



## Brief psycho-education affects circadian variability in nicotine craving during cessation

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### ABSTRACT

**Background:** Nicotine cravings are a key target of smoking cessation interventions. Cravings demonstrate circadian variation during abstinence, often peaking during the morning and evening hours. Although some research has also shown diurnal variation in the efficacy of nicotine replacement medications, little research has examined how brief psychosocial interventions affect temporal patterns of craving during abstinence. The present study examined the impact of two brief psycho-education interventions on circadian variations in cravings during a 24-h period.

**Method:** 176 adult smokers interested in quitting participated in two lab sessions. During the first session, participants received (a) mindfulness psycho-education that encouraged acceptance of cravings as a normal, tolerable part of quitting that people should not expect to perfectly control, (b) standard cessation psycho-education, or (c) no psycho-education. Half the sample initiated a cessation attempt the following day. Dependent variables were assessed using ecological momentary assessment (24-h of monitoring, immediately after first lab session) and questionnaires four days later.

**Results:** Partially consistent with hypotheses, both forms of psycho-education were associated with differential diurnal variation in cravings during cessation. Relative to those receiving no psycho-education, standard smoking cessation psycho-education decreased morning cravings. Psycho-education encouraging acceptance of cravings was associated with lower craving in both the morning and evening, albeit only among successfully abstinent smokers.

**Conclusions:** Results demonstrate that brief non-pharmacological interventions can affect circadian craving patterns during smoking cessation. Further investigation of mechanisms of change and of the impact of psycho-education on cessation outcomes is warranted.

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### 1. Introduction

Nicotine cravings are important predictors of the course and outcome of a smoking cessation attempt. Desire to reduce craving is one of the most frequently cited reasons for smoking (Piasecki et al., 2007), and smokers are particularly likely to lapse after experiencing intense, persistent and distressing cravings (Shiffman et al., 1996, 1997a, 1997b). Understanding circadian variation in cravings may lead to more effective interventions.

Among ad libitum smokers, craving appears to peak in the afternoon or evening (Glassman et al., 1984; Hughes et al., 1984; Schneider et al., 1984), although variation exists. Some studies find a V-shaped pattern, with cravings highest in the morning and

evening (Dunbar et al., 2010; Perkins et al., 2009), while others find little circadian variability among continuing smokers (Teneggi et al., 2002). Diurnal rhythm appears to change during abstinence. Without use of nicotine replacement, cravings peak during the morning and evening, with evening cravings most notably increased by abstinence (Perkins et al., 2009). Interestingly, both morning and evening cravings appear relevant to relapse. Shiffman et al. (1997a), for example, found morning cravings strongly predict the probability of relapse later that day. Chandra et al. (2007), on the other hand, found individuals who tend to smoke more in the evening are at particular risk of lapsing.

Researchers speculate that craving reduction at least partially mediates the efficacy of cessation medications (Ferguson et al., 2006; West et al., 2008). Furthermore, diurnal variability in craving appears sensitive to intervention. Teneggi et al. (2002) examined nicotine cravings over 72 h among individuals smoking regularly or abstaining with the assistance of either nicotine replacement or placebo patches. Among abstainers, cravings were lowest in the morning and peaked in the evening. Interestingly, the presence

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of nicotine in the patches did not influence this rhythm, which suggests a psychological factor may be at least partly responsible. Among abstaining smokers taking bupropion, Teneggi et al. (2005) found cravings were lowest in the morning, with an afternoon peak and subsequent decline. To note, several other studies have shown overall reduction in craving with nicotine replacement aides but no time of day effect (Shiffman et al., 2000; Shiffman and Ferguson, 2008).

Unfortunately, no extant research has explored the influence of non-pharmacological approaches to smoking cessation on diurnal variability in cravings. However, recent evidence suggests that the ways people think about and respond to cravings may affect craving severity. Trying to control smoking-related thoughts has been demonstrated to paradoxically increase both thought frequency and smoking behavior (Erskine et al., 2010; Salkovskis and Reynolds, 1994). Beliefs that nicotine cravings are personally meaningful (e.g., a sign of weakness) and important to control also correlate with increased craving severity and nicotine dependence (Nikcivic and Spada, 2008; Nosen and Woody, 2009). Mindfulness and acceptance-based approaches address these proposed mechanisms by encouraging smokers to accept urges as an uncomfortable but natural part of cessation. These approaches have been gaining evidence as effective addictions interventions. For example, instructing smokers in mindfulness has been shown to decrease both negative affect and smoking behavior (Rogojanski et al., 2011), and adding acceptance-based psychotherapy to bupropion improves smoking cessation relapse rates over medication alone (32% vs. 18% 1-year abstinence; Gifford et al., 2011).

