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Panic attack history and smoking topography

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ABSTRACT

Background: Little is known about panic attacks and puffing topography, a behavioral index of the value of smoking reinforcement. This study examined smoking style during the course of smoking of a single cigarette among adult daily smokers with and without a history of panic attacks.
Method: Participants ($n = 124$, $M_{age} = 43.9$, $SD = 9.7$; 44.4% female) were non-treatment seeking daily smokers. Lifetime panic attack history was assessed via diagnostic assessment; 28.2% ($n = 35$) of the sample had a panic attack history. Participants smoked one cigarette during an ad libitum smoking trial. Puff volume, duration, and inter-puff interval were measured using the Clinical Research Support System (CReSS) pocket device.
Results: Regression analyses revealed that panic attack status was not associated with significant differences in average puff volume, duration, or inter-puff interval. Multi-level modeling was used to examine puffing trajectories. Puff-level data revealed that there was a significant quadratic time x panic effect for puff volume and duration. Those with a panic attack history demonstrated relatively sustained levels of both puff volume and duration over time, whereas those without a history of panic attacks demonstrated an increase followed by a decrease in volume and duration over time. These effects were not accounted for by the presence of general psychopathology.
Discussion: Smokers with a panic attack history demonstrate more persistent efforts to self-regulate the delivery of nicotine, and thus may be at risk for continued smoking and dependence. Tailored treatment may be needed to address unique vulnerabilities among this group.

1. Introduction

Panic attacks reflect an abrupt autonomic surge of intense discomfort and extreme fear or impending doom accompanied by a strong flight-or-fight action tendency (American Psychiatric Association, 2013). Panic attacks can occur from calm or anxious states – and regardless of preceding anxious states, the peak intensity of fear or discomfort is reached within minutes. That is, panic attacks are discrete in nature (Craske et al., 2010), and distinct from anxiety or other generalized negative emotional states (Craske, 1991). Psychophysiological data suggest that panic attacks are indeed reflected by abrupt surges of arousal, typically cardiorespiratory activation/instability that reaches a peak within minutes and subsides within minutes (Craske et al., 2010; Meuret and Ritz, 2010). Research suggests that panic attacks may 'mark' risk for multiple forms of psychopathology, including anxiety disorders (Baillie and Rapee, 2005; Reed and Wittchen, 1998), major depressive disorder (Bittner et al., 2004; Bovasso and Eaton, 1999; Hayward et al., 2000), substance use disorders (Baillie and Rapee, 2005), personality disorders (Goodwin et al., 2005), and severe mental illness (Goodwin et al., 2004).

It is estimated that approximately 28% of the general United States population has experienced a panic attack some point in their life, with 23% experiencing panic attacks without ever meeting criteria for panic disorder and/or agoraphobia (Kessler et al.,

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2005). Lifetime panic attacks are associated with an increased odds of smoking (e.g., Breslau et al., 1991; Breslau and Klein, 1999; Goodwin and Hamilton, 2002; Johnson et al., 2000; Pohl et al., 1992). The prevalence of smoking is significantly higher among those with a history of panic attacks relative to the general non-psychiatric population, and smoking cessation rates are significantly lower (Lasser et al., 2000). Indeed, smoking is a risk factor for the onset and maintenance of panic attacks (Bakhshaie et al., 2016; Breslau et al., 2004; McFall et al., 2005). Research also suggests that panic attacks may maintain smoking behavior (Zvolensky et al., 2003b). For example, panic attacks are associated with more severe nicotine withdrawal symptoms during quitting (Marshall et al., 2009), shorter durations of abstinence from smoking (Zvolensky et al., 2004), and overall lower success rates in quitting (Piper et al., 2011).

Negative reinforcement models of smoking (Zvolensky et al., 2003b) and drug addiction more broadly (McCarthy et al., 2010) posit that smokers with a history of panic attacks may be especially likely to rely on cigarettes (nicotine) for temporary amelioration of aversive internal bodily states. Aligned with this theory, empirical data indicate that panic attack history is predictive of *self-reported* coping-oriented smoking motives (Johnson et al., 2013), which in turn, may maintain tobacco dependence (Farris et al., 2014). Such self-report data suggest that smokers with panic attacks may utilize cigarettes to manage negative affect states, which may increase the reinforcing value of nicotine for this subgroup of smokers.

