2-2012

Peering Through the Smoke: The Effect of Parental Smoking Behavior and Addiction on Daily Smokers' Attentional Bias to Smoking Cues

Cheryl L. Dickter
William & Mary, cldickter@wm.edu

Catherine A. Forestell
William & Mary, caforestell@wm.edu

Recommended Citation

Dickter, Cheryl L. and Forestell, Catherine A., Peering Through the Smoke: The Effect of Parental Smoking Behavior and Addiction on Daily Smokers' Attentional Bias to Smoking Cues (2012). *Addictive Behaviors*, 37(2), 187-192.
https://doi.org/10.1016/j.addbeh.2011.09.017

Addictive Behaviors xxx (2011) xxx

Contents lists available at SciVerse ScienceDirect

Addictive Behaviors

Highlights

Addictive Behaviors xxx (2011) xxx–xxx

Peering through the smoke: The effect of parental smoking behavior and addiction on daily smokers' attentional bias to smoking cues

Cheryl L. Dickter *, Catherine A. Forestell

The College of William and Mary

► Implicit attentional biases to smoking and control cues were measured in smokers. ► Daily smokers with a smoking parent showed a bias to inactive smoking cues. ► Occasional smokers did not show a bias regardless of whether their parents smoked. ► Daily smokers' bias to inactive cues was also influenced by nicotine dependence.

0306-4603/$ – see front matter © 2011 Published by Elsevier Ltd.
doi:10.1016/j.addbeh.2011.09.017

Addictive Behaviors xxx (2011) xxx–xxx

Contents lists available at SciVerse ScienceDirect

Addictive Behaviors

Peering through the smoke: The effect of parental smoking behavior and addiction on daily smokers' attentional bias to smoking cues

Cheryl L. Dickter *, Catherine A. Forestell

The College of William and Mary

ARTICLE INFO

Available online xxxx

Keywords:
Daily smokers
Attentional bias
Addiction
Parental smoking
Dot-probe

ABSTRACT

Although previous research has demonstrated that individuals with parents who smoke are more likely to become smokers and are less successful in smoking cessation efforts compared with those without a smoking parent, the reasons for this link have not been established. In the current study, implicit attentional bias to smoking-related cues was investigated in college-age smokers, based on models of addiction that suggest that attention to drug-related cues plays an important role in drug addiction. Sixty-one participants completed a dot-probe task to measure attentional bias to smoking-related and matched non-smoking-related control pictures. Results indicated that while those who reported smoking occasionally did not demonstrate an attentional bias, daily smokers who had a smoking parent showed more of an attentional bias to the smoking cues than those without a smoking parent, but only to cues that did not contain human content. In addition to parental influence, nicotine dependence explained a significant portion of the variance in the attentional bias for daily smokers. Implications for models of nicotine addiction and the development of smoking cessation programs are discussed.

Smoking is the leading cause of preventable death in the United States, claiming over 440,000 lives each year (American Cancer Society, 2009; Rivara et al., 2004). In addition to the negative health impact on those who smoke cigarettes, research has shown that children who live with a parent who smokes also suffer from a variety of adverse health effects (European Environment and Health Information System [ENHIS], 2007). Moreover, they are two to three times more likely to experiment with smoking and become habitual smokers for a greater number of years (Bauman, Foshee, Linzer, & Koch, 1990; Chassin, Presson, Rose, Sherman, & Prost, 2002; Den Exter Blokland, Engels, Hale, Meeus, & Willemsen, 2004), have more difficulty quitting, and are at increased risk for relapse during quit attempts (Kleinjan et al., 2009) than children without a family history of smoking. Although research has established a link between smoking behavior in parents and their offspring, the reasons for this link remain unclear.

One factor that may mediate this relationship is the existence of an attentional bias for smoking-related cues in those who have smoking parents. This notion has been supported by recent work by Forestell ~~et al. (in press)~~ which demonstrated that parental smoking is associated with an attentional bias to smoking-related cues in non-smokers. Attentional biases are thought to be implicit (McCusker, 2001), and can lead to increases in the detection of drug-related stimuli in the environment and drug-related cognitions, and a reduction in the amount of cognitive resources available for other tasks (Franken, 2003), all of which can lead smokers to maintain smoking behavior and fail in their quit attempts (Waters et al., 2003; Williams, Mathews, & MacLeod, 1996). This may help to explain why children of smokers initiate smoking earlier (Chassin, Presson, Pitts, & Sherman, 2000; Den Exter Blokland et al., 2004), smoke more frequently (Flay et al., 1994), and have more difficulty quitting (Kleinjan et al., 2009) than those without a family history of smoking. This contention is further supported by theories of drug addiction which have shown that attention to drug-related cues plays an important role in the maintenance of drug addiction (e.g., Robinson & Berridge, 1993). That is, smokers have been shown to orient faster toward, maintain their gaze upon, and exhibit greater neural activation in response to smoking-related versus neutral stimuli compared to non-smokers (Bradley, Mogg, Wright, & Field, 2003; Littel & Franken, 2007; Mogg, Bradley, Field, & De Houwer, 2003; Warren & McDonough, 1999). However, to our knowledge, previous research has not examined whether parental smoking leads to an attentional bias in smokers.

College smokers are a particularly interesting group in which to evaluate attentional bias to smoking-related stimuli as 40% report that they smoke (Stromberg, Nichter, & Nichter, 2007), with a sizable proportion of individuals increasing their smoking behavior during these years (e.g., Chassin, Presson, Sherman, & Pitts, 2000; Chassin, Sherman, Presson, & Edwards, 1991). In fact, college students are the only group for which smoking prevalence has remained stable in the United States, while most other groups have shown declines in smoking rates (Centers for Disease Control and Prevention (CDC), 2009). College smokers demonstrate considerable individual variability in their smoking frequency (Colder et al., 2006). Approximately 40-50% are daily smokers who smoke at least one cigarette every

* Corresponding author at: Department of Psychology, College of William and Mary, PO Box 8795, Williamsburg, VA 23187–8795. Tel.: +1 757 221 3722.
E-mail address: cldickter@wm.edu (C.L. Dickter).

