



Mindfulness training for smoking cessation: Moderation of the relationship between craving and cigarette use

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ABSTRACT

Background: Smoking is the leading cause of preventable death in the US, while abstinence rates remain modest. Smoking has been shown to be perpetuated by operant conditioning, notably negative reinforcement (e.g., smoking to relieve negative affective states). Mindfulness training (MT) shows promise for smoking cessation, by potentially altering an individual's tendency to smoke in response to craving. The purpose of this study was to examine the effects of MT and mindfulness practice on the relationship between smoking and craving after receiving four weeks of MT.

Methods: 33 adults received MT as part of a randomized trial for smoking cessation. Individuals in the MT condition recorded formal and informal mindfulness practice during treatment using daily diaries.

Results: Analyses showed that strong correlations between craving and smoking at baseline ($r=0.582$) were attenuated at the end of treatment ($r=0.126$). Mindfulness home practice significantly predicted cigarette use (formal: $B=-1.21$, $p=0.007$; informal: $B=-1.52$, $p<0.0001$) and informal practice moderated the relationship between craving and smoking at the end of treatment ($B=0.52$, $p=0.03$).

Conclusions: These findings suggest that MT may be effective as a treatment for smoking cessation and that informal mindfulness practice predicts a decoupling of the association between craving and smoking.

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1. Introduction

Cigarette smoking is the leading cause of preventable death and disability in the United States (Center for Disease Control and Prevention, 2011). 50% of smokers attempt to quit annually both on their own (i.e., without formal treatment) and with formal treatment. Among those smokers who attempt quitting without formal treatment, only 3–5% remain abstinent for 6–12 months (Center for Disease Control and Prevention, 2011; Hughes et al., 2004).

Nicotine may have a number of behaviorally reinforcing effects that contribute to both the onset and maintenance of psychological dependence. A stimulus may be considered reinforcing if it increases a response or behavior associated with obtaining that stimulus. The reinforcing effects of nicotine may be positive, such as rewarding psychoactive effects of nicotine [e.g., the enhancement of attention and concentration and the blunting of appetite for maintaining lower body weight (Heishman et al., 1994; Perkins, 1993)], or negative, such as the alleviation of aversive states, e.g.,

relief from withdrawal symptoms, or reduction of anxiety, sadness, or fatigue (Carey et al., 1993; Carmody, 1992; Kassel et al., 2003; Piasecki et al., 1997; Wu and Anthony, 1999)]. Through these positively and negatively reinforcing conditions, associative memories are formed (Fig. 1a; Bevins and Palmatier, 2004; Kandel and Davies, 1986; Leknes and Tracey, 2008; Piasecki et al., 1997). Subsequent cues that trigger these affective states may then become associated with smoking, and induce craving for a cigarette (Bargh and Chartrand, 1999; Curtin et al., 2006). Importantly, by virtue of the same positive and negative reinforcement, these affective states themselves can lead to craving (Willner et al., 1995; Willner and Jones, 1996), perhaps accounting for the inconsistent findings in support of cue-induced craving that leads to relapse (Perkins, 2009; Tiffany, 1990; Tiffany and Carter, 1998; Tiffany and Conklin, 2000). As such, both external cues and internal affective states can trigger craving to smoke. Craving then becomes the central hub of this associative learning loop, as cues lead to craving, craving leads to smoking, and smoking reinforces the salience of future external cues and affective states (Baker et al., 2004; Berridge and Aldridge, 2009; Brewer et al., 2012; Curtin et al., 2006; Robinson and Berridge, 2003; Tiffany, 1990).

Robinson and Berridge postulated that to understand addiction, we need to understand the process by which “addicts develop an obsessive craving for drugs, a craving that is so irresistible that it

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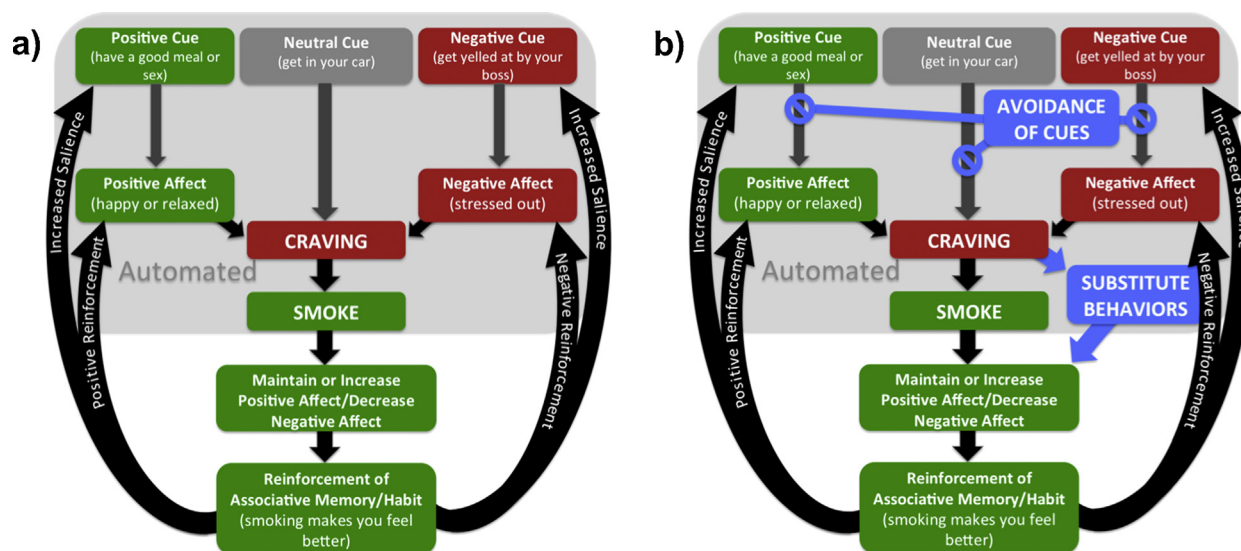


