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## Sustained Smoking Abstinence is Associated with Reductions in Smoking-Specific Experiential Avoidance Among Treatment-seeking Smokers

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### Abstract

**Background and Objectives**—Smoking-specific experiential avoidance is related to the maintenance of cigarette smoking. However, it is unclear whether sustained smoking abstinence is associated with subsequent reductions in smoking-specific experiential avoidance.

**Methods**—Daily smokers ( $n = 149$ ) underwent a cessation attempt in the context of a 4-session smoking cessation treatment trial. Participants provided biochemical verification of smoking status at 1 week, 2 weeks, and 1 Month post-quit day. Smoking-specific experiential avoidance was assessed per the Avoidance and Inflexibility Scale (AIS) – the total score and two factor scores

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were examined at 1 Month post-quit day as a function of abstinence status. Two path models were conducted and included participant sex, treatment condition, and precessation nicotine dependence, smoking-specific experiential avoidance, and presence of emotional disorders as covariates.

**Results**—After adjusting for covariates, sustained smoking abstinence was associated with a reduction in the AIS total score at Month 1 post-quit ( $\beta = -.45, p < .001$ ). Sustained smoking abstinence was associated with reductions across both facets of experiential avoidance -- smoking-related thoughts and feelings ( $\beta = -.44, p < .001$ ) and internal bodily sensations ( $\beta = -.41, p < .001$ ).

**Limitations**—Biochemical verification of smoking status was confirmed only at three time points post-quit day, and continued abstinence throughout the one-month post-quitting period is not fully known.

**Conclusions**—Sustained smoking abstinence may contribute to reductions in smoking-specific experiential avoidance. Findings contribute to the research documenting the relevance of experiential avoidance in various processes of smoking (including smoking abstinence).

### Keywords

smoking cessation; tobacco; experiential avoidance; willingness; acceptance

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Experiential avoidance reflects an unwillingness to experience or remain in contact with uncomfortable or aversive internal experiences (e.g., thoughts, emotions, memories, bodily sensations, images; Hayes et al., 2004; Hayes, Wilson, Gifford, Follette, & Strosahl, 1996). This emotion-regulatory process is posited to play a foundational role in the development and maintenance of various forms of psychopathology (for review, see Chawla & Ostafin, 2007) and various problem health behaviors, including diabetes, obesity, and chronic pain (Gregg, Callaghan, Hayes, & Glenn-Lawson, 2007; Lillis & Hayes, 2008; McCracken & Dhirga, 2002).

Recent work has also implicated experiential avoidance in the context of smoking – termed smoking-specific experiential avoidance (Gifford et al., 2004). This construct is characterized by avoidance or an unwillingness to experience distressing internal states *related to smoking* (e.g., thoughts about smoking, feelings associated with smoking, or internal bodily sensations like nicotine withdrawal). For example, a smoker who is distressed by smoking urges (e.g., intrusive thought of “I need a cigarette”) may be particularly inclined to respond inflexibly to this thought or make attempts to avoid this thought, which may result in re-initiation of smoking. Theoretically, individual differences in the need to respond with action or to control distressing thoughts, feeling, or sensations related to smoking is associated with greater psychological inflexibility and may maintain smoking behavior. Indeed, higher levels of smoking-specific experiential avoidance are associated with greater reliance on cigarettes and affect-regulatory smoking outcome experiences (Farris, Zvolensky, DiBello, & Schmidt, 2015). Also, among anxious/depressed smokers, smoking-specific experiential avoidance indirectly accounts for smoking dependence characteristics (e.g., number of prior failed cessation attempts) and certain cognitive-affective processes (e.g., perceiving greater barriers to smoking cessation; Farris et

al., 2014; Zvolensky, Farris, Schmidt, & Smits, 2014). Additionally, smoking-specific experiential avoidance is associated with greater negative affect, craving, and nicotine withdrawal at the initiation of smoking cessation treatment (Farris, Zvolensky, & Schmidt, 2015). Further, highly experientially avoidant smokers (relative to low) who also experience higher levels of internal distress while attempting to quit smoking (e.g., negative affect, physical withdrawal symptoms), are at an increased likelihood of smoking lapse following smoking cessation treatment (Minami, Bloom, Reed, Hayes, & Brown, 2014).

