Drug and Alcohol Dependence xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Drug and Alcohol Dependence

journal homepage: www.elsevier.com/locate/drugalcdep

Full length article

The role of pain intensity and smoking expectancies on smoking urge and behavior following experimental pain induction

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ARTICLE INFO

Article history:
Received 31 March 2016
Received in revised form 5 May 2016
Accepted 9 May 2016
Available online xxx

Keywords:
Smoking
Pain
Smoking expectancies
Anxiety sensitivity
Pain coping
Smoking cessation

ABSTRACT

Introduction: Contemporary models of pain and smoking posit a cyclical relationship wherein smoking reduces pain in the short term but, ultimately, serves to exacerbate it in the long term. Such models were influenced by initial experimental findings suggesting situational pain is sufficient to increase smoking-urge and behavior. The initial experimental findings have not yet been replicated and potential mediating smoking motives and anxiety variables have not been explored.

Methods: The current investigation was designed with the aims of exploring whether (a) electrical heat-pain is sufficient to increase smoking-urge, (b) pain intensity, anxiety sensitivity, and smoking expectancies for pain relief account for variance in post-pain smoking-urge, and (c) individuals are more likely to smoke following a pain experience.

Results: Participants in the heat-pain condition ($n = 16$) reported greater smoking-urge than those in the no-pain control condition ($n = 16$). In the heat-pain condition, approximately 31% of variance in smoking-urge was accounted for by the belief that smoking would help with pain coping or relief. Anxiety sensitivity and pain intensity ratings were not significant predictors of smoking-urge. Significantly more individuals in the heat-pain condition attempted to smoke (100%) after the pain manipulation than those in the no-pain control condition (62.5%).

Conclusions: Acute heat-pain increases smoking-urge and behavior, especially for individuals with expectancies that smoking will help with pain coping. Pain and pain-related smoking expectancies may serve as barriers to smoking cessation for those experiencing pain. Findings provide support for smoking cessation interventions strategies aimed at pain management and challenging smoking expectancies for pain coping/relief.

1. Introduction

Smoking dependence and chronic pain are public health concerns that account for billions of dollars in medical expenses each year in North America alone (Asmundson et al., 2013; Rehm et al., 2006). Chronic pain is twice as prevalent among smokers than non-smokers (Shiri et al., 2010). Substantial evidence suggests smoking plays an indirect causal role in the development and maintenance of chronic pain conditions (John et al., 2006) as well as increased pain sensitivity (i.e., lower pain threshold, tolerance, or both; Shi et al., 2010). Likewise, initial experimental research has demonstrated that acute pain can increase smoking urge and behavior. Ditre and Brandon (2008) assessed the effects of experimentally-induced pain on smoking urge and behavior. Participants were randomly assigned to a cold-pressor pain or no-pain control condition. Following pain manipulation, participants were given the opportunity to smoke. Cold-pressor pain resulted in greater smoking urges and immediate smoking behavior, the effect of which was partially mediated by pain-induced negative affect. Results were interpreted to suggest that even acute experimental pain can increase smoking motivation and behavior. These findings influenced contemporary models (Ditre and Brandon, 2008), which posit a cyclical relationship wherein individuals smoke to cope with pain experiences in the short term which, in turn, indirectly exacerbates pain in the long term.

Individual differences related to smoking expectancies have been implicated in the causal relationship between experimental pain stimuli and increased smoking urge (Ditre et al., 2010). An expectancy is like a memory or template developed from past experiences, which prepares an organism for similar experiences in the future (Goldman, 1999). In other words, the dynamic effects of smoking in different life domains (e.g., social, cultural) lead to

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http://dx.doi.org/10.1016/j.drugalcdep.2016.05.007
0376-8716/

beliefs and expectancies about the utility of the behavior (e.g., stress relief, anxiety reduction, weight loss), which are confirmed or disconfirmed through personal experiences. It was recently shown that challenging smoking expectancies for pain coping/relief through educational videos resulted in significantly less smoking urge following cold pressor pain manipulation (Ditre et al., 2010). Such findings suggest that smoking expectancies for acute pain coping may mediate the relationship between the pain stimulus and pain reactivity.

Evidence also indicates that anxiety sensitivity—the dispositional tendency to experience anxiety due to the belief that these sensations may signify harmful consequences (Reiss et al., 1986; Taylor, 1999)—plays an important role in the cyclical relationship between pain and smoking. Individuals with high levels of anxiety sensitivity are more likely to report a reduction in anxiety due to smoking than individuals with low anxiety sensitivity when in high stress situations (Evatt and Kassel, 2010), and they have been found to prefer smoking over adaptive coping strategies to deal with negative affect (Zvolensky et al., 2009). Futhermore, anxiety sensitivity has been found to predict early dropout from a tobacco cessation program (Langdon et al., 2016). The role of anxiety sensitivity remains to be assessed in the context of acute experimental pain and smoking.

The current investigation was designed to replicate initial findings indicating that acute experimental pain is sufficient to increase smoking urge and immediate smoking behaviour (Ditre and Brandon, 2008), as well as to explore associated mediating factors involved in such effects. The following hypotheses were assessed: (a) electrical heat pain will increase smoking urge above and beyond the effects of pain-induced negative affect, (b) pain intensity ratings, anxiety sensitivity, and smoking expectancies for pain relief will account for variance in post-pain smoking urge, and (c) individuals will be more likely to attempt to smoke following electrical heat pain.