0306-4603/$ – see front matter © 2011 Published by Elsevier Ltd.
doi:10.1016/j.addbeh.2011.09.017

Please cite this article as: Dickter, C.L., & Forestell, C.A., Peering through the smoke: The effect of parental smoking behavior and addiction on daily smokers' attentional bias to smoking cue..., *Addictive Behaviors* (2011), doi:10.1016/j.addbeh.2011.09.017

day and exhibit physiological and psychological withdrawal symptoms when deprived of cigarettes for a prolonged period of time; the remaining are occasional smokers (Moran, Wechsler, & Rigotti, 2004; Otsuki, Tinsley, Chao, & Unger, 2008). These groups tend to differ in their motivations for smoking (Otsuki et al., 2008; Stromberg et al., 2007) as well as their affective reactivity to smoking cues. That is, daily smokers show more positive implicit responses to smoking-related cues than control cues, while occasional smokers show no differences in their responses to these two types of stimuli (Haight & Dickter, ~~submitted for publication~~). Other studies have also demonstrated that college students who smoke on a daily basis respond more negatively to smoking-related pictures than those who smoke less frequently (Sherman, Rose, Koch, Presson, & Chassin, 2003, Study 2), suggesting that implicit reactions to smoking cues may vary as a function of smoking frequency.

The primary goal of the current study was to investigate whether parental smoking behavior interacts with smoking patterns (i.e., daily vs. occasional smoking) to predict attentional bias to smoking-related stimuli. To this end, a dot-probe paradigm that presented smoking-related and non-smoking-related control pictures was used, based on its demonstrated ability to measure implicit drug-related attentional biases (Bradley et al., 2003; Forestell et al., ~~in press~~). Based on our previous findings with non-smokers (Forestell et al., ~~in press~~), we predicted that daily and occasional smokers with smoking parents would show an attentional bias to smoking-related cues. However, it was expected that daily smokers would additionally demonstrate an attentional bias for smoking-related cues as a function of their dependence on nicotine (Bradley, Field, Mogg, & Houwer, 2004). We predicted that this additive effect of parental smoking and dependence on nicotine would not occur in occasional smokers because they are typically motivated by environmental cues such as social situations and interactions with smoking peers (Otsuki et al., 2008; Stromberg et al., 2007), rather than the physiological effects of nicotine.

This study utilized two different types of smoking and matched control stimuli in the dot-probe paradigm: those that depict the smoking and control stimuli alone (inactive) and those that depict a human interacting with the cues (active). This manipulation addresses an identified limitation in the field as previous studies have not controlled for the human content presented in stimulus pictures. This is problematic because it is not clear whether variation in the stimuli contributed to the variability in participants' implicit responses (Stritzke, Breiner, Curtin, & Lang, 2004). For example, because human-related stimuli yield greater early cognitive processing than pictures of objects alone (e.g., Bentin, Allison, Puce, Perez, & McCarthy, 1996), participants may focus primarily on the human components of the active pictures, distracting them from the smoking-related stimuli. Indeed, previous research from our laboratory that manipulated the human content within the stimulus pictures found that family smoking was related to attentional bias only to inactive smoking-related pictures (Forestell et al., ~~in press~~). Therefore, a secondary goal of the present paper was to determine whether participants' attentional bias to smoking-related cues was moderated by whether the picture cues contained a human. Based on our previous research with non-smokers (Forestell et al., ~~in press~~), we hypothesized that daily smokers with a family history of smoking would demonstrate a stronger attentional bias to *inactive* smoking-related cues than daily smokers without a family history of smoking, while no effects were expected for active pictures.

1. Method

1.1. Participants

Seventy (40 male) smoking undergraduates at a medium-sized liberal arts college were recruited through an online database and provided with credit in their introductory psychology course or recruited through advertisements and paid $10 for their participation. Most of the participants were White ($n = 50$), with the remaining individuals of color (1 Black, 3 Asian, 12 mixed, 2 "other," and 2 non-responses). Participants had an average age of 19.83 years ($SD = 3.46$). All procedures were approved by the school's Protection of Human Subjects Committee, and written informed consent was obtained from each participant.

2. Materials

2.1. Stimuli

The experimental stimuli consisted of 120 color photographs which included 60 smoking-related stimuli.[1] Half of the pictures were active in that they depicted a person interacting with the stimulus, whereas the remaining pictures were inactive, in that they consisted of the stimulus alone. These pictures were presented in pairs that included a smoking-related image as well as a matched neutral image. The sixty neutral photographs were created to be similar on various visual properties such as color, brightness, and object position. All images were successfully pilot-tested with 10 non-smoking undergraduates to ensure that participants could identify their contents and judge whether or not they were drug-related. The average accuracy rate for smoking and non-smoking-related stimuli was 98% ± 0.08 (Range: 90%-100%).

2.2. Questionnaires

In addition to demographic questions about participants' age, ethnic and racial background, family income and parents' level of education, a set of general smoking-related questions were included to measure age at consumption of first cigarette, their current daily smoking habits, and their parents' smoking behaviors. A family history questionnaire determined how many of the participants' first degree relatives (i.e., mother, father, siblings) smoke cigarettes and the amount of time they spent with these smokers currently and in the past. Because of the high comorbidity between smoking and drinking (Saules et al., 2004), participants were interviewed to determine the frequency of drinking, amount of alcohol consumed on a single occasion, type of alcoholic beverages consumed (i.e., beer, wine, liquor) and size of beverage using a time-line follow-back questionnaire. From these data, we estimated the number of standard drinks of alcohol consumed during the previous three weeks (Mennella & Forestell, 2008).

