



## Mindfulness and smoking frequency: An investigation with Australian students

Eugene Y. Chan <sup>\*</sup>

College of Health and Human Sciences, Purdue University, United States

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### ABSTRACT

Mindfulness training has been shown to be effective in reducing smoking frequency. However, mindfulness training instructions that are free of mentions about smoking are rare, which makes it difficult to ascertain if it is the temporary state of being mindful or demand effects that reduce smoking frequency. It has also been posited that mindfulness training lowers smoking frequency by helping smokers surf the urge, but this remains untested. Thus, we conducted an experiment to test the likely process. We used a 6-minute audio clip to induce a brief mindfulness state or a mind-wandering state in 91 Australian students; the brief mindfulness exercise was free of any mentions about smoking. We found that exposure to the mindfulness-inducing audio clip helped smokers surf their urge when they were later exposed to cigarette cues and they smoked less over the subsequent 7 days. The current work offers empirical evidence for why mindfulness training can be effective in smoking cessation.

### 1. Introduction

Mindfulness means being aware, taking note of what is going on within oneself and outside in the world, without shying away from feelings one does not like or wish to be true (Marlatt & Kristeller, 1999). Mindfulness training has been reported to be effective in helping smokers reduce their smoking, for example, relative to the American Lung Association's "Freedom from Smoking" treatment (Brewer et al., 2011; Bowen & Marlatt, 2009; Davis, Fleming, Bonus, & Baker, 2007; de Souza et al., 2015; Elwafi, Witkiewitz, Mallik, Thornhill, & Brewer, 2013). Indeed, a meta-analysis revealed that 25.2% of participants who received mindfulness therapy remain abstinent after four months relative to 13.6% of those in other groups (Oikonomou et al., 2017), which is consistent with how mindfulness training reduces other substance abuses (Grossman, Niemann, Schmidt, & Walach, 2004; Karyadi, VanderVeen, & Cyders, 2014; Li, Howard, Garland, McGovern, & Lazar, 2017).

However, there are two limitations to existing research on mindfulness training as an intervention for smoking cessation. First, the mindfulness training exercises explicitly instruct smokers to ride out and not give into their cigarette cravings. Typical instructions train smokers to specifically be mindful of triggers and related emotions (Davis et al., 2007; Davis et al., 2014) and to "ride out" those urges (Bowen & Marlatt,

2009) via non-judgmental acceptance (Spears et al., 2015). Such instructions can be problematic in identifying why mindfulness treatments can be effective. Is it being mindful that has an effect? Or might it be specific instructions to ride out urges that has the benefit? Indeed, being mindful may not necessarily automatically permit smokers to resist their urges but rather specific instructions to do so. The presence of such specific instructions also poses a possible concern related to demand effects, with self-reported lower cravings a consequence of those instructions and not actual felt lower cravings (Vettese, 2009). Second, as just mentioned, the presumption that mindfulness training lowers smoking frequency by allowing smokers to surf the urge (de Souza et al., 2015) has not been tested directly. Literature reviews and meta-analyses have noted that the primarily-assessed outcome is smoking frequency or intention to quit smoking (de Souza et al., 2015; Oikonomou et al., 2017). But it is unclear how mindfulness training might reduce smoking frequency.

To be sure, there is work examining the effect of mindfulness training on smoking urges (Adams et al., 2012; Bowen & Marlatt, 2009) but they do not explore reactions to smoking cues that have a strong influence on giving in to urges (Carter & Tiffany, 2001), even if smokers were being mindful and so it is not clear if mindfulness might affect smokers' response when smoking cues are present. Others have used inductions free of mentions about smoking to study reactions to smoking cues but

<sup>\*</sup> Address: Eugene Y. Chan is Associate Professor in the College of Health and Human Sciences, Purdue University, Matthews Hall 312A, 812 W. State St., West Lafayette, IN 47907, United States.

E-mail address: [eychan@purdue.edu](mailto:eychan@purdue.edu).

