



Full length article

Anxiety sensitivity as an amplifier of subjective and behavioral tobacco abstinence effects



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ABSTRACT

Background: Anxiety sensitivity, a transdiagnostic cognitive vulnerability factor described as an amplifier of negative emotional states, is implicated in the maintenance of cigarette smoking and cessation difficulties. The current study aimed to examine the role of anxiety sensitivity in predicting abstinence-induced changes in nicotine withdrawal, smoking urges and smoking behavior during an experimental relapse analogue task (RAT).

Method: Participants were 258 non-treatment seeking smokers ($M [SD]$ age = 44.0 [10.73]; 69.8% male). Participants attended two counterbalanced experimental sessions including smoking deprivation (16 h of smoking abstinence) and smoking as usual. The Minnesota Nicotine Withdrawal Scale (MNWS) and Brief Questionnaire of Smoking Urges (QSU) were completed at each session in addition to the RAT. Hierarchical regressions were conducted to examine the predictive impact of anxiety sensitivity on withdrawal and urges during smoking deprivation. Follow-up mediational analyses were conducted to examine whether abstinence-induced withdrawal and urges mediated responding during the RAT.

Results: Anxiety sensitivity amplified the effects of experimentally manipulated acute abstinence on subjective nicotine withdrawal symptoms and smoking urges. Additionally, higher levels of anxiety sensitivity indirectly predicted shorter latency to smoking initiation after deprivation during the RAT through the effects of greater abstinence-induced nicotine withdrawal and smoking urges. Anxiety sensitivity was unrelated to increased smoking during the RAT, although this may be partially attributed to the type of laboratory assessment employed.

Conclusions: Elevated anxiety sensitivity appears to impact initiation of smoking after nicotine deprivation through the effects of abstinence-induced withdrawal and smoking urges.

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1. Introduction

Smokers with comorbid psychiatric conditions often struggle to quit smoking, contributing to a stagnation of smoking base rates in the United States (Hughes, 2011). Smokers with anxiety psychopathology represent one of the most common of these 'high risk' groups (Williams et al., 2013). Indeed, nearly one-fourth of individuals with nicotine dependence suffer from at least one comorbid anxiety disorder (Grant et al., 2004). Moreover, elevated anxiety symptoms and disorder status increases the risk of smoking

experimentation (Leventhal et al., 2011; Patton et al., 1998), progression to daily smoking (Audrain-McGovern et al., 2011), and development of nicotine dependence (McKenzie et al., 2010). Among current smokers, anxiety symptoms and disorders often increase risk of smoking cessation failure (Hall et al., 1994), heighten severity of tobacco withdrawal (Langdon et al., 2013), and contribute to maladaptive cognitive beliefs and cognitive-emotional reactions to tobacco (Peasley-Miklus et al., 2012).

Various types of anxiety symptoms and disorders are associated with smoking variables, including PTSD (Feldner et al., 2007), social anxiety disorder (McCabe et al., 2004), panic attacks and disorder (Zvolensky et al., 2003c), and generalized anxiety disorder (Goodwin et al., 2012). Hence, one promising means of elucidating the role of anxiety in cigarette use is to investigate the influence of transdiagnostic psychological vulnerability factors that

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underlie multiple anxiety-related conditions on smoking. Anxiety sensitivity is one such transdiagnostic factor. Anxiety sensitivity is a relatively stable, but malleable, psychological individual difference factor related to sensitivity to (or anticipation and fear of the consequences of) aversive internal states of anxiety (Reiss et al., 1986). Over two decades of research has indicated that anxiety sensitivity is concurrently and prospectively associated with anxiety symptoms and with the onset of various types of anxiety disorders (Marshall et al., 2010; Schmidt et al., 2006) and incrementally predicts clinical anxiety outcomes over and above trait or state anxiety symptoms and other negative affect states (e.g., depression; Rapee and Medoro, 1994; Zvolensky et al., 2003a).

Importantly, anxiety sensitivity also is consistently implicated in the maintenance of smoking behavior. Indeed, smokers higher relative to lower in anxiety sensitivity perceive quitting as more difficult (Johnson et al., 2013) and have less success when making quit attempts (Assayag et al., 2012; Zvolensky et al., 2009), even when statistically controlling for variation in anxiety symptoms (Zvolensky et al., 2009). Laboratory studies suggest anxiety sensitivity may be involved in affective reactivity to stress during smoking and non-smoking contexts. For example, in one laboratory study, reward and affect relief were greater during a stress-inducing speech preparation task among smokers high in anxiety sensitivity (Perkins et al., 2010a). Based upon these findings, it is important to elucidate the mechanisms by which anxiety sensitivity potentially maintains smoking behavior, particularly upon abstinence.

