 20% of Americans report that they smoke cigarettes, which has been shown to result in a number of serious health issues, including increased risk of heart disease, stroke, and lung disease (Center for Disease Control [CDC], 2011). The adverse health effects of smoking result in as many as 443,000 deaths (approximately 1 in every 5 deaths) per year in the U.S. (CDC, 2008), making it the leading cause of preventable death in the nation (Mokdad et al., 2000). Although most smokers understand the health risks involved with smoking, they continue to smoke because of the addictive properties of nicotine. Approximately 35 million smokers per year express a desire to quit smoking, but 85% of those who attempt to quit relapse within a week (National Institute on Drug Abuse [NIDA], 2012). In addition to the health risks, smoking also takes a large economic toll on society; the estimated economic burden of smoking, which includes healthcare costs and lost productivity, is $193 billion per year (NIDA, 2012). Taken together, these statistics indicate that more effective strategies are needed for smoking prevention and cessation.

One common method of reducing the prevalence of cigarette smoking is the use of health-related warning labels on cigarette packages, which are used in nearly every nation in the world and can easily relay health information to potential consumers (Hammond et al., 2007). The goal of warning labels is to inform consumers about the health risks associated with smoking in order to encourage smoking reduction, cessation, and prevention. Although the introduction of text warning labels on cigarette packages in
the U.S. in the 1960s initially resulted in a dramatic decrease in smoking behavior (CDC, 2000), cigarette smoking continues to be prevalent despite the continued use of text labels. Recently, the U.S. Food and Drug Administration (FDA) attempted to improve the efficacy of health warnings on cigarette packaging by creating a set of graphic warning labels, which include images depicting the health risks of smoking, accompanied by a text explanation of the image and a phone number for a quitting assistance hotline (Department of Health and Human Services [HHS], 2011). For example, one label includes a picture of a healthy lung next to a picture of a diseased lung, along with the text “Cigarettes cause fatal lung disease.” These labels were designed as part of the Family Smoking Prevention and Tobacco Control Act, which became law in 2009 and requires that cigarette packages use more prominent warning labels.

Thus far, the overall efficacy of the FDA’s set of graphic warning labels has not been tested in the US. However, evidence from other countries indicates that graphic warning labels may be more effective at reducing smoking behavior than text-only labels. For instance, a survey of Canadian smokers found that approximately 20% of participants reported smoking less often as a result of the introduction of graphic warning labels (Hammond et al., 2004). In addition, when graphic labels were first used in Australia, smokers reported that they read and noticed the labels more, had more thoughts about health risks and quitting, and chose to forego smoking more often than before the labels were introduced (Borland et al., 2009). In comparison, when larger text-only labels were introduced in the U.K., smokers reported reading and noticing them at similar rates, but did not experience as many thoughts about health risks and quitting as the Australians did to the graphic labels (Borland et al., 2009). Importantly, cognitive responses such as
thinking about health risks and quitting and decisions to forego smoking cigarettes have been found to predict quit attempts (Borland et al., 2009b). Indeed, smokers who live in countries that use graphic warning labels are more likely to attempt to quit smoking than smokers who do not (Azagba & Sharaf, 2012). Finally, a recent review of numerous studies by Hammond (2007) found that prominent graphic warning labels can increase health knowledge, risk awareness, and quit attempts among smokers. Taken together, these findings suggest that graphic labels may be more effective than text-only labels at encouraging quit attempts.

Although the precise mechanism by which graphic warning labels produce these effects has yet to be determined, initial evidence suggests that emotional responses may play an important role in their efficacy. Smokers in Canada, for instance, reported feeling negative emotions such as fear and disgust in response to graphic warning labels, and the greater these negative emotions were experienced, the more likely participants were to attempt to quit smoking (Hammond et al., 2004). Another study found that the relationship between graphic warning label exposure and increased intentions to quit was mediated by the fear response evoked by these labels (Kees et al., 2010). These findings fit well with the extended parallel process model (EPPM), which purports that strong fear appeals such as those used in graphic warning labels promote increased message processing and, if perceived efficacy to change is sufficiently high, motivation to change behavior (Witte, 1992). Comparisons of different types of warning labels indicate that graphic labels more reliably produce negative emotional responses than text-only labels (Hammond, 2007); these findings provide additional support that graphic labels may more effectively reduce smoking behavior than text-only labels.
Some researchers, however, argue that the negative emotional response elicited by graphic warning labels may actually produce maladaptive responses and continued smoking behavior rather than increasing motivations to quit. For instance, two studies have shown that smokers experience reduced risk perception for negative smoking-related health outcomes and reduced intentions to quit after exposure to graphic warning labels (Glock & Kneer, 2009; Harris et al., 2007). Another study found that smokers who were exposed to graphic warning labels were significantly more likely to experience psychological reactance than smokers who viewed text-only labels (Erceg-Hurn & Steed, 2011). These types of defensive reactions in response to the negative affect elicited by graphic warning labels may result in decisions to continue smoking (Glock & Kneer, 2009). Additional support for the harmful impact of this negative emotional response comes from a study by Shiffman and Waters (2004), which found that rapid increases in negative affect can lead to smoking relapse. It is important to note that these findings also fit well with the EPPM (Witte, 1992). It is possible that although graphic warning labels produce a fear response, smokers viewing the labels have low perceived self-efficacy; therefore, fear in response to graphic labels results in continued smoking behavior rather than behavior change. Thus, although the weight of the evidence appears to be in favor of the use of graphic warning labels, other research highlights the potential for maladaptive responses toward these labels and raises serious concerns about their overall impact.

In response to these concerns, Glock, Unz, and Kovacs (2012) developed a set of novel warning labels that avoid fear appeals and negative affective responses altogether. Rather than focus on health risks, these labels seek to counteract common social- and
coping-related outcome expectancies associated with smoking. Common positive outcome expectancies associated with smoking include coping-related outcomes such as reduced stress and satisfaction, as well as social-related outcomes such as feeling more attractive and more popular (Hendricks & Brandon, 2005; Morrell, Song, & Halpern-Fisher, 2010). Thus, this set of text-only labels includes messages such as “Cigarettes will increase your stress level” and “Tobacco smoke makes you unattractive.” Because outcome expectancies are closely related to motivation, smoking behavior, and smoking cessation (Brandon, Juliano, & Copeland, 1999), counteracting these positive expectancies may encourage quit attempts. In an initial study on these social- and coping-related labels, smokers’ implicit attitudes toward smoking shifted from positive to ambivalent after viewing the labels, and they showed a reduction in smoking behavior 24 hours after the experiment (Glock, Unz, & Kovacs, 2012). These changes in attitudes may play a role in reducing smoking behavior.

