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Associations between pain intensity and urge to smoke: Testing the role of negative affect and pain catastrophizing

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ABSTRACT

Background: Cigarette smokers are more likely to experience pain than nonsmokers, and experimental research indicates that pain is a potent motivator of smoking. Urge to smoke is a predictor of early relapse, yet associations between pain and urge to smoke have yet to be tested among daily smokers. This study aimed to conduct the first cross-sectional test of associations between current pain intensity and urge to smoke, and to test the role of negative affect and pain catastrophizing in relations between pain intensity and urge to smoke.

Methods: Participants (N = 229, 42.4% Female, 38.9% black/African American, Mcpd = 21.9) were recruited for a laboratory study of pain and smoking, and these data were collected at the baseline session. Data were analyzed using a series of regressions and conditional process models.

Results: Current pain intensity was positively associated with urge to smoke, and urge to smoke for the relief of negative affect. There was an indirect association via state negative affect, such that pain intensity was positively associated with negative affect, which in turn was associated with greater urge to smoke. Further, positive associations between pain intensity and urge to smoke were only evident among smokers who endorsed low (vs high) levels of catastrophizing.

Conclusions: These findings contribute to an emerging literature indicating that pain and related constructs are relevant to the maintenance of tobacco smoking. Future research should examine how pain-relevant cognitive-affective factors may influence associations between the experience of pain and motivation to smoke tobacco.

1. Introduction

Cigarette smoking remains the leading cause of preventable death worldwide (WHO, 2008). In the United States, an estimated 42.1 million adults (~18%) are classified as current tobacco smokers (CDC, 2011; USDHHS, 2014). Although the majority of smokers report a desire to stop smoking, the most common result of a quit attempt is relapse (CDC, 2011; Hughes et al., 2004; Piasecki, 2006). Relapse is more likely to occur among individuals reporting higher (compared to lower) pre-quit urge to smoke (Allen et al., 2008; Nakamura et al., 2014). Urge to smoke has been defined as the acute desire for the negatively reinforcing effects and rewarding properties of tobacco and is positively associated with nicotine dependence (Cox et al., 2001). Given the importance of urge to smoke in the maintenance of tobacco dependence, researchers have recently turned their attention to pain as a motivator of tobacco smoking and proximal determinant of relapse (Ditre et al., 2017).

Pain and tobacco smoking has been linked to the clinical and

empirical literature for decades (e.g., Nesbitt, 1973; Zale et al., 2016). Epidemiological and clinical data indicate that the prevalence of smoking among persons in pain may be greater than twice the rate observed in the general population (Zvolensky et al., 2009), and an evolving reciprocal model posits that pain and smoking interact in the manner of a positive feedback loop, resulting in greater pain and the maintenance of tobacco dependence (Ditre et al., 2011; Zale et al., 2016). Consistent with this perspective, there is evidence of covariation between pain and tobacco smoking. The frequency of pain has been positively correlated with cigarette consumption (Pisinger et al., 2011), and smokers who endorse past-week pain have been shown to smoke more cigarettes per day than smokers with no pain (Hahn et al., 2006). Furthermore, current pain intensity has been positively associated with current smoking status (Volkman et al., 2015) and daily cigarette consumption (Andersson et al., 1998; Bakhshaei et al., 2016; Pirouzi et al., 2011).

There is also evidence that pain can be a potent motivator for smoking urge and behavior. For example, smokers in pain readily

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endorse the use of tobacco to cope with pain (Hooten et al., 2011b), painful episodes have been shown to precede bouts of smoking (Dhingra et al., 2013), and smokers have reported a perceived need to smoke in the context of clinical pain (Jamison et al., 1991). The results of two laboratory studies indicate a causal effect of pain on the urge to smoke. Ditre and Brandon (2008) showed that cold-pressor pain induction (vs. no pain induction) increased the urge and decreased latency to smoking among a sample of daily tobacco smokers who were recruited from the local community. A recent follow-up study further demonstrated that thermal heat pain (vs. no pain) increased urge to smoke among tobacco users recruited from the local community (Parkerson and Asmundson, 2016). Given that pain is comprised of sensory-physiological (e.g., pain intensity), motivational-affective (e.g., state negative affect), and cognitive-evaluative (e.g., pain catastrophizing) components (IASP, 2008; Melzack and Wall, 1965; Turk and Melzack, 2001), additional research is needed to examine the role of these factors in relations between pain and urge to smoke tobacco.

Negative affect refers to a general form of subjective distress that encompasses a variety of unpleasant emotions (Kassel et al., 2003; Watson et al., 1988). Negative affect has been conceptualized in terms of both trait and state experiences (Watson and Clark, 1984), and measures of state negative affect have been more closely linked to current pain intensity than trait measures (Gaskin et al., 1992). Although negative affect is empirically-distinguishable from pain intensity (Dworkin et al., 2005), it frequently co-occurs with pain (Jensen and Karoly, 2011; Melzack, 1975), and has been positively associated with both pain intensity and tolerance (Janssen, 2002; Lacourt et al., 2015). Importantly, Ditre and Brandon (2008) found that state negative affect accounted for approximately 30% of the variance in the effects of experimental pain induction on self-reported urge to smoke. This observation is broadly consistent with the negative reinforcement model of tobacco dependence, which posits that escape from negative affect is a primary catalyst for smoking urge and behavior (Baker et al., 2004b).

