Anxiety Sensitivity Facets in Relation to Tobacco Use, Abstinence-Related Problems, and Cognitions in Treatment-Seeking Smokers

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Abstract

Anxiety sensitivity (AS)—fear of anxiety-related experiences—has been implicated in smoking motivation and maintenance. In a cross-sectional design, we examined AS facets (physical, cognitive, and social concerns) in relation to tobacco use, abstinence-related problems, and cognitions in 473 treatment-seeking smokers. After controlling for sex, race, age, educational attainment, hypertension status, and neuroticism, linear regression models indicated that AS physical and cognitive concerns were associated with tobacco dependence severity ($\beta = .13–.14$, $p < .01$), particularly the severity of persistent smoking regardless of context or time of day ($\beta = .14–.17$, $p < .01$). All three AS facets were related to more severe problems during past quit attempts ($\beta = .23–.27$, $p < .001$). AS cognitive and social concerns were related to negative affect reduction smoking motives ($\beta = .14$, $p < .01$), but only the social concerns aspect of AS was related to pleasurable relaxation smoking motives and positive and negative reinforcement-related smoking outcome expectancies ($\beta = .14–.17$, $p < .01$). These data suggest that AS physical and cognitive concerns are associated with negative reinforcement-related smoking variables (e.g., abstinence-related problems), whereas the social concerns aspect of AS is associated with positive

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and negative reinforcement-related smoking variables. Together with past findings, current findings can usefully guide AS-oriented smoking cessation treatment development and refinement.

1. Introduction

Anxiety sensitivity (AS), the tendency to fear anxiety-related experiences,[1] is a relatively stable but malleable personality trait that is empirically and theoretically distinguishable from anxiety and other negative affective states.[2–6] Indeed, AS plays a key role in the development of many forms of emotional pathology.[5–7] Furthermore, reductions in AS accompany improvements in treatment outcome for anxiety psychopathology,[8] demonstrating that AS may be involved in the maintenance of emotional disorders.

Given that individuals with emotional disorders are more likely to smoke cigarettes,[9,10] exhibit tobacco dependence,[10,11] and display smoking relapse,[12–14] it is not surprising that AS has also been increasingly implicated in persistent cigarette smoking. AS has been associated with smoking status,[15,16] greater perceived barriers to smoking cessation,[17–20] and greater odds of smoking lapse[21,22] and relapse.[22,23] A prominent theory is that high-AS individuals may be more likely to smoke for the negative affect (NA) alleviating (i.e., negative reinforcing) effects of smoking.[24,25] High-AS smokers report experiencing more severe withdrawal symptoms[26–28] and stronger motives and expectations in regard to reducing NA by smoking,[17–20] and AS associations with smoking-related variables have persisted when controlling for anxiety, depression, NA, daily cigarette use, and tobacco dependence severity.[29–31] Additionally, two experimental studies have shown that high-AS individuals report greater NA reduction from smoking subsequent to laboratory-induced social stress.[32,33] Thus, it appears that AS is a risk factor for smoking largely due to its ability to heighten NA in response to stressors (e.g., tobacco withdrawal), which in turn increases negative reinforcement smoking motivation.

Although prior smoking-oriented work has largely focused on AS as a single dimension, factor analyses of the Anxiety Sensitivity Index (ASI)[34] and its most recent version, the ASI-3,[35] generally have revealed three lower-order factors: physical concerns (fear that anxiety-related physical symptoms may be harmful), cognitive concerns (fear that cognitive difficulties common to anxiety may indicate mental abnormality), and social concerns (fear that others may notice anxiety symptoms).[6,35,36] Yet, relatively few studies have examined smoking variables in relation to the three AS facets, and extant work shows that different facets of AS have different smoking-related correlates. AS physical and cognitive concerns have been consistently associated with greater negative reinforcement-related smoking motives and expectancies,[31,37–39] whereas only one study has associated AS cognitive concerns with positive reinforcement-related smoking motives.[37] Although most studies have reported no relationship between AS facets and cigarette frequency or dependence severity,[31,38,39] one study reported that all three AS facets were associated with daily cigarette consumption.[23] Then in a recent study of non-treatment-seeking smokers,[31] we

found that AS physical and cognitive concerns were associated with more severe (retrospectively reported) problems during tobacco abstinence; all three AS components were associated with stronger negative reinforcement-related smoking outcome expectancies; only AS social concerns were associated with stronger positive reinforcement-related smoking outcome expectancies; and none of the AS facets were associated with tobacco dependence severity or subtypes. However, no prior study has examined AS facets in relation to smoking outcome expectancies or tobacco dependence severity or dependence subtypes in treatment-seeking smokers. Also, our recent study[31] is the only AS facet study to investigate tobacco abstinence-related problems, and no other study has associated AS social concerns with positive or negative reinforcement-related smoking motives or expectancies. Further examining such understudied AS-smoking relations could benefit individualized smoking cessation treatments for high-AS smokers who have different fears regarding anxiety-related experiences.

