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John Randall Haight

College of William and Mary

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Implicit Affective Responses to Smoking Cues:
A Comparison of Smoking Groups and Withdrawal States

A thesis submitted in partial fulfillment of the requirement
for the degree of Bachelor of Science in Neuroscience from
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by

John Randall Haight

Accepted for Honors (Honors)

Dr. Cheryl Dickter, Director

Dr. Catherine Forestell

Dr. Cynthia Battie

Williamsburg, VA
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Implicit Affective Responses to Smoking Cues:
A Comparison of Smoking Groups and Withdrawal States

John Haight
College of William and Mary
Abstract

Previous research examining implicit affective responses to smoking cues has been inconsistent and generally did not differentiate between smoking groups or control for withdrawal. In the current study, the affect misattribution procedure was used to study differences in implicit affective responses to smoking cues between smoking groups. Undergraduate smokers were divided into non-daily (less than 5 cigarettes per day) and daily smokers (greater than five cigarettes per day). All participants refrained from smoking for 12 hours prior to the study, and half were allowed to smoke immediately prior to the study. In support of the hypotheses, results indicated that daily smokers responded more positively to smoking cues than to control cues, while non-daily smokers showed no preference towards smoking or control cues. Contrary to hypotheses, withdrawal did not affect AMP responses. This may have occurred because participants who were not allowed to smoke did not appear to experience withdrawal. The data suggest that implicit affective biases towards smoking cues may differ between smoking groups. Implications for smoking cessation techniques and directions for future research are discussed.
Comparison of Smoking Groups

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Smoking Demographics

Smoking is currently the leading preventable cause of death within the United States, with over 440,000 deaths per year (CDC, 2002). In addition to death, there is a long series of illnesses and disabilities that coincide with smoking including cardiac, vascular, and pulmonary disease, along with a variety of cancers, osteoporosis, respiratory tract infections, and impaired fertility. Besides the high human cost of smoking, there is also a large monetary cost totaling over of $157 billion per year in the United States alone, with costs expected to increase (CDC, 2004). Due to these problems, researchers are looking towards smoking cessation techniques to help with the societal costs of the habit.

Smoking cessation efforts have been gaining more support; for example, in 2004 over half a million people in England attempted to quit smoking (Godfrey, Parrott, Coleman, & Pound, 2005). Although a variety of cessation techniques are available, the overall success rate is only effective for around 15% of patients (Judge, Bauld, Chesterman, & Ferguson, 2005). Those who chose to quit without the help of cessation therapy have only had a meager 4% chance of quitting (Hughes, Keely, & Naud, 2004). Furthermore, smoking cessation techniques have only been proven effective for daily smokers. Non-daily smokers, who physiologically do not always exhibit withdrawal symptoms as seen with daily smokers, do not currently have any evidence-based methods to help them through their cessation process (Schane, Glantz, & Ling, 2009).

Types of Smokers
Comparison of Smoking Groups

In order to provide better cessation techniques, a better understanding of smokers is needed. Recently, research has been examining the emerging trends among smokers, typically dividing them into so-called daily smokers and non-daily smokers. Daily smokers currently represent 23.1% of all men, and 18.8% of all women in the United States (CDC, 2009). Often regarded as ‘typical smokers,’ this group is shown to exhibit physiological and psychological withdrawal symptoms when deprived of cigarettes for a prolonged period of time. Alternatively, non-daily smokers are individuals who smoke on a more irregular basis, typically in social situations, who do not consume more than 20 cigarettes per week (Stromberg, Nichter, & Nichter, 2007).

