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Short Communication

Smoking cue reactivity in current smokers, former smokers and never smokers

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HIGHLIGHTS

- Smoking cues increased craving and heart rate in current smokers.
- In former smokers smoking cue exposure decreased heart rate.
- Smoking cues did not impact subjective or heart rate responses in never smokers.

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ABSTRACT

Introduction: Smoking related stimuli are known to increase both subjective craving and heart rate in smokers; however, little is currently known about the effects of such stimuli in former smokers.
Methods: Subjective craving and heart rate were measured in 38 never smokers, 20 former smokers, and 30 current smokers exposed to video clips containing neutral and smoking related cues.
Results: Compared with neutral cues, smoking cues significantly increased both heart rate and self-reported craving in current smokers, while in former smokers smoking cues were associated with a significant decrease in heart rate as well as with a relatively diminished increase in subjective craving. Neither craving nor heart rate was impacted by the smoking cues in never smokers.
Conclusions: Findings suggest that while smoking related stimuli continue to elicit modest subjective cravings in former smokers, there appears to be a marked change in the typical physiological response associated with such stimuli.

1. Introduction

Smokers are known to be sensitive to the exposure to tobacco smoking related stimuli or cues (e.g. Ferguson & Shiffman, 2009), with smoking related cues being associated with increases in both craving (e.g. Schlagintweit, Good, & Barrett, 2014; Shiffman et al., 2012; Tong, Bovbjerg, & Erblich, 2007) and cardiac responses (e.g. Garcia-Rodriguez, Weidberg, Gutiérrez-Maldonado, & Secades-Villa, 2013; Jenks & Higgs, 2011) as well as with relapse to smoking among those attempting to quit smoking (Cox, Tiffany, & Christen, 2001; Ferguson & Shiffman, 2009). To date, most smoking cue exposure research has focused on current smokers, and little is known about the extent to which smoking cues impact cigarette craving and physiological responses in former smokers. Because former smokers are successful at remaining abstinent despite a high probability of encountering tobacco related stimuli in their environments, a better understanding of their responses to such stimuli could be important for understanding smoking cessation processes (e.g. Payne, Smith, Adams, & Diefenbach, 2006).

Waters et al. (2004) reported that smoking related cues continue to increase cigarette cravings during the first day of a cessation attempt, but it is unclear to what extent these findings are applicable to successful quitters. Nestor, McCabe, Jones, Clancy, and Garavan (2011a, b) examined the neural responses to smoking related cues in both current and former smokers and reported that relative to smokers, former smokers had greater neural responsivity in frontal regions that are typically associated with inhibiting behavior. However, this study did not assess subjective responses to the cues. Finally, Murray, McHugh, Rowley, Sirota, and Otto (2010) found that current smokers rate smoking related stimuli as being significantly more appealing than former smokers do , who in turn rate them as more appealing than non-smokers do. However, this study did not report on the impact of smoking stimuli on subjective craving or physiological responses.

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Collectively, this past research suggests that smoking cues may continue to exert subjective and physiological effects on former smokers and that these effects may differ from those on continuing smokers; however, to our knowledge this has yet to be directly tested. The present study examined the subjective and physiological responses to neutral and smoking related stimuli in current, former and never smokers.

2. Methods

2.1. Participants

Eighty-eight participants (38 never smokers, 20 former smokers, 30 current smokers) were recruited through local online classified advertisements in the Halifax region (Nova Scotia, Canada). All were medically healthy and free from psychiatric illness. Never smokers were recruited on the basis of having smoked less than ten cigarettes in their lifetime. Former smokers had smoked daily for a minimum of one year and had a lifetime score on the Fagerström Test for Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerström, 1991) of three or higher but were completely abstinent from tobacco for a minimum of 3 months ($M = 40$ months, $SD = 54$ months) and had a current FTND score of zero. Current smokers had smoked daily for a minimum of one year ($M = 10$ years, $SD = 9$ years) and had a current FTND score of three or higher. The sample characteristics are summarized in Table 1.

2.2. Smoking and neutral cues

Participants were exposed to previously validated, 2-minute long neutral and smoking video clips (McBride, Barrett, Kelly, Aw, & Dagher, 2006; Schlagintweit et al., 2014). The neutral video consisted of scenes of individuals receiving/giving haircuts and contained no smoking imagery, while the smoking video showed individuals smoking alone or with others in a variety of different settings.

