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Associations Between Mindfulness and Implicit Cognition and Self-Reported Affect

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Abstract

Theory suggests that mindful individuals exhibit enhanced attentional processing (e.g., attentional control) and that they maintain a detached perspective to problematic stimuli. For smokers, smoking and affective stimuli are problematic stimuli when they try to quit. In this cross-sectional study, smokers ($n = 158$) completed 3 modified Stroop tasks (to assess attentional control), 3 Implicit Association Tests (IATs; to assess detached perspective), and a battery of self-report assessments. Degree of mindfulness was negatively associated ($P < .05$) with self-reported negative affect, perceived stress, and depressive symptom severity, and positively associated ($P < .05$) with positive affect. Degree of mindfulness was not associated with the ability to disengage attention from smoking or affective stimuli. On the depression IAT, more mindful participants exhibited a more negative IAT effect, suggesting that they may have developed a detached

perspective to depression-related stimuli. Theoretical and clinical implications of the data are discussed.

Keywords

Implicit Association Test; implicit cognition; mindfulness; Stroop

INTRODUCTION

Theoretical analyses and empirical data suggest that mindfulness-based interventions may be a useful treatment for substance use disorders, including tobacco dependence (1–5). Mindfulness has been defined as “paying attention in a particular way: on purpose, in the present moment, and non-judgmentally” (6). Shapiro and colleagues identified 3 axioms of mindfulness: “Intention,” “Attention,” and “Attitude” (7). Intention refers to the reasons why an individual chooses to practice mindfulness. Attention refers to the process by which an individual observes his or her moment-to-moment conscious experiences. Attitude refers to how an individual relates to or interprets the content of conscious experience. Similarly, Bishop and colleagues describe 2 components: increased attention to immediate conscious experience, and the development of an attitude of openness and acceptance toward that conscious experience (8). Thus, there is agreement among theorists that acquiring mindfulness skills may result in changes in cognitive processes related to “Attention” and “Attitude.”

The “Attention” axiom itself has 2 subcomponents, “mindful awareness” and “attentional control.” Mindful awareness refers to the ability to attend to the contents of consciousness on a moment-by-moment basis. Perhaps as a consequence of extensive practice at manipulating the spotlight of attention (9), mindfulness may improve other components of attention, such as sustained attention, attention switching, and inhibition of elaborative processing (“attentional control”) (7,8,10). For example, in depressive disorders, enhanced attentional control engendered by mindfulness may allow attention to be redirected from depressive or anxious rumination back to the experience of the present moment with resulting improvement in clinical outcomes (11,12). Moreover, there is evidence that improvement in the degree of mindfulness can enhance certain attentional processes (10,13). One may therefore view the development of mindfulness skills as a form of attention retraining.

However, mindfulness can be more than just attention retraining. Mindfulness practice teaches an individual to process the contents of conscious awareness in a nonjudgmental manner (“Attitude” component), and to experience cognitions and emotions as mental events in a broader context of awareness (12). Hayes and colleagues conceptualize the shift from “self as content” (the self is an object in consciousness) to “self as context” (the self is observing the objects in consciousness and is not the object itself) (14). That is, individuals can allow distressing thoughts and feelings to occupy awareness, without necessarily trying to change them and without becoming engaged in their content. Thus, in a context of mindfulness, thoughts and feelings can be viewed simply as passing mental events that may

or may not reflect reality. Ultimately, an individual realizes that “this depression is not me” and “these thoughts are not me.”

In the current study, we examined the associations between questionnaire-assessed mindfulness and affect/cognition in smokers enrolled in a smoking cessation study. The rationale for the focus on self-reported affect is twofold: Self-reported affect is associated with both mindfulness (e.g., 15,16) and smoking cessation (e.g., 17,18). The rationale for the focus on attention and attitude is likewise twofold. As noted above, mindfulness should be associated with the ability to disengage attention from smoking or affective stimuli, and to maintain a detached perspective to those stimuli. In addition, improved attention (19) and a detached attitude may assist smokers trying to quit. Stated simply, an effect of mindfulness training on smoking cessation might be mediated through an effect on affect/cognition. To gather initial data on this issue, we examined the association between questionnaire-assessed mindfulness and affect/cognition in smokers.