The Fagerström Test of Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerström, 1991) was included to measure smokers' dependence upon nicotine. This brief questionnaire consists of the following six items: time to the first cigarette of the day, level of difficulty refraining from smoking, importance of the first morning cigarette, smoking frequency, importance of smoking in the morning, and determination to smoke. Scores range from 0 to 10, with higher scores indicating a greater level of dependence. Reliability of this questionnaire is .78, and Cronbach alpha levels for internal consistency range from 0.56 - 0.70 (Etter, Duc, & Perneger, 1999; Haddock, Lando, Klesges, Talcott, & Renaud, 1999; Payne, Smith, McCracken, McSherry, & Antony, 1994; Pomerleau, Carton, Lutzke, Flessland, & Pomerleau, 1994).

2.3. Computer Task

All participants completed a dot-probe task to measure their attentional bias. The task consisted of two blocks counterbalanced across participants. Each contained 60 trials, for a total of 120 trials. Each trial began when a fixation-cross appeared in the middle of the

[1] The remaining photographs consisted of 60 alcohol-related and matched non-alcohol-related control pictures. However, only reaction times to smoking and non-smoking-related target stimuli (i.e. those replaced by a probe in the dot-probe task) are analyzed since the theoretical and analytical focus of the present study is reactions to smoking-related stimuli by smokers.

Please cite this article as: Dickter, C.L., & Forestell, C.A., Peering through the smoke: The effect of parental smoking behavior and addiction on daily smokers' attentional bias to smoking cue..., *Addictive Behaviors* (2011), doi:10.1016/j.addbeh.2011.09.017

computer screen for 1000 milliseconds (ms). A picture pair then appeared on the screen for either 500 or 2000 ms, on either side of where the fixation-cross had been, depending on the block. Each pair was presented with equal probability in random order. Different presentation times were used because previous research demonstrated that attentional bias to smoking-related relative to non-smoking-related cues differed based on the stimulus presentation time (Bradley et al., 2003) as a function of smoking exposure. Visual masks then replaced the images for 433 ms. Following the masks, a black dot appeared where one of the pictures had previously been. The participants' task was to identify the side of the screen (i.e., left or right) on which the dot appeared by pressing one of two keys. The dot remained on screen until a response was made by the participant. The inter-trial interval varied randomly between 1500 ms and 3000 ms to prevent expectations of when the next trial would begin (see Fig. 1).

2.4. Carbon monoxide monitor

A carbon monoxide BreathCO monitor (Vitalograph, Lenexa, Kansas) was used to assess prior tobacco smoke exposure.

2.5. Procedure

Participants were asked to come to the lab for two test sessions which were scheduled on separate days. They were informed that Session 1 would consist of a behavioral task and a series of questionnaires, and that Session 2 would consist of another set of questionnaires about their daily habits. Participants were instructed to refrain from smoking for one hour before the first experimental session. This was necessary given that individual differences in nicotine craving can affect attention to smoking-related cues (Waters & Feyerabend, 2000).

2.6. Session 1

The first session, which lasted approximately forty minutes, consisted of the dot-probe task, ~~an approach/avoidance task,~~ and electronically administered questionnaires. Participants completed this session in small groups of two to four students and were seated at private computer stations. All participants were seated 90 cm from the standardized position of a computer monitor, yielding a visual angle of about 6 degrees. Participants were told that the purpose of the study was to examine connections between attention and various variables. After completing a consent form, a carbon monoxide reading was taken via a BreathCO monitor (Vitalograph, Lenexa KS) as a measure of compliance (Field, Duka, Tyler, & Schoenmakers, 2009). Participants were then given instructions on how to complete the computer task and were given a practice block of six trials to familiarize them with the paradigm. Two experimental blocks of the dot-probe task were then completed, separated by a short (25–30 second) break. Finally, participants completed the Fagerstrom Test for Nicotine Dependence (FTND) online.

2.7. Session 2

This session lasted approximately forty-five minutes and consisted of a series of electronically-based questionnaires and interviews which included the demographic questionnaire, the general smoking questionnaire, and the timeline follow-back procedure for alcohol consumption. This session occurred within 2 weeks of the first session. After the completion of these measures, participants were debriefed, paid (if applicable), and thanked for their time.

3. Results

3.1. Participant Characteristics

Of the 70 participants recruited, nine were excluded from data analysis because they were older than 25 years ($n=1$), failed to comply with instructions to not smoke for one hour before the first testing session ($n=1$), or they did not return for the second day of testing ($n=7$). Of the remaining 61 participants, 11 participants reported that they had a smoking father, 8 had a smoking mother, and for 10, both parents smoked. These participants were all combined into one group ($n=29$). The remaining 32 participants reported that their parents did not smoke during their lifetime. Participants were also categorized according to their smoking frequency; that is, those who smoked at least one cigarette per day were classified as daily smokers ($n=34$), whereas those who did not smoke every day were classified as