Taken together, research on warning labels has produced conflicting results. One major weakness of this research, which may contribute to these inconsistent results, is that the vast majority of these studies rely entirely on self-reported responses to the labels and changes in behavior. Self-report measures may not accurately reflect participants’ actual responses or behavior, and, more importantly, they do not reveal any information about how warning labels affect the underlying cognitive processes associated with nicotine addiction. Understanding how the cognitive processes associated with smoking are affected by warning labels is important, as nicotine addiction involves cognitive and neurological changes, which stem from the drug’s effects on the mesocorticolimbic dopamine system (Koob et al., 1994). These changes produce a number of long-term
cognitive effects, including drug craving and increased incentive salience of drug-related stimuli (Berridge, 2007; Robinson & Berridge, 1993). Increased incentive salience in particular leads to a common cognitive feature associated with drug addiction: attentional bias (i.e., preferential cognitive processing) toward drug-related stimuli (Field & Cox, 2008). This attentional bias toward drug-related stimuli is widely considered to be implicit, such that relevant stimuli automatically capture the individual’s attention, and this occurs outside of the individual’s awareness (Williams, Mathews, & MacLeod, 1996).

In support of these addiction models, research shows that attentional bias plays a significant role in drug addiction, including nicotine addiction. Many studies have demonstrated that smokers show an attentional bias toward smoking-related stimuli (Dickter & Forestell, 2012, Mogg et al., 2003; Waters & Feyerabend, 2000; Waters et al., 2003b). This attentional bias may be particularly relevant for inactive images, images that do not contain human content, rather than active images which contain human content (Dickter & Forestell, 2012; Forestell, Dickter, & Young, 2012). Greater attentional bias toward drug-related cues is associated with the severity of the drug addiction (Forestell, Dickter, & Young, 2012; Townshend & Duka, 2001; Vadhan et al., 2007). As greater attentional bias toward smoking-related cues is associated with addiction-related cognitive changes in smokers that have been linked to difficulty with quitting smoking, including an increased likelihood of relapse after a cessation attempt (e.g., Bradley et al., 2003; Waters et al., 2003), it is important to examine whether warning labels and other public health campaigns affect implicit attentional bias toward smoking-related cues.
The goal of the current study was to examine how graphic and social/coping warning labels affect implicit cognitive responses to smoking-related cues. Such research is vital in understanding the mechanism through which warning labels can lead to behavioral change in smokers and could help resolve some of the inconsistencies in the literature regarding their efficacy. In the current study, we examined whether the FDA graphic warning labels and a set of social/coping labels similar to those used by Glock, Unz, and Kovacs (2012) would be effective in changing smokers’ attentional biases to smoking-related cues. To this end, a Dot Probe task was used to measure smokers’ and nonsmokers’ implicit attentional bias to smoking-related cues before and after exposure to one of four sets of warning labels. Nonsmokers were included as a control group to ensure that any changes between pre-test and post-test in smokers were due to the warning labels and not task repetition. The four label sets included the FDA graphic warning labels, health-related text-only labels, social/coping text-only labels, and control labels that contained neutral text statements.

Because graphic warning labels have been shown to induce negative affect in viewers (Hammond et al., 2004), and have also been shown to reduce self-reported smoking behavior (Hammond, 2007; Borland et al., 2009), we hypothesized that the graphic labels would effectively reduce smokers’ attentional bias toward smoking-related images. In addition, the non-health-related message content of the social/coping labels has been shown to reduce smoking behavior as well, likely through shifts in attitudes toward smoking (Glock et al., 2012). It is possible, however, that a shift in attitudes is not the sole mechanism underlying these effects, and that changes in attention toward smoking cues also contribute to behavior change. Thus, we hypothesized that the
social/coping labels would also reduce smokers’ attentional bias toward smoking images as well. Because research using the active and inactive picture stimuli shows that smokers tend to show more attentional bias toward inactive cues (Dickter & Forestell, 2012), we predicted that these effects would be greater for the inactive than the active cues. We also hypothesized that text-only health-related labels would not affect attentional bias because research shows that these types of labels do not change smoking behavior as effectively as graphic labels (Hammond, 2007). Finally, because many nonsmokers do not show attentional bias toward smoking-related images (Forestell et al., 2011), we hypothesized that their cognitive responses to the cues would be unaffected by any of the warning labels.

Method

Participants

A total of 315 participants completed the study using Amazon’s Mechanical Turk, an online marketplace that allows requesters to recruit individuals to complete tasks in exchange for payment. Participants were required to be 18 years of age or older and reside in the United States. Each participant provided informed consent prior to their participation and received $0.60 upon completion of the study tasks. All study materials and procedures were approved by the College of William and Mary’s Protection of Human Subjects Committee.

Materials

Dot Probe Task. The Dot Probe Task is a reaction time measure designed to assess relative attention between two types of stimuli and has been used to measure attentional
bias toward smoking- and alcohol-related images relative to control images (Dickter & Forestell, 2012; Forestell, Dickter, & Young, 2012; Forestell et al., 2012). The Dot Probe task was administered using Inquisit software (2012 [Seattle, WA]). Each Dot Probe trial begins with the presentation of a fixation cross in the middle of the screen for 1000 ms. Following the fixation cross, two matched images (i.e., one smoking-related image and one matched non-smoking-related image) are displayed on the screen simultaneously at equal distance to the left and the right of the center of the screen for 500 ms. The two images are then masked for 433 ms. Finally, a black dot appears in the center of the location where one of the pictures previously appeared. The dot remains on the screen until participants respond by pressing one of two keys indicating on which side of the screen (i.e., left or right) the dot appeared. The sequence for each Dot Probe trial is illustrated in Figure 1. Reaction times are recorded for each trial throughout the task. To assess attentional bias toward target stimuli relative to control stimuli, reaction times for trials in which the dot appears in the same location as the target stimuli are compared to reaction times for trials in which the dot appears in the same location as the control stimuli. Faster reaction times to the target dot trials indicate a higher degree of attentional bias toward the smoking-related images.

**Picture Stimuli.**

**Dot Probe stimuli.** The target stimuli used in the study consisted of digital photographs of smoking-related and control stimuli taken on the same neutral background. The smoking-related stimuli consisted of 40 photographs of objects directly related to smoking, such as a burning cigarette or a lit cigarette in a person’s mouth. The control stimuli consisted of 40 photographs of non-smoking-related neutral stimuli, such
as pens and dental floss (Forestell et al., 2011). Each neutral image was matched to a specific smoking-related image on several characteristics, including object shape, size, and position, as well as the lighting and color of the photograph. Half of the images in the set were active, meaning they contained human interaction, such as a hand holding a lighter or a cigarette held up to a person’s mouth, while the other half were inactive, meaning they contained the objects alone without any human content.