Reductions in experiential avoidance by quit day are also associated with increased likelihood of quit day abstinence, and are associated with lower levels of internal distress on quit day (Farris, Zvolensky, & Schmidt, 2015). A related corpus of work indicates that smoking cessation treatments that specifically target smoking-related psychological flexibility (e.g., acceptance and commitment-based therapies; ACT) are associated with better clinical outcomes (e.g., Bricker, Mann, Marek, Liu, & Peterson, 2010; Gifford et al., 2004; Hernández-López, Luciano, Bricker, Roales-Nieto, & Montesinos, 2009). In fact, ACT-based treatment effects may be driven by reductions in smoking-related experiential avoidance (i.e., increased willingness to experience distressing internal experiences linked to smoking without attempting to control them; Bricker, Wyszynski, Comstock, & Heffner, 2013; Gifford et al., 2004, 2011). Moreover, the effectiveness of non-ACT-based treatments appear to be related to increases in acceptance of craving (versus avoidance/control) and increased self-efficacy for quitting (Schuck, Otten, Kleinjan, Bricker, & Engles, 2014).

Theoretically, while experiential avoidance may maintain smoking behavior, it is possible that changes in smoking behavior may influence the degree to which individuals are willing to experience smoking-relevant internal distress (Nosen & Woody, 2014). For instance, quitting smoking often produces internal distress (e.g., withdrawal, negative mood); for a smoker who struggles to maintain abstinence and may have bouts of interoceptive distress, the internal experience may be viewed as “confirmatory evidence” that smoking-related experiences are unmanageable and best delimited. For instance, experimental data suggest that smokers who fail to quit smoking, relative to those who abstain, appraise craving-related thoughts as more negative and personally relevant/threatening, and these maladaptive appraisals are associated with higher levels of subjective nicotine withdrawal and psychological distress while attempting to quit (Nosen & Woody, 2014). Alternatively, a smoker who is successfully able to abstain from smoking may be more likely to appraise smoking-related internal experiences as inaccurate or discount the relevance and accuracy of these previously avoided internal experiences. Thus, some initial evidence suggests that acceptance of craving (one type of avoided smoking-relevant experience) may be promoted by successful smoking cessation.

The current study aimed to test the hypothesis that, following a smoking cessation intervention, those who achieved abstinence (for 1 month), relative to those who do not, would report lower experiential avoidance of distressing internal experiences that typically cue smoking (i.e., greater willingness/acceptance of experiences versus efforts to avoid/control experiences). Specifically, smoking abstinence status was examined in terms of its effect on experiential avoidance for both thoughts and feelings that typically cue smoking and physical bodily sensations that typically cue smoking, based on the factor-analytic

findings that indicate differential predictive validity of these aspects of experiential avoidance (Farris et al., 2015). Additionally, based on findings that smoking-specific experiential avoidance is differentially related to sex, nicotine dependence, and psychopathology (Farris et al., 2015), the hypothesized effects of smoking abstinence on reductions in experiential avoidance were expected to be evident after adjusting for participant sex, severity of pre-quit levels of nicotine dependence, and presence of emotional disorders (anxiety, PTSD, depressive disorders). Finally, to account for pre-quit levels of smoking-specific experiential avoidance, and treatment condition, these effects were also adjusted for in the current analytic approach.

## Methods

### Participants

Participants in the current study were recruited from a larger smoking cessation and panic disorder prevention trial (clinicaltrials.gov #NCT01753141). Individuals participating in the parent trial were included based on being between the ages of 18 – 65 years, reporting smoking at least 8 cigarettes per day for at least one year, and motivation to quit of 5 or higher on a 10-point scale (higher ratings indicating higher motivation). Exclusion criteria included: current use of smoking cessation products or treatment, regular use of other tobacco products, unstable psychotropic medication use (participants had to be stable 3+ months), history of panic disorder (per the DSM-IV-TR), endorsement of past-month suicidality, a history of psychotic-spectrum disorders, current pregnancy or nursing, and inability to provide informed consent. The current study included data from a sub-set of the eligible (and enrolled) participants who were sampled based on (a) having available data for the measure of smoking-specific experiential avoidance at baseline (n = 259) and (b) having smoking outcome data available for at least two of three post-quit follow-up appointments (Week 1, Week 2, and/or Month 1; n = 160).

