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Clearing the Smoke: Parental Influences on Non-smokers' Attentional Biases to Smoking-Related Cues
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Clearing the Smoke: Parental Influences on Non-smokers’ Attentional Bias to Smoking-Related Cues

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Children who have a parent who smokes are more likely to begin smoking than their peers who do not have a family history of smoking behavior. The goal of this study was to explore a potential mechanism to explain this relationship. It was hypothesized that college-age nonsmokers who have smoking parents would express an attentional bias for smoking-related cues relative to those without smoking parents. Participants were grouped according to whether one or both of their parents smoked (n = 32) or neither parent smoked (n = 31). A dot-probe paradigm was used in which picture pairs that consisted of a smoking-related picture and a nonsmoking control picture were displayed for either 500 or 2,000 ms. Each picture pair contained either human elements or objects alone. Attentional bias was calculated by subtracting reaction times to the smoking stimuli from nonsmoking stimuli as a function of content and presentation time. Participants with at least one smoking parent demonstrated an attentional bias to smoking-related pictures relative to control pictures when displayed for 2,000 ms, but only when they did not contain human content. Participants without a smoking parent showed no attentional bias. These results suggest that college-age nonsmokers who have smoking parents may be at-risk for late-onset smoking initiation because of their enhanced attention to smoking-related cues.

Keywords: attention, parental smoking, nonsmokers, dot-probe

Currently, smoking is the most common preventable cause of death in the United States (American Cancer Society, 2009). As a result of the prevalence of smoking behavior among adults in our society, approximately one quarter of children in North America (Soliman, Pollack, & Warner, 2004) and half of children worldwide (European Environment and Health Information System [ENHIS], 2007) live in a household with a parent who smokes cigarettes, placing them at higher risk for a wide variety of adverse health effects, including colds, lower respiratory tract infections such as pneumonia and bronchitis, and asthma (ENHIS, 2007). Additionally, children who have a parent who smokes are significantly more likely to experiment with smoking and become habitual smokers (Bauman, Foshee, Linzer, & Koch, 1990; Chassin, Presson, Rose, Sherman, & Prost, 2002; den Exter Blokland, Engels, Hale, Meeus, & Willemsen, 2004).

Environmental factors may either trigger or prevent genetically oriented tendencies to smoke cigarettes (Shanahan & Hofer, 2005). Previous research has shown that smoking initiation may be partially dependent on the smoking attitudes and smoking behaviors of parents. In one study (Andersen et al., 2002), the number of children who began smoking by 12th grade was reduced by approximately 50% if, by the time the child was 8 years old, their mothers communicated strong antismoking attitudes to them. However, maternal attitudes and concerns about smoking influenced their children’s smoking initiation only when they were consistent with parental smoking habits. That is, antismoking communications by the mother did not have a protective effect if she or the father was a smoker (see also Murray, Kiryluk, & Swan, 1985; Substance Abuse & Mental Health Services Administration, 2008). Thus, it appears that children’s exposure to parental smoking influences their propensity to smoke throughout early and late adolescent developmental periods (Villanti, Boulay, & Juon, 2011).

One factor that may mediate this relationship is the development of enhanced attention toward smoking-related stimuli. Those who are addicted to drugs show an attentional bias for stimuli related to these substances (Bradley, Mogg, Wright, & Field, 2003; Waters & Feyerabend, 2000). This bias is thought to be implicit, suggesting that, despite their efforts to ignore smoking-related cues, attention is implicitly drawn to these emotionally valanced stimuli (Williams, Mathews, & MacLeod, 1996). For example, when passing a billboard that advertises a cigarette brand, a smoker might be unable to ignore the cigarette products displayed, which may activate motivational responses that eventuate in the act of smoking (Tiffany, 1990). Little research has investigated attentional biases in nonsmoking college-age samples who may be at risk for smoking initiation. This group may be especially important to study because while smoking is on the decline for most age groups in the United States, college-age students have remained the only group to show marked increases in smoking over the past decade (Centers for Disease Control & Prevention, 2009; Rigotti et al., 2000). Although this rise has been primarily attributed to the aging of high school students who smoke (Johnston, O’Malley,
Bachman, & Schulenberg, 2005; Wechsler, Rigotti, Gledhill-Hoyt, & Lee, 1998), longitudinal research suggests that a sizable proportion of individuals begin smoking after age 18 (e.g., Chassin, Presson, Sherman, & Pitts, 2000; Chassin, Sherman, Presson, & Edwards, 1991). While most college students are aware of the negative health implications of smoking behavior and express no explicit desire to start smoking (Goddard, 1992; Stern, Prochaska, Velicer, & Elder, 1987), it is possible that prior exposure to parental smoking may lead to implicit changes in attentional processes that could predispose them to initiate smoking.