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not smoking frequency (Westbrook et al., 2011). Accordingly, we study the likely impact of mindfulness training free of mentions about smoking on both smokers' reactions to cigarette cues and their smoking frequency singly.

## 2. Method

### 2.1. Participants

We recruited 98 undergraduates from a research-intensive Australian university. The participants were recruited in partnership with the health and wellness clinic who identified interested participants who were smokers, smoked 10 + cigarettes per day, had fewer than 3 months of abstinence in the past year, and reported interest in quitting smoking. A total of 234 participants were invited, producing a response rate of 41.8%. In total, there were 38 men and 60 women, with a mean age of 21.21 years old. Participants were excluded if they reported using psychoactive medications, had an unstable medical condition within the past year, or met DSM-5 criteria for substance dependence in the past year. Research ethics and informed consent were received. Of the 98 students attending the lab session, 91 attended the follow-up study one-week later, thus a retention rate of 92.8%. Incentive was given for each session attended.

### 2.2. Procedure

Students took part in a supposed market research study for a headphone manufacturer without any awareness that the study was about smoking. Although the students were identified in partnership with the university health and wellness clinic, students were invited by researchers within the business school.

Students were assigned to partitioned cubicles and followed instructions on the computer. They first listened to a mindfulness or mind-wandering audio clip with the headphones provided. Students were assigned to one condition on a random basis. The mindfulness clip was 6 min long (Arch & Craske, 2006; Hafenbrack, Kinias, & Barsade, 2014) that featured a mindfulness exercise suitable for those without mindfulness experience; it instructed them to focus on their breathing, consistent with the notion that focusing on the inner state facilitates an inclusive consideration of thoughts. The mind-wandering clip was also 6 min but it instructed them to follow their thoughts. This condition replicated a waking baseline mental state and thus is suitable as a control condition to compare mindfulness (Winning & Boag, 2015). After listening to their respective track, students answered a few questions about the headphones, ostensibly in line with the cover story: how comfortable the headphone was, how easy it was to use, and how clear the audio was, all on separate 9-point scales from 1 = "Not at All" to 9 = "Very Comfortable/Easy/Clear."

Participants then completed another study ostensibly separate from the audio track exercise. Here, we showed them a picture of John Player Special cigarettes and asked students how "colorful" and "interesting" they found the product packaging to be, under the pretense that this was an academic study about colors on "consumer products" (1 = "Not at All" to 9 = "Very Colorful/Interesting").

Next, students completed the 10-item short form of the Questionnaire of Smoking Urges (QSU-Brief; Cox, Tiffany, & Christen, 2001; on 9-point scales from 1 = "Strongly Disagree" to 9 = "Strongly Agree") to test if our brief mindfulness training exercise might affect the intensity of smoking urges on exposure to the cigarette cue. Then, students answered two questions about their present ability to resist smoking urges: "I feel I am able to resist my urge to smoke" and "I feel in control of my smoking" (1 = "Strongly Disagree" to 9 = "Strongly Agree"). These four questions were randomized across participants.

Finally, as part of the demographics section, students indicated how many cigarettes, on average, they smoke each day. At this point, the lab session concluded. All students wrote down their e-mail addresses so

that we could contact them about future research studies. A week later, we e-mailed all 98 students with a link to an online questionnaire. We asked students to indicate how many cigarettes that they smoked each day in the past 7 days. At this point, students were debriefed about the study and given contact information for smoking cessation programs offered by the university.

We received ethics approval from [institution name here].

## 3. Results

Results at Time 1 refer to responses to our questions about headphones and smoking urges during the initial lab attendance. Results at Time 2 refer to the students' responses to our smoking questions at the follow-up 7-days later.