As hypothesized previously,[31] individuals higher in AS physical concerns may be prone to smoke because they believe smoking will minimize aversive physical sensations associated with tobacco abstinence, such as hunger and changes in heart rate[40,41] (related to negative reinforcement). Individuals higher in AS cognitive concerns may be prone to smoke because they believe smoking will improve their mood and concentration difficulties associated with tobacco abstinence[40,41] (related to negative reinforcement). Lastly, individuals higher in AS social concerns may be prone to smoke because they believe it will enhance their social comfort[42,43] (related to positive reinforcement).

Hence, we examined whether our prior findings in non-treatment-seeking smokers would be replicated in a treatment-seeking sample of smokers and hypothesized that: (1) all three AS components will be associated with greater negative reinforcement-related smoking motives and expectancies; (2) AS physical and cognitive concerns will be associated with greater severity of abstinence-related problems; (3) only AS social concerns will be associated with greater positive reinforcement-related smoking motives and expectancies; and (4) none of the AS facets will be associated with daily cigarette consumption or tobacco dependence severity or subtypes.

2. Methods

2.1 Participants

Participants were 473 treatment-seeking smokers (47.4% female; age: $M = 37.3$, $SD = 13.4$) who took part in a larger, tobacco cessation study, of whom 85.0% were White, 9.5% were Black, and 5.5% were of another race (e.g., Asian or mixed) or did not specify their race. Participants generally were well-educated, with 73.2% indicating that they had completed at least some college. The current report is based on secondary analyses of baseline (pre-treatment) data for a subset of the larger sample. Eligible participants were at least 18 years old, reported smoking an average of 8+ cigs/day for at least one year, and reported motivation to quit smoking of at least 5 on a 10-point scale. Exclusion criteria included current use of smoking cessation products or treatment, current suicidality requiring immediate intervention, and history of psychotic-spectrum disorders. On average, participants reported initiating regular smoking at 17.5 ($SD = 4.0$) years of age and being a

regular smoker for 18.8 (*SD* = 13.3) years. Participants' mean score on the Fagerström Test for Nicotine Dependence was 5.2 (SD = 2.3), indicative of moderate tobacco dependence.[44]

2.2 Measures

2.2.1 Anxiety Sensitivity Index-3 (ASI-3)

The ASI-3[1,35] assesses fearfulness of anxiety-related experiences. The ASI-3 consists of a Total Scale (18 items) and three 6-item subscales: Physical Concerns (e.g., "It scares me when my heart beats rapidly"), Cognitive Concerns (e.g., "When my thoughts seem to speed up, I worry that I might be going crazy"), and Social Concerns (e.g., "I worry that other people will notice my anxiety").[35] Responses are rated on a 5-point Likert scale ranging from 0 (*very little*) to 4 (*very much*). The ASI-3 has been validated for use in smokers.[36]

2.2.2 Fagerström Test for Nicotine Dependence (FTND)

The FTND[45] is a 6-item self-report measure that assesses tobacco dependence severity on a scale of 0–10. The FTND has been factor analyzed into two tobacco dependence subtypes: Morning Smoking (i.e., smoking urgency and heaviness not long after waking; 2 items with a subscore range of 0–2) and Daytime Smoking (i.e., severity of persistent smoking regardless of context or time of day; 3 items with a subscore range of 0–6).[46]

2.2.3 Smoking History Questionnaire (SHQ)

The SHQ[47] was used to assess average number of cigarettes smoked per day during the past week (Average Number of Cigs/Day) and severity of problems experienced during past quit attempts (Abstinence-Related Problems; 17 items). The SHQ Abstinence-Related Problems scale items are rated on a 5-point Likert scale ranging from 1 (*not at all*) to 5 (*extremely*). Although the SHQ Abstinence-Related Problems scale is not specific to tobacco withdrawal symptoms and thus is not a measure of tobacco withdrawal per se, the large majority (11) of its items pertain to symptoms commonly associated with tobacco withdrawal,[47] such as increased eating, depression, difficulty concentrating, anxiety, irritability, and decreased heart rate.[40,41]

2.2.4 Reasons for Smoking Scale (RFS)

Two subscales from the RFS[48] were used to assess smoking motives, including smoking for Pleasurable Relaxation (2 items; e.g., "I find cigarettes pleasurable") and Negative Affect Reduction (5 items; "I light up a cigarette when I feel angry about something"). Items are rated on a 5-point Likert scale ranging from 1 (*never*) to 5 (*always*).