### Measures

The *Avoidance and Inflexibility Scale* (AIS; Gifford et al., 2004) is a 13-item self-report measure of smoking-specific experiential avoidance. Respondents are first asked to rate how they respond to difficult thoughts, feelings (stress, fatigue, etc.), and bodily sensations (craving, withdrawal symptoms) that encourage smoking (e.g., “How likely is it these [thoughts/feelings/sensations] would lead you to smoke?”, “How much are you struggling to control these [thoughts/feelings/sensations]?”). Responses are rated on a five-point Likert-scale ranging from “not at all” to “very much/very likely.” Items are totaled, with higher scores reflecting less willingness, or more avoidance of (efforts to control) internal experiences that typically cue smoking (possible range 13–65). Exploratory factor analytic findings suggest the AIS comprises of two factors, reflecting experience avoidance related to smoking-relevant thoughts and feelings (possible range possible 9–45), as well as uncomfortable internal bodily sensations (possible range 4–20; Farris et al., 2015). The psychometric properties of the AIS measure among treatment-seeking smokers have been documented, and support adequate internal consistency, test-retest reliability, convergent and discriminant validity, and predictive validity (Farris et al., 2015). Data indicate that pre-quit AIS sub-factor scores are differentially associated with quit-day processes including

levels of negative affect and depressive symptoms (uniquely associated with AIS-Thought/Feelings) versus craving and withdrawal symptoms (uniquely associated with AIS-Internal Sensations; Farris et al., 2015). Based on the differential predictive validity of the AIS sub-factors, the total and subscales scores were modeled separately in the current study. The AIS was administered at baseline and Month 1 post-quit attempt.

A *demographics questionnaire* was used to gather information about participant characteristics. The *Smoking History Questionnaire* (SHQ; Brown, Kahler, Zvolensky, Lejuez, & Ramsey, 2001), a self-report assessment of smoking history (e.g., total years smoking regularly), pattern (e.g., number of cigarettes consumed per day), and quit history (e.g., number of quit attempts in lifetime), was used for descriptive purposes. The *Structured Clinical Interview-Non-Patient Version for DSM-IV Disorders* (SCID-I/NP; First et al., 2007) is a clinician-administered diagnostic assessment of DSM-IV defined psychological disorders, which was used to assess the presence of lifetime psychopathology. Interviews were conducted by trained research assistants or doctoral-level students/staff. All assessments were audio-recorded in order to ensure the reliability and accuracy of diagnoses (no disagreements in the diagnoses were noted). For the current study, a variable was coded to index the presence of past-year (12 months) emotional disorders (anxiety, PTSD, or depressive psychopathology; coded = 1) versus no past-year emotional disorder (coded = 0). This variable was entered as a covariate in all analyses. The *Fagerström Test for Nicotine Dependence* (FTND; Heatherton, Kozlowski, Frecker, & Fagerström, 1991) is a self-report form that assess gradations in nicotine dependence, with higher scores indicating greater physiological dependence on nicotine (possible range 0–10). The FTND measure has exhibited acceptable psychometric properties and is associated with key smoking indices (Heatherton, Kozlowski, Frecker, & Fagerström, 1991; Pomerleau, Carton, Lutzke, Flessland, & Pomerleau, 1994). In the current study, the FTND was used for descriptive purposes and as a covariate in all analyses.

*Abstinence status* was determined based on a self-reported continuous abstinence for the 7 days prior to the Week 1 and Week 2 assessment, and 14-days prior to the Month 1 assessment. If all three data points were available, a case was classified as having a sustained abstinence status if there was consistency across all three time points or if a case had consistency across at least one of the two earlier time points with the Month 1 assessment. Moreover, to balance accurate classification with missing data in verification of sustained abstinence status, it was determined that cases would be included in the analyses if data were available for at least two time points, and for which a consistent pattern (i.e., non-quitter or successful quitter) was present. That is, if case had data available at Week 1 and at Month 1, but the data conflicted regarding quit status categorization, this case was excluded from data analysis. However, if a case had data available at Week 1 and at Month 1, and both time points were consistent regarding quit status, this case would be classified accordingly. The *Timeline Follow-Back* (TLFB; Robinson, Sobell, Sobell, & Leo, 2014) was used to collect self-report smoking data, aided by a clinician who prompted participants to retrospectively recall smoking behavior for the specified time (Robinson et al., 2014). In addition, cases of self-reported abstinence were biochemically verified via *expired carbon monoxide (CO) breath samples* (using the a CMD/CO Carbon Monoxide Monitor, Model