2. Materials and methods

2.1. Participants

Eligible participants were smokers between the ages of 18–65 years who were fluent in English and nicotine dependent (a score of 1 or greater on the Fagerström Test for Nicotine Dependence; FTND; Heatherton et al., 1991). Individuals with contraindicated medical conditions (i.e., medicated pain conditions or injury, diabetes, epilepsy) and those taking medication for pain, heart, or circulatory problems were excluded from participation. A total of 37 participants from the University of Regina and surrounding community participated. Data were excluded for 3 participants due to equipment malfunction. The remaining participants ($n = 34$; $M_{age} = 35.06$, $SD = 14.15$ years; 56% male) had a mean FTND score of 5.59 ($SD = 1.94$), indicating moderate nicotine dependence. Ethnicity was not queried; however, similar studies conducted out of the same lab have been primarily White/Caucasion (greater than 75%) with a smaller proportion of participants identifying as Asian (less than 10%) or First Nations/Aboriginal (less than 10%; e.g., see Carleton et al., 2015). Ethical approval was obtained through the University of Regina Ethics Board.

2.2. Measures

2.2.1. The Fagerström test for nicotine dependence (Heatherton et al., 1991). The FTND is 6-item self-report measure that assesses nicotine dependence. Three items are multiple choice, scored from 0 to 3, and three items are yes/no, scored 0 (no) and 1 (yes). The FTND is a widely used measure of nicotine dependence. A score of 1 or greater was used as an inclusion criterion prior to acceptance into the investigation. The coefficient alpha value of the FTND in the current investigation, at 0.57, was typical for the measure.

2.2.2. Anxiety sensitivity index-3 (ASI-3; Taylor et al., 2007). The ASI-3 is an 18-item self-report measure that assesses the extent to which a person fears anxiety-related arousal symptoms due to the belief that such sensations will lead to physical, social, or psychological harm (Reiss et al., 1986; Taylor, 1999). Items are rated on a 5-point Likert scale ranging from 0 (very little) to 4 (very much). The ASI-3 has demonstrated strong reliability and validity in previous studies (Taylor et al., 2007). The ASI-3 was employed as a baseline measure to assess individual differences in anxiety sensitivity. The coefficient alpha value of the ASI-3 in the current investigation was 0.91.

2.2.3. Positive and negative affect schedule (PANAS; Watson et al., 1988). The PANAS is a 20-item questionnaire designed to assess both state and trait positive and negative affect. Items are responded to on a 5-point scale ranging from 1 (very slightly or not at all) to 5 (extremely). The two subscales have demonstrated strong internal consistency (Crawford and Henry, 2004; Watson et al., 1988). The PANAS negative affect subscale was used as a baseline measure to assess state negative affect, and to assess state negative affect upon completion of pain manipulations. The coefficient alpha value of the baseline PANAS state negative affect subcale was 0.90.

2.2.4. Numerical rating scale (NRS; Dworkin et al., 2005). The NRS is a measure used to numerically assess pain intensity. Following each experimental trial, participants were asked to rate their pain intensity on an 11-point scale ranging from "0 = no pain" to "10 = worst pain imaginable."

2.2.5. Pain and smoking expectancies scale (PSE; Ditre, 2006). The PSE is a 5-item measure designed to assess expectancies that smoking will help cope with pain or aid in pain reduction. Items are responded to on a Likert scale with options ranging from 0 (completely unlikely) to 9 (completely likely). The PSE was administered as a baseline measure. Coefficient alpha for the PSE was 0.96.

2.2.6. Questionnaire of smoking urges-brief (QSU-brief; Cox et al., 2001). The QSU-brief is a 10-item measure assessing urge to smoke. Items are responded to on a Likert scale with options ranging from 1 (strongly disagree) to 7 (strongly agree). The QSU-brief total scale and subscales have demonstrated good internal consistency (Cox et al., 2001). The QSU-brief was assessed at baseline and upon completion of experimental trials. The coefficient alpha value of the baseline administration (QSU-brief) was 0.94.

2.2.7. Smoking behavior. An attempt to smoke following pain manipulation was used as a behavioral index of smoking urge. Participants were provided with a cigarette and lighter immediately following completion of the experimental task and told they were allowed to use the experimental room to smoke. The smoking attempt was recorded by discrete video camera.

2.3. Equipment

2.3.1. Medoc pathway pain and sensory system. Pain manipulations consisted of thermal heat delivered by the Medoc Pathway Pain and Sensory Evaluation System—ATS model (Ramat Yishay, Israel), which allowed for precise, programmable delivery of heat stimulation using the Advanced Thermal Stimulator (ATS) thermode. The ATS thermode has a 30 mm × 30 mm contact pad that produces temperatures between 0 °C and 55° at rate of change of up

Please cite this article in press as: Parkerson, H.A., Asmundson, G.J.G., The role of pain intensity and smoking expectancies on smoking urge and behavior following experimental pain induction. Drug Alcohol Depend. (2016), http://dx.doi.org/10.1016/j.drugalcdep.2016.05.007