2.2.5 Smoking Consequences Questionnaire (SCQ)

The SCQ[49] assesses smoking outcome expectancies, including the extent to which an individual expects smoking will provide Positive Reinforcement (i.e., sensory satisfaction; 12 items) and Negative Reinforcement (i.e., negative affect reduction; 15 items). Items are rated on a 7-point Likert scale ranging from 1 (*not true of me at all*) to 7 (*very true of me*).

2.2.6 Demographics Questionnaire

This author-constructed questionnaire asked about sex, race, age, and educational attainment, which were used for descriptive purposes and as covariates.

2.2.7 Medical History Form—This author-constructed questionnaire was used to assess history of medical problems, including hypertension status (covariate).

2.2.8 Big Five Inventory (BFI) Neuroticism Scale—The BFI Neuroticism Scale[50] is an 8-item self-report measure that assesses the trait tendency to experience negative affective states (covariate). Cronbach's α for the BFI Neuroticism Scale was .84 in the current study.

2.3 Procedure

Adult daily smokers were recruited from the community with flyers, newspaper ads, and radio announcements in order to participate in a dual-site randomized controlled clinical trial examining the efficacy of a standard smoking cessation treatment versus an integrated treatment for smoking and anxiety. The current study utilized data from the baseline (pre-treatment) session. After providing informed consent, participants were administered the Structured Clinical Interview for *DSM-IV-TR* Axis I Disorders Non-Patient Edition (SCID-I/NP)[51] by trained research assistants or doctoral-level staff. Notably, the correlation between AS and being diagnosed with any anxiety disorder in the current sample was significant (r_{pb} = .35, p < .0001), with this correlation falling within the range of mean correlations between AS and individual anxiety disorders reported in a prior meta-analysis (.32–.52).[6] Participants then completed a computerized battery of self-report measures. The study protocol was approved by the Institutional Review Board at each study site. Participants who completed all study measures were included in current analyses.

2.4 Data Analysis

Alpha (two-tailed) was set at .01 instead of .05 for all analyses in order to correct for multiple testing without being overly conservative and unduly inflating the Type II error rate (such as with a Bonferroni correction) given that several variables are likely to be highly correlated with each other.[52–54] Prior to analyses, we chose six covariates as factors that might impact relations between predictor and criterion variables: sex (0 = Male; 1 = Female),[55] race (0 = Non-White; 1 = White),[31] age,[42] educational attainment level (0 = No College; 1 = Attended College),[56] hypertension status (0 = No Diagnosis; 1 = Hypertension Diagnosis),[57,58] and neuroticism (or negative affectivity).[38] For preliminary analyses, we obtained descriptive statistics and Cronbach's alphas for AS and smoking measures, and we then examined correlations between sex and AS/smoking variables. For primary analyses, we ran regression models in which one AS variable served as the predictor of each smoking variable controlling for covariates. Regression results are reported as standardized regression coefficients (βs) or odds ratio (ORs).

3. Results

3.1 Preliminary Analyses

Descriptive statistics and Cronbach's alphas for AS and smoking measures are shown in Table 1. Female participants reported lower SHQ Average Number of Cigs/Day (r_{pb} = −.12, p = .007) but greater SHQ Abstinence-Related Problems (r_{pb} = .31, p < .001), RFS Negative

Affect Reduction (r_{pb} = .26, p < .001), and SCQ Negative Reinforcement scores (r = .19, p < .001).

3.2 Primary Analyses

Individual regression models between AS and smoking measures are shown in Table 2. After controlling for sex, race, age, educational attainment, hypertension status, and neuroticism, linear regression models indicated that ASI-3 Total Scale, Physical Concerns, and Cognitive Concerns were significantly associated with higher FTND total scores and Daytime Smoking scores. ASI-3 Total Scale and its three subscales were significantly associated with greater SHQ Abstinence-Related Problems scores. ASI-3 Total Scale, Cognitive Concerns, and Social Concerns were significantly associated with greater RFS Negative Affect Reduction scores. Only the ASI-3 Social Concerns subscale was significantly associated with greater SCQ Positive Reinforcement scores. ASI-3 Total Scale and Social Concerns were significantly associated with greater SCQ Negative Reinforcement scores. Neither the ASI-3 Total Scale nor its three subscales were associated with SHQ Average Number of Cigs/Day or with FTND Daytime Smoking or RFS Pleasurable Relaxation scores.

