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The interactive effect of anxiety sensitivity and negative smoking cessation cognitions on reductions in cigarette consumption during acute cessation

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Abstract

Introduction: Anxiety sensitivity (AS) as well as negative cognitions about one's ability to quit smoking represent cognitive-affective vulnerabilities implicated in smoking cessation success. However, the extent to which one's perceived sensitivity to anxiety and cessation-related cognitions uniquely and interactively affect acute abstinence outcomes has not been examined. The current study examined the interactive effects of AS and cessation cognitions on percent reductions in cigarettes smoked during the first 24-hours of a quit attempt.

Methods: Adult cessation-motivated smokers (n=64; M_{age} = 34.21, SD = 11.49) completed a planned quit attempt. AS and cessation cognitions were evaluated prior to quit day. Percent cigarette reduction was assessed by number of cigarettes smoked the day before and during the first 24 hours of the quit attempt.

Results: Significant interactive effects between AS and cessation cognitions (i.e., expectation of success in quitting, intolerance of withdrawal symptoms, and lack of cognitive coping) were observed. Consistent with hypotheses, individuals reporting higher AS and a greater perceived ability to tolerate withdrawal as well as a greater expectation of success reported larger reductions in cigarettes post quit compared to those who did not endorse these beliefs. Unexpectedly, individuals reporting lower AS who did not endorse the belief that they should be able to tolerate withdrawal discomfort, or a lack of cognitive coping, reported larger reductions compared to those who did endorse this belief.

Conclusion: AS may interact with specific cessation cognitions. Pre-cessation beliefs that individuals will be successful and be able to tolerate withdrawal symptoms may support cessation efforts.

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Keywords

Anxiety Sensitivity; Expectancies; Cigarette Smoking

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1. Introduction

Initial cessation success is implicated in favorable long-term outcomes, with abstinence on the first day (Leyro, Hendricks, & Hall, 2015) predicting prolonged abstinence. Factors that promote success within the first 24 hours of a quit attempt may serve to support sustained success. Trait vulnerability factors have consistently been found to predict poorer cessation outcomes, yet work examining how cessation cognitions, or a priori beliefs about cessation, alter these effects may help identify malleable treatment targets in the presence of vulnerability factors.

Anxiety sensitivity (AS), the sensitivity to affective and interoceptive anxiety symptoms, is a transdiagnostic vulnerability factor associated with poorer smoking outcomes (Leventhal & Zvolensky, 2015), including lapse (Assayag, Bernstein, Zvolensky, Steeves, & Stewart, 2012), fewer quit attempts and greater intensity of withdrawal (Farris, Zvolensky, & Schmidt, 2015; Johnson, Stewart, Rosenfield, Steeves, & Zvolensky, 2012). AS is hypothesized to predict cessation failure due to intolerance of withdrawal (Hughes et al., 2007; Leventhal & Zvolensky, 2015). However, there is limited work examining the effect of AS, and its interactive effects with potential protective factors, on acute cessation.

Holding certain adaptive cognitions about cessation may interact with AS to reduce the negative effect of this vulnerability on cessation by combating anticipated and experienced distress. Transtheoretical models of motivation suggest that desire to quit predicts variability in cessation outcomes (Spencer, Pagell, Hallion, & Adams, 2002). Measures of an individual's readiness to quit is associated with abstinence at end of treatment and six months post-quit (Pineiro et al., 2016). Expectations of success predict abstinence at six weeks (Smit et al., 2014) and twenty-seven weeks (Schnoll et al., 2011). The Thoughts About Abstinence measure (TAA; Hall, Havassay, & Wasserman, 1990) is one self-report measure that captures multiple cessation cognitions, including desire to quit, expectations of quitting success, and the perceived difficulty of quitting.

In addition to an individual's desire to quit and their beliefs about expected success and difficulty in quitting, their expectations about withdrawal symptoms may also impact acute cessation success. Relevant work has found that greater intensity of withdrawal symptoms is prospectively associated with relapse during a 24-hour quit attempt (al'Absi, Hatsukami, Davis, & Wittmers, 2004). Intolerance of withdrawal may be particularly relevant to elevated AS, as AS encompasses discomfort with physical and affective states that overlap with withdrawal symptoms. Finally, cognitive coping, assessed in the current study as an endorsement in the belief that one must tolerate withdrawal discomfort to successfully quit smoking (Sirota et al., 2010), may similarly predict improved cessation outcomes.

