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Dispositional Mindful Attention in Relation to Negative Affect, Tobacco Withdrawal, and Expired Carbon Monoxide on and after Quit Day

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Abstract

Background—Mindfulness (or ‘Mindful Attention’) has been described as the presence or absence of attention to, and awareness of, what is occurring in the present moment. Among smokers, greater mindfulness is associated with greater affect stability and reduced cue-induced craving. While studies have shown that mindfulness is associated with other smoking-related factors such as reduced withdrawal symptoms using cross-sectional data, relatively little is known about the associations between baseline mindful attention and future abstinence-related affect/withdrawal. The current study sought to examine whether levels of mindful attention pre-cessation predicts negative affect, withdrawal, and level of expired carbon monoxide (CO) on quit day as well as 3- and 7- days post-quit, during a self-quit attempt.

Methods—Data from 58 adults (*M*_{age}=34.9; 65.5% male) participating in a self-quit study were available for analysis. Self-report measures of mindful attention, negative affect, and withdrawal symptoms were collected. Biochemical measurement of expired CO was also collected. Dependent variables were assessed on quit day, as well as three- and seven-days post-quit. Covariates included age, race, gender, self-reported level of cigarette dependence, and smoking status through 7 days. Multivariate regression was used to evaluate the association of baseline mindful attention in relation to the studied outcomes.

Results—Greater mindful attention predicted lower negative affect and reduced withdrawal at all three time-points. Mindful attention did not predict levels of expired CO.

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Conclusions—The findings suggest that mindful attention prior to or during smoking cessation treatment may help to reduce negative affect and withdrawal, which serve as barriers to cessation for many smokers.

Keywords

Smoking; Mindfulness; Mindful Attention; Affect; Withdrawal

1. Introduction

There is a growing effort to better understand the role of mindfulness in addictive behavior (Vidrine et al., 2015). Despite the lack of a unified overarching theoretical framework and operationalization of mindfulness (Roemer and Orsillo, 2002; Zvolensky et al., 2005), there has been a recent, more concerted effort to develop theoretically-driven assessment instruments for operationally-defining such factors (e.g., Baer et al., 2004; Brown and Ryan, 2003). Brown and Ryan (2003) developed a promising theoretically-derived self-report measure entitled the Mindful Attention Awareness Scale (MAAS), which assesses individual differences in the frequency of *mindful attention* states over time. According to Brown and Ryan (2003), mindful attention, as indexed by the MAAS, denotes conscious “attention to, and awareness of, what is occurring in the present”(Brown and Ryan, 2003, p. 824).

Mindful attention is negatively related to the intensity and frequency of negative affect symptoms over time (Brown and Ryan, 2003). For example, high levels of mindful attention, as indexed by the MAAS, have been associated with lower mood disturbance and stress symptoms among cancer patients (Carlson and Brown, 2005). Furthermore, high levels of mindful attention have been associated with enhanced self-awareness and psychological well-being, self-regulated behavior, and positive emotional states (Brown and Ryan, 2003). Other studies have found that the MAAS incrementally predicts affective vulnerability relative to negative and positive affect and emotional expression and processing associated with approach-oriented coping (Gonzalez et al., 2012; Zvolensky et al., 2015, 2006). Such findings indicate that the conceptualization and operationalization of mindful attention encompassed by the MAAS may hold promise in terms of better understanding psychological vulnerability and resilience. Although promising, little work has explored the potential of mindful attention to better understand processes governing the maintenance of addictive behavior, such as smoking.

Research focused on mindfulness and smoking has employed a range of instruments to measure the construct. Studies have documented relations between lower reported mindfulness (using the Five Facet Mindfulness Questionnaire [FFMQ]; Baer et al., 2006) and subjective well-being in smokers, relative to non-smokers (e.g., Barros et al., 2015). Among smokers, greater mindfulness (assessed via the Kentucky Inventory of Mindfulness Skills [KIMS]; Baer et al., 2004) is associated with reduced ratings of withdrawal, psychological stress, negative affect, and depression (Vidrine et al., 2015) although these findings have not been consistently observed (Luberto et al., 2014). Furthermore, each of these studies is limited due to cross-sectional analyses.