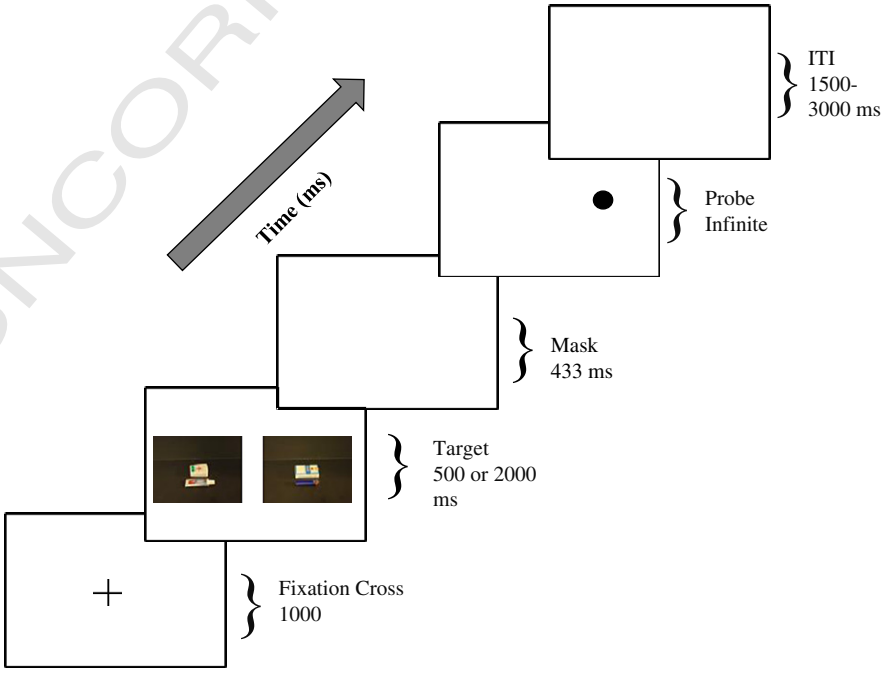

Fig. 1. A schematic of the dot-probe task. The screens were presented in chronological order. Duration is listed to the right of each screen.

Please cite this article as: Dickter, C.L., & Forestell, C.A., Peering through the smoke: The effect of parental smoking behavior and addiction on daily smokers' attentional bias to smoking cue..., *Addictive Behaviors* (2011), doi:10.1016/j.addbeh.2011.09.017

occasional smokers ($n = 27$; Hammond, 2005, Leatherdale & McDonald, 2005).

Compared to occasional smokers, daily smokers had higher CO levels ($M = 7.03$, $SE = 1.15$ vs. $M = 1.26$, $SE = 0.20$, $F(1, 56) = 24.08$, $p < .001$, $\eta^2 = .30$), reported smoking more cigarettes per week ($M = 43.67$, $SE = 5.76$ vs. $M = 1.75$, $SE = 0.23$; $F(1, 55) = 37.92$, $p < .001$, $\eta^2 = .408$), and had higher nicotine dependence scores on the FTND ($M = 2.07$, $SE = 0.26$ vs. $M = 0.27$, $SE = 0.10$; $F(1, 55) = 26.57$, $p < .001$, $\eta^2 = .334$). However, there was no difference in the number of standard drinks they had consumed over the previous three weeks between these groups ($M = 36.0$, $SE = 5.25$ vs. $M = 34.0$, $SE = 6.90$). There were no significant main effects of parental smoking status, nor did parental smoking status interact with participants' smoking status on any of these variables (all $ps > .33$).

3.2. Measures of Attentional Bias

Only reaction times (RTs) from correct trials, where participants accurately identified the location of the dot, were used in the analyses. To examine the relative attention to smoking compared to non-smoking cues, a difference score was calculated in which reaction times to trials in which the dot-probe appeared on the side of the smoking picture were subtracted from the reaction times to trials in which the dot-probe appeared on the side of the non-smoking picture for 500 ms and 2000 ms blocks. Initial analyses revealed that stimulus presentation time was not a significant predictor of attentional bias and did not interact with other variables; therefore this variable was not included in any of the subsequent analyses. Positive difference scores indicated greater attention to the smoking-related pictures relative to the non-smoking-related pictures. Greenhouse-Geisser-adjusted p values are reported for analyses involving multiple numerator degrees of freedom.

To test the hypothesis that attentional bias to smoking-related cues would differ based on the parents' smoking status and the properties of the stimuli for each group of smokers, a 2 (parent smoking status: neither vs. one or both parents smoke) x 2 (participant smoking status: occasional vs. daily) x 2 (stimulus category: active vs. inactive) mixed-model analysis of covariance (ANCOVA) was conducted with attentional bias to smoking-related cues as a dependent measure. CO level was included as a covariate in the analyses to control for exposure to cigarette smoke, as was time spent with smokers over the past month to control for the influence of smoking peers. Results revealed the hypothesized stimulus category x participant smoking status x parental smoking status interaction, $F(1, 52) = 5.97$, $p < 0.02$, $\eta^2 = 0.103$.

In order to further investigate this three-way interaction, parent smoking status x stimulus category ANCOVAs were conducted separately for daily and occasional smokers. While this analysis failed to reveal a significant interaction for occasional smokers ($p > .34$), for daily smokers, there was a parental smoking status x stimulus category interaction, $F(1, 28) = 7.60$, $p = .01$, $\eta^2 = 0.21$. As depicted in Fig. 2, simple main effects analyses suggested that for the inactive cues, daily smokers who had a smoking parent displayed more of an attentional bias relative to daily smokers without a smoking parent, $F(1, 28) = 5.22$, $p = .03$, $\eta^2 = 0.16$. However, for the active stimuli, no differences between daily smokers with a smoking parent and those without a smoking parent emerged ($p > 0.25$).

Additional analyses were performed to determine whether nicotine dependence and parental smoking uniquely predicted attentional bias to the inactive smoking-related cues in daily smokers. Specifically, measures of nicotine dependence as measured by the FTND and the proportion of primary smoking relatives with whom the participant had contact were included as independent variables in a regression analysis. Results revealed that the proportion of smoking primary relatives was a significant predictor, $ß = 0.38$, $p < .05$, as was nicotine dependence (FTND), $ß = 0.32$, $p < .03$, with the overall model predicting a significant amount of the variance in attentional bias, $F(2, 30) = 7.03$, $p < .01$, $R^2 = 0.32$.

4. Discussion

The current study investigated how parental smoking interacts with participants' smoking habits to influence attentional bias to smoking-related cues. Results indicated that daily smokers who had exposure to parents who smoked showed more of an attentional bias to inactive smoking-related cues than those without parents who smoked. Additionally, nicotine dependence independently predicted attentional biases to the smoking cues in daily smokers.