3.3 Supplemental Analyses

Because ASI-3 Total Scale, Physical Concerns, and Cognitive Concerns were related to FTND Daytime Smoking, we next examined associations between those AS measures and FTND Daytime Smoking items in order to better understand AS associations with tobacco dependence severity (excluding FTND Item 4, which asks about daily cigarette consumption). After controlling for sex, race, age, educational attainment, hypertension status, and neuroticism, binomial logistic regression models indicated that ASI Total Scale, Physical Concerns, and Cognitive Concerns were associated with FTND Item 2, such that greater AS was related to higher odds of endorsing difficulty refraining from smoking in places where it is forbidden (Total Scale: OR = 1.04, p = .0001; Physical Concerns: OR = 1.09, p = .0004; Cognitive Concerns: OR = 1.10, p = .0007). Binomial logistic regression models indicated that neither the ASI-3 Total Scale nor its three subscales were associated with FTND Item 6 (choosing to smoke when so ill that bed rest is required for most of the day; p > .15).

4. Discussion

Partially consistent with our first hypothesis, AS social concerns were associated with greater negative reinforcement-related smoking motives and expectancies, and AS cognitive concerns were associated with NA reduction smoking motives. Though AS cognitive concerns have been consistently associated with greater negative reinforcement-related smoking motives and expectancies in previous studies,[31,37–39] most prior studies have not found a relation between AS social concerns and negative reinforcement-related smoking motives and expectancies.[37–39] However, we did find an association between AS social concerns and greater NA reduction smoking outcome expectancies in our recent prior study of non-treatment-seeking smokers.[31] Notably, our prior study and the current study employed sample sizes that were much larger than previous studies examining AS facets in

relation to smoking motives and expectancies (current N = 473 and prior N = 314 vs. previous Ns = 90–151). The current lack of associations between AS physical concerns and negative reinforcement-related smoking motives and expectancies is unexpected because this conflicts with prior studies.[31,37–39] However, this is the first study to examine AS facets in relation to smoking expectancies in treatment-seeking smokers, and the only prior study to examine AS facets in relation to smoking motives in treatment-seeking smokers[37] did not examine the RFS Pleasurable Relaxation and Negative Affect Reduction subscales individually as in the current study.

Mostly in accord with our second hypothesis, all three AS facets were related to more severe problems during past quit attempts. Although the only prior study to relate AS facets to problems during tobacco abstinence found that only AS physical and cognitive concerns were associated with more severe problems during past quit attempts, that study did report a trend-level association between AS social concerns and abstinence-related problems.[31] Perhaps increases in NA that accompany tobacco abstinence have a negative impact on socializing and consequently are amplified in smokers high in AS social concerns. Thus, AS and its facets have been especially tied to NA reduction smoking motives and expectancies as well as problems commonly associated with tobacco withdrawal (of which NA is a core component[40,41,59]), consistent with the notion that high-AS individuals are primarily motivated to smoke for the NA alleviating effects of smoking.

Partially concordant with our third hypothesis, only AS social concerns were associated with greater positive reinforcement-related smoking outcome expectancies. Notably though, there was a trend-level association between ASI Social Concerns and greater RFS Pleasurable Relaxation motives (p = .025). It is also noteworthy that the RFS Pleasurable Relaxation scale consists of two items and thus is quite limited in its coverage of positive reinforcement, which may attenuate the AS-smoking motive relationship. Hence, future research examining associations between AS facets and positive reinforcement-related smoking motives may benefit from utilizing smoking motive measures that are more comprehensive (e.g., WISDM-68[60]). Regardless, the current association between AS social concerns and positive reinforcement-related smoking outcome expectancies is consistent with our recent study of non-treatment-seeking smokers.[31] Although another prior study did not find an association between AS social concerns and positive reinforcement-related smoking outcome expectancies,[38] that particular study used a sample size of 90 participants compared to hundreds of participants in our prior and current study. To summarize, AS social concerns has been associated with positive and negative reinforcement-related smoking outcome expectancies in two large samples of smokers. Given that AS social concerns is closely related to social anxiety[6,7], and social anxiety is characterized by both low positive affect (PA) and high NA,[61,62] smokers high in AS social concerns may be motivated to smoke to alleviate NA and enhance PA. Consistent with this possibility, one experimental study reported that AS was related to smoking-induced increases in PA during tobacco non-abstinence.[63]

As expected, none of the AS facets were related to daily cigarette consumption, which is in accord with most prior studies.[23,38,39]. Contrary to our fourth hypothesis, however, AS physical and cognitive concerns were related to more severe tobacco dependence,

particularly the severity of persistent smoking regardless of context or time of day (FTND Daytime Smoking). This finding contrasts with two previous studies that reported no significant relationship between AS components and tobacco dependence severity.[31,38] However, the current study is the first to examine AS facets in relation to tobacco dependence severity and subtypes in treatment-seeking smokers, and the only prior study to examine AS facets in relation to tobacco dependence subtypes did report a trend-level association between ASI Cognitive Concerns and higher FTND Daytime Smoking scores (p = .019).[31]