Therefore, variations in important cessation cognitions may interact with AS to support or impede cessation efforts. The current study examined these interactions during the first

twenty-four hours of a quit attempt. We hypothesized that individuals higher in AS reporting a greater desire to quit, higher expected success in quitting, less perceived difficulty of abstinence, greater ability to tolerate withdrawal symptoms, and endorsement of cognitive coping would exhibit smaller reductions in cigarettes smoked as compared to those holding less adaptive cessation cognitions.

2. Method

2.1 Participants

This study was a secondary analysis of data collected from participants who responded to community advertising within the greater San Francisco and New Jersey areas. The sample (n=64; 42% Female) included daily smokers aged 18–45 (M age = 34.21, SD = 11.49; Table 1) in order to increase representation of the modal smoker (Creamer et al., 2019). Participants identified as 57.8% Caucasian, 12.5% African-American, 7.8% Asian, and 9.4% other. 12.5% of the sample identified as Hispanic or Latino. Participants reported an average of 16.91 (SD=7.20) cigarettes smoked per day, desire to quit smoking within 6 months as measured by the Readiness to Quit Ladder, and a willingness to make at least a 24-hour quit attempt. The sample reported moderate levels of cigarette dependence (M_{FTCD} = 3.64 (SD=1.23)), 17.23 years (SD=11.69) of smoking regularly, and 3.74 (SD=2.74) previous quit attempts. Smoking status was biochemically verified via expired carbon monoxide analysis. Average baseline CO was 20.77ppm (SD=9.54). Exclusion criteria were self-reported current pregnancy contraindicated for completion of stressful experimental tasks, pain or endocrine disorder due to the impact on saliva hormone levels, serious mental illness, as well as current use of anti-psychotic medication or mood stabilizers, substance dependence other than nicotine, difficulty writing or reading English, and lack of ability to provide consent.

2.2 Measures

2.2.1 The Anxiety Sensitivity Index-3—The Anxiety Sensitivity Index-3 (ASI-3; Taylor et al., 2007) assessed degree of concern about anxiety-related symptoms, and the 18 items were summed for a total score. The ASI-3 is a robust measure with strong psychometric properties in clinical and non-clinical samples (Taylor et al., 2007); internal consistency in the present sample was $\alpha = 0.87$.

2.2.2 Thoughts About Abstinence Questionnaire—Thoughts About Abstinence Questionnaire (TAA; Hall et al., 1990) assessed single items for desire to quit, expected success in quitting, and expected difficulty in quitting on a 10-point Likert scale, with higher numbers indicating greater endorsement of these beliefs. TAA scores are associated with cessation treatment outcomes and positive abstinence expectancies (Hendricks, Wood, Baker, Delucchi, & Hall, 2011).

2.2.3 Intolerance for Smoking Abstinence Discomfort Questionnaire— Intolerance for Smoking Abstinence Discomfort Questionnaire (IDQ-S; Sirota et al., 2010) assessed perceived inability to tolerate discomfort associated with abstinence. Two scales were examined: intolerance of withdrawal symptoms (i.e., "Going through nicotine withdrawal is more stress than I can tolerate") and lack of cognitive coping (i.e., "I just have

to tolerate how I feel in order to quit cigarettes;" "The pain I experience when quitting smoking won't go away right away, but I just have to wait it through"), with higher scores indicating greater intolerance and lack of coping, that is, a perceived deficit in using cognitive coping to tolerate withdrawal. Higher IDQ-S scores are associated with higher smoking rate, dependence, and fewer and shorter cessation attempts (Sirota et al., 2010); internal consistency in the present sample was $\alpha = 0.92$ (withdrawal intolerance) and $\alpha = 0.74$ (cognitive coping).

2.2.4   The Timeline Followback—The Timeline Followback method (TLFB; Sobell & Sobell, 1995) documented past-30-days use of tobacco in order to measure average cigarettes smoked per day. However, the percent reduction in the number of cigarettes smoked within the last 24 hours was derived from the average number of cigarettes smoked in the prior 24-hrs for visits one and two.