A notable rise in the number of non-daily smokers has been reported despite a steady decrease in the numbers of daily smokers (Rigotti, Lee, & Wechsler, 2000; Otsuki, Tinsley, Chao, & Unger, 2008; Wechsler, Rigotti, Gledhill-Hoyt, & Lee, 1998). Although daily smokers have been on the decline, young adults, who comprise a majority of the non-daily smokers, have remained the only group which has actually shown marked increases in smoking (CDC, 2002). In fact, a recent survey from Stromberg et al. (2007) showed that over 30% of college-aged individuals reported smoking within the last 30 days, and over 40% reported smoking within the past year. Non-daily smoking consisted of 16% of the population in 1997, and has risen to 19% in 1999 and 24% in 2001 (CDC, 2003). Another study showed that smoking among young adults increased from 22% in 1990 to 28% in 1997 (Rigotti et al., 2000). Since non-daily smokers report smoking on a more irregular basis, less often, and do not typically exhibit physiological withdrawal symptoms, as many as 42% do not classify themselves as smokers (Schane, 2009; Fergusson & Horwood, 1995). Less research has focused on non-daily smokers,
but these individuals are at risk for becoming daily smokers, and still experience many of the health problems associated with daily smoking, although to a lesser degree (Baker, Brandon, & Chassin, 2004). Due to the lack of research on non-daily smokers, a better understanding of this group is necessary to create more effective cessation techniques for them.

Predictors of Smoking Initiation and Addiction

There are concerns that non-daily smokers may become daily smokers through their continued smoking activities. Robinson and Berridge (1993) have outlined the stages leading up to addiction with repeated use, known as the Incentive Sensitization Theory, or IST. After repeated uses of addictive substances, such as nicotine, sensitization occurs, which in turn produces strong drug wanting urges for the user in response to drug-related cues. The transition between initial drug use and addiction can be traced back to dopamine release from the nucleus accumbens. Prolonged use sensitizes the dopamine receptors, causing further dopamine release, eventually leading to drug wanting instead of the initial state of drug liking (Robinson & Berridge, 2001). In accordance with the IST, it has shown that the anticipation of smoking rather than physical process of smoking causes a greater increase of dopamine release. The increased dopamine release through anticipation supports the IST, showing that prolonged use results in increased sensitization to dopamine, which in turn requires further experiences to warrant the same physiological response (Balfour, 2003). The sensitization then causes a shift from drug liking to drug wanting due to increased releases of dopamine from the nucleus accumbens.
Prolonged use, then, is necessary to result in an addiction to nicotine. The main motivations given for smoking post-initiation can be broken down into internal and external reasons (Otsuki et al., 2008; Stromberg et al., 2007). The internal reasons most commonly cited include reducing negative affect, boredom, stress reduction, sensory satisfaction, and appetite/weight control (Stromberg et al., 2008). The external reasons consist primarily of facilitating social interactions, such as engaging in conversation with friends or smoking a cigarette with friends at a party (Otsuki et al., 2008). Daily smokers often associate themselves more with internal motivations to smoke, while non-daily smokers focus more upon external motivations to smoke (Stromberg et al., 2007).

After continued use, non-daily smokers may begin to internalize their motivations for smoking, putting them at a higher risk for becoming a daily smoker (Piper, Piasecki, Federman, Bolt, Smith, Fiore, & Baker, 2003). Internal motivations to reduce negative mood, or negative affect, are the strongest predictor of future nicotine addiction (Wetter, Kenford, Welsch, Smith, Fouladi, Fiore, & Baker 2003). Although non-daily smokers often initially smoke to increase positive affect, such as during social situations, it has been shown to be a less powerful predictor of future addiction than negative affect (Tiffany & Drobes, 1990). A shift from externalization to internalization of motivations, and a continued intake of nicotine are the two most important aspects for a non-daily smoker to become a daily smoker (Wetter et al., 2004; Fagerström, 1978). The transformation from external to internal motivations is important to evaluate future risks of smoking. Since smokers may be unwilling to explicitly state their smoking motivations, a method of discovering smokers’ implicit affective responses to smoking cues is necessary to provide a better idea of future risks involved.
Explicit and Implicit Measures of Affective Responses

Assessing affective responses to smoking has been difficult, as there have been inconsistencies reported in the field. Typically, when smokers were asked explicitly about their attitudes towards smoking, the results were overwhelmingly negative towards their habits, despite their continued use (Elders, Perry, Eriksen, & Giovino, 1994; Johnston, O’Malley, & Bachman, 1997). Such findings suggest that outright explicit measures of affective responses to drug cues may be unreliable, especially with stigmatized behaviors such as smoking (Swanson, Rudman, & Greenwald, 2001). In fact, explicit and implicit measures showed little to no correlation with one another, suggesting that implicit and explicit measures assess different constructs (Swanson et al., 2001). Because of the biases that can result from explicit measures, researchers have focused on implicit means of investigating smokers’ motivations.