3110; Spirometrics, Inc.). Expired CO levels  $\leq 4$  ppm collected on the assessment day (Week 1, Week 2, Month 1) were used to confirm self-reported abstinence status (Perkins, Karelitz, & Jao, 2013).<sup>1</sup> A total of 160 participants had smoking status data available for at least two of three time points -- 11 cases (6.9%) had conflicting smoking status thus were excluded, which resulted in a final sample of 149 cases included in the final sample (30.6% abstinent, 62.5% non-abstinent).<sup>2</sup>

## Procedure

Participants in this study were recruited from two treatment sites located at the University of Vermont (Burlington, VT) and Florida State University (Tallahassee, FL) through advertisements in each community. Potential participants were scheduled for a baseline assessment in order to assess/verify eligibility. During baseline appointments, the SCID-I/NP was administered; participants provided a CO breath sample in order to verify smoking status and completed a battery of computerized self-report questionnaires. Those found to be appropriate for the study were randomly assigned to one of two smoking cessation treatment programs and scheduled to initiate treatment approximately 1–2 weeks post-baseline. The smoking cessation treatment consisted of either (1) a standard smoking cessation program (Fiore & Panel, 2008) or (2) an anxiety-focused smoking cessation treatment (Zvolensky, Yartz, Gregor, Gonzalez, & Bernstein, 2008). The treatment protocols are described in detail elsewhere (Farris, et al., 2015). Both treatment groups received nicotine replacement therapy via the transdermal nicotine patch, which was initiated at treatment Session 4 (quit-day) and participants could continue to utilize the patch up through six weeks post-quit day. Treatment consisted of four 60-min weekly sessions conducted by trained doctoral-level graduate students. Assessments (all in-person) occurred on quit-day (following treatment session 4), and at Week 1, 2, and Month 1 post-quit day. All participants provided informed consent prior to participation and the Institutional Review Boards at both treatment sites approved the study protocol.

## Data Analytic Plan

The general aim of the current study was to examine changes in AIS total and subscale scores over a one-month period as a function of abstinence from smoking. A path analysis was conducted to evaluate changes in smoking-specific experiential avoidance (measured by AIS total score) as a function of abstinence status. Then, a second path model was constructed to examine experiential avoidance specifically related to smoking-relevant thoughts/feelings (AIS-Thoughts/Feelings subscale) and internal bodily sensations (AIS-Internal Sensations subscale) as a function of abstinence status. For all analyses, baseline AIS scores, treatment condition, participant sex, presence of emotional disorders, and

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<sup>1</sup>In the event a participant self-reported continued abstinence on the TLFB, but expired CO values were  $> 4$ ppm, the participant was considered non-abstinent. If a participant self-reported continued abstinence per the TLFB but was missing CO data, the case was excluded due to unverified abstinence. Participants that self-reported non-continuous abstinence per the TLFB were counted as such, even if CO data were missing. In the event TLFB data were missing in the presence of available CO data, if expired CO values were  $> 4$ ppm, cases were considered as non-abstinent. However, if TLFB data were missing and expired CO  $\leq 4$  ppm, these cases were excluded due to ambiguity regarding smoking behavior beyond the 24-hour prior to the CO assessment.

<sup>2</sup>There were no differences in age, treatment condition, presence of emotional psychopathology, baseline nicotine dependence, or baseline levels of smoking-specific experiential avoidance between included ( $n = 160$ ) and excluded ( $n = 99$ ) cases. However, there were significantly more male smokers who were excluded (59.6%) relative to female smokers (40.4%), whereas significantly more female smokers were included (54.4%) relative to male smokers (45.6%);  $\chi^2(1) = 4.78, p = .029$ .

nicotine dependence (per FTND) were included as covariates (predictors of both abstinence status and Month 1 AIS scores). Path analyses were performed using AMOS 22.0.

Maximum Likelihood was employed as the estimation method and residual errors were estimated as well. When examining model fit, several tests were used. First, the overall model  $\chi^2$  (e.g., Bollen, 1989) was used. Generally, a non-significant chi-square test, leading to non-rejection of the model, would suggest a relatively good approximation of the data. Additionally, the model was evaluated using the Root Mean Square Error of Approximation (RMSEA; Browne & Cudeck, 1992) and the Comparative Fit Index (CFI; Bentler, 1990). These difference indices were selected to provide a comprehensive examination of the different models and were evaluated in concert as they provide a conservative and reliable evaluation of the tested models (Jaccard & Wan, 1996).