Pain catastrophizing is a cognitive-affective construct that reflects the tendency to interpret actual or anticipated pain in an exaggerated manner (Sullivan et al., 1995). Pain catastrophizing exhibits a wide distribution and is positively associated with physical and emotional distress in response to acute pain, among non-chronic pain samples (Sullivan et al., 1995; Kristiansen et al., 2014). Furthermore, catastrophizing has been positively associated with current pain ratings among non-chronic pain samples (Bialosky et al., 2008; Spanos et al., 1981; Sullivan et al., 1995), and individuals who score higher on measures of catastrophizing tend to report greater fear and worry about their pain (Edwards et al., 2011; Quartana et al., 2009). Interestingly, smokers have been shown to endorse greater pain catastrophizing than non-smokers (Hooten et al., 2009), and cigarette smoking has been conceptualized as a behavioral coping strategy that is used to manage aversive internal experiences (Baker et al., 2004b; Lazarus and Folkman, 1984). Thus, smokers who are prone to greater pain catastrophizing may experience greater urge to smoke in the context of pain.

Previous studies that directly tested associations between pain and urge to smoke tobacco relied almost exclusively on experimental pain paradigms that are subject to limitations in terms of experimenter demand and generalizability (Ditre and Brandon, 2008; Ditre et al., 2015; Zale et al., 2016). Furthermore, most of the published cross-sectional studies investigating the relationship between pain and tobacco use have been conducted among smokers with chronic pain. Evidence that such associations extend to individuals without chronic pain would have clinical implications for many tobacco smokers (Nahin, 2015; Zvolensky et al., 2009). Thus, the current study was conceptualized as a cross-sectional extension of this formative laboratory work, with the goal of examining the association between current pain intensity (i.e., pain that is not experienced in the context of clinical pain or experimental pain induction) and self-reported urge to smoke, among a sample of daily cigarette smokers who did not report chronic pain.

Given contemporary negative reinforcement models of addiction motivation (Baker et al., 2004a) and empirical work implicating negative affect in bidirectional relations between pain and smoking (Ditre et al., 2011; Zale et al., 2016), we were especially interested in the association between current pain intensity and self-reported urge to smoke for the purpose of relieving negative affect.

We hypothesized that current pain intensity would be positively associated with scores on self-report measures of overall urge to smoke and urge to smoke for the relief of negative affect. We also hypothesized an indirect association via state negative affect, such that greater pain would be associated with the greater state negative affect, which in turn would be associated with greater urge. Finally, we hypothesized that pain catastrophizing would moderate the association between pain intensity and urge to smoke, such that the relationship between pain intensity and urge scores would be greater among smokers who endorse high levels of catastrophizing.

2. Method

2.1. Participants

Participants ($N = 229$) were recruited from the greater Syracuse, New York area via local newspapers and internet advertisements (i.e., online versions of local newspapers, Craigslist advertisements) for a larger experimental study requiring two visits. Current analyses were conducted using data obtained from the baseline survey at the first visit. Potential participants were screened by phone for the following inclusion criteria: (1) current age between 18 and 65; (2) ability to speak and read English; and (3) currently smoking a mean of ≥ 15 cigarette per day. Participants were excluded if they endorsed: (1) current chronic pain, (2) current use of prescription pain medications, (3) pepper allergy (contraindicated for the larger experimental study), or (4) actively engaging a current attempt to reduce or quit smoking. Eligible participants were scheduled for a baseline visit, at which time they provided informed consent and completed a baseline assessment that included measures of current pain, state negative affect, state urge to smoke, and trait catastrophizing. Both negative affect and urge to smoke have been shown to fluctuate over short periods of time (Morgan et al., 1999) and state negative affect has been positively associated with urge to smoke in laboratory settings (Ditre and Brandon, 2008). Thus, we selected measures that reflect current experience. Smoking status was biochemically-verified via expired breath carbon monoxide ($\text{CO} \geq 8$ ppm; Benowitz et al., 2002). Exclusion based on smoking status was based solely on biochemical verification, regardless of self-reported smoking status.

2.2. Measures

2.2.1. Pain intensity

Current pain intensity was rated on a Numerical Rating Scale (NRS; McCaffery and Beebe, 1989) that ranged from 0 (no pain) to 10 (pain as bad as you can imagine). The instructions asked participants to rate their pain at the time of assessment (i.e., “Please rate your pain by selecting the one number that tells how much pain you have right now.”). The NRS has been used extensively to index pain in both research and clinical settings and has demonstrated excellent construct and discriminant validity (Hjermstad et al., 2011; Williamson and Hoggart, 2005).

2.2.2. Nicotine dependence

The Heaviness of Smoking Index (HSI; Heatherton et al., 1989) is comprised of two items: cigarettes smoked per day, and time to the first cigarette after waking. The HSI has demonstrated excellent sensitivity and specificity (Huang et al., 2008), and good reliability over time (Borland et al., 2010). The HSI is highly correlated with the widely used Fagerstrom Test for Cigarette Dependence (FTCD) and avoids potential

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