Regarding mindful attention as measured by the MAAS, greater mindful attention is concurrently related to lower smoking rates (Loucks et al., 2015) and has been shown to moderate (i.e., buffer against) the impact of intentions to smoke and smoking frequency (Black et al., 2012) as well as the effects of stress on alcohol use among smokers (Adams et al., 2015). Additionally, lower mindful attention, in concert with greater negative affect reduction expectancies of smoking, is associated with greater anxious arousal and difficulties regulating emotion (Gonzalez et al., 2009). Mindful awareness is also associated with a greater ability to tolerate distress (Luberto et al., 2014). Among African Americans in particular, greater mindful attention has been linked to better affect stability over the course of smoking cessation (Adams et al., 2014) and has been shown to enhance cessation outcomes despite no mindfulness components involved in treatment (Heppner et al., 2016). Furthermore, participants randomized to view smoking images using mindful attention experienced reduced craving in response to smoking images relative to those viewing the images passively (Westbrook et al., 2013).

Although promising, past work on mindful attention and smoking is limited. Specifically, past work has not examined longitudinal associations of mindful attention with negative affect, tobacco withdrawal, or smoking outcomes in the context of a self-quit attempt. With this background, the current study aimed to examine mindful attention as a prospective predictor of negative affect, tobacco withdrawal symptoms, and smoking levels (via biochemical assessment of expired carbon monoxide [CO]) over the course of a self-guided smoking cessation attempt (i.e., absence of any treatment). Negative affect, withdrawal symptoms, and expired CO were measured at three time-points: (1) on quit day, (2) three days post-quit, and (3) seven days post-quit. Greater mindful attention was expected to predict lower negative affect, less withdrawal, and lower levels of expired CO. Associations were expected to be evident after controlling for theoretically-relevant covariates: participant gender, age, race/ethnicity, baseline level of cigarette dependence, and smoking status.

2. Material and methods

2.1 Participants

Inclusion criteria consisted of: (1) 18–65 years old; (2) daily smoker (8 or more cigarettes per day for at least 1 year); (3) motivated to quit smoking (indicated via score of 5 or greater on a 0–10 motivation scale); and (4) not having decreased smoking rate by more than 50% over the previous six months. Individuals were excluded in cases of: (1) inability to provide informed consent; (2) pregnancy; (3) current use of nicotine replacement therapy or smoking cessation treatment; (4) psychotic-spectrum symptoms/disorders; (5) substance dependence (other than nicotine dependence); (6) suicidality; or (7) use of PRN (i.e., as needed) psychological medications.

2.2 Procedures

This study represents secondary analysis of a larger study examining self-quit attempts (Langdon et al., 2016). Individuals were recruited from two sites: Burlington, VT (86%) and Houston, TX (14%) from 2012–2013. Identical procedures were used at both sites, which were approved by Institutional Review Boards at the University of Vermont and University

of Houston, respectively. There were no differences in study measures between sites for any time point (p 's from .367–.883). Individuals completed a baseline session in the laboratory including biochemical verification of smoking via expired carbon monoxide (CO). Participants provided informed written consent prior to participation. Following consent, inclusion/exclusion criteria were assessed. Eligible participants completed self-report measures and were compensated with \$20. Eligible participants were invited to complete a self-guided (i.e., unaided) quit attempt. Quit day was scheduled for a date approximately 14 days following the baseline assessment. Thus, the participant was able to select his/her quit date. On quit day, participants returned to the laboratory to complete questionnaires. Participants were also scheduled to complete post-quit assessments (i.e., three- and seven-days post-quit) in the laboratory and received \$10 for completing each assessment. Post-quit assessments involved the same procedures as the quit day appointment including measurement of expired CO.

2.3 Measures

2.3.1 Mindful Attention and Awareness Scale (MAAS; Brown and Ryan, 2003)

—The MAAS is a 15-item self-report measure of dispositional mindfulness. Each item (e.g., “I find myself doing things without paying attention”) is rated on a Likert scale from 1 (*almost always*) to 6 (*almost never*). Higher average scores correspond to greater levels of mindfulness. The MAAS has good psychometric properties including test-retest reliability (Brown and Ryan, 2003). In the current study, internal consistency was good for MAAS ($\alpha=.89$), which was administered at baseline.