4.1 Limitations

The current study has some limitations. Because it is cross-sectional, it cannot examine changes over time or determine causality. Also, it only used self-report measures, which may be influenced by common-method bias or inaccurate reporting. Another limitation is the current sample is predominantly White; therefore, our findings may not generalize to non-White (e.g., African-American) smokers and should further be interpreted with caution until replicated in another sample of treatment-seeking smokers given that this was the first study to examine many of the current AS-smoking relations in a treatment-seeking sample. Lastly, the internal consistency coefficients of FTND measures were all low. Although this is consistent with prior FTND studies,[46] such low estimates of reliability may have contributed to discrepant findings across AS studies.

4.2 Conclusions

In summary, the current study suggests that AS physical and cognitive concerns are associated only with negative reinforcement-related smoking variables (e.g., abstinence-related problems and NA reduction smoking motives), whereas AS social concerns is associated with both negative and positive reinforcement-related smoking variables (e.g., expectations that smoking will provide sensory satisfaction and alleviate NA). In other words, current findings suggest that: (1) all three AS facets (i.e., physical, cognitive, and social concerns) are tied to negative reinforcement smoking, such as being more prone to smoke in response to experiencing greater aversive abstinence-related symptoms or to reduce NA; and (2) AS social concerns is the only AS facet tied to positive reinforcement smoking, such as being more prone to smoke in order to obtain sensory satisfaction or elevate PA (perhaps as a social lubricant or in response to not deriving adequate PA from social situations). If this pattern of associations between AS components and smoking variables continues to be replicated, then this may have important implications for treating smokers high in AS. Specifically, given the relationship between all three AS components and negative reinforcement-related smoking variables, it is likely that standard tobacco cessation treatment for high-AS smokers (e.g., interoceptive exposure with cognitive restructuring,[64] which focuses on habituating and cognitively inoculating individuals to panic/anxiety-related symptoms) would be effective in reducing AS and ultimately smoking behavior regardless of which AS components are elevated. However, individuals high in AS social concerns, who may also smoke to increase PA and relax in social situations, may additionally benefit from relaxation training[65] (a cognitive-behavioral therapy technique developed for individuals with social anxiety disorder) as well as alternative methods of

obtaining sensory satisfaction that are devoid of nicotine (e.g., nicotine-free chewing gum,[66,67] nicotine-free inhalator,[68] or nicotine-free e-cigarette[69]).

Acknowledgments

References

1. Reiss S, Peterson RA, Gursky DM, McNally RJ. Anxiety sensitivity, anxiety frequency and the prediction of fearfulness. Behav Res Ther. 1986; 24:1–8. [PubMed: 3947307]

2. McNally RJ. Anxiety sensitivity and panic disorder. Biol Psychiatry. 2002; 52:938–46. [PubMed: 12437935]

3. Grant DM, Beck JG, Davila J. Does anxiety sensitivity predict symptoms of panic, depression, and social anxiety? Behav Res Ther. 2007; 45:2247–55. [PubMed: 17418804]

4. Zavos HM, Rijsdijk FV, Eley TC. A longitudinal, genetically informative, study of associations between anxiety sensitivity, anxiety and depression. Behav Genet. 2012; 42:592–602. [PubMed: 22437876]

5. Schmidt NB, Zvolensky MJ, Maner JK. Anxiety sensitivity: prospective prediction of panic attacks and Axis I pathology. J Psychiatr Res. 2006; 40:691–9. [PubMed: 16956622]

6. Naragon-Gainey K. Meta-analysis of the relations of anxiety sensitivity to the depressive and anxiety disorders. Psychol Bull. 2010; 136:128–50. [PubMed: 20063929]

7. Olatunji BO, Wolitzky-Taylor KB. Anxiety sensitivity and the anxiety disorders: a meta-analytic review and synthesis. Psychol Bull. 2009; 135:974–99. [PubMed: 19883144]

8. Simon NM, Otto MW, Smits JA, Nicolaou DC, Reese HE, Pollack MH. Changes in anxiety sensitivity with pharmacotherapy for panic disorder. J Psychiatr Res. 2004; 38:491–5. [PubMed: 15380399]

9. Lawrence D, Mitrou F, Zubrick SR. Smoking and mental illness: results from population surveys in Australia and the United States. BMC Public Health. 2009; 9:285. [PubMed: 19664203]