In the present study, we sought to examine the impact of mindfulness psycho-education on cravings during the first 24 h of a quit attempt, as compared to both standard psycho-education (offering information on the health risks of smoking, cessation options, and general coping techniques) and no psycho-education, and to individuals assigned to continuing smoking ad lib. We anticipated that encouraging smokers to think about and respond to cravings from a nonjudgmental, nonreactive perspective (i.e., mindfulness psycho-education) may decrease cravings during the first day of abstinence. The other conditions were not expected to have any specific effects on diurnal variation in cravings.

## 2. Method

### 2.1. Participants

Participants were 176 English-speaking adult smokers from Western Canada. Participants were recruited from the community and received \$20 per visit (total \$40). Eligible participants reported smoking at least 10 cigarettes/day for the previous two years and expressed a commitment to quitting smoking on a date selected in collaboration with the researchers. A Bedfont Scientific Ltd. piCO+™ Smokerlyzer carbon monoxide breathalyzer was used to confirm smoking status ( $\text{CO} \geq 8$  ppm; Benowitz et al., 2002). Exclusion criteria were probable past year alcohol or substance dependence based on a score above 5 on the Brief Michigan Alcoholism Screening Test (Pokorny et al., 1972) or above 2 on the Drug Abuse Screening Test-10 (Cocco and Carey, 1998; Maisto et al., 2000). Participants were not excluded based on either current or planned use of nicotine replacement therapies.

Participants' average age was 41.47 years ( $SD = 13.43$ ). The majority of the sample were male (64.77%), Caucasian (77.84%), and employed (51.16%). Most participants had completed at least some post-secondary education (67.05%). Participants reported smoking an average of 16.49 cigarettes per day ( $SD = 6.05$ ) for an average of 23.01 years ( $SD = 13.11$ ). The mean Cigarette Dependence Scale (Etter et al., 2003) score was 48.55 ( $SD = 6.89$ ).

### 2.2. Measures

**Metacognitive beliefs.** A primary goal of the mindfulness psycho-education was to reduce maladaptive ways of thinking about cravings. Accordingly, the Appraisals of Craving Questionnaire (ACQ) was completed during both lab sessions as a manipulation check. Participants rate strength of belief (0–100%) in each of 17 interpretations of idiographic smoking-related thoughts, including that craving-related thoughts are personally reflective, directly tied to the success of the quit attempt, and need to be controlled. Items are averaged to create a total 0–100 score. This measure demonstrates acceptable psychometric properties (Nosen and Woody, 2009).

**Craving.** During the 24-h ecological momentary assessment (EMA), participants answered a single-item Visual Analogue Scale (VAS) assessment of smoking urge (“How strong is your urge to smoke?”) on a 50 mm line anchored by “not at all” on the left and “extremely” on the right (Dols et al., 2000, 2002).

The VAS showed reasonable convergence with the Questionnaire of Smoking Urges-Brief (Cox et al., 2001) completed during the same session, total score,  $r = 0.54$ ,  $p < 0.001$ , and good discrimination from the Depression Anxiety and Stress Scale (description below),  $r = 0.09$ ,  $p = 0.26$ .

**Cessation-relevant covariates.** The 21-item form of the Depression Anxiety and Stress Scales (DASS; Lovibond and Lovibond, 1995) was completed during both lab sessions to assess negative affect. The total score shows excellent reliability and convergent validity (Antony et al., 1998; Henry and Crawford, 2005).

The Cigarette Dependence Scale (CDS; Etter et al., 2003) assesses nicotine dependence on a 12-item scale with good psychometric properties (Etter, 2008). The Anxiety Sensitivity Index-Revised (ASI-R; Peterson and Reiss, 1993) is a 16-item measure of concern about possible cognitive, physical and social consequences of anxiety symptoms, and also shows good reliability and convergent validity (Deacon et al., 2003). Both the CDS and ASI-R were completed during the first lab session.

### 2.3. Procedure

Study eligibility was assessed by telephone. Participants selected a date to quit smoking within the next two weeks and were randomly assigned to a cessation condition. Individuals in the *cessation attempt* condition were scheduled for the first lab session on the day immediately before their selected quit date; they attended the second lab session four days later. Individuals in the *anticipated cessation* condition were scheduled for their first lab session 8 days before their anticipated quit date and the second session four days later. Thus, half of participants completed the 24-h monitoring period during the first day of cessation; the other half completed it while smoking ad lib. Fig. 1 illustrates this design.

**Session 1.** Following informed consent and biochemical confirmation of smoking status, participants completed approximately 30 min of questionnaires (including measures of metacognitive beliefs, craving and covariates). Participants were then randomly assigned to one of three psycho-education conditions. During this portion of the study, participants received either psycho-education about mindful, accepting responses to cravings (*mindfulness* psycho-education) or general information about smoking and cessation methods (*standard* psycho-education), or they completed some additional questionnaires (*no psycho-education* control). Both forms of psycho-education were presented on a computer via a slide presentation overlaid with a professional voiceover that verbalized the written educational points. To enhance engagement, participants were asked to stop after key presentation points (every 3–5 min) to respond to structured questions. A research assistant discussed participants' answers to confirm comprehension and

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