To summarize, in this cross-sectional study we examined the following hypotheses. First, consistent with the extant literature and theory (15), we hypothesized that mindfulness should be positively associated with positive affect, and negatively associated with negative affect, stress, and depression. Second, we hypothesized that mindfulness should be associated with reduced identification with problematic stimuli. Third, we hypothesized that mindfulness should be associated with an enhanced ability to disengage attention from problematic stimuli.

METHODS

Main Study

The current manuscript presents an analysis of the baseline data of 158 adult smokers, recruited from the Houston metropolitan area, who were enrolled in a randomized controlled pilot study to evaluate a mindfulness-based group therapy treatment for nicotine dependence. Details of study procedures, including inclusion and exclusion criteria, are described in detail elsewhere (20). The study was approved by the Institutional Review Board of The University of Texas M. D. Anderson Cancer Center.

Participants

Participants were 158 adult smokers who reported smoking 5+ cigarettes a day for the past year, and that they were motivated to quit smoking within the next 30 days.

Procedures

Interested prospective subjects ($N = 569$) completed an initial telephone interview during which their eligibility was assessed. Eligible individuals were invited to attend an in-person informational and enrollment meeting, which occurred on average 7.4 ($SD = 4.2$) days after the telephone interview. Then, enrolled subjects ($N = 158$) completed their baseline assessments, which included the Stroop tasks and IATs (completed in that order) and computer-administered questionnaires.

Measures

After verbal consent was obtained, demographic assessments and the Center of Epidemiologic Studies Depression Scale (CESD) (21) were administered at the telephone interview. Other assessments were administered at the baseline visit.

Questionnaire Measures—Degree of mindfulness was assessed using the 15-item Mindfulness Attention Awareness Scale (MAAS) and the 39-item Kentucky Inventory of Mindfulness Skills (KIMS). MAAS scores (mean score on the 15 items) have been shown to correlate with level of well-being, to differentiate mindfulness practitioners from nonpractitioners, and to predict self-regulation and positive emotional states (15). The KIMS is a multidimensional questionnaire that yields 4 scales: Observing, Describing, Acting with Awareness, and Accepting without Judgment. Internal consistency and test-retest reliability of the KIMS is good, as is convergent and discriminant validity (22). “Observing” most closely captures the process by which attention is deliberately focused on the contents of consciousness (“mindful awareness”). “Describing” assesses the tendency to apply verbal labels to the contents of conscious experience. “Acting with Awareness” assesses the ability to engage undivided attention in a current task. “Accepting without Judgment” best captures the “Attitude” component (detached perspective).

Depressive symptom severity was assessed with the CESD (21), which has good psychometric properties and has been widely used in smoking cessation research (e.g., 23).

Positive and negative affect was evaluated using the Positive and Negative Affect Scale (PANAS), which is comprised of 2 mood scales: Positive (PA) and Negative (NA) Affect (24). The PANAS-NA scores have been reported to be among the best predictors of tobacco relapse (17).

Stress symptom severity was evaluated using the Perceived Stress Scale (PSS), a 4-item measure designed to assess the degree to which respondents have experienced stress (25). The PSS total score is predictive of relapse (26).

Cognitive Assessments—We assessed “Attention” and “Attitude” using implicit cognitive assessments. Recent theory and empirical research in the field of addiction have emphasized the utility of implicit cognitive assessments (27, 28). We administered the Implicit Association Test (IAT) (assessment of “Attitude”) and the modified Stroop task (assessment of “Attention”). Both tasks have been widely used to study addiction (e.g., 29,30), and psychopathology (e.g., 31,32); the IAT has also been used to study mindfulness (15,33). We focused on responses to affective and smoking-related stimuli, which are problematic stimuli for smokers trying to quit (e.g., 18,19). Three IATs and 3 modified Stroop tasks were administered on a desktop computer using E-prime software (version 1.1) (34). Order of completion of the IATs was counterbalanced across participants; the same was true for the modified Stroop tasks. Each IAT and Stroop task took around 5 and 2 minutes to complete, respectively.