Implicit measures of smoking are important in order to assess the underlying emotions of the subject (Sherman, Rose, Koch, Presson, & Chassin, 2003). Past studies have used the Implicit Association Test, or IAT to measure smokers’ implicit responses to smoking cues (Greenwald, McGhee, & Schwartz, 1998). The IAT is used to determine the implicit positive and negative associations that perceivers have with various stimuli. With respect to smoking studies and the IAT, however, the results have been consistently unreliable. Across several studies, smokers had negative affective responses to smoking cues (Swanson et al., 2001), others showed neutral affective responses (De Houwer, Custers, & De Clercq, 2006), and yet some were positive (Sherman et al., 2003). These differences have been attributable to methodological issues with the IAT (Swanson et al.
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2001), and a new measure of implicit responses to affective responses has been proposed to help alleviate the discrepancies.

Another implicit measure, the Affect Misattribution Procedure (AMP), was introduced to implicitly measure affective responses towards various stimuli (Payne, Cheng, Govorun, & Stewart, 2005). The AMP’s reliability is typically above 0.8 with high internal consistencies, which makes it useful for measuring implicit affective responses to smoking cues (Payne et al., 2005). The AMP consists of prime pictures presented for a short duration, quickly followed by Chinese pictographs. Subjects are asked to rate the pictographs as either pleasant or unpleasant, comparing it to their perceived idea of an average pictograph. Due to the ambiguous nature of the Chinese pictographs, the underlying principle of the AMP is that users will implicitly rate the prime pictures.

When using the AMP, it was found that smokers had a less negative affective response towards smoking cues when compared to nonsmokers (Payne, McClernon, & Dobbins, 2007). There was, however, much variability in affective responses to smoking cues within the smoking group, while the nonsmoking group had little variance. It is unclear whether the variance within the smoking group was entirely attributable to withdrawal differences, since smokers within the study were not controlled for nicotine withdrawal. Payne et al.’s sample of smokers ($M = 6.19$, $SD = 5.85$) ranged from less than one cigarette to 20 cigarettes per day, showing a high variability within the smoking group of their study. Due to the high variance, the current study was designed to look at differences among smoking groups, specifically between implicit affective responses between daily and non-daily smokers.
The Present Study

Currently, there has been limited research examining affective responses among different smoking groups. Specifically, the current study focuses on differences between daily and non-daily smokers and their affective responses toward smoking stimuli, a comparison currently lacking in the literature. Previous studies have suggested that there are high variances among smokers (Payne et al., 2007), but it is still unclear as to whether these differences are attributable to withdrawal states or smoking habits.

We hypothesize that daily smokers will have stronger affective responses to smoking cues when compared to non-daily smokers, in accordance with the IST. Non-daily smokers are expected to differ based on smoking habits, such as negative versus positive motivations, and other factors such as social versus non-social smoking. In addition, the current study was also designed to examine how affective responses to smoking stimuli may be affected by nicotine deprivation between these groups. Baker, Morse, & Sherman (1987) suggested that affective responses to smoking cues may be heightened during nicotine deprivation. In order to examine the effects of nicotine deprivation upon smokers, Sherman et al. (2003) conducted a study to compare changes in implicit responses as a result of nicotine withdrawal. They compared ‘light’ smokers, which were defined as those who smoke less than 15 cigarettes per day, and ‘heavy’ smokers, who were defined as smoking 15 or more cigarettes per day. Using the IAT, their results showed that lighter smokers had more positive responses to smoking cues after smoking, while heavier smokers had more positive responses to smoking cues while deprived of nicotine. Although the study gave an interesting comparison among smoking groups, their focus was upon separation of daily smokers. The current study was
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designed to examine differences between daily and non-daily smokers. In addition, the effect of nicotine withdrawal upon affective responses among smokers was measured. It is expected that withdrawal would cause daily smokers to have a greater positive affective response prior to smoking, and non-daily smokers would have a greater positive affective response after smoking, in accordance with Sherman et al.’s study.