**Warning Label stimuli.** Four sets of 8 warning labels were used in the study, each of which was presented on an image of a non-branded cigarette package, as shown in Appendix F. The graphic health set consisted of the FDA’s graphic warning labels with both images and text included. The text health set contained only the text from the FDA labels (HHS, 2011). For example, a label from the graphic health set included an image of a diseased lung along with the message “Cigarettes cause fatal lung disease,” while the equivalent label from the text health set included the same text with no image. The social-coping label set contained text-only labels originally created by Glock, Unz, and Kovacs (2012). These labels contained messages that contradict common positive social-and coping-related outcome expectancies related to smoking, such as the idea that smoking reduces stress or is socially desirable. These labels were adapted from the original study (Glock, Unz, & Kovacs, 2012), translated from German into English, and rephrased to match the sentence structure and length of the FDA labels. Some examples include “Cigarettes reduce your ability to concentrate” and “Tobacco smoke makes you unattractive.” Finally, the control set of labels included text-only neutral smoking-related message (i.e., “Cigarettes weigh 1.2 grams” and “Smoking is often depicted in films”).
These labels were also matched to the other label sets in terms of sentence structure and length.

**Questionnaires.** Participants provided demographic information, including their age, gender, race, marital status, employment status, education, and income. They also reported whether or not they had difficulty with the Dot Probe task, in order to insure that data from participants who did not understand the task were excluded from analysis. Participants then completed several smoking-related questionnaires. They first completed a general smoking questionnaire, which involved questions regarding participants’ exposure to cigarette smoking (i.e., reports of parents’ and friends’ smoking habits, and their own smoking habits and history). Items about smoking exposure included free-response items such as “How many of your close friends smoke cigarettes?” as well as items such as “Has anyone close to you ever experienced negative health impacts from smoking cigarettes?” with response options “Yes,” “No,” or “I don’t know.” Parental smoking history was evaluated with 3 items; the first item was “Have either of your parents smoked during your lifetime?” with response options “Yes, father only,” “Yes, mother only,” “Yes, both parents,” and “No, neither parent.” The second and third item asked participants to indicate the context or contexts in which their mother and father typically smoked – at social events, on stressful days, or daily.

Participants also answered questions about their attitudes toward cigarette smoking and the use of warning labels on cigarette packaging, which were included in order to evaluate differences in these attitudes across smoking groups. This group of questions included items such as “How unpleasant is it for you to be in the presence of people who are smoking?” with response options “Very unpleasant,” “Somewhat
unpleasant,” and “Not at all unpleasant.” Participants were also asked questions such as “How much do you agree or disagree with cigarette packages having health warning messages?” with response options on a Likert scale ranging from 1 - “Strongly disagree” to 5 - “Strongly agree,” and “How accurately do you feel the warning labels depict the risks to your health?” with responses options on a Likert scale ranging from 1 – “Very inaccurately” to 5 – “Very accurately.”

Finally, participants answered several questions about their own smoking habits. They reported their frequency of smoking per day and per week, and whether they had quit smoking within the last 2 years. These items were used to categorize participants into one of four groups: nonsmokers, occasional smokers, daily smokers, and former smokers. They also reported the age in years at which they first smoked a cigarette, and the age in years at which they began to smoke cigarettes regularly. Following the general smoking questionnaire, participants who identified themselves as smokers completed two additional validated questionnaires, described below. All questions and response options for the demographic and general smoking questionnaire are shown in Appendix B.

**Fagerstrom Test for Nicotine Dependence.** The Fagerstrom Test for Nicotine Dependence (FTND; Fagerstrom, 1978) is a measure of physical dependence on nicotine, and consists of 6 questions related to nicotine dependence ($\alpha = .61$). Items include questions such as “How soon after you wake up do you smoke your first cigarette?” and “Do you smoke if you are so ill that you are in bed most of the day?” Participants receive a total score from 0 to 11, with 0 indicating minimum physical dependence and 11 indicating maximum physical dependence. All items from the FTND are shown in Appendix C.
**Michigan Nicotine Reinforcement Questionnaire.** The Michigan Nicotine Reinforcement Questionnaire (Pomerleau et. al, 2003) assesses smoking habits related to positive and negative reinforcement. The questionnaire consists of 13 total items, with 5 measuring positive reinforcement ($\alpha = .79$) and 8 measuring negative reinforcement ($\alpha = .84$). Participants respond to items such as “I like the taste of cigarettes” and “I crave a cigarette to provide relief from withdrawal” using a 0 to 3 scale, with 0 indicating “never” or “not at all” and 3 indicating “always” or “severe.” Total scores on each subscale are used to measure positive and negative reinforcement. All items from the MNRQ are shown in Appendix D.

**Procedure**

After consenting to participate in the study (see Appendix A), participants were directed to the Inquisit study website and given instructions to download the software and begin the experiment. Participants then read instructions for the Dot Probe Task and completed five practice trials before completing one pre-test block of 80 trials. After completing the pre-test task, participants completed the warning label viewing task. During this task, participants were randomly assigned to view one of the four sets of eight warning labels described previously, and were instructed to pay close attention to the content of each label. Following a fixation cross displayed for 1000 ms, a randomly selected warning label from the assigned set appeared on the screen for 5000 ms, followed by an inter-trial interval of 3000 ms. Each label in the set of eight was displayed once, and no response from the participants was required.
After viewing the eight warning labels, participants repeated the post-test Dot Probe task, which was exactly the same as the pre-test task except that no practice trials were given. Participants were given the opportunity to take short breaks between each of the experimental blocks. Finally, following completion of the post-test experimental tasks, participants were redirected to an online survey and completed the demographic questionnaire and the general smoking questionnaire. Participants who identified themselves as smokers also completed the FTND and the MNRQ. These participants also answered a “Yes” or “No” item at the end of the study that asked them to confirm their smoking status (see Appendix E). Finally, all participants read a debriefing statement, shown in Appendix E, that revealed the purposes of the study and were given a code to use on Mechanical Turk in order to receive their compensation.