IAT: On the IAT, participants were asked to respond rapidly by pressing a certain keyboard key for items representing 2 concepts (e.g., depressed + me), and with a different key for

items from 2 other concepts (e.g., not depressed + not me) (Task 1). In Task 2, the assignment of one concept was switched, such that, for example, “not depressed” + “me” shared a common key-response, and “depressed” + “not me” shared the other response. The idea underlying the IAT is that it is easier to perform the IAT when the 2 concepts are strongly associated in memory than when the 2 concepts are unrelated (35). The critical outcome measure (the IAT effect) is the difference in reaction times (RTs) on Task 1 versus Task 2. The IAT effect is considered an index of the relative strength of mental associations. In the example above, it indicates whether associations are stronger between depressed and me, and not depressed and not me, than between not depressed and me, and depressed and not me.

Each participant completed a smoking IAT (smoking/not smoking, me/not me), an anxiety IAT (anxious/not anxious, me/not me), and a depression IAT (depressed/not depressed, me/not me). Lower (more negative) scores on these IATs (e.g., faster responses when “depression” is paired with “not me” compared to when “depression” is paired with “me”) are interpreted as indicating a more detached perspective to depression, anxiety or smoking stimuli.

Each IAT consisted of 7 blocks: (1) Practice of categorization for the target concept (e.g., depressed/not depressed); (2) Practice of categorization for me/not me; (3) First block of combined categorization task (Task 1); (4) Second block for Task 1; (5) Practice of categorization for the target concept but with the response keys reversed from the assignment in (1) (not depressed/depressed); (6) First block of alternative combined categorization task (Task 2); (7) Second block for Task 2. The order in which participants performed the combined categorization blocks (i.e., 3–4 and 6–7) was counterbalanced across participants. Blocks 1, 2, and 3 each had 20 trials, and blocks 4, 5, 6, and 7 each had 40 trials.

For the smoking IAT, we used smoking and nonsmoking pictures from a previous study (30). For the anxiety IAT, the anxious words were jittery, nervous, jumpy, troubled, uptight, stressed, tense, strained, fidgety, and irritable. The not anxious words were calm, cool, relaxed, unconcerned, unworried, untroubled, carefree, restful, composed, and comfortable. For the depression IAT, the depressed words were sad, lonely, hopeless, guilty, unhappy, discouraged, gloomy, low, depressed, and failure. The not depressed words were content, joyful, happy, cheerful, pleased, fun, merry, funny, excited, and positive. Me/not me words were derived from previous IAT research (15). “Me” words included I, me, and mine. “Not me” words included they, them, and other. The same “me/not me” words were used in all IATs.

Procedure: On each trial, a stimulus (word or picture) was presented in the center of a computer monitor. On the top of the screen were labels (on each side of the screen) to remind participants of the categories assigned to each key for the current task. Participants responded to the categorization task by pressing either an “L” key or the “R” key on the keyboard as quickly as possible (see (36) for further details of procedures).

Scoring: We used a currently recommended scoring algorithm (see 37) that involves dividing the IAT effect (difference in mean RTs on Tasks 1 and 2) by the pooled standard deviation of RTs. This algorithm also eliminates assessments on which a participant had RTs of <300 ms on more than 10% of trials (6, 9, and 7 assessments for the smoking, anxiety, and depression IATs, respectively), and RTs > 10,000 ms. RTs on incorrect responses were replaced by the block mean (correct responses) plus 600 ms. For comparability with other research, we also elected to present the IAT effect in milliseconds. Due to experimenter error, computer error, or subject circumstances, 11 subjects did not complete the IATs.