Method

Participants

Participants consisted of 54 William & Mary students who reported smoking on an occasional to regular basis ($M = 3.59$ cigarettes per day, $SD = 3.73$ cigarettes per day). Participants were recruited through flyers looking for people who have any cigarettes in the past 30 days. Thirty-seven participants were defined as non-daily smokers who smoked an average of 1.5 cigarettes per day ($SD = 1.134$) with a range from 0-4. Seventeen participants were defined as daily smokers who smoked on average 7.78 cigarettes per day ($SD = 3.606$) with a range of 5-20. The mean age was 19.83 ($SD = 1.53$), with 15 females, and 39 males. After refraining from smoking for 12 hours, 29 of the participants were asked to continue refraining from smoking during the experiment, while 25 were asked to smoke prior to the experiment. Participants received credit for their Introduction to Psychology course or were paid $10 for their cooperation.

Materials

**Reaction Time Task.** The Affect Misattribution Procedure (AMP) is used to measure subjects' implicit responses to presented primes (Payne et al., 2007). The AMP consists of a prime being presented for 75 milliseconds (ms), followed by a blank screen for 125 ms, a Chinese pictograph for 100 ms, and a black and white masking screen. The
masking screen remains on the monitor until a response from the subject has been made. Participants are given a choice to decide whether the pictograph was either pleasant or unpleasant. There were 160 trials presented to participants during the AMP, which took between 5-7 minutes total.

The Chinese pictographs are used due to the ambiguous nature and participants' unfamiliarity with such symbols. The ambiguous nature of the pictographs cause participants to respond to the primes presented rather than the pictograph itself. The primes consist of both active and passive smoking cues, with neutral controls. The active smoking cues depicted persons smoking or holding smoking related products. The active control cues depicted persons in similar situations as the smoking group, but holding objects unrelated to smoking. The passive smoking cues did not have human components involved, and consisted of objects such as ashtrays or lighters. The passive control cues referred to similar looking objects but which were unrelated to smoking, such as a box of crayons. The stimuli and pictographs were from Payne et al. (2007) and from pilot tested stimuli (Wright, Forestell, & Dickter, 2011).

**Questionnaires.** A series of questionnaires were administered to determine smoking habits, family history, disposition, and withdrawal. A general smoking questionnaire asked about family history of smoking as well as questions related to smoking habits in group and private settings. Examples are, “on the occasions in which I smoked over the last month, I smoked with my friends,” and “on the occasions in which I smoked over the last month, I smoked when I felt relaxed.” Answers included the choices of “never,” “rarely,” “sometimes,” “often,” and “always/everyday.”
The Michigan Nicotine Reinforcement Questionnaire looked at the positive reinforcements such as reward dependence and negative reinforcements of smoking such as self-treatment of depression (Pomerleau, Fagerström, Marks, Tate, & Pomerleau, 2003). Sample questions included “I crave a cigarette to provide pleasure,” and “I crave a cigarette to provide relief from withdrawal.” Answers consisted of the choices of “never,” “sometimes,” “often,” and “always.”

The Wisconsin Inventory of Smoking Dependence Motives questionnaire measured a variety of criteria including affiliation attachment, automaticity, behavioral reinforcement, cognitive enhancement, craving, cue processes, loss of control, negative/positive reinforcement, social and environmental goads, task and sensory properties, tolerance, and weight control (Piper et al. 2004). Sample questions include “smoking makes a good mood better, and “if I always smoke in a certain place it is hard to be there and not smoke.” The questionnaire was based upon a 7-point Likert scale ranging from “not true of me at all” to “extremely true of me.”