Consistent with our findings with non-smokers (Forestell et al., ~~in press~~), the presence of an attentional bias in the current study was found only for cues that did not depict humans interacting with the smoking stimuli. This result may have occurred because participants were distracted by the human content in the active picture stimuli (see Bentin et al., 1996). In contrast to the findings with daily smokers in the current study and non-smokers in previous work (Forestell et al., ~~in press~~), occasional smokers' attentional bias did not differ for either the active or inactive stimuli as a function of parental smoking behavior. Previous research with occasional smokers, often referred to as "chippers," suggests that while some may progress to daily smoking, many continue to smoke only occasionally throughout their lifetime without becoming dependent on nicotine (e.g., Shiffman, 1989; Shiffman, Paty, Gnys, Kassel, & Elash, 1995). This may be related to the fact that occasional smokers are motivated by environmental cues such as social situations and interactions with smoking peers (Otsuki et al., 2008; Stromberg et al., 2007) rather than the physiological effects of nicotine. Therefore, while occasional smokers may enjoy the acute effects of nicotine and may be motivated to smoke around other smokers in social situations, because they do not have an attentional bias, they may not be drawn to cigarette cues outside of these situations. Whether occasional smokers who have stronger attentional biases to smoking-related cues are more likely to progress to daily smoking is an important topic of investigation which will require longitudinal studies.

Given that non-smokers in previous work and daily smokers in the current study demonstrated the same pattern of attentional bias to smoking-related cues, while non-addicted occasional smokers showed no evidence of attentional bias, our results suggest that attentional bias may not be a predictor for smoking initiation per se. Instead, those who have attentional biases to smoking cues may be more vulnerable to nicotine addiction once they have initiated smoking and as a result, may have an especially difficult time quitting smoking (e.g. Bradley et al., 2003). Why some children of smokers who clearly demonstrate attentional biases to smoking-related cues never engage in smoking behavior while others do is unknown. Clearly, early learning about tobacco and cigarette smoking is complex and involves many factors such as frequency of exposure to family and peer smokers and parental attitudes about smoking (Andersen et al., 2002). Q11

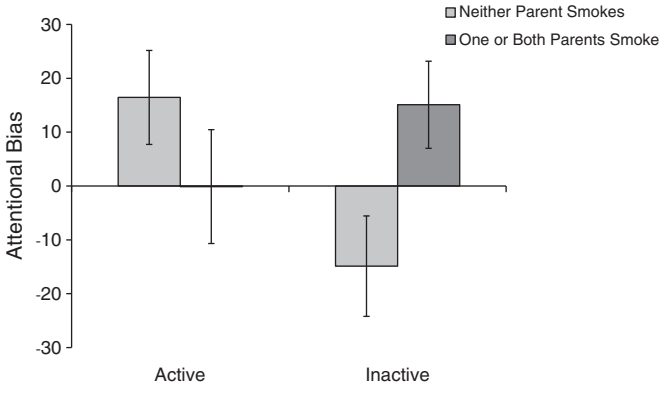

Fig. 2. Attentional bias in daily smokers as a function of cue type and parental smoking. Error bars represent standard errors.

Please cite this article as: Dickter, C.L., & Forestell, C.A., Peering through the smoke: The effect of parental smoking behavior and addiction on daily smokers' attentional bias to smoking cue..., *Addictive Behaviors* (2011), doi:10.1016/j.addbeh.2011.09.017

Previous work has also suggested that the context in which parents smoke may also play a role, as children whose mothers smoked cigarettes to relieve tension disliked the odor of cigarette smoke more than children whose mothers smoked for reasons other than relief from tension (Forestell & Mennella, 2005). In other words, when children experienced odors during negative emotional situations, they were less likely to subsequently prefer them, suggesting that associative learning in the context of emotionally salient conditions is a powerful mechanism by which smoking-related cues acquire personal significance and influence subsequent behaviors. Because the current study was retrospective, it was impossible to determine whether the associations formed between smoking-related cues and the emotional contexts in which smoking occurs ultimately influence the attentional biases observed in the current sample of adults. Future research can address this by measuring attentional biases in young children who differ in terms of the emotional context in which their parents smoke. Although it is possible that exposure to smoking cues in the home causes these cues to become salient attractors of attention, research has also established a genetic link for smoking initiation and addiction (Heath et al., 1993). Therefore, children of smokers may also be genetically predisposed to attend to these stimuli. These two possibilities are not mutually exclusive and, regardless of the mechanism, the current results help inform models of drug addiction.

In addition to parental influence, dependence as measured by the FTND was also related to the strength of the attentional bias demonstrated in daily smokers. Theories of drug addiction suggest that attention to drug-related cues is important in the maintenance of drug use and the success of drug cessation attempts (e.g., Bradley et al., 2003; Robinson & Berridge, 1993; Waters & Feyerabend, 2000). As a result, most quit attempts by daily smokers are unsuccessful, with a success rate of less than 5% for smokers who try to quit on their own and less than 25% for those with professional help (Hughes et al., 1992; Ward, Klesges, Zbikowski Ryan, & Susan, 1997). Our results suggest that attentional bias may help explain why relapses tend to occur within the first few days of quitting (Garvey, Bliss, Hitchcock, Heinold, & Rosner, 1992; Hughes et al., 1992). However, it should be noted that the FTND is limited as a measure of nicotine dependence despite the extensive use of this scale and its predecessor (i.e., the Fagerström Tolerance Questionnaire; Fagerström & Schneider, 1989). Over the past 25 years, its reliability and validity have been questioned (for a review see Piper, McCarthy, & Baker, 2006) as measures of dependence. Instead, the FTND has been shown to be a better predictor of smoking heaviness and relapse rather than nicotine dependence per se (e.g., Alterman, Gariti, Cook, & Cnaan, 1999; Breslau & Johnson, 2000; Patten, Martin, Calfas, Lento, & Wolter, 2001). In response to these drawbacks, new measures of tobacco dependence are being developed, but more research is required to establish construct validity. A better understanding of mechanisms underlying tobacco dependence and how it interacts with various theoretical and social factors such as those reported herein is warranted.