2.3.2 Positive and Negative Affect Schedule (PANAS; Watson et al., 1988)—

The PANAS is a self-report measure of positive and negative affect. The negative affect subscale (PANAS-NA) consists of 10 items (e.g., “*upset*”) each rated on a Likert scale from 1 (*very slightly or not at all*) to 5 (*extremely*) as to how the respondent feels right now (i.e., state-level negative affect). The PANAS has strong psychometric properties (Watson et al., 1988). Internal consistency for PANAS-NA was good to excellent at all time points: quit day ($\alpha=.85$), three days post-quit ($\alpha=.90$), and seven days post-quit ($\alpha=.91$).

2.3.3 Minnesota Nicotine Withdrawal Scale-Revised (MNWS-R; Hughes, 2007)

—The MNWS-R is a 15-item self-report measure of tobacco withdrawal symptoms. Each item (e.g., “*craving*”) is rated on a Likert scale from 0 (*none*) to 4 (*severe*). Internal consistency for MNWS-R was good at all time points: quit day ($\alpha=.87$), three days post-quit ($\alpha=.86$), and seven days post-quit ($\alpha=.87$).

2.3.4 Fagerstrom Test for Cigarette Dependence (FTCD; Fagerström, 2012)—

The FTCD is a six-item self-report measure of cigarette dependence, which yields a total score ranging from 0–10. The FTCD was administered at baseline.

2.3.5 Expired Carbon Monoxide (FTCD; Fagerström, 2012)—

Expired air carbon monoxide levels were assessed with a Vitalograph Breathco carbon monoxide monitor (Jarvis et al., 1987).

2.4 Data Analytic Strategy

First, correlations among study variables and descriptive statistics were examined. Next, a multivariate hierarchical regression was run to examine baseline mindful attention (MAAS) in relation to negative affect (PANAS), tobacco withdrawal (MNWS-R), and expired CO each measured at three time points: quit day, three days post-quit, and seven days post-quit. Covariates (age, gender, race/ethnicity, FTCD, and smoking status [coded as 0 = abstinent from quit day to the day 7 assessment; 1 = smoked between quit day and the day 7 assessment]) were selected a priori and entered in the first step. Mindful attention was then entered in the second step to evaluate associations after controlling for covariates. This multivariate approach allows for related outcomes to be tested simultaneously without conducting multiple tests (Rencher and Christensen, 2012). Following significant multivariate tests, post-hoc univariate tests were conducted to examine specific associations between mindful attention and each outcome. The effect of time (i.e., change in negative affect, withdrawal, and expired CO) was not examined. Partial eta-squared (η_p^2) was used to measure effect size.

3. Results

3.1 Descriptive Results

Correlations and descriptive statistics are presented in Table 1. Participants included 58 adult daily smokers (65.5% male; $M_{\text{age}}=34.9$ [$SD=14.3$]). The majority identified as White (87.9%), with 5.2% Black/African-American, 1.7% Asian, and 5.2% as multi-racial. On average, participants reported smoking 16.1 cigarettes per day ($SD=9.6$) at baseline. At baseline, expired CO was 18.9 parts per million (ppm; $SD=9.2$). Of the 58 individuals, 81.0% ($n=47$) did not smoke on quit day (i.e., made a self-quit attempt). On day three 32.8% ($n=19$) had not smoked, and on day seven 24.1% ($n=14$) had not smoked. Through seven days, 19.0% ($n=11$) remained abstinent through the three assessments (quit day, day three, and day seven).

3.2 Multivariate Results

Results of the multivariate regression revealed non-significant associations of age [$F(9, 44) = 1.49, p = .180, \eta_p^2 = .23$] and gender [$F(9, 44) = 1.57, p = .154, \eta_p^2 = .24$] in relation to the multivariate outcome. However, there were significant effects of race/ethnicity [$F(9, 44) = 4.09, p = .001, \eta_p^2 = .46$], FTCD [$F(9, 44) = 2.46, p = .023, \eta_p^2 = .34$] and smoking status [$F(9, 44) = 2.23, p = .037, \eta_p^2 = .31$]. After controlling for covariates, there was a significant positive association between mindful attention and the multivariate outcome [$F(9, 43) = 2.95, p = .008, \eta_p^2 = .38$].