The final questionnaire looked at smoking factors such as stimulation, indulgent, psychosocial, sensorimotor, addictive, and automatic smoking (Russell, Peto, & Patel, 1974). Questions included “I smoke in order to keep myself from slowing down,” and “handling a cigarette is part of the enjoyment of smoking it.” Choices available were “not at all,” “a little,” “quite a bit,” and “very much so.”

**Carbon Monoxide Monitor.** A carbon monoxide monitor, which assesses biochemical changes resulting from exposure to cigarette smoke, was used to measure recent smoking behavior in participants.

**Procedure**
All participants arrived between the hours of 10-12 in the morning and were asked to refrain from smoking for 12 hours prior to the study in order to control for individual levels of nicotine craving, which have been shown to temporarily increase attention to smoking-related cues (Sherman et al., 2003). Participants were then randomly assigned to either smoke immediately prior to the main task, or to abstain throughout the entire experiment in order to measure differences between withdrawal states. To measure for compliance, carbon monoxide levels were recorded prior to the experiment as well as after smoking for the smoking-assigned group. Participants were first asked to complete the AMP, in which a series of smoking and non-smoking pictures followed by Chinese pictographs are presented (Payne et al., 2007). Participants were asked to disregard the priming pictures and to rate only the pictographs as pleasant or unpleasant by pressing the corresponding key on the keyboard. Once the AMP procedure was completed, participants answered the questionnaires in an online format, using Opinio. All participants were paid, thanked, and debriefed upon completion of the study. Participation in the study took approximately 40 minutes.

Results

Four participants’ data were not included in the analyses described below. Three participants were excluded due to indicating only ‘more pleasant’ or ‘unpleasant’ for every trial. One participant was excluded due to very slow reaction times (> 1.5 s) per response, after being given multiple prompts to go as quickly as possible.

Manipulation Checks

Carbon monoxide levels between participants in the smoking condition ($M = 4.20, SD = 2.87$) and non-smoking condition ($M = 3.45, SD = 3.08$) upon entering the study
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were not different from one another, \( t(52) = -0.92, p = .360 \), suggesting that no differences in recent smoking behavior between groups existed prior to the study. To ensure that participants in the smoking condition took in nicotine, carbon monoxide levels were tested before and after smoking. Results indicated that carbon monoxide levels were higher after smoking (\( M = 7.60, SD = 5.54 \)) than before smoking (\( M = 4.20, SD = 2.87 \)), \( t(24) = -5.61, p < .001 \). To ensure that craving was lower in participants who smoked relative to those who did not smoke, self-reported craving was tested between these conditions. Results indicated that craving in the smoking condition (\( M = 2.56, SD = 1.25 \)) did not significantly differ from craving in the non-smoking condition (\( M = 2.16, SD = 1.12 \)), \( t(51) = -1.23, p = .225 \).

**Tests of Hypotheses**

To measure implicit affective responses to smoking and non-smoking trials, as with Payne et al.’s (2007) study, the average proportions of pleasant responses from the AMP for smoking and non-smoking trials were calculated. Data were analyzed using a 2 (Prime Type: smoking, non-smoking) X 2 (Smoking Group: non-daily smokers, daily smokers) X 2 (Smoking Condition: smoked, did not smoke) mixed analysis of variance (ANOVA), with repeated measures on the first factor. This analysis revealed that no main effects were statistically significant. However, there was a marginally significant interaction between Prime Type and Smoking Group, \( F(1, 50) = 3.46, p = .069, \eta^2 = .065 \). To test specific hypotheses that non-daily smokers would not respond differently to smoking compared to non-smoking trials and that daily smokers would respond more positively to smoking relative to non-smoking trials, two \( t \)-tests were performed. Results indicated that, in support of the hypotheses, the daily smokers responded with
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proportionately higher pleasant responses to smoking cues \( (M = 0.61, \text{SD} = 0.16) \) than to control cues \( (M = 0.46, \text{SD} = 0.17) \), \( t(16) = -2.30, p = .035 \). Non-daily smokers showed no difference between pleasant responses to smoking cues \( (M = 0.53, \text{SD} = 0.20) \) and control cues \( (M = 0.56, \text{SD} = 0.15) \), \( t(36) = 0.44, p = .666 \) (see Figure 1). The hypothesized Prime Type X Smoking Group X Smoking Condition interaction was not significant, \( F(1, 50) = 1.24, p = .271 \).