## Results

Participants ( $n = 149$ ; 54.4% female;  $M_{age} = 39.6$ ,  $SD = 13.51$ ) identified primarily as Caucasian (90.6%) and the majority completed at least part-college (81.2%). On average, the baseline (pre-quit) daily smoking rate was 18.2 ( $SD = 8.56$ ) cigarettes per day and moderate levels of nicotine dependence were reported per the FTND ( $M = 5.5$ ,  $SD = 2.13$ ). Expired CO levels averaged 21.4 ppm ( $SD = 11.91$ ) at baseline. Past year emotional disorders (anxiety, PTSD and/or depressive psychopathology) were reported among 34.2% of the sample.

### Path Analysis of Reduction in Experience Avoidance (AIS Total score)

The first model examined the effect of abstinence status on changes in smoking-specific experience avoidance measured as 1 Month post-quit day. Mean AIS-total scores at baseline and Month 1 were 46.3 ( $SD = 10.80$ ) and 33.2 ( $SD = 14.22$ ), respectively. There were no significant differences in baseline AIS scores for those who were abstinent ( $M = 47.9$ ,  $SD = 10.05$ ) relative to non-abstinent ( $M = 45.6$ ,  $SD = 11.12$ ). By abstinence status, Month 1 AIS-total scores for those who achieved sustained abstinence averaged 26.0 ( $SD = 12.87$ ) versus for those who did not averaged 38.1 ( $SD = 13.04$ ). Please see Table 1 for path analysis results including the standardized regression effects, standard errors, and significance values of Model 1. Figure 1(a) presents the standardized coefficients for the resulting model. Please note covariates are not displayed for the sake of clarity. This model evidenced adequate fit:

$\chi^2(7, n = 149) = 10.24, p = .175, \chi^2_{df} = 1.46$ ; RMSEA = .056, CI<sub>90%</sub> = .02–.12; CFI = .93.

Overall, the results indicate that participants who achieved sustained abstinence evidenced a significant reduction in AIS total scores at 1 Month post-quit day relative to those who did not achieved abstinence ( $\beta = -.45, p < .001$ ).<sup>3</sup>

<sup>3</sup>A revised model was constructed to include Month 1 levels of negative affect (per the Positive and Negative Affect Scale-Negative Affect Subscale), smoking urges (per the Questionnaire of Smoking Urges), and withdrawal symptom severity (per the Minnesota Nicotine Withdrawal Scale) as covariates of Month 1 AIS scores. These covariates were included to account for overall severity of internal distress symptoms related to smoking. After controlling for these variables, the effect of sustained abstinence on Month 1 AIS scores remained significant.

### Path Analysis of Reduction in Experience Avoidance (AIS Subscale scores)

The next model examined changes in specific aspects of smoking-specific experiential avoidance (thoughts/feelings and internal bodily sensations) as a function of abstinence status. Mean AIS-Thoughts/Feelings scores at baseline and Month 1 were 32.5 ( $SD = 7.49$ ) and 23.8 ( $SD = 9.98$ ), respectively. There were no significant differences in baseline AIS-Thought/Feeling scores for those who were abstinent ( $M = 33.4$ ,  $SD = 7.19$ ) relative to non-abstinent ( $M = 32.2$ ,  $SD = 7.63$ ). Stratified by abstinence status, Month 1 AIS-Thoughts/Feelings for those who achieved sustained abstinence averaged 18.8 ( $SD = 9.28$ ) versus for those who did not averaged 27.3 ( $SD = 9.00$ ). Mean AIS-Internal Sensations scores at baseline and Month 1 were 13.8 ( $SD = 4.12$ ) and 9.3 ( $SD = 4.82$ ), respectively. There were no significant differences in baseline AIS-Internal Sensations scores for those who were abstinent ( $M = 14.5$ ,  $SD = 4.15$ ) relative to non-abstinent ( $M = 13.4$ ,  $SD = 4.08$ ). Stratified by abstinence status, Month 1 AIS- Internal Sensations for those who achieved sustained abstinence averaged 7.2 ( $SD = 4.04$ ) versus for those who did not averaged 10.8 ( $SD = 4.78$ ). Please see Table 2 for path analysis results including the standardized regression effects, standard errors, and significance values of the model. Figure 1(b) presents the standardized coefficients for the resulting model. The model fit was good:  $\chi^2 (10, n = 149) = 11.90$ ,  $p = .292$ ,  $\frac{\chi^2}{df} = 1.19$ ; RMSEA = .036,  $CI_{90\%} = .00-.10$ ; CFI = .993. Participants who achieved sustained abstinence experienced a significant reduction in distressing smoking-related thoughts and feelings ( $\beta = -.44$ ,  $p < .001$ ) and internal bodily sensations ( $\beta = -.41$ ,  $p < .001$ ).<sup>4</sup>