The investigation of smokers' and non-smokers' implicit biases to smoking-related cues could be instrumental in the development of evidence-based strategies for identifying at-risk individuals and cessation techniques. For example, the results of the current study and other recent work (Bradley et al., 2004; ~~Haight & Dickter, submitted for publication~~) imply that the presence of implicit biases, both attentional and affective, could impact the success of smoking cessation programs. As a result, these programs may benefit from taking these implicit biases into consideration in their design. Because implicit biases have been shown to be somewhat malleable (Dasgupta & Greenwald, 2001), one strategy that may improve the success rate of daily smokers involves altering their implicit biases to smoking-related stimuli. Implicit cognitive tasks may be used to train smokers with attentional biases to avoid attending to smoking-related stimuli. In fact, implicit training has been successfully implemented in substance-addicted individuals (Field et al., 2009; Schoenmakers et al., 2007), who showed lower instances of short-term and long-term drug use (Fadardi & Cox, 2009). One potential implementation of this could involve presenting participants with images depicting negative smoking-related stimuli, such as those recently designed by the Food and Drug Association to appear on packages of cigarettes and smoking advertisements in the United States. Future research should investigate whether exposure to these negative smoking images affects the implicit cognitive processing of smoking-related cues.

Another avenue for future work should involve investigating how peer smoking behavior relates to attentional biases to smoking cues, as previous work has suggested that peer smoking behavior plays a key role in smoking initiation (e.g., Alexander, Piazza, Mekos, & Valente, 2001). Although it is possible that individuals who had smoking parents were drawn to peers who smoke, which may have mediated the strength of their attentional bias observed in this study, our results suggest that their attentional bias was not merely a function of peer smoking behavior. First, smokers with a smoking parent did not differ from those without a smoking parent in time spent with peers who smoke. Second, the results demonstrated an attentional bias while controlling for time spent with smoking peers. Together these findings suggest that parental smoking leads to an attentional bias over and above the influence of smoking peers. It is possible that peer influence may play a unique role in the acquisition and maintenance of attentional biases, especially for early-onset adolescent smokers.

The current study investigated how participants' smoking behavior and their parents' smoking behavior interact to affect attentional biases towards smoking-related cues. Results indicated that daily smokers with a smoking parent demonstrate an attentional bias towards smoking stimuli without human content. Importantly, these results were found despite controlling for recent smoking behavior and time spent with smokers. Results demonstrated that the higher participants' dependence on nicotine and the more family members who smoke, the greater the attentional bias. These findings help to explain why children of smokers initiate and maintain smoking at higher levels than those without a smoking parent and suggest that smokers who are addicted to nicotine may have a particularly challenging time quitting, especially if they were exposed to parental smoking throughout development. Future research that examines the effects of parental smoking on children through the use of psychophysiological measures, such as electroencephalography, will provide further insight into the mechanisms involved in the development of attentional biases to smoking-related cues.

Uncited references

Cox et al., 2001
d' Alfonso, et al., 2000
Dasgupta and Asgari, 2004
Tiffany and Drobes, 1990

Role of Funding Sources
No funding was provided for this project.

Contributors
Cheryl L. Dickter and Catherine A. Forestell designed the study, conducted data analysis, and wrote the manuscript together. Both authors have approved the final manuscript.

Conflict of Interest
Both authors declare that they have no conflicts of interest.

Acknowledgement
The authors thank Jason Wright, Alexandra Hayes, Ariel Sims, and Chelsie Young for their help with data collection.

Please cite this article as: Dickter, C.L., & Forestell, C.A., Peering through the smoke: The effect of parental smoking behavior and addiction on daily smokers' attentional bias to smoking cue..., *Addictive Behaviors* (2011), doi:10.1016/j.addbeh.2011.09.017

References

Alexander, C., Piazza, M., Mekos, D., & Valente, T. W. (2001). Peer networks and adolescent cigarette smoking: An analysis of the national longitudinal study of adolescent health. *Journal of School Health*, *29*, 22–30.

Alterman, A. I., Gariti, P., Cook, T. G., & Cnaan, A. (1999). Nicodermal patch adherence and its correlates. *Drug and Alcohol Dependence*, *53*, 159–165.

American Cancer Society (2009). *Cancer Prevention & Early Detection, Facts & Figures 2009*. Atlanta, GA: American Cancer Society.

Andersen, M. R., Leroux, B. G., Marek, P. M., Peterson, A. V., Jr., Kealey, K. A., Bricker, J., et al. (2002). Mothers' attitudes and concerns about their children smoking: Do they influence kids? *Preventive Medicine: An International Journal Devoted to Practice and Theory*, *34*(2), 198–206.

Bauman, K. E., Foshee, V. A., Linzer, M. A., & Koch, G. G. (1990). Effect of parental smoking classification on the association between parental and adolescent smoking. *Addictive Behaviors*, *15*(5), 413–422.

Bentin, S., Allison, T., Puce, A., Perez, E., & McCarthy, G. (1996). Electrophysiological studies of face perception in humans. *Journal of Cognitive Neuroscience*, *8*(6), 551–565.

Bradley, B. P., Field, M., Mogg, K., & Houwer, De (2004). Attentional and evaluative biases for smoking cues in nicotine dependence: Component processes of biases in visual orienting. *Behavioral Pharmacology*, *15*, 29–36.

Bradley, B. P., Mogg, K., Wright, T., & Field, M. (2003). Attentional bias in drug dependence: Vigilance for cigarette-related cues in smokers. *Psychology of Addictive Behaviors*, *17*(1), 66–72.

Breslau, N., & Johnson, E. O. (2000). Predicting smoking cessation and major depression in nicotine-dependent smokers. *American Journal of Public Health*, *90*, 1122–1127.

Centers for Disease Control and Prevention (CDC) (2009). Cigarette smoking among adults and trends in smoking cessation — United States. *Morbidity and Mortality Weekly Report*, *58*(44), 1227–1232.