2.3. Cigarette craving

Cigarette craving was measured using the Questionnaire of Smoking Urges-Brief (QSU-B), a standard psychometrically sound measure consisting of 10 self-report items that assess craving across two dimensions (Factor 1: intention to smoke; Factor 2: withdrawal-related craving; Toll, Katulak, & McKee, 2006).

2.4. Heart rate

A Polaris Heart Rate Monitor (Polar Electro Canada, Inc., Lachine, Quebec, Canada) was used to measure heart rate.

Table 1
Sample characteristics.

	Never smokers	Former smokers	Smokers
Demographic data			
N (% of total N)	38 (43)	20 (23)	30 (34)
Age, M (SD)	22.6 (4.3)	29.5 (8.1)	29.3 (8.7)
Gender, male (%)	14 (37)	13 (65)	19 (63)
Smoking-related variables			
FTND, M (SD)	–	5.2 (2.3)	5.3 (1.7)
Years of smoking, M (SD)	–	8.0 (6.4)	10.3 (9.1)
Peak cigarettes per day, M (SD)	–	20.0 (9.1)	21.2 (8.9)
Months of abstinence, M (SD)	–	35.6 (52.0)	–

Note. Demographic and smoking variables by group.

2.5. Procedure

At the onset of the laboratory session, current smokers were required to smoke one cigarette of their preferred brand in order to avoid ceiling effects on measures of cigarette craving (Erblich, Bovbjerg, & Sloan, 2011; Tong et al., 2007). Subsequently, demographic and smoking history information was collected. Participants were required to wait one hour before completing any additional study measures to allow craving to increase to above satiated levels in the current smokers (see Tiffany & Drobes, 1991). They then completed the QSU-B and heart rate was measured. Next, subjects viewed the neutral and smoking videos. Heart rate was measured for 60 s beginning 10 s following the start of each video and subjective craving was measured immediately following the end of each video. The end of the neutral video and beginning of the smoking video were separated by approximately 5 min. The neutral video was always shown before the smoking video to reduce the likelihood of carryover effects (see Sayette, Griffin, & Sayers, 2010).

2.6. Statistical analyses

Data were analyzed using mixed models in SPSS version 20 for Macintosh (SPSS Inc., Chicago, Illinois, USA). Model simplicity and likelihood ratio tests were used to select appropriate covariance structures. The main measures were Factor 1 and Factor 2 craving scores on the QSU-B and maximum and average heart rates for each time point. Data for the main measures were analyzed using time point (baseline (T1), exposure to the neutral cue (T2), and exposure to the smoking cue (T3)) as a fixed and repeated factor, sex and smoker group (Current, Former, Never) as fixed factors, and subject as a random factor, with baseline scores (T1) entered as a time-varying covariate. The effects of interest were interactions between time and smoker group. When interactions were observed, the simple effects of variables within each level combination of the other variable(s) were tested. Tests of simple main effects were performed on the linearly independent pairwise comparisons between the estimated marginal means for all analyses.

3. Results

3.1. Craving

A significant Group × Time interaction for Factor 1 craving [$F(2, 84) = 14.312$, $p < 0.001$] revealed that the smoking cue video was associated with an increase in Factor 1 craving in both current smokers ($p < 0.001$) and former smokers ($p = 0.01$) relative to the neutral cue. Factor 1 craving was not impacted in never smokers (Fig. 1). There was also a Group × Time interaction for Factor 2 Craving [$F(2, 84) = 13.975$, $p < 0.001$] resulting from an increase in Factor 2 craving at T3 in current smokers only.

3.2. Heart rate

A significant Group by Time interaction [$F(2, 63.2) = 6.05$, $p = .004$] revealed that, relative to the neutral cue video, the smoking cue video was associated with a significant decrease in maximum heart rate in former smokers ($p = 0.015$), but with a significant increase in maximum heart rate in current smokers ($p = 0.018$). Maximum heart rate was not affected in never smokers (Fig. 1). Similarly, there was a Group × Time interaction for average heart rate [$F(2, 63.7) = 3.515$, $p = 0.036$], indicating that former smokers had a lower average heart rate at T3 relative to T2 ($p = 0.035$), while current smokers had an elevated heart rate at T3 relative to both former smokers ($p = 0.018$) and never smokers ($p = 0.010$).