Results

Participant Characteristics

Out of 315 participants, data for 58 participants were excluded from the original sample because they did not follow the task instructions (n = 8), they completed the study twice (n = 5), their computer task data could not be matched to their questionnaire data or they did not complete the questionnaires (n = 8), they were a former smoker but did not currently smoke (n = 21), or because they reported at the conclusion of the study that their given smoking status was inaccurate (n = 16). Finally, an additional 58 participants who identified themselves as occasional smokers were excluded because daily smoking was a criterion used for the inclusion of smokers in the analyses. These exclusions left a final sample size of 199 participants that included 111 smokers and 88 nonsmokers.
The final sample consisted of 63.8% females, and 84.4% of the participants were White, 4.5% were Black or African American, 4.0% Hispanic or Latino, 2.5% Asian, and 4.0% multiracial or “other.” The mean age of participants was 33.43 years ($SD = 11.71$). For marital status, the sample broke down as follows: 39.2% of participants were married, 51.8% were single, and 9.0% were divorced, separated, or widowed. For annual family income, 35.2% of participants reported income of $25,000 or under, 49.3% reported incomes between $25,000 and $75,000, and 15.5% reported incomes of $75,000 or higher. Smokers and nonsmokers did not significantly differ on any of these demographic variables, other than nonsmokers tended to be more highly educated than smokers, $\chi^2(6, n = 199) = 21.55, p = .001$.

**Smoking History, Exposure, and Attitudes**

Smokers reported smoking approximately 15 cigarettes per day ($M = 14.97, SD = 7.81$). On average, they reported smoking their first cigarette before they were 15 years of age ($M = 14.84, SD = 3.28$), and had been smoking for about 19 years ($M = 18.82, SD = 12.44$). Their average MNRQ positive reinforcement score was 7.99 ($SD = 3.48$) and their average negative reinforcement score was 12.96 ($SD = 5.54$); both of these scores fall in the middle range of their respective scales. Finally, their mean FTND score was 4.26 ($SD = 2.23$), indicating that on average, this sample of smokers experienced moderate nicotine dependence. There were no significant differences between the label conditions for the smokers on any of the smoking history measures.

As shown in Table 1, there were numerous differences between nonsmokers and smokers in terms of exposure to smoking and attitudes toward smoking and warning
labels. Smokers were more likely than nonsmokers to have a smoking parent, $\chi^2(3, N = 199) = 15.54, p = .001$, or a close friend who smoked, $F(1, 179) = 26.45, p < .001, \eta^2 = .129$, and spent significantly more time around others who were smoking, $F(1, 193) = 34.55, p < .001, \eta^2 = .152$. The likelihood of reporting a close friend or relative who experienced negative health effects from smoking was also higher for smokers than nonsmokers, $\chi^2(2, N = 199) = 6.48, p = .039$. The two smoking groups also differed in their attitudes toward warning labels. Compared to nonsmokers, smokers were less likely to agree with the use of warning labels, $\chi^2(4, N = 199) = 33.91, p < .001$, reported lower increased health risk awareness from warning labels, $\chi^2(3, N = 199) = 55.43, p < .001$, and rated the warning labels as less accurate, $\chi^2(4, N = 199) = 11.39, p = .023$.

**Dot Probe Results**

In order to assess attentional bias toward the smoking stimuli relative to the control stimuli in the pre- and post-tests, difference scores were calculated by subtracting the mean reaction times for the trials in which the dot appeared behind the control pictures from the mean reaction times for the trials in which the dot appeared behind the smoking pictures. Thus, positive scores indicated increased attentional bias toward the smoking images, and negative scores indicated increased attentional bias toward the control images.

Differences in attentional bias across smoking groups and label conditions were assessed by performing a $2 \times 2 \times 2 \times 4$ mixed-model analysis of variance (ANOVA), with repeated
measures on the first two factors. This initial analysis revealed significant main effects of Smoking Group, $F(1, 183) = 12.91, p < .001, \eta^2 = .066$, and Label Group, $F(3, 183) = 4.54, p = .004, \eta^2 = .069$. In addition, a marginal three-way Time x Image Type x Label Group interaction was identified, $F(3, 183) = 2.13, p = .098, \eta^2 = .034$.

All of these findings were qualified by a significant four-way Time x Image Type x Smoking Group x Label Group interaction, $F(3, 183) = 2.69, p = .048, \eta^2 = .042$. Simple main effects analyses were conducted in order to break down this interaction by Smoking Group, such that results for nonsmokers and smokers were analyzed separately. As shown in Figure 2A, only a main effect of label condition was found for the nonsmokers, $F(3, 82) = 3.17, p = .028, \eta^2 = .104$, such that participants in the text health label condition showed significantly less bias toward the smoking images than participants in the graphic label condition, $F(1, 35) = 6.60, p = .015, \eta^2 = .159$. No other significant effects were found for the nonsmokers.

Next, simple main effects analyses were conducted for smokers. As shown in Figure 2B, this analysis revealed a significant Time x Image Type x Label Group interaction, $F(3, 101) = 2.87, p = .040, \eta^2 = .078$. Further analyses were conducted separately for each label condition. No significant effects were found in the control group or the text health group. For the social/coping group, there was a marginal Time x Image Type interaction, $F(1, 23) = 2.90, p = .102, \eta^2 = .112$. Simple main effects analyses for this interaction, however, revealed no significant effects. For the graphic label group, there was a significant main effect of Time, $F(1, 26) = 5.16, p = .032, \eta^2 = .166$, such that at pretest, smokers showed greater attentional bias toward the smoking stimuli ($M = 6.59, SE = 7.86$) than at posttest ($M = -21.98, SE = 9.64$).
Discussion

The results of the current study indicated that smokers experienced significant shifts in attention in response to the graphic labels, but not in response to either of the sets of text-only labels. That is, while smokers showed greater attentional bias for the control images after viewing the graphic warning labels, their attentional bias did not differ after viewing either the text health or the social/coping labels. It is important to note, however, that the smokers did not show significant attentional bias toward the smoking-related images at pretest. While many previous studies have demonstrated that smokers show attentional bias toward smoking stimuli (Dickter & Forestell, 2012, Mogg et al., 2003; Waters & Feyerabend, 2000; Waters et al., 2003b), our results were not consistent with this previous research. Our ability to make strong conclusions about the effects of warning labels on attention is therefore somewhat limited by this finding. Because of this limitation, rather than suggesting that graphic warning labels reduce attentional bias toward smoking images, our results seem to show that graphic warning labels can promote increased attention toward non-smoking-related stimuli over smoking-related stimuli.