### 3.1. Final sample size and random assignment check

Out of the 234 participants invited, only 98 took part at Time 1, with 50 assigned to the mindfulness condition and 48 to the mind-wandering condition. At Time 2, 91 took part, producing an attrition rate of 9.2%. Of this final group, 46 were in the mindfulness condition while 45 were in the mind-wandering condition. Thus, attrition rates were similar in both groups. Moreover, at Time 2, there were no differences between the mindfulness and mind-wandering conditions on both age,  $t(89) = 1.24$ ,  $p = .21$ , and in the gender proportion,  $\chi^2(1) = 0.36$ ,  $p = .54$ . Furthermore, students in the mindfulness treatment reported that they smoked on average 15.64 cigarettes per day ( $S.D. = 9.45$ ), whereas those in the mind-wandering treatment reported they smoked on average 16.11 cigarettes per day ( $S.D. = 9.11$ ). There was no significant difference between these two conditions,  $t(89) = 0.24$ ,  $p = .81$ . Thus our random assignment was successful at Time 1, producing no noticeable differences on these variables at Time 2. A sensitivity analysis conducted using G\*Power revealed that our sample size of 91 could test an effect size of  $d = 0.53$  with 2 groups at the  $\alpha = 0.05$  and power = 0.80 levels.

### 3.2. Time 1

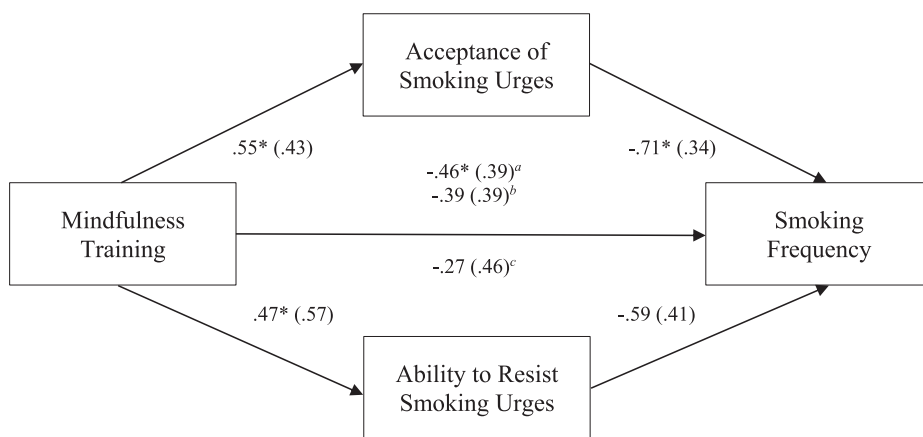
**Headphone quality.** We averaged the items about headphone quality ( $\alpha = 0.87$ ), with higher scores indicating better headphone quality. Those in the mindfulness treatment scored 6.89 ( $S.D. = 2.00$ ) while those in the mind-wandering treatment scored 6.82 ( $S.D. = 1.98$ ). The difference was not significant,  $t(89) = 0.17$ ,  $p = .86$ .

**Cigarette product colors.** We averaged items about how colorful and interesting they found JPS cigarettes to be ( $r = 0.85$ ), with higher scores indicating more positive attitudes. Those in the mindfulness treatment scored 6.44 ( $S.D. = 2.11$ ) whereas students who were in the mind-wandering treatment scored 6.71 ( $S.D. = 2.56$ ). The difference was not significant,  $t(89) = 0.55$ ,  $p = .58$ .

**QSU-Brief.** We averaged the items on the QSU-Brief ( $\alpha = 0.83$ ), with higher scores indicating stronger cravings upon being exposed to the cigarette cue. Those in the mindfulness treatment scored 4.56 ( $S.D. = 1.78$ ) while students in the mind-wandering one scored 4.71 ( $S.D. = 1.56$ ). The difference was insignificant,  $t(89) = 0.42$ ,  $p = .67$ . Thus, mindfulness does not affect the intensity of felt urges after exposure to cigarette cues.

**Acceptance of cravings.** We averaged the two items about acceptance of cigarette cravings ( $r = 0.94$ ,  $p < .001$ ), with higher scores indicating greater acceptance. Students in the mindfulness condition scored 5.87 ( $S.D. = 1.46$ ) while those in the mind-wandering condition scored 5.21 ( $S.D. = 1.33$ ),  $t(89) = 2.23$ ,  $p = .03$ ,  $d = 0.47$ . Thus, mindfulness increased the acceptance of one's smoking urges.