2.2.5   Readiness to Quit Ladder—Readiness to Quit Ladder (Abrams et al., 2003) was used to assess motivation to quit by asking participants to provide a ranking of their readiness to quit smoking on a scale ranging from 1 (i.e., "I have decided not to quit smoking") to 10 (i.e., "I have quit smoking"). Each value on the scale had a corresponding description of readiness. Responses in the current sample ranged from 6 to 8 indicative of readiness to quit, and no participants reported abstinence at time of enrollment in the study. Ratings on the Readiness to Quit Ladder are associated with intention to quit, number of previous quit attempts, and engagement in cessation programs (Biener & Abrams, 1991).

2.3   Procedures

Eligible participants gave informed consent and completed the ASI, IDQ-S, TAA, TLFB, and CO analysis at visit 1. Participants returned to the lab 24 hours into their quit attempt to report the number of cigarettes smoked and provide another CO analysis. All participants were compensated for study participation regardless of quit success. Study procedures were approved by the Institutional Review Board of each university.

2.4   Data analysis

Descriptive statistics and bivariate correlations of all study variables were examined (Table 1). Five moderation analyses were conducted to examine the effect of the continuous predictor variable, AS, effect of the continuous moderator variables, or cessation cognitions, and the interactive effect on the criterion variable, percentage reduction in cigarettes from visit 1 to visit 2 using PROCESS for SPSS 25.0. Continuous predictor and moderator variables were centered. Conditional effects of AS at values of the moderators were examined.

3.   Results

3.1   Correlations

None of the predictor variables exhibited a significant correlation with percent reduction in cigarettes (Table 1). Recruitment site was significantly correlated with the percent reduction in cigarettes smoked, and therefore, site was included as the only covariate.

3.2 Interaction Analyses

3.2.1 AS and TAA—The analysis examining the interactive effects of AS and expectations for success on reductions controlling for site (R^2=0.23, F(4,41)=3.00, p=0.03) included 49 participants, as 15 participants from the first recruitment site did not complete the TAA. There was no significant effect of AS (b=−0.19, p=0.48) or expectation of success (b=1.09, p=0.38) on reductions. There was a significant interactive effect (b=0.20, SE=0.09, CI$_{95\%}$= 0.02, 0.37, p=0.03) on reductions. Examination of this effect suggests that, among individuals reporting higher AS, holding a greater expectation of success compared to a lower expectation of success predicted larger reductions in cigarettes smoked (Figure 1). Analyses examining the effects of perceived difficulty of abstinence (R^2=0.16, F(4,41)=2.00, p=0.11) and AS as well as the effects of desire to quit (R^2=0.11, F(4,41)=1.21, p=0.32) and AS were not significant.

3.2.2 AS and IDQ-S—The analysis using the full sample (n=64) examined the interactive effects of intolerance of withdrawal and AS on reductions while controlling for site (R^2=0.17, F(4,55)=2.74, p=0.04). There was no significant effect of AS (b=−0.03, p=0.90) or intolerance of withdrawal (b=−7.73, p=0.08). However, there was a significant interactive effect (b=−0.60, SE=0.28, CI$_{95\%}$= −1.18, −0.06, p=0.03). Among those reporting higher AS, endorsement of greater tolerance of withdrawal symptoms as opposed to less tolerance of withdrawal symptoms predicted larger reductions in cigarettes smoked (Figure 1).

The final analysis (n=64) examined the interactive effects of perceived lack of cognitive coping and AS while controlling for site (R^2=0.17, F(4, 55)=2.75, p=0.04). There was no significant effect of AS (b=−0.31, p=0.18) or lack of cognitive coping (b=2.65, p=0.43) on reductions. An interactive effect was observed (b=−0.44, SE=0.22, CI$_{95\%}$= −0.88, −0.01, p=0.05). Contrary to hypotheses, participants reporting lower AS and less of an endorsement in the belief that one needs to wait out withdrawal symptoms (i.e., a higher lack of cognitive coping) exhibited larger reductions in cigarettes as compared to those endorsing this belief (Figure 1).

4. Discussion

This study examined the effect of AS and cessation cognitions on cigarette reductions during the first 24-hours of a quit attempt in order to examine whether cognitions support cessation efforts for individuals endorsing AS. Significant interactions between AS and expectations of success, intolerance of withdrawal, and endorsement of a lack of cognitive coping on reductions in cigarettes were observed. Examination of the interactions suggest that among individuals reporting higher AS, endorsing greater expectation of success and tolerance of withdrawal are predictive of larger reductions in cigarettes smoked as compared to less endorsement. Unexpectedly, among participants reporting lower AS, larger reductions were observed for those who endorsed less utilization of cognitive coping for cessation as compared to a greater endorsement.