Modified Stroop Task—Participants completed 3 40-trial Stroop tasks: 1 containing smoking (e.g., cigarette) and neutral words (e.g., tablespoon); 1 containing anxiety (e.g., stressed) and neutral words; and 1 containing depression (e.g., sad) and neutral words. For all tasks, a mixed randomized format was used to examine the impact of the smoking or affective words on RTs on the subsequent trial (38–40). The carry-over effect (or “slow” Stroop effect) (38) may index the degree of difficulty in disengaging attention from the target stimulus (smoking or affective words).

Participants were instructed that words written in different colors will be presented on the screen, one after the other, and that their task was to indicate as rapidly and as accurately as possible which color the word was written in, by pressing 1 of 3 colored buttons on a keyboard. They were instructed to ignore the meaning of the word itself and to respond just to the color (see 19 for details).

The smoking words were tobacco, cigarette, smoke, craving, urge, ashtray, lighter, puff, drag, and nicotine. The depression and anxiety words were the same as those used in the respective IATs. There were 10 neutral words (household features) in each Stroop task; different neutral words were used in each Stroop task. The smoking, depression, and anxiety words did not differ in length or frequency from their respective neutral words using established norms (41).

Scoring: RTs < 100 ms and RTs on incorrect responses were excluded from analyses (2.85% of data); data from 1 subject were excluded because the subject's error rate was >33%. The carry-over effect was computed from the difference in RTs on trials after smoking words (or after depression or anxiety words) versus trials after neutral words. Due to experimenter error, computer error, or subject circumstances, 5 subjects did not complete the Stroop tasks.

Data Analysis Plan

One hundred fifty-eight subjects were included in the analyses. Analyses were conducted using SAS version 9.1. Visual inspection of the data revealed that IAT and Stroop effects appeared to be normally distributed. Scores on the mindfulness questionnaires, the PANAS-PA, and the PSS also appeared normally distributed; scores on the PANAS-NA and CESD appeared to be positively skewed. Descriptive statistics were used to describe participants' demographic and smoking history characteristics, self-reported affect, perceived stress, depressive symptom severity, IAT effects, and carry-over effects. Results are presented as mean (standard deviation [SD]) unless otherwise specified.

All correlational analyses were conducted using Pearson product moment correlations. Pearson's r has been shown to be robust to violations in normality (42). Analyses on IAT effects used the D score. All statistical tests were 2-tailed. Alpha was set to .05.

RESULTS

Participants' ($N = 158$) average age was 43.8 (11.8) years. Fifty-five percent were male. Participants smoked an average of 20.8 (9.2) cigarettes per day for an average of 24.8 (12.1) years. Details of participants' demographics are described elsewhere (20).

Descriptive Statistics

On the IAT, participants exhibited a robust implicit self-identification with smoking (versus not smoking; $t = 3.14$, $df = 140$, $P < .01$), not anxious (versus anxious; $t = -9.51$, $df = 137$, $P < .01$), and not depressed (versus depressed; $t = -10.6$, $df = 139$, $P < .01$) (Table 1).

On the modified Stroop task, participants were slower to perform the correct color classifications on words that followed: smoking words (versus neutral words; $t = 2.82$, $df = 151$, $P < .01$), and depression words (versus neutral words; $t = 4.33$, $df = 151$, $P < .01$); they also tended to be slower on words that followed anxiety words (versus neutral words; $t = 1.86$, $df = 151$, $P = .06$) (Table 1).

Association Between Mindfulness and Self-Reported Affect

As expected, the degree of mindfulness, assessed by MAAS, was negatively correlated ($P < .05$) with symptom severity of depression, negative affect, and stress, and positively correlated ($P < .05$) with positive affect (Table 2).

On the KIMS mindfulness questionnaire, the scores of the Describing, Acting with Awareness, and Accepting scales, but not of the Observing scale, were correlated ($P < .05$) with symptom severity of depression, negative affect, and stress in the expected direction. All KIMS scales were correlated ($P < .05$) with positive affect in the expected direction (Table 2).