### Discussion

The current investigation aimed to examine the impact of sustained smoking cessation (for one month) versus continued smoking after a cessation attempt, in terms of acceptance of and flexibility to thoughts, feelings and internal bodily sensations that typically cue smoking. Consistent with initial experimental findings (Nosen & Woody, 2014) and the proposed hypotheses, findings indicated that smokers who achieved smoking abstinence for one month (via continued self-reported abstinence, biochemically confirmed), relative to those smokers who did not quit, reported significantly lower levels of experiential avoidance of smoking-related internal distress at Month 1 post-quit attempt. These effects were seen for both experiential avoidance related to distressing thoughts and feelings that typically cue smoking and physical bodily sensations that could lead to smoking (e.g., withdrawal, physical craving). This latter finding is interesting based on prior data indicate that the AIS sub-factors have differential predictive validity (Farris et al., 2015). Thus, while these sub-factors appear to be differentially related to quit-day internal bodily experiences, the current findings suggest smoking abstinence (relative to non-abstinence) is similarly associated with willingness to experience (i.e., less efforts to control) both thoughts/feelings and bodily sensations that cue smoking. Additionally, these results were observed after accounting for several covarying factors, including participant sex, level of nicotine dependence, presence

<sup>4</sup>A revised model was constructed to include Month 1 levels of negative affect, smoking urges, and withdrawal symptom severity as covariates of Month 1 AIS-Thoughts/Feelings and AIS-Internal Sensations subscales. After controlling for these variables, the effect of sustained abstinence on Month 1 AIS subscale scores remained significant.

of emotional disorders, baseline levels of experiential avoidance related to smoking, and study treatment condition. Moreover, while not the central focus of this investigation, consistent with other work (Minami et al., 2014), baseline levels of smoking-specific experiential avoidance were not significantly associated with smoking abstinence status. Thus, pre-quit levels of experiential avoidance do not appear to serve as a risk factor for decreased likelihood of smoking abstinence, although does appear to importantly affect smoking outcomes when considered in the context of internal distress experienced while quitting (interactive effect; Minami et al., 2014).

It is important to underscore that the current study examined how smokers who achieved abstinence (relative to those who did not) *respond to* internal distress related to smoking, and not whether they differed in terms of the severity/intensity of internal distress, although the latter has been empirically documented (see meta-analysis by Taylor et al., 2014). As a clinical illustration, an individual who quit smoking may still experience intrusive smoking-related thoughts (e.g., smoking urges), although in response, may notice when thoughts are present and identify them as just thoughts and not something that needs to be acted on (e.g., increased willingness, less avoidance/control efforts). Similarly, in the context of experiencing certain feelings or sensations (e.g., stress, physiological arousal) that would typically prompt smoking re-initiation, this individual who quit smoking may be more willing to experience (allow) this discomfort to be present without responding (e.g., via use of mindfulness skills, acceptance). This framework is consistent with recent smoking cessation efforts that have prioritized addressing smokers response/reactivity to distress rather than targeting reduction of the severity of distress (e.g., Bricker et al., 2013; Brown et al., 2008; Gifford et al., 2004, 2011).

Although not a primary study aim, it is noteworthy that female smokers, relative to male smokers, had significantly higher levels of smoking-specific experiential avoidance at baseline (Farris et al., 2015), which persisted at Month 1. Patterning of sex differences across the smoking-specific experience avoidance sub-scales indicated that, at baseline, being a female smoker was specifically associated with greater avoidance/inflexibility in response to distressing thoughts and feelings related to smoking, but not internal bodily sensations. In contrast, being a female smoker was associated with greater avoidance/inflexibility in response to distressing bodily sensations related to smoking at Month 1, but not thoughts/feelings related to smoking. It is notable however that participant sex was not differentially related to sustained abstinence status, although due to the relatively small number of smokers who maintained abstinence, these findings warrant replication. Broadly, these data suggest female smokers may be particularly likely to avoid or be non-accepting of uncomfortable bodily sensations related to smoking (e.g., withdrawal, physical craving) after a cessation attempt, which could be a gender-specific risk marker for later (re)lapse, due to the unwillingness to experience such smoking-related discomfort. An additional point that warrants comment is the significant effect of nicotine dependence on baseline levels of experiential avoidance of physical bodily sensations, but not thoughts/feelings related to smoking. Higher levels of nicotine dependences therefore appear to be associated with greater avoidance of bodily sensations related to smoking (e.g., nicotine withdrawal symptoms).