3.3 Follow-Up Tests

Examining the univariate post-hoc tests revealed significant negative associations of mindful attention with negative affect on quit day [$F(1, 51) = 24.47, t = -4.95, p < .001, \eta_p^2 = .32$], three days post-quit [$F(1, 51) = 12.47, t = -3.53, p = .001, \eta_p^2 = .20$], and seven days post-quit [$F(1, 51) = 8.94, t = -2.99, p = .004, \eta_p^2 = .15$] as well as tobacco withdrawal on quit day [$F(1, 51) = 7.25, t = -2.69, p = .010, \eta_p^2 = .12$], three days post-quit [$F(1, 51) = 8.93, t$

$= -2.99, p = .004, \eta_p^2 = .15]$, and seven days post-quit [$F(1, 51) = 5.17, t = -2.27, p = .027, \eta_p^2 = .09]$. Regarding expired CO, there was no significant effect of mindful attention on quit day [$F(1, 51) = 0.51, t = 0.71, p = .478, \eta_p^2 = .01]$, three days post-quit [$F(1, 51) = 0.04, t = 0.19, p = .853, \eta_p^2 = .001]$, or seven days post-quit [$F(1, 51) = 0.66, t = 0.81, p = .422, \eta_p^2 = .013]$.

4. Discussion

The current study is the first to examine mindful attention as a predictor of negative affect, tobacco withdrawal, and expired CO in the context of a self-guided quit attempt. As hypothesized, lower mindful attention was a significant predictor, with a large effect (η_p^2), of a multivariate outcome comprised of negative affect, tobacco withdrawal, and expired CO among a sample of smokers who were recruited from the local community. Importantly, these effects were evident above and beyond the variance accounted for by an array of covariates, including cigarette dependence and smoking status. Only recently have researchers begun to evaluate mindful attention and mindfulness more generally as potential mechanisms in the maintenance of tobacco dependence (e.g., Adams et al., 2014; Loucks et al., 2015; Luberto et al., 2014), and these findings are consistent with demonstrated positive associations between mindful attention, and mindfulness measured via other instruments, and a number of clinically significant smoking processes (e.g., abstinence, mood regulation, mood severity). However, post-hoc analyses demonstrated that the relations between mindful attention and dependent variables were limited to negative affect and withdrawal, measured at all three time points. Effects were large for negative affect and ranged from medium to large for withdrawal across the three time points. Contrary to hypothesis, mindful attention was not significantly associated with expired CO and demonstrated small effect sizes for this variable. Thus, in the current sample, it appears as though mindful attention relates to symptomatology but not smoking behavior (CO). However, mindful attention was associated with important affective and smoking-related constructs of negative affect and withdrawal despite the lack evidence for a direct link with CO and thus it is possible that mindful attention may still impact smoking behavior, indirectly via factors such as negative affect and withdrawal. It is also possible that mindful attention relates to symptoms of negative affect and withdrawal regardless of smoking status and quit attempt. Given the present sample size, it is important that future work continue to examine potential direct and indirect effects of mindful attention via negative affect and/or withdrawal on smoking outcomes to better explicate relations between mindful attention and smoking behavior.

Mindful attention is hypothesized to change one's relationship to internal experiences (such as withdrawal, craving, and negative affect) by focusing on the present moment in an observational, non-judgmental manner (Brown and Ryan, 2003). Negative emotional experiences and desires often divert one's attention away from the present moment and focus them on future-oriented thinking (e.g., worry, cravings) as a way of avoiding current distress (e.g., Hayes et al., 1996). Paradoxically, this avoidance of the present moment places more emphasis on future-oriented thinking and maladaptive strategies to avoid feeling discomfort (e.g., smoking to reduce negative affect). By focusing attention on the present moment, one can habituate to unpleasant sensations and the urgency to engage in maladaptive coping (e.g., smoking) is reduced. Furthermore, one may be better able to see

negative emotional states as transient rather than ever-present (i.e., that they will subside eventually).

Clinical research has implicated mindful attention in the maintenance of tobacco use (Heppner et al., 2016) and substance use more generally (Dakwar et al., 2011), and these data contribute to an emerging literature which suggests that mindful attention may also play a role in negative affect and withdrawal during a quit attempt. Thus, mindful attention may warrant further consideration as a transdiagnostic factor in the co-occurrence of emotional distress and psychopathology and tobacco addiction. Because some work suggests mindfulness can be enhanced via intervention (Carim-Todd et al., 2013; de Souza et al., 2015), addressing mindful attention through treatment among smokers prior to smoking cessation efforts may be beneficial to improving smoking cessation outcomes. Although, there is mixed evidence from past work regarding the effects of mindfulness interventions on smoking and further work is needed to examine facets of mindfulness (such as mindful attention) that may be most relevant to treatment. For example, one study examining mindful *meditation* found a non-significant effect on smoking outcomes (Maglione et al., 2017) whereas mindfulness-based stress reduction (MBSR; which includes meditation practice) modified for smoking cessation demonstrated an effect on 7-day point-prevalence smoking abstinence (Davis et al., 2007). However, future work will need to evaluate the degree to which such mindfulness-based interventions (e.g., MBSR) impact mindful attention.