The current study aimed to determine whether college-age non-smokers who have parents who smoke demonstrate an attentional bias for smoking-related cues. To investigate this possibility, a dot-probe reaction time task was employed. This reaction time task has been used to measure attentional biases to drug-related cues in smokers (e.g., Bradley et al., 2003), alcohol consumers (e.g., Field, Mogg, Zetteler, & Bradley, 2004), and caffeine consumers (Stafford, Wright, & Yeomans, 2010). We hypothesized that college students who have a history of exposure to parental smoking behavior would show quicker reaction times to smoking-related pictures relative to nonsmoking control pictures in the dot-probe task, compared to those with no history of parental smoking exposure.

Previous research examining the processing of drug-related cues has been limited due to the content of the stimuli used (Stritzke, Breiner, Curtin, & Lang, 2004). Specifically, the proportion of pictures that depict humans interacting with drug-related cues relative to those that present the cues alone is often not reported, although both types of stimuli are used. This is potentially problematic due to psychophysiological evidence showing that stimuli containing people are processed to a greater extent than stimuli containing objects (e.g., Allison et al., 1994; Bentin, Allison, Puce, Perez, & McCarthy, 1996; Bobes, Valdés-Sosa, & Olivares, 1994; VanRullen & Thorpe, 2001). Therefore, an additional goal of the current study was to examine whether pictures that contain humans are processed differently from those that do not.

Method

Participants

Eighty-four (42 male) nonsmoking undergraduates at a medium-sized liberal arts college were recruited through an online database and provided with credit in their introductory psychology course. Most of the participants were White (n = 55), with the remaining individuals of color (9 African Americans, 2 Asian Indians, 1 Chinese, 2 Koreans, and 15 Mixed or “Other”). All procedures were approved by the school’s Protection of Human Subjects Committee, and written informed consent was obtained from each participant.

Materials

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 60 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 nonsmoking 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%).

Questionnaires. A demographic questionnaire measured participants’ age, gender, race, family income, and parents’ level of education. Additional questions were asked about parents’ smoking behavior and current exposure to secondhand smoke. Because of the comorbidity of drinking and smoking behavior (Saules et al., 2004), we also measured consumption of standard drinks of alcohol over the previous 3 weeks.

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 computer screen for 1,000 milliseconds (ms). A picture pair then appeared on the screen for either 500 or 2,000 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 intertrial interval varied randomly between 1,500 ms and 3,000 ms to prevent expectations of when the next trial would begin (see Figure 1).

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

Procedure

Participants came to the lab for two test sessions, which were scheduled on separate days. In Session 1, participants completed the dot-probe task, which took approximately 40 minutes. After completing the informed consent, participants’ carbon monoxide reading was taken. Participants were then seated in small groups of two to four students approximately 90 cm from a computer monitor at private computer stations where they were given instructions on how to complete the dot-probe task. They completed six practice trials to familiarize themselves with the paradigm. Participants were told that the purpose of the study was to examine responses to drug-related stimuli. The two experimental blocks of the dot-probe task were then completed, separated by a short

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 the examination of reactions to smoking-related stimuli by smokers.
break. In the second session, participants completed the electronically based questionnaires and were then debriefed.

Results

Participant Characteristics

Only those participants who reported that they “had never smoked cigarettes” were included in the analyses (N = 68). Of these, five participants were excluded because they reported that they did not know the smoking status of at least one parent (n = 4) or they were older than 25 (n = 1). Thirty-one participants reported that neither parent smoked, while 14 had only a smoking father, 10 had only a smoking mother, and 8 reported that both parents smoked. All participants who reported that they had at least one smoking parent were combined into one group (n = 32). As shown in Table 1, those with smoking and nonsmoking parents did not differ on any of the demographic variables, nor in their CO measurement, second-hand smoking exposure, or number of standard alcoholic drinks consumed in the last three weeks.