10. Goodwin RD, Zvolensky MJ, Keyes KM, Hasin DS. Mental disorders and cigarette use among adults in the United States. Am J Addict. 2012; 21:416–23. [PubMed: 22882392]

11. Grant BF, Hasin DS, Chou SP, Stinson FS, Dawson DA. Nicotine dependence and psychiatric disorders in the United States: results from the national epidemiologic survey on alcohol and related conditions. Arch Gen Psychiatry. 2004; 61:1107–15. [PubMed: 15520358]

12. Piper ME, Smith SS, Schlam TR, et al. Psychiatric disorders in smokers seeking treatment for tobacco dependence: relations with tobacco dependence and cessation. J Consult Clin Psychol. 2010; 78:13–23. [PubMed: 20099946]

13. Piper ME, Cook JW, Schlam TR, Jorenby DE, Baker TB. Anxiety diagnoses in smokers seeking cessation treatment: relations with tobacco dependence, withdrawal, outcome and response to treatment. Addiction. 2011; 106:418–27. [PubMed: 20973856]

14. Weinberger AH, Desai RA, McKee SA. Nicotine withdrawal in U.S. smokers with current mood, anxiety, alcohol use, and substance use disorders. Drug Alcohol Depend. 2010; 108:7–12. [PubMed: 20006451]

15. McLeish AC, Zvolensky MJ, Yartz AR, Leyro TM. Anxiety sensitivity as a moderator of the association between smoking status and anxiety symptoms and bodily vigilance: replication and extension in a young adult sample. Addict Behav. 2008; 33:315–27. [PubMed: 17967508]

16. Zvolensky MJ, Forsyth JP, Fuse T, Feldner MT, Leen-Feldner EW. Smoking and non-clinical panic attacks: an initial empirical test of panic-relevant cognitive processes. Cogn Behav Ther. 2002; 31:170–82.

34. Patterson F, Jepson C, Loughead J, et al. Working memory deficits predict short-term smoking resumption following brief abstinence. Drug Alcohol Depend. 2010; 106:61–4. [PubMed: 19733449]

35. Taylor S, Zvolensky MJ, Cox BJ, et al. Robust dimensions of anxiety sensitivity: development and initial validation of the Anxiety Sensitivity Index-3. Psychol Assess. 2007; 19:176–88. [PubMed: 17563199]

36. Farris SG, DiBello AM, Allan NP, Hogan J, Schmidt NB, Zvolensky MJ. Evaluation of the Anxiety Sensitivity Index-3 Among Treatment-Seeking Smokers. Psychol Assess. 201510.1037/pas0000112

37. Battista SR, Stewart SH, Fulton HG, Steeves D, Darredeau C, Gavric D. A further investigation of the relations of anxiety sensitivity to smoking motives. Addict Behav. 2008; 33:1402–8. [PubMed: 18691826]

38. Zvolensky MJ, Feldner MT, Leen-Feldner E, Bonn-Miller MO, McLeish AC, Gregor K. Evaluating the role of anxiety sensitivity in smoking outcome expectancies among regular smokers. Cognit Ther Res. 2004; 28:473–86.

39. Zvolensky MJ, Bonn-Miller MO, Feldner MT, Leen-Feldner E, McLeish AC, Gregor K. Anxiety sensitivity: concurrent associations with negative affect smoking motives and abstinence self-confidence among young adult smokers. Addict Behav. 2006; 31:429–39. [PubMed: 15964151]

40. Hughes JR. Effects of abstinence from tobacco: valid symptoms and time course. Nicotine Tob Res. 2007; 9:315–27. [PubMed: 17365764]

41. Leventhal AM, Waters AJ, Moolchan ET, Heishman SJ, Pickworth WB. A quantitative analysis of subjective, cognitive, and physiological manifestations of the acute tobacco abstinence syndrome. Addict Behav. 2010; 35:1120–30. [PubMed: 20807673]

42. Otsuki M. Social connectedness and smoking behaviors among Asian American college students: An electronic diary study. Nicotine Tob Res. 2009; 11:418–26. [PubMed: 19346509]

43. Buckner JD, Vinci C. Smoking and social anxiety: the roles of gender and smoking motives. Addict Behav. 2013; 38:2388–91. [PubMed: 23639849]

44. Fagerstrom KO, Heatherton TF, Kozlowski LT. Nicotine addiction and its assessment. Ear Nose Throat J. 1990; 69:763–5. [PubMed: 2276350]

45. Heatherton TF, Kozlowski LT, Frecker RC, Fagerstrom KO. The Fagerstrom Test for Nicotine Dependence: a revision of the Fagerstrom Tolerance Questionnaire. Br J Addict. 1991; 86:1119–27. [PubMed: 1932883]