A number of limitations of the present investigation and points for future directions should be considered. First, participants volunteered to participate in an unaided quit attempt (i.e., no psychosocial or pharmacological treatment was provided) for monetary compensation. Therefore, it is unclear whether these results will generalize to smokers receiving formal cessation treatment. Replication of these findings in a treatment-seeking sample may be an important next step. Second, our sample was largely comprised of a relatively homogenous group of smokers (~87% White). To increase the generalizability/representativeness of these findings, it will be important for future studies to recruit a more ethnically/racially diverse sample of smokers. Third, mindful attention was only measured at baseline. Although mindful attention is conceptualized as a trait-like construct, it may be malleable. Thus, future research may benefit from assessing changes in mindful attention over time in relation to smoking processes among self-quitters. Fourth, although we covaried for smoking status, future work utilizing larger samples may examine relations of mindfulness as a function of smoking status. Finally, there is a high degree of overlap between negative affect and tobacco withdrawal symptoms. Thus, although theoretically distinct, shared variance between negative affect and withdrawal may be evident.

In summary, results of the current study represent an initial, important step towards better understanding the role of mindful attention in the experience of tobacco withdrawal. Building from these findings, future work has the potential to inform the development of tailored cessation interventions for smokers to address mindful attention to facilitate less severe negative affect and tobacco withdrawal during a quit attempt.

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Table 1

Means, standard deviations and bivariate correlations among variables ($n=58$)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Age	-														
2. Gender	-.12	-													
3. Minority Status	.01	-.05	-												
4. FTCD	.33*	-.02	.03	-											
5. Smoking Status	-.10	.07	.18	-.01	-										
6. MAAS BL	.34*	-.19	.10	.25	-.09	-									
7. PANAS-NA QD	.10	.14	.15	.36**	.12	-.40**	-								
8. PANAS-NA 3DPQ	.06	.28*	-.06	.08	.06	-.41**	.70**	-							
9. PANAS-NA 7DPQ	.15	.17	.05	.15	.10	-.30*	.70**	.90**	-						
10. MNWS-R QD	.01	.16	.13	.13	.12	-.31*	.75**	.55**	.51**	-					
11. MNWS-R 3DPQ	.01	.22	-.02	.08	.05	-.37**	.73**	.86**	.76**	.73**	-				
12. MNWS-R 7DPQ	-.10	.24	.04	.03	.03	-.32*	.65**	.71**	.71**	.74**	.86**	-			
13. CO QD	.19	-.24	.53**	.27*	.26*	.23	.05	-.06	.12	-.03	-.03	-.01	-		
14 CO 3DPQ	.27*	-.21	.49**	.28*	.42**	.15	.09	-.10	.06	.07	-.07	.01	.76**	-	
15. CO 7DPQ	.37**	-.23	.25	.38**	.40**	.11	.16	.09	.23	.01	-.01	-.01	.70**	.82**	-
Mean/N	34.91	20	7	3.16	47	4.20	17.33	18.87	17.74	13.72	16.01	15.20	7.24	7.62	8.45
SD/%	14.28	34.50	12.10	1.81	81.00	0.91	6.29	7.32	6.97	7.98	7.71	7.93	7.50	8.66	8.63

Note:

* $p < .05$ ** $p < .01$

Gender=percent female; Minority Status=percent identifying as a racial/ethnic minority; FTCD=Baseline Fagerstrom Test of Cigarette Dependence; Smoking Status=percent who smoked between quit day and 7-day follow-up; BL=Baseline; QD=Quit Day; 3DPQ=3 Days Post-Quit; 7DPQ=7 Days Post-Quit; MAAS= Mindful Attention and Awareness Scale; PANAS-NA=Positive and Negative Affect Schedule, Negative Affect Subscale; MNWS-R=Minnesota Nicotine Withdrawal Scale-Revised; CO=Expired Carbon Monoxide. Age, gender, Minority Status, FTCD, and Smoking Status were covariates. Numbers across header correspond with variables numbered 1–15.