Table 1
Participant Characteristics by Smoking Group

<table>
<thead>
<tr>
<th></th>
<th>Neither parent smokes (n = 31)</th>
<th>One or both parents smoke (n = 32)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (in years)</td>
<td>19.10 ± 0.16</td>
<td>19.00 ± 0.17</td>
</tr>
<tr>
<td>Gender (% female)</td>
<td>54.80</td>
<td>43.80</td>
</tr>
<tr>
<td>Family Income (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;$100,000/year</td>
<td>54.80</td>
<td>46.90</td>
</tr>
<tr>
<td>&lt;$100,000/year</td>
<td>45.20</td>
<td>53.10</td>
</tr>
<tr>
<td>Parental Education Level* (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School</td>
<td>3.20</td>
<td>6.30</td>
</tr>
<tr>
<td>Community College</td>
<td>0.00</td>
<td>3.10</td>
</tr>
<tr>
<td>Undergraduate</td>
<td>29.00</td>
<td>34.40</td>
</tr>
<tr>
<td>Graduate/Professional</td>
<td>67.70</td>
<td>56.30</td>
</tr>
<tr>
<td>Mean CO reading (parts/million)</td>
<td>1.06 ± 0.11</td>
<td>1.37 ± 0.12</td>
</tr>
<tr>
<td>Secondhand Smoking Exposure (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>19.40</td>
<td>9.40</td>
</tr>
<tr>
<td>Occasional</td>
<td>45.20</td>
<td>40.60</td>
</tr>
<tr>
<td>Weekly</td>
<td>29.00</td>
<td>28.10</td>
</tr>
<tr>
<td>Daily</td>
<td>6.50</td>
<td>21.90</td>
</tr>
<tr>
<td>Alcohol consumed (drinks/3 weeks)</td>
<td>5.59</td>
<td>4.29</td>
</tr>
</tbody>
</table>

* Highest education level of mother and father reported.
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 2,000 ms blocks. 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 smoking status of the parent and the properties of the stimuli at 2,000 ms, a 2 (Parent Smoking: Neither vs. One or Both Parent Smokes) × 2 (Stimuli: Active vs. Inactive) mixed-model analysis of variance (ANOVA) with repeated measures on the last factor was conducted. As shown in Figure 2, the results revealed that those who had a parent who smoked were significantly faster to respond to the smoking-related stimuli than those who did not have a smoking parent, \( F(1, 61) = 4.07, p = .048, \eta^2 = .063 \). This main effect was qualified by a significant Parent Smoking × Stimuli interaction, \( F(1, 61) = 4.51, p = .038, \eta^2 = .069 \). Simple main effects analyses demonstrated that participants with a parent who smoked had more of an attentional bias to the inactive smoking stimuli (\( M = 18.58, SE = 10.29 \)) than the participants without a smoking parent (\( M = -19.95, SE = 9.56 \)), \( t(61) = 2.74, p = .008 \). However, for the active smoking stimuli, attentional biases did not differ between those with a parent who smoked (\( M = -18.21, SE = 8.65 \)) and those without a smoking parent (\( M = -9.42, SE = 9.18 \)), \( t(61) = -0.70, p = .488 \). Similar analyses conducted for 500 ms trials failed to reveal any significant effects (\( ps > .22 \)).

The present study is the first to report that nonsmoking college-age students with a smoking parent demonstrate an attentional bias to smoking-related cues. This provides evidence that, for individuals who have never smoked themselves, exposure to parental smoking behavior may enhance attention to smoking-related cues. Given that most college-age participants explicitly report negative attitudes toward smoking (e.g., Goddard, 1992; Stern et al., 1987) and show negative implicit affective responses toward smoking-related stimuli (Payne, McClerndon, & Dobbins, 2007), the attentional bias demonstrated by nonsmoking individuals in the present study is especially interesting because it may represent a sensitive measure of smoking vulnerability in nonsmokers.

Because most people are unaware of the factors that influence their decision to smoke (McCusker, 2001), the examination of implicit attention is an informative avenue for understanding people’s unconscious responses to smoking cues. The results of the current study suggest that nonsmokers are not a homogeneous group. While nonsmokers without a smoking parent direct their attention away from smoking-related cues, those with exposure to a smoking parent displayed an implicit attentional bias toward smoking-related stimuli at 2,000 ms. That nonsmoking individuals with a smoking parent show the opposite pattern of attention when compared to individuals without a smoking parent is particularly striking given that most of these young adults no longer live with their parents. This finding underscores the dramatic long-term effects of early exposure to smoking behaviors.