**Relationships between AMP and individual difference measures**

To examine whether implicit affective scores to smoking cues were related to individual differences in smoking behavior and motivation, correlational analyses were conducted. These measures examined the relationship between AMP scores and smoking factors such as cognitive enhancement, craving, cue exposure and associative props, (Piper et al., 2004), negative reinforcement, positive reinforcement (Piper et al., 2004; Pomerleau et al. 2003) and WISDM, indulgence, addiction, and stimulation smoking (Russell et al., 1974). Significant positive correlations were found between AMP responses to smoking cues and cognitive enhancement, craving, negative reinforcement, positive reinforcement, stimulation smoking, and addiction (see Table 1). These analyses showed that positive implicit responses to smoking cues were greater in those with greater levels of smoking dependence. The correlation between AMP scores to smoking cues and the number of cigarettes smoked per day was positive, but did not reach conventional levels of statistical significance, \( r = .21, p = .13 \).

**Discussion**

The current study examined differences in implicit affective responses to smoking cues and control cues among smoking groups. We hypothesized that although non-daily
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smokers would not show a difference between positive responses to smoking compared to control cues, daily smokers would rate the smoking cues as more pleasant than the controls. We were also interested in looking at how withdrawal affected smokers’ responses to smoking cues, and hypothesized that daily smokers experiencing withdrawal would elicit more positive responses to smoking cues than those who were not withdrawn. In addition, it was hypothesized that non-daily smokers would elicit more negative responses in withdrawal than those who were not withdrawn. The specific hypotheses focused upon withdrawal are in accordance with Sherman et al.’s (2003) study which looked at differences among implicit affective responses to smoking cues in daily smokers and withdrawal. This hypothesis was not supported in the current study. When looking at craving levels among participants upon entering the study, however, we observed that despite having abstained from cigarettes for 12 hours, many were not reporting any craving. More importantly, when craving was compared between those who had just smoked and those who were still withdrawn, there was not a significant difference in craving between these groups. Thus, it appears that the manipulation of craving was not successful. We believe that this is due in part to the relatively light smoking habits of the participants involved, since many of the smokers may not have experienced much withdrawal from the 12 hour timeframe.

The current study, however, did support the hypothesis that daily smokers would respond more positively to smoking cues relative to control cues and that non-daily smokers would not show a difference between cues. This finding importantly extends previous research by Payne and colleagues (2007) that showed that smokers had more pleasant responses to smoking cues in comparison to nonsmokers, but that smokers
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displayed no preference between smoking and control cues. Although Payne et al. reported a great deal of variance within their smoking group in reactions to the smoking stimuli, they did not examine different types of smokers. Thus, the current study suggests that daily smokers show more positive responses to smoking cues than control cues, suggesting that it is important to examine different types of smokers when considering implicit affective reactions to smoking stimuli.

These findings suggest that non-daily and daily smokers may differ in their implicit emotional processing of drug cues. Payne et al.’s (2007) study showed that non-smokers have a significantly less positive proportional response to smoking cues than control cues. In the current study, we found that daily smokers process smoking cues more positively than non-daily smokers do. Although these results are preliminary, the data may suggest that implicit affective responses are sensitive to relatively small changes in smoking behavior, and show that even low doses of nicotine consumption can lead to changes in implicit affective biases towards smoking cues in the environment. The findings of the current study also help in the understanding of smokers’ implicit attitudes and responses to smoking cues.