46. Richardson CG, Ratner PA. A confirmatory factor analysis of the Fagerstrom Test for Nicotine Dependence. Addict Behav. 2005; 30:697–709. [PubMed: 15833575]

47. Brown RA, Lejuez CW, Kahler CW, Strong DR. Distress tolerance and duration of past smoking cessation attempts. J Abnorm Psychol. 2002; 111:180–5. [PubMed: 11866171]

48. Ikard FF, Green DE, Horn D. A scale to differentiate between types of smoking as related to the management of affect. International Journal of the Addictions. 1969; 4:649–59.

49. Brandon TH, Baker TB. The Smoking Consequences Questionnaire: the subjective expected utility of smoking in college students. Psychol Assess. 1991; 3:484–91.

50. Benet-Martinez V, John OP. Los Cinco Grandes across cultures and ethnic groups: multitrait multimethod analyses of the Big Five in Spanish and English. J Pers Soc Psychol. 1998; 75:729–50. [PubMed: 9781409]

51. First, MB.; Spitzer, RL.; Gibbon, M.; Williams, JBW. Structured Clinical Interview for DSM-IV-TR Axis I Disorders, Research Version, Non-Patient Edition (SCID-I/NP). New York: Biometrics Research, New York State Psychiatric Institute; 2007.

52. Perneger TV. What's wrong with Bonferroni adjustments. BMJ. 1998; 316:1236–8. [PubMed: 9553006]

53. Conneely KN, Boehnke M. So many correlated tests, so little time! Rapid adjustment of P values for multiple correlated tests. Am J Hum Genet. 2007; 81:1158–68. [PubMed: 17966093]

54. Roussos P, Giakoumaki SG, Bitsios P. Cognitive and emotional processing associated with the Season of Birth and dopamine D4 receptor gene. Neuropsychologia. 2010; 48:3926–33. [PubMed: 20875435]

55. Dahne J, Hoffman EM, MacPherson L. The association between anxiety sensitivity and motivation to quit smoking among women and men in residential substance use treatment. Subst Use Misuse. 2015; 50:72–8. [PubMed: 25265420]

56. Reitzel LR, Langdon KJ, Nguyen NT, Zvolensky MJ. Financial strain and smoking cessation among men and women within a self-guided quit attempt. Addict Behav. 2015; 47:66–9. [PubMed: 25879712]

57. Norman SB, Lang AJ. The functional impact of anxiety sensitivity in the chronically physically ill. Depress Anxiety. 2005; 21:154–60. [PubMed: 16035054]

58. Shahab L, Mindell J, Poulter NR, West R. Hypertension and its identification among current, past and never smokers in an English population sample. Eur J Cardiovasc Prev Rehabil. 2010; 17:63–70. [PubMed: 19609210]

59. Hendricks PS, Ditre JW, Drobes DJ, Brandon TH. The early time course of smoking withdrawal effects. Psychopharmacology. 2006; 187:385–96. [PubMed: 16752139]

60. Piper ME, Piasecki TM, Federman EB, et al. A multiple motives approach to tobacco dependence: the Wisconsin Inventory of Smoking Dependence Motives (WISDM-68). J Consult Clin Psychol. 2004; 72:139–54. [PubMed: 15065950]

61. Brown TA, Chorpita BF, Barlow DH. Structural relationships among dimensions of the DSM-IV anxiety and mood disorders and dimensions of negative affect, positive affect, and autonomic arousal. J Abnorm Psychol. 1998; 107:179–92. [PubMed: 9604548]

62. Hughes AA, Heimberg RG, Coles ME, Gibb BE, Liebowitz MR, Schneier FR. Relations of the factors of the tripartite model of anxiety and depression to types of social anxiety. Behav Res Ther. 2006; 44:1629–41. [PubMed: 16457777]

63. Wong M, Krajisnik A, Truong L, et al. Anxiety sensitivity as a predictor of acute subjective effects of smoking. Nicotine Tob Res. 2013; 15:1084–90. [PubMed: 23144083]

64. Zvolensky MJ, Yartz AR, Gregor K, Gonzalez A, Bernstein A. Interoceptive exposure-based cessation intervention for smokers high in anxiety sensitivity: a case series. J Cogn Psychother. 2008; 22:346–65.