Two explanations, not mutually exclusive, may account for the attentional bias to the smoking-related cues in nonsmokers with smoking parents. First, it is possible that those with a family history of smoking are genetically predisposed to attend to these stimuli, which leads them to experiment with and initiate smoking behavior. Twin studies estimate the heritability of the risk of smoking initiation to be between 0.45 and 0.61 (Heath et al., 1993). Second, through frequent exposure to a parent who smokes throughout development, smoking-related stimuli (such as the odor and look of cigarettes) may become associated with early memories and as a result become potent attractors of attention (Forestell & Mennella, 2005). Although the present study did not find differences in the amount of time participants interacted with peers who smoked, previous research has shown that peer smoking behavior plays a key role in smoking initiation (e.g., Alexander, Piazza, Mekos, & Valente, 2001). Given their attentional bias for smoking-related cues, those who have smoking parents may be drawn to peers who smoke, which may further strengthen this attentional bias.

That nonsmokers demonstrated an attentional bias at 2,000 ms but not at 500 ms suggests that the attentional bias was not a function of initial attention to the smoking stimuli, but rather reflected nonsmokers’ prolonged attention to the smoking cues, which is similar to that seen in individuals who are addicted to cigarettes (Bradley et al., 2003). Thus, although nonsmokers with an attentional bias may explicitly attempt to ignore smoking-related cues such as cigarette products in a supermarket or in an advertisement because of negative attitudes and affect associated with these stimuli, they may have difficulty doing so. It is possible that their enhanced attention for smoking-related cues may increase the likelihood that they will become late-onset smokers (see Figure 2. Mean attentional bias difference scores (ms) (± SE) for those without a smoking parent and those whose parent(s) smoked. Positive values reflect an attentional bias (i.e., faster reaction times) to the smoking-related cues relative to the non-smoking cues, whereas negative values reflect attentional bias to the non-smoking cues relative to the smoking-related cues. Discussion

The present study is the first to report that nonsmoking college-age students with a smoking parent demonstrate an attentional bias to smoking-related cues. This provides evidence that, for individuals who have never smoked themselves, exposure to parental smoking behavior may enhance attention to smoking-related cues. Given that most college-age participants explicitly report negative attitudes toward smoking (e.g., Goddard, 1992; Stern et al., 1987) and show negative implicit affective responses toward smoking-related stimuli (Payne, McClerndon, & Dobbins, 2007), the attentional bias demonstrated by nonsmoking individuals in the present study is especially interesting because it may represent a sensitive measure of smoking vulnerability in nonsmokers.

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Tiffany, 1990). Research that considers these cognitive processes as well as other potential characteristics that may predict late-onset smoking would aid in the development of effective evidence-based strategies for the prevention of smoking in this vulnerable group of young adults.

A strength of this study was the carefully controlled pictorial stimuli. In the current study, a set of stimuli was developed in which the pictures were carefully matched in familiarity, brightness, and color. To ensure that these picture pairs were easily identifiable as smoking- and non-smoking-related, we pilot tested them with a sample of college students. Additionally, we also manipulated content by including an equal number of active and inactive stimuli pictures to determine whether differences in the processing of people would affect attentional biases. Our results revealed that when stimuli contained a human component, there were no attentional biases for any of the nonsmokers. This finding is consistent with previous work that has found greater early processing (i.e., larger N170 amplitudes) for pictures of human-related stimuli relative to pictures of objects (e.g., Bentin et al., 1996). Thus, participants may have focused primarily on the human components of the active pictures which distracted them from the smoking-related stimuli, thereby reducing the attentional bias in these trials. These findings should be used to inform the design of future studies in this area and may lead to a reconsideration of the findings from previous research that has failed to distinguish between active and inactive stimuli, or has focused on only active stimuli. Future research that examines whether attention may be more directed toward specific types of smoking-related stimuli (i.e., cigarettes vs. lighters or ashtrays) is also warranted.

From a theoretical perspective, this study fills a gap in the current literature with respect to the mechanisms involved in the development of smoking behavior in college-age individuals. While previous research has identified early exposure, availability of cigarettes, parental monitoring, and parental imitation as contributing factors of child smoking behavior (Avenevoli & Merikangas, 2003), the current findings indicate that those who have a smoking parent have enhanced cue reactivity to smoking-related pictures, which may place them at risk for smoking initiation. Given that college-age individuals are the only population to still exhibit increases in smoking behavior (Centers for Disease Control & Prevention, 2009; Rigotti et al., 2000), it is of great importance to investigate the role of attentional bias to smoking cues in order to develop better evidence-based strategies to discourage smoking initiation in this population.

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