Association Between Mindfulness and Implicit Measures

MAAS-assessed degree of mindfulness was negatively correlated ($P < .05$) with the depression IAT, but not the anxiety IAT or the smoking IAT (Table 2); higher MAAS scores were associated with a lower (more negative) depression IAT effect (Figure 1). That is, more mindful participants (higher MAAS score) found it easier to perform the classification task when depression was paired with not me compared to when depression was paired with me. Table 2 shows that Describing and Accepting (but not Observing or Acting with Awareness) were negatively correlated ($P < .05$) with the depression IAT.

There were no significant correlations between the mindfulness measures and the carryover effects on the modified Stroop task (Table 2).

DISCUSSION

This cross-sectional study of 158 smokers examined the associations between questionnaire-assessed mindfulness and affect/cognition. This is one of a few studies to apply the methods of implicit cognition to the study of mindfulness (15,33). It yielded several key findings. First, consistent with previous data (15), the degree of mindfulness was robustly associated with self-reported affect, stress, and depressive symptom severity. Second, the degree of mindfulness was negatively associated with implicit self-identification with depression (but not anxiety or smoking). Third, there was no evidence that mindfulness was associated with the ability to disengage attention from problematic stimuli.

Perhaps the most interesting finding of the study was the association between questionnaire-assessed mindfulness and the depression IAT effect. Confidence in the reliability of this observed association is bolstered by the fact that it was observed for both the MAAS questionnaire and (two) KIMS scales, and by the fact that there was a robust correlation between the degree of mindfulness and the depression IAT effect assessed on participants' quit day (not reported in paper). Following the logic of the IAT (35), the data indicate that greater mindfulness is associated with weaker automatic mental associations between "depressed" and "me" concepts and/or stronger automatic mental associations between "depressed" and "not me" concepts.¹ Interestingly, the association between questionnaire-assessed mindfulness and the depression IAT effect seemed more evident in the Attitude (detached perspective) component of mindfulness on the KIMS questionnaire (Describing and Accepting without Judgment).

Contrary to the study hypotheses, a correlation between mindfulness and the IAT effect was not observed for anxiety or smoking concepts. The reason for these null associations is not clear. Regarding the latter, it is possible that mindfulness in unselected participants (like those in the current study) targets affective rather than smoking stimuli.

Participants exhibited robust carry-over effects on all 3 modified Stroop tasks. Consistent with previous data, this suggests that they experienced difficulty disengaging attention from the salient smoking and affective words (39). However, we did not find any relationship between questionnaire-assessed degree of mindfulness and the carry-over effects. The meaning of this finding is not clear. In previous studies where an effect of mindfulness-based training on attention had been reported, participants had received an intensive mindfulness-based intervention (10, 13). In addition, an effect of mindfulness might be observed on alternative measures of attentional disengagement, such as those assessed by the visual probe task (43).

¹According to the logic of the IAT (35), this interpretation requires that mindfulness is not associated with correspondingly weaker associations between "not depressed" and "not me," and/or stronger associations between "not depressed" and "me." Given that mindfulness-based therapies most commonly target negative emotions (e.g., depression), we assume that the detached perspective component of mindfulness is more readily applied to negative (e.g., depressed) than positive cognitions/absence of negative cognitions (e.g., not depressed).

Limitations

The main limitation of the study is that it was restricted to a cross-sectional analysis of baseline data. Thus, the casual relationships linking mindfulness, implicit cognition, and well-being remain uncertain. In addition, we administered only a single measure of attention. The study was also limited to heavy adult smokers who wished to quit. We do not know whether our findings would generalize to other populations of smokers, or other substances abusers.

Strengths

We included a comprehensive battery of self-report affect and mindfulness measures. In addition, our assessment strategy was guided by a conceptual analysis of the cognitive processes underlying mindfulness.

To our knowledge, this study is the first to evaluate the association between mindfulness and affect/cognition in smokers. The data are potentially theoretically and clinically important. Theoretically, the data suggest that an association between mindfulness and cognition in smokers is most apparent on a measure that assesses a detached perspective to depression stimuli. It is possible that this cognitive assessment is the most sensitive to mindfulness training and captures a fundamental feature of mindfulness. Clinically, it is possible that performance on the depression IAT may help to identify smokers who do not possess a detached perspective; these smokers may therefore benefit the most from a mindfulness-based treatment that promotes such a perspective. Further research is required to more comprehensively characterize the relationships between mindfulness training, affect/cognition, and smoking cessation.