Nicotine withdrawal symptoms experienced as a result of smoking reduction are key mechanisms of tobacco dependence. They are reliably associated with increased risk of smoking behavior (Nakajima and al'Absi, 2012; Patterson et al., 2008; Piper et al., 2011a), presumably because withdrawal provokes negative reinforcement processes that motivate the resumption of smoking upon abstinence to quell withdrawal distress (Baker et al., 2004). Available work provides a reason to predict that anxiety sensitivity may enhance acute nicotine withdrawal, possibly due to greater cognitive-affective reactivity to interoceptive and other internal affective stimuli experienced in withdrawal (Zvolensky and Bernstein, 2005). The vast majority of work on this topic has primarily been drawn from cessation studies, which illustrate that higher levels of anxiety sensitivity are indeed related to more intense nicotine withdrawal symptoms during the early phases of quitting (Johnson et al., 2012; Langdon et al., 2013; Marshall et al., 2009). However, these investigations were limited in that not all smokers successfully maintained abstinence at the time of withdrawal measurement, potentially leaving open the confounding factor of variation in smoking deprivation level (i.e., smokers who relapsed are protected against abstinence-induced exacerbation in withdrawal symptoms). Laboratory based designs involving experimental manipulation of acute (overnight) tobacco abstinence in smokers not wishing to quit allow for the control and standardization of degree of smoking deprivation, thereby preventing such confounds that can occur in naturalistic quit smoking studies. Though there are limits to external validity, tobacco withdrawal severity during experimentally-induced abstinence predicts withdrawal in a subsequent naturalistic self-initiated quit attempt (al'Absi et al., 2005), suggesting that experimentally-manipulated abstinence research may generalize outside the laboratory. Furthermore, these acute abstinence effects are relevant to the withdrawal experiences of smokers not attempting to quit that may ultimately maintain daily smoking behavior (e.g., symptoms experienced before the first cigarette of the day). This type of process may be especially pertinent to anxiety sensitive smokers who report greater worry about quitting (Zvolensky et al., 2009), tend to lapse faster (Brown et al., 2001), and endorse negative reinforcement smoking

expectancy effects and motives (Johnson et al., 2013; Leyro et al., 2008).

In addition to limits in study design, the assessment of withdrawal phenomena in anxiety sensitivity research has been narrow. For instance, no past work has explored psychological motivation (Piasecki et al., 2010), one of the most robust phenotypic expressions of the tobacco withdrawal syndrome (Leventhal et al., 2010) and a key predictor of smoking relapse (Piper et al., 2011b). Further, anxiety sensitivity research has yet to examine important behavioral reactions to acute tobacco abstinence effects. A key behavioral consequence related to withdrawal is abstinence-provoked increases in motivation smoke. In the laboratory, researchers have assessed this process using analogue models of lapse behavior in which participants are monetarily rewarded to: (1) delay the opportunity to initiate smoking and (2) smoke fewer cigarettes when given the opportunity to smoke (McKee et al., 2006). This behavioral consequence of tobacco abstinence is particularly important given research illustrating that smokers with current anxiety disorders are more likely to lapse on their planned quit date or avoid making a quit attempt altogether (Leventhal et al., 2012). Establishing if anxiety sensitivity effects on lapse-like behavior during tobacco abstinence are mediated by abstinence-related provocations of subjective withdrawal symptoms may shed important light on the mechanisms through which anxiety sensitivity helps maintain smoking behavior.

To address gaps in existing knowledge, the current laboratory study examined the extent to which (trait) anxiety sensitivity amplifies the influence of experimentally-manipulated acute tobacco abstinence on subjective withdrawal symptoms and smoking urge as well as on an analogue objective measure of lapse-like behavior. First, it was hypothesized that higher levels of anxiety sensitivity would predict greater abstinence-induced increases in nicotine withdrawal symptoms and smoking urges. Second, it was hypothesized that anxiety sensitivity would be associated with abstinence-induced lapse behavior (i.e., reductions in ability to delay smoking for money and increases in cigarettes purchased following delay) indirectly through greater abstinence-induced subjective withdrawal and urge.

2. Method

2.1. Participants

Participants were non-treatment seeking smokers recruited in the Los Angeles, California area to participate in a study of individual differences in tobacco withdrawal (Leventhal et al., 2014). The sample in the current report included 258 smokers (M [SD] age = 44.0 [10.73]; 69.8% male) who were administered measures of anxiety sensitivity. Inclusion criteria for the study included being 18 years of age or older, smoking at a daily rate of ≥ 10 cigs/day (biochemically verified by ≥ 10 ppm carbon monoxide expired breath sample at baseline), being a regular smoker for at least the past two years, and fluency in English. Exclusion criteria included current *DSM-IV* non-nicotine substance dependence, current *DSM-IV* mood disorder or psychotic symptoms, regular use of other tobacco/nicotine products, current use of psychotropic medications, current pregnancy, and intentions to quit or substantially cut down smoking in the next 30 days. The original sample included 343 participants; 57 did not complete the study after enrolling and 28 participants completed the study prior to the introduction of anxiety sensitivity and other measures analyzed in this report, which were introduced into the study midstream through recruitment.

Participants primarily identified as African American (51.6%) and White (33.7%); 14.3% identified their ethnicity as Hispanic. The average daily smoking rate of this sample was 16.6 ($SD = 7.01$), and

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