Importantly, no change in attentional bias was observed for nonsmokers as a function of viewing any of the label categories, which supports our final hypothesis. Although all participants were more familiar with the picture stimuli during the posttest task, the fact that nonsmokers’ attentional bias did not shift suggests that the shift observed in the smokers was likely not a function of mere exposure or familiarity toward the cues.
Our results provide support for previous research that shows that graphic labels are more effective than text-only labels at encouraging quit attempts and factors that contribute to quitting (Borland et al., 2009; Borland et al., 2009b; Hammond et al., 2004; Hammond, 2007). To date, this body of research has relied almost entirely on self-report or population-based measures of smoking-related variables. Thus, although the results of these previous papers are suggestive, they lack support from implicit measures, which are far less susceptible to response bias. Indeed, the current study is the first to provide evidence that viewing graphic warning labels can affect implicit cognitive processes. Moreover, results from previous studies did not provide information about how graphic warning labels reduce smoking behaviors. Our results suggest a possible cognitive mechanism to explain the effectiveness of graphic warning labels, a subject which had not been studied previously. Whereas text-only health-related warning labels produced no change in smokers’ attentional bias, graphic warning labels promoted greater attention toward control images over smoking images at posttest. Graphic warning labels’ effect on attentional bias, therefore, may be the mechanism underlying the changes in smoking behavior reported by other researchers (Borland et al., 2009; Hammond et al., 2004).

Attentional bias is a common feature of nicotine addiction (Mogg et al., 2003; Waters & Feyerabend, 2000; Waters et al., 2003b) and plays an important role in the perpetuation of addiction-related behaviors. Greater attentional bias toward drug-related cues is associated with greater addiction severity (Forestell, Dickter, & Young, 2012; Townshend & Duka, 2001; Vadhan et al., 2007), and contributes to relapse and difficulty quitting (Bradley et al., 2003; Waters et al., 2003). Thus, reducing attentional bias toward smoking-related cues can make it easier for smokers to successfully reduce their
smoking behavior or quit altogether. Indeed, decreasing attentional bias toward smoking cues through cognitive-behavioral therapy techniques has been shown to reduce nicotine craving (Attwood et al., 2008). Although our sample of smokers did not show attentional bias toward smoking cues at pretest, the current study did demonstrate that viewing graphic warning labels increased attentional bias to non-smoking cues. Because attentional bias toward drug-related cues and drug craving are closely related (Field & Cox, 2008), warning labels that encourage the direction of attention toward neutral cues over smoking-related cues may have a positive impact on nicotine craving and smoking behavior. Together with previous research, then, the current study suggests that graphic warning labels may have a greater impact on important addiction-related process than text-only health labels. In addition, our study supports the idea that drug-related attentional biases are malleable. Although researchers in cognitive-behavioral therapy have found mixed results regarding the efficacy of a single attentional bias-reducing training session, and the duration of their effects is believed to be fairly short (Field et al., 2009; McHugh et al., 2010), graphic warning labels could overcome these issues because smokers would be exposed to them each time they reached for a cigarette or purchased a package of cigarettes.

Finally, our second hypothesis, which stated that exposure to the social/coping labels would also reduce smokers’ attention toward smoking stimuli, was not supported by the study results. Smokers in the social/coping label group did not show any significant change in their attention from pretest to posttest. As outlined above, reducing attentional bias may have beneficial effects for people who are addicted to nicotine, but we cannot conclude that social/coping labels are ineffective simply because they do not
affect attention. The goal of the current study was to examine a potential cognitive mechanism underlying warning labels’ effectiveness, rather than their effectiveness itself; thus, we did not measure changes in smoking behavior after label exposure and cannot draw conclusions about social/coping labels’ effectiveness at reducing smoking behavior. It may be that social/coping labels reduce smoking behavior by relying only on shifts in attitudes rather than changes in attention. Indeed, Glock and colleagues (2012) proposed that they produce changes in smoking behavior by challenging smokers’ positive outcome expectancies related to smoking, thereby encouraging more negative attitudes toward smoking. Because outcome expectancies are closely related to the perpetuation of smoking behavior as well as quitting (Brandon, Juliano, & Copeland, 1999), changing these outcome expectancies through warning labels may be another effective mechanism of reducing smoking behavior, even if attention is unaffected.

It is also possible that social/coping warning labels and graphic warning labels differentially impact different types of smokers. Previous research conducted in our lab shows that responses to graphic warning labels are affected by an individual’s frequency of smoking behavior. In this study, daily smokers responded with significantly more negative affect to graphic warning labels than occasional smokers (Harris, Forestell, & Dickter, in preparation). Thus, it is important to take into account the characteristics of the smokers in a given study when drawing conclusions about the effects of warning labels. Previous research shows that daily smokers are more likely than occasional smokers to show attentional bias toward smoking images, most likely because they are more dependent on nicotine (Dickter & Forestell, 2012). It is possible that the fear-evoking graphic warning labels have a greater impact on the behavior of daily smokers,
whereas the outcome expectancy-challenging messages in the social/coping labels may
be more impactful for occasional smokers or other smoking groups who are less likely to
show attentional bias toward smoking images. Additional research is necessary to
determine exactly how the social/coping labels affect smoking behavior, and for which
types of smokers they most effectively produce these changes.

One major strength of the current study was the use of Amazon’s Mechanical
Turk for online data collection. Mechanical Turk is an online work service that has been
used successfully for various types of behavioral research, including implicit measures.
Results from studies completed on Mechanical Turk have been found to be just as
reliable as those completed in traditional lab settings (Buhrmester, Kwang, & Gosling,
2011; Mason & Suri, 2012). In addition, the use of Mechanical Turk allowed us to
collect a much larger and more diverse sample of smokers and nonsmokers than are
typically found in the smoking literature. Research on smoking is typically conducted on
a convenience sample of undergraduate students recruited from a geographically-
restricted area, and these samples tend to have a limited range of ages, backgrounds, and
smoking history. In contrast, our study’s sample ranged in age from 18 to 70 and had a
wide variety of educational and socio-economic backgrounds. Our sample of smokers
had significant experience with smoking, averaging 19 years of smoking history, and
smoked more heavily than a typical undergraduate smoker, averaging 15 cigarettes per
day. Because of the diversity of our sample, our results are more generalizable to the
general population of smokers in the United States.

There are, however, several limitations that should be taken into account when
interpreting the findings of this study. First, although research does show that data
collected using Mechanical Turk are reliable (Buhrmester, Kwang, & Gosling, 2011; Mason & Suri, 2012), because this study was administered online, we had no control over the environments in which participants completed the tasks. It is possible that our results were influenced by variability from this lack of environmental control. Future studies can address this issue by conducting similar studies in more controlled laboratory settings, perhaps with clinical populations such as individuals enrolled in smoking cessation classes. In addition, because we used the same images in both the pretest and posttest Dot Probe Tasks, it is possible that familiarity with the images affected participants’ attention toward the stimuli during the posttest. Because our data showed significant changes in attentional bias only in one experimental group, however, it is very unlikely that familiarity with the images affected the results of the study.