A few limitations warrant comment. First, self-reported smoking status was used to determine abstinence, which was biochemically verified. While this approach was utilized to bolster self-report assessment, given expired CO data were confirmed at only three time points post-quit attempt, continued abstinence throughout the one-month post-quitting period is not fully known. For example, it is unclear if smokers who achieved expired CO levels  $\leq 4$  ppm at the three post-quit time points (e.g., week 1, 2, and month 1 post-quit day) also would have met this same criteria continuously throughout the four weeks (even despite self-reported abstinence). Second, given the presence of missing CO data (due to study attrition), a portion of the sample was excluded from analyses. Our selection procedures could have resulted in inadvertent bias (complete data are not representative of the total population that was sampled for the study, loss of power), although coding cases with missing data as non-abstinent has been criticized in the smoking cessation literature based on increased likelihood of both type I and type II errors (Hall et al., 2001).

Third, it is unknown if the observed effects of abstinence in terms of smoking-specific experiential avoidance would have been observed after shorter or longer periods of abstinence (Minami et al., 2014). Future work may consider exploring more nuanced models of abstinence-timing effects in terms of smoking-specific experiential avoidance. Fourth, smoking-specific experiential avoidance was examined at one time-point post-quit attempt. Thus, it is unknown whether the *course of experiential avoidance* (slope) over time would continue to decrease or potentially remain at a lower-stable level as a function of smoking abstinence. Fifth, given divergent findings in terms of how domain-specific versus domain-general experiential avoidance impact the processes of quitting smoking (Minami et al., 2014), it would be important to potentially also consider how the general tendency to experientially avoid is affected by quitting smoking. Last, while pre-cessation (baseline) levels of smoking-specific experiential avoidance were adjusted for in all analyses, it is possible that increases in willingness to experience internal distress related to smoking that occurred prior to the quit attempt could have impacted the cessation likelihood (Farris, Zvolensky, & Schmidt, 2015), and in turn accounted for later reductions in smoking-specific experiential avoidance observed following the cessation attempt.

Based on negative-reinforcement models of addiction and models characterizing the acquisition and maintenance of psychopathology (Hayes et al., 1996; McCarthy, Curtin, Piper, & Baker, 2010), experiential avoidance of internal distress related to smoking appears to be a cognitive-affective risk factor that may mutually maintain negative emotional states (both general and smoking-specific) and smoking behavior (dependence and quit processes). The current findings suggest that smoking abstinence is associated with lower levels of smoking-specific experiential avoidance. These findings compliment the literature that implicates experiential avoidance as a psychological risk factor for smoking dependence which may promote cessation if reduced (e.g., Bricker et al., 2013; Gifford et al., 2004), thus, collectively, smoking behavior and responding inflexibly to thoughts, feelings, and sensations that promote smoking may maintain bi-directional relations to one another. Based on evidence that suggests smoking cessation generally produces reductions in anxiety and depressive symptomology (Taylor et al., 2014), it is possible that reductions in experiential avoidance related to smoking (increased willingness to experience internal distress) may be

a mechanism associated with the attenuation of negative affective symptoms after cessation. By extension, promoting willingness to experience internal distress related to smoking (e.g., via cognitive defusion, mindfulness techniques) may also facilitate increases in individuals' willingness (acceptance) to experience distressing psychological experiences more broadly (e.g., symptoms of anxiety, depression). This work would be meaningfully bolstered by experimental tests to further isolate how smoking status affects how smokers respond to internal distress related to smoking. For example, experimental psychopathology methodologies could be employed to test smokers' willingness or tolerance to internal distress after periods of sustained abstinence versus continued smoking.