65. Hambrick JP, Weeks JW, Harb GC, Heimberg RG. Cognitive-behavioral therapy for social anxiety disorder: supporting evidence and future directions. CNS Spectr. 2003; 8:373–81. [PubMed: 12766693]

66. Cohen LM, Collins FL Jr, Vanderveen JW, Weaver CC. The effect of chewing gum flavor on the negative affect associated with tobacco abstinence among dependent cigarette smokers. Addict Behav. 2010; 35:955–60. [PubMed: 20598808]

67. Cortez-Garland M, Cohen LM, Vanderveen JW, Cook K. The effect of chewing gum on self-reported nicotine withdrawal: is it the flavor, the act of chewing, or both? Addict Behav. 2010; 35:224–8. [PubMed: 19914004]

68. Caponnetto P, Cibella F, Mancuso S, Campagna D, Arcidiacono G, Polosa R. Effect of a nicotine-free inhalator as part of a smoking-cessation programme. Eur Respir J. 2011; 38:1005–11. [PubMed: 21565921]

69. Dawkins L, Turner J, Hasna S, Soar K. The electronic-cigarette: effects on desire to smoke, withdrawal symptoms and cognition. Addict Behav. 2012; 37:970–3. [PubMed: 22503574]

HIGHLIGHTS

- We examined anxiety sensitivity (AS) facets in relation to smoking measures.

- AS physical and cognitive concerns were related to tobacco dependence severity.

- AS social concerns were related to positive and negative reinforcement variables.

- All three AS facets were related to the greater abstinence-related problems.

- Additional treatment methods may benefit smokers high in AS social concerns.

Table 1

Descriptive Statistics and Cronbach's Alphas for Anxiety Sensitivity and Smoking Measures

	M (*SD*)	Cronbach's α
ASI-3 Total Scale	15.0 (12.4)	.93
ASI-3 Physical Concerns	4.6 (4.7)	.88
ASI-3 Cognitive Concerns	3.2 (4.3)	.91
ASI-3 Social Concerns	7.2 (5.2)	.83
FTND	5.2 (2.3)	.58
Factor 1: Morning Smoking	1.1 (0.8)	.39
Factor 2: Daytime Smoking	2.1 (1.2)	.41
SHQ Average Number of Cigs/Day	16.7 (10.1)	
SHQ Abstinence-Related Problems	34.8 (11.4)	.90
RFS Pleasurable Relaxation	7.5 (1.6)	.83
RFS Negative Affect Reduction	20.7 (4.8)	.88
SCQ Positive Reinforcement	84.6 (23.0)	.89
SCQ Negative Reinforcement	67.6 (21.7)	.93

Note. *N* = 473; ASI-3 = Anxiety Sensitivity Index-3; FTND = Fagerström Test for Nicotine Dependence; SHQ = Smoking History Questionnaire; RFS = Reasons for Smoking Scale; SCQ = Smoking Consequences Questionnaire.

Table 2

Individual Regression Models between Anxiety Sensitivity and Smoking Measures Expressed as β (*SE*)

Measure	ASI-3: Total Scale	Physical Concerns	Cognitive Concerns	Social Concerns
Tobacco Dependence				
FTND	**.16 (.05)** *	**.13 (.05)** *	**.14 (.05)** *	.11 (.05)
Factor 1: Morning Smoking	.12 (.06)	.06 (.05)	.13 (.05)	.09 (.05)
Factor 2: Daytime Smoking	**.18 (.05)** *	**.17 (.05)** *	**.14 (.05)** *	.12 (.05)
Smoking History				
SHQ Average Number of Cigs/Day	.08 (.05)	.09 (.05)	.03 (.05)	.07 (.05)
SHQ Abstinence-Related Problems	**.31 (.05)** **	**.23 (.05)** **	**.27 (.05)** **	**.23 (.05)** **
Smoking Motives/Expectancies				
RFS Pleasurable Relaxation	.05 (.06)	−.02 (.05)	.02 (.06)	.12 (.05)
RFS Negative Affect Reduction	**.15 (.05)** *	.09 (.05)	**.14 (.05)** *	**.14 (.05)** *
SCQ Positive Reinforcement	.13 (.06)	.05 (.05)	.09 (.05)	**.16 (.05)** *
SCQ Negative Reinforcement	**.15 (.05)** *	.07 (.05)	.10 (.05)	**.17 (.05)** **

Note. $N = 473$; ASI-3 = Anxiety Sensitivity Index-3; FTND = Fagerström Test for Nicotine Dependence; SHQ = Smoking History Questionnaire; RFS = Reasons for Smoking Scale; SCQ = Smoking Consequences Questionnaire. Individual regression models involve one measure of anxiety sensitivity as the predictor of each smoking measure adjusted for sex, race, age, educational attainment, hypertension status, and neuroticism. Significant associations are displayed in bold print.

*
 $p < .01$,

**
 $p < .001$