**Ability to resist cravings.** We averaged the two items about ability to resist cigarette cravings ( $r = 0.91$ ,  $p < .001$ ), with higher scores indicating a greater ability (however perceived). Students in the mindfulness condition scored 4.18 ( $S.D. = 1.51$ ) whereas students in the mind-



**Fig. 1.** Individual Pathways in Mediation Model. Multiple mediation model with (a) acceptance of cravings and (b) ability to resist smoking urges as competing mediators in the impact of a brief mindfulness (vs. mind-wandering) treatment on smoking frequency. Standardized coefficients are reported, with standard errors in parentheses. <sup>a</sup>Direct effect of mindfulness on smoking frequency; <sup>b</sup>Indirect effect of mindfulness on smoking frequency through acceptance of cravings; <sup>c</sup>Indirect effect of mindfulness on smoking frequency through ability to resist urges. \* $p < .05$ .

wandering group scored 3.45 ( $S.D. = 1.78$ ). The difference was significant,  $t(89) = 2.11$ ,  $p = .04$ ,  $d = 0.44$ . Thus, mindfulness increases smokers' ability to resist cravings.

### 3.3. Time 2

**Smoking frequency.** We averaged the number of cigarettes that students reported they smoked each day of the previous week ( $\alpha = 0.76$ ). Those who were in the mindfulness treatment reported smoking on average 12.57 cigarettes ( $S.D. = 8.57$ ), while those in the mind-wandering treatment reported smoking on average 16.45 cigarettes per day ( $S.D. = 9.01$ ). The independent samples  $t$ -test revealed a significant difference,  $t(89) = 2.10$ ,  $p = .04$ ,  $d = 0.44$ . We also examined our data comparing difference in smoking frequency from Time 1 to Time 2. For those who were in the mindfulness treatment, the change of ( $M = -3.07$ ,  $S.D. = 3.76$ ) was larger than that for those in the mind-wandering condition ( $M_{\text{change}} = +0.34$ ,  $S.D. = 4.00$ ),  $t(89) = 4.18$ ,  $p < .001$ ,  $d = 0.88$ . Moreover, students in the mindfulness treatment reduced their smoking frequency from Time 1 to Time 2, though the difference was only marginally-significant,  $t(98) = 1.70$ ,  $p = .09$ ,  $d = 0.36$ . However, students in the mind-wandering treatment did not differ in smoking frequency between Time 1 and Time 2,  $t(80) = 0.17$ ,  $p = .86$ .

**Parallel mediation analysis.** Finally, we conducted a parallel mediation analysis by utilizing the SPSS bootstrapping protocols (notably, Model 4; Hayes, 2013). The mindfulness (vs. mind-wandering) treatment was the independent variable, smoking frequency reported at Time 2 was the dependent variable, and (a) acceptance of cravings and (b) ability to resist urges were the two presumed mediators in parallel. The results are presented in Fig. 1. Mindfulness treatment reduced smoking frequency through both (a) acceptance of cravings and (b) an ability to resist smoking urges. Each indirect effect was significant, illustrating that the two processes acted as parallel mediators. The indirect effect of mindfulness training on smoking frequency via acceptance of cravings was estimated between  $-0.34$  and  $-0.03$ , while that via their ability to resist smoking urges was estimated to lie between  $-0.49$  and  $-0.05$ . The mediation analysis was conducted with 5000 bootstrapped samples at the 95% C.I. The findings are in-line with how mindfulness training conceivably reduces smoking frequency by allowing smokers to surf the urge when they are exposed to cigarette cues.

## 4. Discussion

The current results replicate previous research that mindfulness training can be an effective treatment in helping smokers reduce smoking frequency. Moreover, we address two limitations. First, we use an experimental induction of a mindfulness state free of any mentions about smoking. Second, mindfulness training reduces smoking frequency by helping smokers to surf their urges upon exposure to a

cigarette cue. Mindfulness training did not affect the intensity of urges but it helped smokers to accept and not give in to them. We thus illustrate the efficacy of mindfulness training on smoking cessation and demonstrate a likely mechanism.