Fig. 1. Associative learning “addictive loop” for nicotine dependence. (a) Smoking becomes associated with positive (green) and negative (red) affective states through positive and negative reinforcement. Cues that lead to these states (gray arrows) can also trigger cue-induced craving, and subsequent smoking, which becomes habitual after multiple rounds of reinforcement. (b) Strategies that teach avoidance of cues or substitute behaviors may not directly dismantle the core addictive loop (black arrows). Avoidance of cues dampens input into the addictive loop, while substitute behaviors (blue arrows) circumvent the targeted addictive behavior (e.g. smoking). ©Judson Brewer. Reprinted with permission of author.

almost inevitably leads to drug seeking and drug taking” (Robinson and Berridge, 1993). Indeed, craving and subsequent smoking have long been closely associated amongst daily smokers (Baker et al., 2004; Carter et al., 2008; Killen et al., 1997; Shiffman et al., 1997; Tiffany, 1990). For example, both adults and adolescents who report higher levels of craving also exhibit higher levels of daily cigarette consumption (Bagot et al., 2007; Pomerleau et al., 2000; Prokhorov et al., 2005).

Craving is potentially the most difficult obstacle to overcome for smokers attempting to quit (Killen et al., 1997; West and Schneider, 1987). Intense and unremitting craving often precedes the initial lapse following a cessation attempt and a number of studies have shown that increases in the intensity of craving can accurately predict lapse and relapse risk (Herd et al., 2009; Killen et al., 1997; Piasecki, 2006; Shiffman et al., 1997). For example, in a study of treatment-seeking smokers, for each standard deviation increase in craving on the target quit date, the risk of lapsing rose by 43% on that day, and 65% on the following day (Ferguson et al., 2006).

The sheer number of cues that smokers can associate with positive and negative affective states, in addition to neutral states, greatly complicates individuals’ attempts to quit smoking. Many current behavioral treatments for smoking cessation teach individuals to avoid cues, divert their attention away from cravings, substitute other activities for smoking, or to promote positive affective states by practicing relaxation or exercising (Fiore et al., 2008; Lando et al., 1990). It is hypothesized that these treatments may not be successful in targeting the addictive loop (Fig. 1b, black arrows). These treatments have shown only modest success, as abstinence rates in the United States have remained under 30% for the past 30 years (Fiore et al., 2008). This is perhaps partly due to the ubiquity of cues; avoiding them often takes a lot of cognitive effort, which may be unavailable during strong affective or ‘ego-depleted’ states (Baumeister et al., 1998; Muraven and Baumeister, 2000; Tiffany et al., 2000). Also, substitutions are not always available or effective as they may treat “around” craving rather than directly targeting it (Fig. 1b, blue arrows). Taken together with the basic scientific findings of the central role of craving in addiction, the shortfalls of current treatments point toward the development of new approaches that directly target and dismantle the core links of

the addictive loop. Recent evidence suggests that treatments such as mindfulness training (MT) may confer these benefits (Bowen et al., 2009; Brewer et al., 2012).

In a clinical context, mindfulness can be described as an awareness of moment-to-moment experience arising from attention that is characterized by curiosity toward and acceptance of these present-moment experiences (Bishop et al., 2004; Kabat-Zinn, 2003). Mindfulness training is derived from Buddhist practices, and has been adapted for use in Western cultures in a variety of ways, taking the form of mindfulness-based stress reduction, mindfulness-based cognitive therapy, and mindfulness-based relapse prevention (Bowen et al., 2009; Kabat-Zinn, 1982; Marlatt and Donovan, 2005; Teasdale et al., 2000). Importantly, mindfulness directly targets wanting/craving, postulating that this causes the majority of unhealthy behaviors and thought patterns (Brewer et al., 2012; Thanissaro, 2010). MT has been explored as a treatment for pain (Kabat-Zinn, 1982; Kabat-Zinn et al., 1985), anxiety disorders (Evans et al., 2008; Kabat-Zinn et al., 1992; Roemer and Orsillo, 2002), and depression (Segal et al., 2010; Teasdale et al., 2000) among others.

Recently, MT has been evaluated as a treatment for addictions (Bowen et al., 2009; Brewer et al., 2010; Zgierska et al., 2008) and specifically smoking (Bowen and Marlatt, 2009; Brewer et al., 2011; Davis et al., 2007), though the majority of studies have been of pilot nature (Zgierska et al., 2009). For example, Davis and colleagues reported that 10 of 18 participants who had received MT were abstinent six weeks after quitting (Davis et al., 2007). In another trial, Bowen and colleagues found that after providing brief mindfulness-based instructions to college students (to accept thoughts non-judgmentally, and to pay attention to urges and accompanying sensations without trying to change or get rid of them), the students smoked significantly fewer cigarettes seven days post-intervention compared with students who did not receive the instructions (Bowen and Marlatt, 2009). Interestingly, this was despite the fact that the two groups did not differ significantly on measures of urges.

More recently, Brewer and colleagues conducted a randomized clinical trial in which participants were randomized to receive either MT or freedom from smoking (FFS, a cognitive behavioral

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