Finally, and perhaps most importantly, our ability to make conclusions about warning labels’ effects on attention are limited by the fact that our sample of smokers did not show significant attentional bias toward the smoking-related pictures at pretest. Numerous studies show that smokers typically show attentional bias toward smoking stimuli (Dickter & Forestell, 2012, Mogg et al., 2003; Waters & Feyerabend, 2000; Waters et al., 2003b), but our study failed to replicate this finding. This unusual finding may have resulted from the lack of environmental control involved with collecting data online, or perhaps from a characteristic of the sample of smokers that was not measured. For instance, we did not include a measure of nicotine craving, which is related to attentional bias toward smoking cues (Field & Cox, 2008). It is possible that our sample of smokers experienced lower levels of nicotine craving than samples from previous studies, thus resulting in atypical pretest attentional bias results. Future research on
warning labels and attentional bias, perhaps using more controlled laboratory settings and additional smoking-related measures, will be necessary to make stronger conclusions about the impact of these labels on attention.

The results of this study suggest a few additional areas for future research on the cognitive effects of warning labels. First, the duration of the effect of graphic warning labels on implicit attentional bias to smoking-related cues should be examined more closely in future studies. The effects of habituation to the graphic labels should also be examined, as there is some evidence of a “wear-out effect” of the labels, such that over time population smoking rates return to near-baseline levels (Borland et al., 2009). A better understanding of the duration of these effects on attention, and the influence of habituation on the labels’ efficacy, will allow for more effective warning label policy. Second, future work should also aim to investigate how changes in attentional bias might lead to decisions to reduce smoking behavior, such as through reducing craving (Attwood et al., 2008). Future research should also examine the cognitive effects of the social/coping labels in order to better understand the mechanism by which they affect smoking behavior. Finally, this study examined attentional bias, a common feature of nicotine addiction; thus, we were able to draw conclusions about warning labels’ potential to affect people who are already addicted to smoking, but not others who may be at risk for addiction. Future research should focus on the preventive power of different types of warning labels for nonsmokers who may be at risk to start smoking, as well as occasional smokers, who may not be addicted to nicotine.

Recently, the U.S. Court of Appeals for the District of Columbia ruled that the FDA’s graphic warning labels violated tobacco companies’ First Amendment protections
against compelled speech. According to the judge in the case, the graphic images did not serve to increase consumers’ awareness of health risks, but “rather, they were crafted to evoke a strong emotional response calculated to provoke the viewer to quit or never start smoking.” Research has demonstrated, however, that the negative affective response evoked by these graphic warning labels (Harris, Forestell, & Dickter, in preparation) may be the key to their effectiveness (Kees et al., 2010; Witte, 1992). The results of the current study suggest that one mechanism responsible for reduced smoking behavior from the graphic labels may be an increase in smokers’ attentional bias toward non-smoking cues. Given that attentional bias toward smoking-related stimuli is associated with addiction-related cognitive changes in smokers that have been linked to difficulty with quitting smoking (e.g., Bradley et al., 2003; Waters et al., 2003), the current findings support the efficacy of the graphic warning labels. Although text-only health labels, which are currently in use in the U.S., may be noticed by smokers (Borland et al., 2009), the results of the current study and past research suggest that they less effective at changing smoking behavior than graphic labels. Similarly, because social/coping labels, which do not evoke the same fear response, do not affect daily smokers’ attentional bias, they may also be less effective than the graphic warning labels at changing smoking behavior. The U.S. courts and other policymakers will need to determine whether the emotional content of graphic labels is legal, but should consider the scientific evidence provided by previous work and the current study in their decision-making. Based on this evidence, graphic warning labels may have the potential to have a strong impact on cognitive processes related to nicotine addiction.
References


Inquisit 3.0.6.0 [Computer software]. (2012). Seattle, WA: Millisecond Software LLC.


Footnotes

To determine whether smokers showed pretest differences in attention across label groups, a one-way ANOVA was conducted with attentional bias score as the dependent variable. No group differences were found, $p > .05$. 
Table 1