Chassin, L., Presson, C. C., Pitts, S. C., & Sherman, S. J. (2000). The natural history of cigarette smoking from adolescence to adulthood in a midwestern community sample: Multiple trajectories and their psychosocial correlates. *Health Psychology*, *19*, 223–231.

Chassin, L., Presson, C., Rose, J., Sherman, S. J., & Prost, J. (2002). Parental smoking cessation and adolescent smoking. *Journal of Pediatric Psychology*, *27*(6), 485–496.

Chassin, L., Presson, C. C., Sherman, S. J., & Pitts, S. C. (2000). The natural history of cigarette smoking from adolescence to adulthood in a 21idwestern community sample: Multiple trajectories and their correlates. *Health Psychology*, *19*, 223–231.

Chassin, L., Sherman, S. J., Presson, C. C., & Edwards, D. (1991). Four pathways to young-adult smoking status: Adolescent social–psychological antecedents in a 21idwestern community sample. *Health Psychology*, *10*, 409–418.

Colder, C. R., Lloyd-Richardson, E. E., Flaherty, B. P., Hedeker, D., Segawa, E., & Flay, B. R. (2006). The natural history of college smoking: Trajectories of daily smoking during the freshman year. *Addictive Behaviors*, *31*, 2212–2222.

Cox, L. S., Tiffany, S. T., & Christen, A. G. (2001). Evaluation of the brief questionnaire of smoking urges (QSU-brief) in laboratory and clinical settings. *Nicotine & Tobacco Research*, *3*, 7–16.

d' Alfonso,, A. A. L., van Honk, J., Hermans, E., Postma, A., & de Haan, E. H. F. (2000). Laterality effects in selective attention to threat after repetitive transcranial magnetic stimulation at the prefrontal cortex in female subjects. *Neuroscience Letters*, *280*(3), 195–198, doi:10.1016/S0304-3940(00)00781-3.

Dasgupta, N., & Asgari, S. (2004). Seeing is believing: Exposure to counterstereotypic women leaders and its effect on the malleability of automatic gender stereotyping. *Journal of Experimental Social Psychology*, *40*, 642–658.

Dasgupta, N., & Greenwald, A. G. (2001). On the malleability of automatic attitudes: Combating automatic prejudice with images of admired and disliked individuals. *Journal of Personality and Social Psychology*, *81*, 800–814.

Den Exter Blokland, E. A. W., Engels, R. C. M. E., Hale, W. W., III, Meeus, W., & Willemsen, M. C. (2004). Lifetime parental smoking history and cessation and early adolescent smoking behavior. *Preventive Medicine: An International Journal Devoted to Practice and Theory*, *38*, 359–368.

Etter, J. F., Duc, T. V., & Perneger, T. V. (1999). Validity of the Fagerström test for nicotine dependence and the Heaviness of Smoking Index among relatively light smokers. *Addiction*, *94*, 269–281.

European Environment and Health Information System (2007). Exposure of children to environmental tobacco smoke. May. http://www.euro.who.int/data/assets/pdf_file/0006/97422/3.4_WEB.pdf Retrieved from

Fagerström, K. O., & Schneider, N. G. (1989). Measuring nicotine dependence: a review of the Fagerstrom Tolerance Questionnaire. *Journal of Behavioral Medicine*, *12*, 159–182.

Field, Matt, Duka, T., Tyler, E., & Schoenmakers, T. (2009). Attentional bias modification in tobacco smokers. *Nicotine & Tobacco Research*, *11*, 812–822, doi:10.1093/ntr/ntp067.

Flay, B. R., Hu, F. B., Siddiqui, O., Day, L. E., Hedeker, D., Petraitis, J., Richardson, J., et al. (1994). Differential Influence of Parental Smoking and Friends' Smoking on Adolescent Initiation and Escalation and Smoking. *Journal of Health and Social Behavior*, *35*(3), 248–265, doi:10.2307/2137279.

Forestell, C. A., & Mennella, J. A. (2005). Children's hedonic judgments of cigarette smoke odor: Effects of parental smoking and maternal mood. *Psychology of Addictive Behaviors*, *19*, 423–432.

Forestell, C. A., Dickter, C. L., Wright, J. D., & Young, C. M. (in press). Clearing the smoke: Parental influences on non-smokers' attentional biases to smoking-related cues. *Psychology of Addictive Behaviors*.

Franken, I. H. A. (2003). Drug craving and addiction: integrating psychological and neuropsychopharmacological approaches. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, *27*, 563–579.

Garvey, A. J., Bliss, R. E., Hitchcock, J. L., Heinold, J. W., & Rosner, B. (1992). Predictors of smoking relapse among self-quitters: A report from the normative aging study. *Addictive Behaviors*, *17*, 367–377.

Haddock, C. K., Lando, H., Klesges, R. C., Talcott, G. W., & Renaud, E. A. (1999). A study of the psychometric and predictive properties of the Fagerström Test for Nicotine Dependence in a population of young smokers. *Nicotine & Tobacco Research*, *1*, 59–64.

Haight, J., Dickter, C. L., & Forestell, C. A. A comparison of daily and occasional smokers' implicit affective responses to smoking cues. *Manuscript submitted for publication.* Q18

Hammond, D. (2005). Smoking behaviour among young adults: Beyond youth prevention. *Tobacco Control*, *14*, 181–185.

Heath, A. C., Cates, R., Martin, N. G., Meyer, J., Hewitt, J. K., Neale, M. C., & Eaves, L. J. (1993). Genetic contribution to risk of smoking initiation: Comparisons across birth cohorts and across cultures. *Journal of Substance Abuse*, *5*, 221–246.

Hughes, J. R., Gulliver, S. B., Fenwick, J. W., Valliere, W. A., Cruser, K., Pepper, S., Shea, P., et al. (1992). Smoking cessation among self-quitters. *Health Psychology*, *11*, 331.