Although previous studies had looked at implicit affective responses using the IAT, the data has been inconsistent among the use of smoking cues (De Houwer et al., 2006; Sherman et al., 2003; Swanson et al., 2001). The discrepancies among past IAT studies have been attributable to methodological issues with the IAT (Swanson et al. 2001), and a new measure of implicit affective responses was used in order to get a better picture of implicit affective responses among smokers. For the current study, the
Affective Misattribution Procedure was used, which has been shown to have higher reliability and internal consistencies than the IAT (Payne et al., 2005).

Gaining reliable implicit affective responses to smoking cues could help determine whether there are differences in stimuli processing between smoking groups. This could be especially helpful when looking at cessation techniques for smokers. There are currently no proven smoking cessation programs for non-daily smokers, since traditional smoking cessation programs focus upon withdrawal symptoms, which non-daily smokers often do not exhibit (Schane et al., 2009). Non-daily smokers consist of up to 24% of the young adult US population, and still are prone to the serious side effects associated with daily smoking (CDC, 2003; Baker et al. 2004). When the data is compared to Payne et al.’s study (2007), the research suggests that non-daily smokers exhibit more positive implicit affective responses to smoking cues than nonsmokers do, suggesting that non-daily smokers process smoking stimuli differently than non-smokers. Further cessation program problems arise with non-daily smokers since they often do not classify themselves as smokers through explicit measures (Fergusson et al., 1995). Implicit measures, then, are important in figuring out important differences among smoking groups in order to create more effective cessation techniques for non-daily smokers.

In addition to differences in implicit affective responses, the current study also found interesting correlations between AMP responses and smoking measures. Correlations between positive AMP scores and other measures such as cognitive enhancement, craving, cue exposure and associative props, (Piper et al., 2004), negative reinforcement, positive reinforcement (Piper et al., 2004; Pomerleau et al. 2003) and
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WISDM, indulgence, addiction, and stimulation smoking (Russell et al., 1974) were positively correlated. These correlations help support the data in that those with higher nicotine consumption (daily smokers) were more likely to respond positively to smoking cues than to the control cues. These correlations could suggest that increased consumption of nicotine may lead to increased implicit affective biases towards smoking cues.

A major limitation of the current study was that college students are not a representative group of smokers. They have been smoking for a relatively short time and they generally are light smokers – that is, few participants smoked more than ten cigarettes per day. Thus, it is possible that with a heavier group of daily smokers, the manipulation of craving could lead to differences in affective responses to smoking cues between daily and non-daily smokers. Future studies focused on recruiting a wider range of smokers would help eliminate the problems associated with craving in the current study. It is interesting to note, however, that despite our limited sample, we were still able to demonstrate differences in implicit affective responses between daily and non-daily smokers. This highlights the importance of investigating different types of smokers in research examining cue reactivity. Furthermore, future studies could also incorporate the use of electronic cigarettes, which could be used to administer a range of nicotine doses to participants in order to more precisely measure relationships between withdrawal and implicit responses to smoking stimuli.

Despite limitations with the current study, the major findings suggest that there are important differences between implicit affective responses to smoking cues among smoking groups. These findings could be important in looking for improved cessation
techniques for individuals in different smoking groups. Little research regarding implicit affective responses have been conducted among smoking groups, and although this is a preliminary study, the data suggest that even occasional smoking can cause changes in implicit affective biases towards smoking cues.
Comparison of Smoking Groups

References


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Comparison of Smoking Groups


Wetter DW, Kenford SL, Welsch SK, Smith SS, Fouladi RT, Fiore MC, Baker TB.


Comparison of Smoking Groups

Figure 1.

Relationships between AMP scores among smoking groups
### Table 1.

Comparison of Smoking Groups

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

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

Correlations among AMP scores, self-reported smoking behavior, and self-reported smoking motivation.