Style of puffing behavior (topography) is used to comprehensively examine factors that maintain regular tobacco use (e.g., nicotine dependence, smoking frequency/quantity), and to understand individual aspects of nicotine regulation (Burling et al., 1985; Frederiksen et al., 1977). Puffing style also provides a *behavioral index* of the value of smoking reinforcement (Perkins et al., 2010). Empirical data convincingly indicate that smokers will change (compensate) how they smoke to maintain stable levels of nicotine (Ashton and Watson, 1970; Kumar et al., 1977; Sutton et al., 1978), including following laboratory-manipulated anxiety/stress paradigms (Farris and Zvolensky, 2016; McKee et al., 2011; Rose et al., 1983). That is, a smoker may not only rely on smoking as an affective-regulatory aid but also tailor *how* he/she smokes (puffs/inhales) as a means to increase the negative reinforcing value of a cigarette. Initial data also indicate that smokers with affective symptoms/psychopathology (e.g., depression, posttraumatic stress disorder) display altered smoking styles relative to those without (e.g., larger puff volume, McClernon et al., 2005; Perkins et al., 2010), although this set of findings has not always been consistently reported (Malpass and Higgs, 2007).

The majority of studies that have examined smoking topography calculate averages of topographic behavior of a smoked cigarette (e.g., Corrigall et al., 2001; Kassel et al., 2007; Perkins et al., 2010). However, puff behavior typically changes during the course of smoking a cigarette (e.g., Collins et al., 2010; Guyatt et al., 1989; Kolonen et al., 1992). Smokers tend to take longer and larger initial puffs, potentially to increase immediate consumption of nicotine (Guyatt et al., 1989). Over the course of a cigarette, the magnitude of puff volume and puff duration decreases and the inter-puff interval increases (Guyatt et al., 1989; Kolonen et al., 1992); varying patterns may reflect individual differences in sensitivity to nicotine/cigarette components, satiation, and persistence in efforts to self-regulate the delivery of nicotine (Guyatt et al., 1989). Thus, the topographic trajectory may provide unique and nuanced information about the reinforcing value of smoking, and may vary as a function in psychological vulnerabilities.

In a prior study, we found that an intense surge in panic/arousal (induced in the laboratory) resulted in *reductions* in average puff volume and duration (Farris and Zvolensky, 2016), possibly a result of the intensity of the acute subjective and cardiorespiratory distress. The current study aimed to extend this line of work examining smoking topography among smokers with and without a history of panic attacks. This approach allows for broader characterization of smoking topography and panic, beyond a context-specific test. Such a test could potentially provide novel and nuanced information about the nature of panic vulnerability on smoking reinforcement and risk for tobacco dependence. We are aware of at least one study among light adolescent smokers that examined trait anxiety symptoms in terms of puff-to-puff changes in topography during the course of a single cigarette (Veilleux et al., 2011). Findings indicated that higher anxiety symptoms were associated with linear increases in puff volume and duration over the course of the cigarette (Veilleux et al., 2011). Moreover, smokers with an 'atypical' pattern of increasing puff volume profile had a more rapid progression to tobacco dependence over the course of two years (Veilleux et al., 2011). Although not directly tested, these data suggest that adolescent smokers with anxiety symptoms may be an at risk group for tobacco dependence based on their smoking topographical profile. This methodological approach has not been extended to panic attack psychopathology specifically.

The current study examined differences in ad libitum smoking topography, a behavioral index of smoking motivation, among non-treatment seeking adult smokers with and without a lifetime history of panic attacks. Smoking topography indices were examined in two ways: (a) averaging puff data across a single cigarette to derive a mean index and (b) utilizing puff-to-puff data to examine variability during a single cigarette. It was hypothesized that (1) Smokers with a history of panic attacks would have larger average puff volumes and duration and shorter inter-puff intervals compared to smokers with no history of panic attacks and (2) Smokers with a history of panic attacks would demonstrate an 'atypical' pattern of smoking over the course of one cigarette – increasing puff volume and duration. We examined whether these associations were unique beyond the effect of other psychopathology, gender, and tobacco dependence.

2. Material and methods

2.1. Participants

Non-treatment seeking adult daily smokers were recruited for an experimental study on anxiety and smoking behavior (Farris and Zvolensky, 2016). Community-recruited smokers who were between 18 and 65 years of age, reported smoking 10 or more cigarettes per day for at least one year, and smoked within the first 30 min of waking in the morning, were invited for a baseline assessment to determine eligibility for the experimental study (described in Farris and Zvolensky, 2016). Participants were excluded from participation during an initial telephone screen if they reported frequent drinking (≥9 standard drinks/week), illicit drug use (≥3 days/week), unstable medical conditions, or current psychotic symptoms. The current study is a secondary analysis of data from participants who completed the baseline assessment ($n = 126$), regardless of whether or not they were deemed eligible for the experimental phase of the study. Two participants were missing smoking topography data due to equipment malfunction, thus were excluded from the analyzed sample. Thus, 124 participants ($M_{age} = 43.9$, $SD = 9.7$; 44.4% female) were included in analyses.

2.2. Procedure

Participants were screened for potential eligibility by telephone, scheduled for an in-person appointment and instructed to bring their usual brand of cigarettes (at least 2 full cigarettes) to the