Prior work has found that negative abstinence-related expectancies (al'Absi et al., 2004) and elevated AS (Assayag et al., 2012) predict poorer cessation outcomes. The observed

interaction between AS and the expectations that one will be successful in quitting and can tolerate withdrawal extend these findings and suggest that smokers' cognitive and affective response styles exert an interactive effect on their ability to engage in cessation-related behaviors. These results lend support for the hypothesis that variations in smoking cessation cognitions differentially affect the association between AS and cigarette reductions during a 24-hour quit attempt. At higher levels of AS, which is typically predictive of poor cessation outcomes (Leventhal & Zvolensky, 2015), a greater expectation of success in quitting as well as a greater belief in an individual's ability to tolerate withdrawal predicted larger reductions in cigarettes smoked. This is in contrast to smaller reductions in cigarettes smoked for those holding lower expectations of success or the ability to tolerate withdrawal. Holding certain cessation cognitions may be particularly important for high-AS smokers attempting to quit. Adaptive cognitions regarding an individual's expected success and the tolerability of withdrawal may serve to attenuate the feared affective and physical consequences of cessation.

The observed interaction between AS and a lack of cognitive coping differs from previous research (Sirota et al., 2013). The current findings suggest that among participants reporting lower AS and less endorsement of believing in the need to tolerate, or wait out, the discomfort of withdrawal, reductions in cigarettes are larger as compared to those endorsing this belief at both high and low levels of AS. When interpreting this finding it may be important to consider the operationalization of cognitive coping as assessed in the IDQ-S in the current study, which emphasizes an expectation that individuals are required to push through withdrawal. This assessment may actually preclude use of specific cognitive coping strategies. It is possible that individuals who utilize certain cognitive coping skills, such as thought challenging or acceptance, may not endorse the perspective of simply pushing through withdrawal symptoms, and these individuals may employ different strategies not captured by the IDQ-S to enhance their success. Future work will have to examine the interactive effects between AS and endorsement of specific coping strategies to investigate whether similar reductions are observed.

A few limitations are noted. Although participants were motivated to quit within the next 6-months, they were not treatment seeking. The lack of a naturalistic cessation attempt may limit the generalizability and predictive utility of these findings. The current sample may also not be fully representative of all smokers, and our findings may not extend to older adults, for whom these processes may differ. The sample size of our investigation was adequately powered to determine a relatively large effect, whereas power analyses suggest a slightly larger sample to sufficiently power our observed effect. Thus, although our findings signal an effect, they should be used to inform a larger investigation.

Findings suggest that to best understand the role that transdiagnostic vulnerabilities play in early cessation success, it is important to concurrently consider smokers' a-priori cessation cognitions. Holding certain cessation cognitions that may increase self-efficacy in quitting, such as expectations of success and the ability to tolerate withdrawal, may attenuate the effects of AS on smoking outcomes during a cessation attempt. Future work should investigate whether treatments aimed at modifying beliefs about the outcome and process of quitting can reduce the likelihood of cessation failure among higher AS smokers.

Funding:

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Anxiety sensitivity (AS) and cognitions predict 24-hour cessation outcomes.

High AS and intolerance of withdrawal interact to predict smaller reductions.

High AS and lower success in quitting interact to predict smaller reductions.