*Smoking History, Exposure, and Attitudes by Smoking and Label Group*

<table>
<thead>
<tr>
<th></th>
<th>Control Group (n = 26)</th>
<th>Graphic Group (n = 12)</th>
<th>Text Health Group (n = 25)</th>
<th>Social/Coping Group (n = 23)</th>
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<tbody>
<tr>
<td>Parental Smoking History (%) *</td>
<td></td>
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<tr>
<td>Neither parent smoked</td>
<td>61.5</td>
<td>50</td>
<td>44</td>
<td>30.4</td>
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<tr>
<td>One or both parents smoked</td>
<td>38.5</td>
<td>50</td>
<td>56</td>
<td>69.6</td>
</tr>
<tr>
<td>Number of friends who smoke *</td>
<td>1.5 (2.23)</td>
<td>1.5 (1.97)</td>
<td>1.92 (2.86)</td>
<td>1.83 (2.50)</td>
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<tr>
<td>Close to someone who has experienced health effects of smoking (% Yes) *</td>
<td>46.2</td>
<td>41.7</td>
<td>28</td>
<td>56.5</td>
</tr>
<tr>
<td>Time spent with others while smoking (Hours per week) *</td>
<td>4.54 (14.03)</td>
<td>6.0 (12.82)</td>
<td>1.52 (2.00)</td>
<td>2.71 (8.43)</td>
</tr>
<tr>
<td>Agree with label use (% agree or strongly agree) *</td>
<td>84.6</td>
<td>83.3</td>
<td>100</td>
<td>82.6</td>
</tr>
<tr>
<td>Perceptions of label accuracy (% accurate or very accurate) *</td>
<td>73.1</td>
<td>75</td>
<td>80</td>
<td>60.9</td>
</tr>
<tr>
<td>Label risk awareness rating (% somewhat or a lot) *</td>
<td>57.7</td>
<td>83.3</td>
<td>80</td>
<td>78.2</td>
</tr>
<tr>
<td>Cigarettes smoked per day</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Age when first began smoking (Years)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Age when began smoking regularly (Years)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Total time smoking (Years)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>MNRQ Positive score</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>MNRQ Negative score</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>FTND Total score</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Smokers</td>
<td>Control Group (n = 23)</td>
<td>Graphic Group (n = 27)</td>
<td>Text Health Group (n = 32)</td>
<td>Social/Coping Group (n = 24)</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>------------------------</td>
<td>------------------------</td>
<td>---------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Parental Smoking History (%)*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neither parent smoked</td>
<td>17.4</td>
<td>44.4</td>
<td>9.4</td>
<td>8.3</td>
</tr>
<tr>
<td>One or both parents smoked</td>
<td>82.5</td>
<td>55.5</td>
<td>90.6</td>
<td>91.7</td>
</tr>
<tr>
<td>Number of friends who smoke *</td>
<td>2.95 (2.78)</td>
<td>5.28 (4.12)</td>
<td>5.44 (6.10)</td>
<td>4.91 (6.12)</td>
</tr>
<tr>
<td>Close to someone who has experienced health effects of smoking (% Yes)*</td>
<td>60.9</td>
<td>51.9</td>
<td>75</td>
<td>58.3</td>
</tr>
<tr>
<td>Time spent with others while smoking (Hours per week)*</td>
<td>25.48 (32.01)</td>
<td>22.89 (36.50)</td>
<td>23.47 (31.43)</td>
<td>21.48 (22.90)</td>
</tr>
<tr>
<td>Agree with label use (% agree or strongly agree) *</td>
<td>56.5</td>
<td>44.4</td>
<td>56.3</td>
<td>58.3</td>
</tr>
<tr>
<td>Perceptions of label accuracy (% accurate or very accurate) *</td>
<td>43.4</td>
<td>51.8</td>
<td>65.7</td>
<td>58.3</td>
</tr>
<tr>
<td>Label risk awareness rating (% somewhat or a lot) *</td>
<td>8.7</td>
<td>22.2</td>
<td>28.2</td>
<td>16.6</td>
</tr>
<tr>
<td>Cigarettes smoked per day</td>
<td>16.41 (7.47)</td>
<td>16.80 (10.57)</td>
<td>13.79 (6.32)</td>
<td>14.42 (6.18)</td>
</tr>
<tr>
<td>Age when first began smoking (Years)</td>
<td>15.84 (3.32)</td>
<td>14.48 (3.20)</td>
<td>15.27 (3.27)</td>
<td>13.95 (3.20)</td>
</tr>
<tr>
<td>Age when began smoking regularly (Years)</td>
<td>18.16 (2.93)</td>
<td>17.68 (3.16)</td>
<td>17.30 (2.81)</td>
<td>17.18 (2.92)</td>
</tr>
<tr>
<td>Total time smoking (Years)</td>
<td>17.67(11.41)</td>
<td>20.28 (13.61)</td>
<td>19.37 (15.43)</td>
<td>19.32 (7.14)</td>
</tr>
<tr>
<td>MNRQ Positive score</td>
<td>7.09 (3.42)</td>
<td>8.30 (3.24)</td>
<td>8.53 (3.76)</td>
<td>7.08 (3.13)</td>
</tr>
<tr>
<td>MNRQ Negative score</td>
<td>12.39 (5.34)</td>
<td>13.74 (6.07)</td>
<td>12.15 (4.84)</td>
<td>13.50 (5.96)</td>
</tr>
<tr>
<td>FTND Total score</td>
<td>3.87 (2.30)</td>
<td>4.78 (2.34)</td>
<td>4.13 (2.16)</td>
<td>4.29 (2.24)</td>
</tr>
</tbody>
</table>

* p < .05
Figure Captions

*Figure 1.* Dot Probe trial sequence.

*Figure 2.* Attentional bias results. Attentional bias scores indicate the difference between the control image reaction times and the smoking image reaction times, with positive scores indicating attentional bias toward smoking images and negative scores indicating attentional bias toward control images.
Figure 1.
Figure 2.

A. Nonsmoker attentional bias

B. Smoker attentional bias
Appendix A: Informed Consent Form

Informed Consent Form
Responses to Smoking Images
Psychology Department - College of William & Mary

The purpose of this study is to examine your responses to a series of pictures and pictographs that will be presented.

• You will first be asked to complete two computer tasks. Both tasks will involve making judgments about pictures by pressing keys on the keyboard. You will be given instructions for each task.

• After the computer tasks, you will view a series of pictures and will be asked to study them carefully.

• Finally, you will answer several questions related to your smoking habits and your opinions about smoking.

You will be compensated for your participation at the conclusion of the study.

Your privacy is important to us and we will make every effort to protect your privacy. An arbitrary code number will be assigned to you for this study. The link between your code and your data will be kept in a locked location and no identifying information will be connected to your code number. The results of this experiment will not be linked to any specific individual; we are only interested in group averages. No identifying information will ever be made public.
Please read the paragraph below, then click to indicate that you wish to participate.

The general nature of this study has been explained to me. I understand that I will be completing several computer tasks and questionnaires. My participation in this study should take approximately 30 to 45 minutes. I understand that my responses will be confidential and that my personal information will not be associated with any results of this study. I know that I do not have to participate in this study and that if I do choose to participate I may stop at any time and still be compensated for my participation. I know that I may refuse to answer any question asked and I also understand that any compensation for participation will not be affected by my responses or by my exercising any of my rights. I am aware that I may report dissatisfactions with any aspect of this experiment to the Chair of the Protection of Human Subjects Committee, Dr. Lee Kirkpatrick, 757-221-3997 or consent@wm.edu. I understand that I may contact Dr. Cheryl Dickter, Dr. Cathy Forestell, or Anna Harris about this experiment to ask any questions or to obtain the results of this study after it is completed at clrickter@wm.edu, caforestell@wm.edu, or akharris@email.wm.edu. I am aware that I must be at least 18 years of age to participate.

By clicking below the link below and proceeding to the experiment website, I confirm that I wish to participate in this project and that I understand the terms that I have just read in this consent statement.
Appendix B: Demographic and general smoking questionnaire

Did you have any difficulty understanding or completing the dot-locating task?

- Yes
- No

If yes, please explain:

Have you ever seen the new health warnings on cigarette packs, which include pictures?

- Yes
- No
- Don't Know

What is your age?

What is your date of birth?

What is your gender?

- Male
- Female
- Other

How do you describe yourself? (Please check the one option that best describes you).

- American Indian or Alaska Native
- Hawaiian or Other Pacific Islander
- Asian or Asian American
• Black or African American  
• Hispanic or Latino  
• Non-Hispanic White  
• Biracial or Multiracial  

What is your marital status?
  
• Married  
• Widowed  
• Divorced  
• Separated  
• Never married  
• A member of an unmarried couple  

What is the highest degree or level of school you have completed? If currently enrolled, mark the previous grade or highest degree received.  
  
• Some high school  
• High school graduate  
• Some college  
• Trade/technical/vocational training  
• College graduate  
• Some postgraduate work  
• Postgraduate degree
Employment Status: Are you currently...

- Employed for wages
- Self-employed
- Out of work and looking for work
- Out of work but not currently looking for work
- A homemaker
- A student
- Military
- Retired
- Unable to work

What is your family's total yearly income?

- Under $10,000
- $10,000 - $14,999
- $15,000 - $24,999
- $25,000 - $34,999
- $35,000 - $49,999
- $50,000 - $74,999
- $75,000 - $99,999
- $100,000 or more

Have either of your parents smoked during your lifetime?