The results of our current investigation largely parallel Acceptance and Commitment Therapy (ACT) techniques (Hayes, Luoma, Bond, Masuda, & Lillis, 2006; Hernández-López, Luciano, Bricker, Roales-Nieto, & Montesinos, 2009) that encourage people to accept unpleasant, aversive thoughts or feeling and to experience but not lessen them. ACT has been applied successfully to smoking (Gifford et al., 2004). However, ACT differs from mindfulness in how the smoking cessation goal is achieved (McCracken & Vowles, 2014). ACT comes from improving psychological flexibility, while mindfulness comes from a mental focus on the present. Thus, although the basic tenet that mindfulness helps smokers surf their urge is similar to the ACT literature, the approach and mechanism differ. We document empirically the mediating role of riding out one's urges in reducing smoking frequency.

That said, there are limitations to the current investigation. We only assessed smoking frequency after 7 days. It is unknown if the benefits of a brief mindfulness-inducing audio clip would persist. It may be difficult for the effects of a mere brief 6-minute audio clip to maintain for a long period of time, so regular sessions of mindfulness training may be needed. Also, we only assessed urges at Time 1. We found that mindfulness training reduces smoking frequency over 7 days due to the initial acceptance of and ability to not give in to those urges. However, it would be prudent to see if both acceptance and ability to not give in could be maintained over a longer period of time.

Similarly, there are different conceptualizations of mindfulness that delineate it into different dimensions or aspects (Baer, Smith, & Allen, 2004; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006; Lau et al., 2006). We focus on "acceptance" and "acting with judgment" common to most conceptualizations and relevant to how mindfulness training might help smokers surf urges. But, there was no effect of mindfulness training on the intensity of felt smoking urges, only on acceptance and the ability to not give into them. This could suggest that one's ability to identify or describe emotions, another dimension of mindfulness, may be less relevant to the success of mindfulness training on smoking cessation. A more thorough study examining the various dimensions of mindfulness (whether as a trait or as a brief state) on smoking cessation would be helpful. Further, while we disguised parts of the study as market research, our questions about smoking may have been salient, which could bias results. But prior research on mindfulness has often used explicit mentions of smoking in their exercises, and our focus here is on the effectiveness of mindfulness free of such mentions on smoking urges and smoking frequency. In this regard, we believe that we are successful.

Finally, we only examine smokers' ability to surf and "ride out" their smoking urges (Bowen & Marlatt, 2009; Davis et al., 2007; Davis et al.,

2014; Spears et al., 2015). There have been other mechanisms proposed for why mindfulness training might promote smoking cessation. For example, mindfulness training also facilitates perceived control over smoking behavior (Spears et al., 2017) and change how female smokers specifically respond to body image challenges (Adams et al., 2012). It is possible that the ability to surf one's smoking urges may be stronger—or weaker—than these other potential mechanisms. Thus, further research would be necessary to compare the mechanisms via which mindfulness reduces smoking frequency. Experimental techniques would, in particular, allow for a determination of possible causation.

Our results are of interest to therapists and practitioners. Certainly, qualified therapists are required to guide smokers through a proper mindfulness meditation exercise. But because mindfulness can be achieved outside of clinical and therapeutic settings (e.g., self-help books on mindfulness exist), mindfulness training may be helpful for those who wish to quit. Participation in non smoking-specific meditation training sessions may furthermore be appealing as it does not make salient the stigma of being smokers that can impede smoking cessation goals (Evans-Polce, Castaldelli-Maia, Schomerus, & Evans-Lacko, 2015; Luoma, Kohlenberg, Hayes, Bunting, & Rye, 2008). Mindfulness training practiced at home can also decrease costs in time and money for smokers. To be sure, we have no data to support the propositions but they are conceivable if a brief mindfulness training exercise free of any smoking mentions can exert a positive effect on smoking cessation.

#### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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