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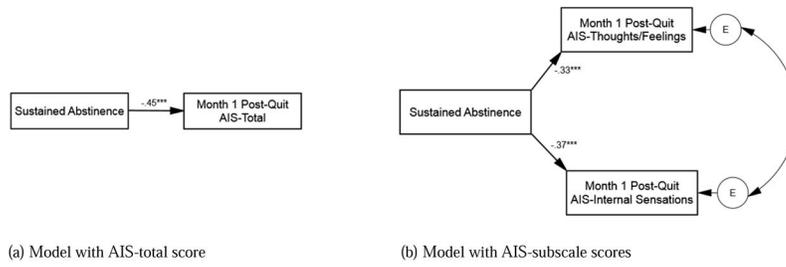
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### Highlights

- Smoking-specific experiential avoidance is the tendency to avoid smoking-related distress
- Smoking abstinence is associated with reductions in smoking-specific experiential avoidance
- Inflexibility/avoidance of smoking-related thoughts/feelings and somatic symptoms decreased



**Figure 1.**  
 Impact of Abstinence Status on Reductions in Smoking-Specific Experiential Avoidance at 1 Month Post-Quit  
 \*  $p < .05$ , \*\*  $p < .01$ , \*\*\* $p < .001$ ; AIS = Avoidance and Inflexibility Scale (AIS);  
 Covariates not visually displayed for clarity.

**Table 1**

Path Analysis of AIS Total Score as a Function of Abstinence

DV	Predictors	B	SE	p
Baseline AIS-Total	Gender	.19	1.70	.016
	Emotional Dx	.05	1.79	.549
	FTND	.22	.40	.006
Abstinence Status	Gender	.06	.08	.492
	Emotional Dx	-.19	.08	.022
	FTND	-.01	.02	.927
	TX Condition	-.01	.08	.876
	Baseline AIS-Total	.11	.01	.196
Month 1 AIS-Total	Gender	.18	2.37	.030
	Emotional Dx	-.03	2.56	.735
	FTND	.18	.57	.034
	TX Condition	.03	2.37	.759
	Baseline AIS-Total	.20	.13	.040
	Abstinence Status	-.45	2.42	<.001

Note: These models were run simultaneously using path analyses in AMOS. Gender (coded 0 = male, 1 = female); Emotional Disorder Dx (coded 0 = no 12-month anxiety/depressive disorder, 1 = current anxiety/depressive disorder); TX Condition (coded 0 = control treatment, 1 = anxiety and smoking reduction treatment); FTND (Fagerstrom Test of Nicotine Dependence); Abstinence Status (coded 0 = non-abstinent, 1 = abstinent).

**Table 2**

Path Analysis of AIS sub-scales (Thoughts/Feelings and Internal Sensations) as a Function of Abstinence

DV	Predictors	B	SE	p
Baseline AIS- Thoughts/Feelings	Gender	.22	1.19	.006
	Emotional DX	.03	1.25	.738
	FTND	.15	.28	.061
Baseline AIS- Internal Sensations	Gender	.10	.64	.204
	Emotional DX	.08	.68	.333
	FTND	.30	.15	< .001
Abstinence Status	Gender	.07	.08	.403
	Emotional DX	-.20	.08	.017
	FTND	-.03	.02	.731
	TX Condition	-.02	.08	.827
	Baseline AIS-Thoughts/Feelings	-.04	.01	.720
	Baseline AIS-Internal Sensations	.17	.01	.138
	Abstinence Status	-.44	1.69	< .001
Month 1 AIS- Thoughts/Feelings	Gender	.16	1.66	.066
	Emotional DX	-.01	1.79	.975
	FTND	.19	.38	.026
	TX Condition	.04	1.67	.670
	Baseline AIS-Thoughts/Feelings	.21	.09	.004
	Abstinence Status	-.44	1.69	< .001
Month 1 AIS- Internal Sensations	Gender	.23	.82	.008
	Emotional DX	-.07	.90	.450
	FTND	.18	.20	.037
	TX Condition	.01	.83	.935
	Baseline AIS-Internal Sensations	.14	.08	.046
	Abstinence Status	-.41	.85	< .001

Note: These models were run simultaneously using path analyses in AMOS. Gender (coded 0 = male, 1 = female); Emotional Disorder Dx (coded 0 = no 12-month anxiety/depressive disorder, 1 = current anxiety/depressive disorder); TX Condition (coded 0 = control treatment, 1 = anxiety and smoking reduction treatment); FTND (Fagerstrom Test of Nicotine Dependence); Abstinence Status (coded 0 = non-abstinent, 1 = abstinent)