Kleinjan, M., Engels, R. C. M. E., van Leeuwe, J., Brug, J., van Zundert, R. M. P., & van den Eijnden, R. J. J. M. (2009). Mechanisms of adolescent smoking cessation: Roles of readiness to quit, nicotine dependence, and smoking of parents and peers. *Drug and alcohol dependence*, *99*, 204–214.

Leatherdale, S., & McDonald, P. (2005). What smoking cessation approaches will young smokers use? *Addictive Behaviors*, *30*, 1614–1618.

McCusker, C. G. (2001). Cognitive biases and addiction: An evolution in theory and method. *Addiction*, *96*, 47–56.

Mennella, J. A., & Forestell, C. A. (2008). Children's hedonic responses to the odors of alcoholic beverages: A window to emotions. *Alcohol*, *42*(4), 249–260.

Mogg, K., Bradley, B. P., Field, M., & De Houwer, J. (2003). Eye movements to smoking-related pictures in smokers: relationship between attentional biases and implicit and explicit measures of stimulus valence. *Addiction*, *98*, 825–836.

Moran, S., Wechsler, H., & Rigotti, N. (2004). Social smoking among US college students. *Pediatrics*, *114*, 1028–1034.

Otsuki, M., Tinsley, B., Chao, R., & Unger, J. (2008). An ecological perspective on smoking among Asian American college students: The roles of social smoking and smoking motives. *Psychology of Addictive Behaviors*, *22*, 514–523.

Patten, C. A., Martin, J. E., Calfas, K. J., Lento, J., & Wolter, T. D. (2001). Behavioral treatment for smokers with a history of alcoholism: Predictors of successful outcome. *Journal of Consulting & Clinical Psychology.*, *69*, 796–801.

Payne, T. J., Smith, P. O., McCracken, L. M., McSherry, W. C., & Antony, M. M. (1994). Assessing nicotine dependence: a comparison of the Fagerstrom Tolerance Questionnaire (FTQ) with the Fagerstrom Test for Nicotine Dependence (FTND) in a clinical sample. *Addictive Behaviors*, *19*, 307–317.

Piper, M. E., McCarthy, D. E., & Baker, T. B. (2006). Assessing tobacco dependence: a guide to measure evaluation and selection. *Nicotine and Tobacco Research*, *8*, 339–351.

Pomerleau, C. S., Carton, S. M., Lutzke, M. L., Flessland, K. A., & Pomerleau, O. F. (1994). Reliability of the Fagerström Tolerance Questionnaire and the Fagerström Test for Nicotine Dependence. *Addictive Behaviors*, *19*, 33–39.

Rivara, F. P., Ebel, B. E., Garrison, M. M., Christakis, D. A., Wiehe, S. E., & Levy, D. T. (2004). Prevention of smoking-related deaths in the United States. *American Journal of Preventive Medicine*, *27*, 118–125.

Robinson, T., & Berridge, K. (1993). The neural basis of drug craving: An incentive-sensitization theory of addiction. *Brain Research Reviews*, *18*, 247–291.

Saules, K. K., Pomerleau, C. S., Snedecor, S. M., Mehringer, A. M., Shadle, M. B., Kurth, C., & Krahn, D. D. (2004). Relationship of onset of cigarette smoking during college to alcohol use, dieting concerns, and depressed mood: Results from the Young Women's Health Survey. *Addictive Behaviors*, *29*, 893–899.

Sherman, S., Rose, J., Koch, K., Presson, C., & Chassin, L. (2003). Implicit and explicit attitudes toward cigarette smoking: The effects of context and motivation. *Journal of Social and Clinical Psychology*, *22*, 13–39.

Shiffman, S. (1989). Tobacco "chippers"—individual differences in tobacco dependence. *Psychopharmacology*, *97*(4), 539–547.

Shiffman, S., Paty, J. A., Gnys, M., Kassel, J. D., & Elash, C. (1995). Nicotine withdrawal in chippers and regular smokers: Subjective and cognitive effects. *Health Psychology*, *14*(4), 301.

Stritzke, W., Breiner, M., Curtin, J., & Lang, A. (2004). Assessment of substance cue reactivity: Advances in reliability, specificity, and validity. *Psychology of Addictive Behaviors*, *18*, 148–159.

Stromberg, P., Nichter, M., & Nichter, M. (2007). Taking play seriously: Low-level smoking among college students. *Culture, Medicine & Psychiatry*, *31*, 1–24.

Tiffany, S., & Drobes, D. J. (1990). Imagery and smoking urges: The manipulation of affective content. *Addictive Behaviors*, *15*, 531–539.

Ward, K. D., Klesges, R. C., Zbikowski Ryan, E., & Susan, M. (1997). Gender differences in the outcome of an unaided smoking cessation attempt. *Addictive Behaviors*, *22*, 521–533.

Warren, C. A., & McDonough, B. E. (1999). Event-related brain potentials as indicators of smoking cue-reactivity. *Clinical Neurophysiology*, *110*, 1570–1584.

Waters, A. J., & Feyerabend, C. (2000). Determinants and effects of attentional bias in smokers. *Psychology of Addictive Behaviors*, *14*, 111–120.

Waters, A. J., Shiffman, S., Sayette, M. A., Paty, J. A., Gwaltney, C. J., & Balabanis, M. H. (2003). Attentional bias predicts outcome in smoking cessation. *Health Psychology*, *22*, 378.

Williams, J. G. W., Mathews, A., & MacLeod, C. (1996). The emotional Stroop task and psychopathology. *Psychological Bulletin*, *120*, 3–24.

Please cite this article as: Dickter, C.L., & Forestell, C.A., Peering through the smoke: The effect of parental smoking behavior and addiction on daily smokers' attentional bias to smoking cue..., *Addictive Behaviors* (2011), doi:10.1016/j.addbeh.2011.09.017