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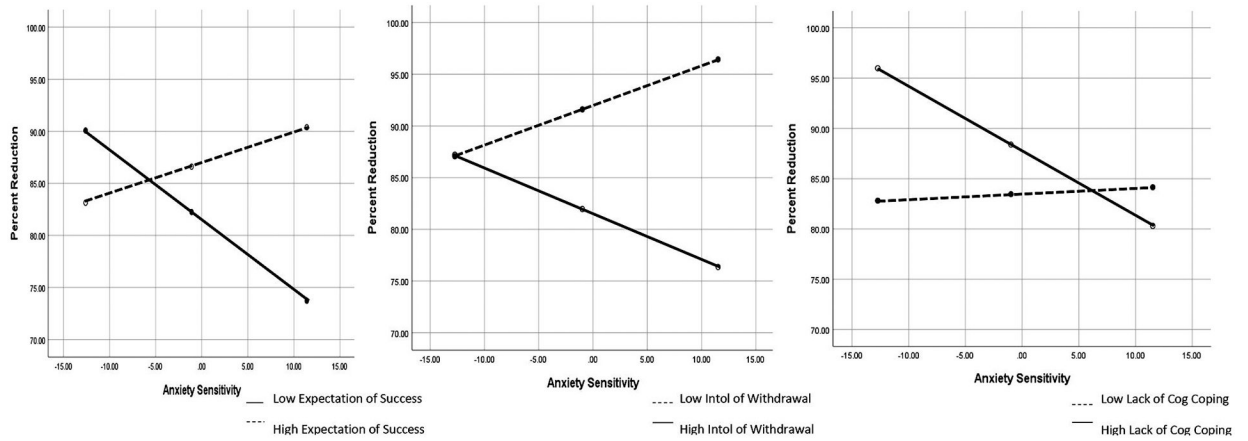
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Fig. 1.
Interactive effects of AS and cessation cognitions. Panel A depicts differences in cigarette reductions for AS and expectations of success. Panel B depicts differences in cigarette reductions for AS and intolerance of withdrawal symptoms. Panel C depicts differences in cigarette reductions for AS and lack of cognitive coping. The continuous moderator variables were dichotomized for visualization purposes.

Table 1.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	M(SD)
1. Age	1																34.21 (11.49)
2. Race	−0.01	1															37% White
3. Sex	−0.23	−0.16	1														42% Female
4. Site	−0.51**	−0.01	0.09	1													39% California
5. Baseline CO	0.16	0.02	0.05	−0.14	1												20.77 (9.54)
6. FTCD	0.30*	0.07	0.20	−0.08	0.23	1											3.64 (1.23)
7. RTQ	0.28*	−0.01	0.07	−0.06	0.04	0.30*	1										6.82 (0.70)
8. ASI	0.09	0.05	0.03	0.02	0.17	0.18	0.14	1									19.15 (11.59)
9. IDQ-S WD	−0.05	−0.01	0.15	−0.04	0.20	0.24	0.15	0.36**	1								3.47 (0.81)
10. IDQ-S CC	−0.02	0.04	0.01	−0.13	0.10	0.26	0.20	0.15	0.30*	1							3.84 (0.80)
11. TAA1	−0.08	−0.01	0.20	−0.01	0.07	0.30	0.35*	0.13	0.19	0.29*	1						7.02 (2.43)
12. TAA2	−0.24	−0.11	0.15	0.19	−0.35*	−0.02	0.05	−0.14	−0.01	0.19	0.19	1					5.57 (2.46)
13. TAA3	0.04	−0.23	−0.07	0.10	0.29*	0.01	0.22	0.13	0.18	0.06	0.27	−0.17	1				7.22 (2.40)
14. Percent Reduction in Cigarettes	0.08	−0.11	−0.16	−0.24	−0.28*	−0.06	0.01	−0.13	−0.10	0.17	−0.05	0.16	−0.09	1			85.23% (20.68)
15. Reductions in Cigarettes	0.27*	−0.10	−0.07	−0.37**	0.18	0.33*	0.07	0.08	0.21	0.18	0.06	0.01	−0.11	0.61**	1		13.26 (6.61)
16. Visit 2 CO	0.03	0.05	−0.04	0.12	0.44**	0.10	−0.15	0.06	−0.12	−0.20	−0.03	−0.21	−0.07	−0.56**	−0.18	1	9.73 (8.28)

Note.

*
$p<.05$,

**
$p<.01$, two-tailed;

M=Mean;

SD=Standard deviation;

Sex was coded 1 for males and 2 for females;

[1] CO= Carbon monoxide,

[2] FTCD= Cigarette Dependence,

[3] RTQ=Readiness to Quit;

[4.] ASI=Anxiety Sensitivity Index (higher scores indicate greater AS);

[5.] IDQ-S WD= Intolerance for Smoking Abstinence Discomfort Questionnaire, Withdrawal Symptoms;

[6.] IDQ-S CC= Intolerance for Smoking Abstinence Discomfort Questionnaire, Lack of Cognitive Coping;

[7.] TAA1= Thoughts About Abstinence, Desire to Quit;

[8.] TAA2= Thoughts About Abstinence, Expected Success in Quitting;

[9.] TAA3= Thoughts About Abstinence, Expected Difficulty in Quitting.