- Yes, father only
• Yes, mother only
• Yes, both parents
• No, neither parent

If your mother has ever smoked during your lifetime, when did/does she typically smoke?

• At social events only
• On stressful days only
• At social events and on stressful days
• Every day
• My mother has never smoked during my lifetime

If your father has ever smoked during your lifetime, when did/does he typically smoke?

• At social events only
• On stressful days only
• At social events and on stressful days
• Every day
• My father has never smoked during my lifetime

How many of your close friends smoke cigarettes?

How many hours per week, on average, do you spend with people who smoke while they are smoking?

How unpleasant is it for you to be in the presence of people smoking?

• Not at all unpleasant
• Somewhat unpleasant
• Very unpleasant

How much do you agree or disagree with cigarette packages having health warning messages?

• Strongly disagree
• Disagree
• Neither Agree nor Disagree
• Agree
• Strongly Agree

To what extent, if at all, do warning labels on cigarette packages make you think about the health risks of smoking?

• Not at all
• A little
• Somewhat
• A lot

How accurately do you feel the warning labels depict the risks to your health?

• Very inaccurately
• Inaccurately
• Somewhat accurately
• Accurately
• Very accurately
What is the likelihood that you will smoke less often as a result of warning labels?

- Warning labels do not affect how often I smoke
- I smoke a little less because of warning labels
- I smoke a lot less because of warning labels
- I do not smoke

Has anyone close to you ever experienced negative health impacts from smoking cigarettes, such as lung cancer, emphysema, high blood pressure, etc?

- Yes
- No
- Don't Know

Do you ever smoke cigarettes?

- I have never smoked a cigarette
- I have smoked before, but not within the last two years
- Yes, I smoke cigarettes about once a week or less
- Yes, I smoke a few times a week
- Yes, I smoke every day

If yes, how many cigarettes do you smoke per day, on average?

How many cigarettes do you smoke per week, on average?

How old were you when you first smoked a cigarette?

How old were you when you began to smoke cigarettes regularly?
Appendix C: The Fagerstrom Test for Nicotine Dependence

Please select the most accurate answer for each question.

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

- Within 5 minutes
- 6 - 30 minutes
- 31 - 60 minutes
- After 60 minutes

Do you find it difficult to refrain from smoking in places where it is forbidden (e.g. in church, at the library, in cinema, etc)?

- Yes
- No

Which cigarette would you hate most to give up?

- The first one in the morning
- All others

How many cigarettes per day do you smoke?

- 10 or less
- 11 - 20
- 21 - 30
- 31 or more
Do you smoke more frequently during the first hours after waking than during the rest of the day?

- Yes
- No

Do you smoke if you are so ill that you are in bed most of the day?

- Yes
- No
Appendix D: Michigan Nicotine Reinforcement Questionnaire

Choose the answer that best describes you regarding the statements below:

I crave a cigarette to provide pleasure.

Never    Sometimes    Often    Always

I crave a cigarette to provide relief from withdrawal.

Never    Sometimes    Often    Always

I like the taste of cigarettes.

Never    Sometimes    Often    Always

I smoke because it is pleasurable.

Never    Sometimes    Often    Always

At times when I have been unable to smoke due to restrictions on smoking or because I was trying to quit, I experienced trouble falling asleep to the following extent:

Not At All    Mild    Moderate    Severe
At times when I have been unable to smoke due to restrictions on smoking or because I was trying to quit, I experienced anxiety to the following extent:

Not At All    Mild    Moderate    Severe

I smoke because smoking feels good.

Never    Sometimes    Often    Always

At times when I have been unable to smoke due to restrictions on smoking or because I was trying to quit, I experienced depressed mood to the following extent:

Not At All    Mild    Moderate    Severe

At times when I have been unable to smoke due to restrictions on smoking or because I was trying to quit, I experienced irritability, frustration, and/or anger to the following extent:

Not At All    Mild    Moderate    Severe

I smoke to get a sense of euphoria or pleasure.

Never    Sometimes    Often    Always
At times when I have been unable to smoke due to restrictions on smoking or because I was trying to quit, I experienced difficulty concentrating to the following extent:

Not At All    Mild    Moderate    Severe

At times when I have been unable to smoke due to restrictions on smoking or because I was trying to quit, I experienced increased appetite and/or weight gain to the following extent:

Not At All    Mild    Moderate    Severe

At times when I have been unable to smoke due to restrictions on smoking or because I was trying to quit, I experienced restlessness to the following extent:

Not At All    Mild    Moderate    Severe
Appendix E: Smoking Status Item and Debriefing Statement

Do you really smoke cigarettes? If you answer "no" you will still be paid for participating in our study. However, if you answer "yes" and you do not ever smoke cigarettes, you limit our ability to find accurate and significant results.

- Yes
- No

The purpose of this study was to examine how people respond to smoking-related images before and after they have seen different types of warning labels. The computer tasks you just completed were measures of your emotional response to smoking-related pictures, as well as your attentional response to smoking-related pictures. Depending on which version of this study you completed, you may have seen a set of warning labels that included images, or you may have seen a set of text-only labels. We expect that our results will show that some types of warning labels result in stronger reactions to the smoking pictures than others.

If you have any questions or concerns about this project, please remember that you can contact the researchers. Our contact information is in the consent statement on the Mechanical Turk HIT page.

Now, please return to the HIT page and enter the following Completion Code: XXXXX

Thank you again!
Appendix F: Warning Label Stimuli

A. Graphic warning labels
B. Text-only health warning labels

1. WARNING: Cigarettes are addictive
2. WARNING: Cigarettes cause cancer
3. WARNING: Tobacco smoke can harm your children
4. WARNING: Tobacco smoke causes fatal lung disease in nonsmokers
5. WARNING: Smoking can kill you
6. WARNING: Smokes during strokes and pregnancy can harm your baby
7. WARNING: Cigarettes cause strokes and heart disease
C. Text-only social/coping warning labels

- Cigarettes reduce your ability to concentrate
- Smoking takes control of you
- Cigarettes rob your energy
- Smoking shows insecurity
- Cigarettes will not satisfy you
- Cigarettes will increase your stress level
- Tobacco smoke makes you unattractive
- Smoking makes you unpopular
D. Control warning labels

Smoking is often depicted in films

Cigarettes are often advertised on billboards

Cigarettes are sold in packs of 20

Smoking became common in the 19th century

Cigarettes weigh 1.2 grams

Cigarettes are available in regular or menthol

Cigarettes are 3.9 inches long

Tobacco smoking originated in Central America