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FIGURE 1.

Scatterplot of relationship between MAAS-assessed degree of mindfulness (mean item score) and the IAT effect (in ms) on the depression IAT. The best-fit regression line is shown for illustrative purposes. Positive IAT values reflect the extent to which participants are faster to perform the classification task when depression is paired with me (versus not me). Negative IAT values reflect the extent to which participants are slower to perform the classification task when depression is paired with me (versus not me). MAAS = Mindfulness Attention Awareness Scale; IAT = Implicit Association Test.

TABLE 1

Descriptive Statistics for Study Measures

Measure	N	M	SD
MAAS	158	4.2	1.0
KIMS-Observing	158	37.0	7.0
KIMS-Describing	158	28.1	5.6
KIMS-Acting with Awareness	158	31.3	5.4
KIMS-Accepting	158	29.3	6.4
PANAS-PA	158	32.4	9.0
PANAS-NA	158	20.9	8.9
PSS	158	6.6	3.1
CESD	158	17.1	12.9
Smoking IAT (ms)	141	102	389
Anxiety IAT (ms)	138	-279	347
Depression IAT (ms)	140	-340	383
Smoking IAT (D score)	141	0.12	0.59
Anxiety IAT (D score)	138	-0.53	0.52
Depression IAT (D score)	140	-0.57	0.50
Smoking Stroop (ms)	152	19.2	83.8
Anxiety Stroop (ms)	152	12.1	80.1
Depression Stroop (ms)	152	23.8	67.7

Note. Key: MAAS = Mindfulness Attention Awareness Scale; KIMS = Kentucky Inventory of Mindfulness Skills; PANAS-NA = Negative affect scale of the Positive and Negative Affect Scale; PANAS-PA = Positive affect scale of the Positive and Negative Affect Scale; PSS = Perceived Stress Scale; CESD = Center of Epidemiologic Studies Depression Scale; IAT = Implicit Association Test; D score = method of scoring IAT (see text); *N* = number of participants contributing data on each measure. Data shown for Stroop tasks shows carry-over effect in ms (see text for details).

TABLE 2
Pearson's Correlation Coefficients (*r*) Between Mindfulness, Implicit Measures, and Self-Reported Affect

	Smoking IAT	Anxiety IAT	Implicit			Depression carry-over	Anxiety carry-over	Depression carry-over	Self-Report			
			Smoking IAT	Depression IAT	Smoking carry-over				PANAS-PA	PANAS-NA	PSS	CESD
MAAS	.00	-.14	-.27**	.15	.01	.07	.07	.07	.28**	-.44**	-.45**	-.33**
KIMS-Observing	.07	-.07	.05	-.04	-.02	.06	.06	.06	.31**	.07	-.01	-.01
KIMS-Describing	-.01	-.03	-.23**	-.09	-.00	.09	.09	.09	.50**	-.25**	-.41**	-.25**
KIMS-Acting with Awareness	-.06	-.16	-.14	.11	-.05	.05	.05	.05	.18*	-.41**	-.35**	-.27**
KIMS-Accepting	-.10	-.12	-.18*	.09	-.04	.11	.11	.11	.28**	-.54**	-.45**	-.35**

Note. Key: MAAS = Mindfulness Attention Awareness Scale; KIMS = Kentucky Inventory of Mindfulness Skills; PANAS-NA = Negative affect scale of the Positive and Negative Affect Scale; PANAS-PA = Positive affect scale of the Positive and Negative Affect Scale; PSS = Perceived Stress Scale; CESD = Center of Epidemiologic Studies Depression Scale; IAT = Implicit Association Test. Ns are 141 (smoking IAT), 138 (anxiety IAT), 140 (depression IAT), 152 (Carry-over effects), and 158 (all other variables). On the MAAS and the KIMS, higher scores indicate more mindfulness. Significant correlations are in bold.

* $P < .05$

** $P < .01$.