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## Anxiety-Related Constructs and Smoking Outcome Expectancies among Latinx Smokers

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### Abstract

Hispanic/Latinx (hereafter Latinx) smokers in the United States (US) experience unique smoking cessation-related challenges. Smoking outcome expectancies (i.e., positive and negative beliefs about the consequences of smoking behavior) have been linked to the maintenance of smoking and comorbidity with negative emotional states such as anxiety among Latinx smokers. However, past work has not characterized rates of probable anxiety disorder and elevated levels of anxiety sensitivity among English-speaking daily Latinx smokers from the US, or concurrently evaluated the explanatory relevance of anxiety symptoms and anxiety sensitivity for negative and positive smoking outcome expectancies. The present investigation sought to 1) determine the base rate of probable anxiety disorder and elevated anxiety sensitivity and 2) explore the unique roles of anxiety symptoms and anxiety sensitivity in relation to negative and positive smoking outcome expectancies. Participants included 338 English-speaking Latinx adult daily cigarette smokers from the US ( $M_{age} = 35.53$  years;  $SD = 8.65$ ; age range 18–61; 37.3% female). Findings revealed high rates of probable anxiety disorder (50.9%) and elevated anxiety sensitivity (73.4%) among

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#### Contributors Statement

All authors contributed in a significant way to this manuscript and all authors have read and approved the final manuscript.

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English-speaking Latinx smokers from the US. Anxiety sensitivity, but not anxiety symptoms or disorders, was significantly related to negative consequences, negative reinforcement, positive reinforcement, and appetite/weight control smoking outcome expectancies. Overall, anxiety experiences were common among Latinx smokers, and anxiety sensitivity was a relatively more consistent and robust predictor of negative and positive outcome expectancies relative to anxiety symptoms and probable anxiety disorder.

## Keywords

smoking outcome expectancies; Latinx/Hispanic; tobacco; anxiety; anxiety sensitivity

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Smoking is a major public health concern among the Latinx population (Castro, 2016; Trinidad, Pérez-Stable, White, Emery, & Messer, 2011), and is a leading cause of preventable death and disability among this group (Brehm & Celedón, 2008; Control & Prevention, 2011; Daviglius et al., 2012; Kaplan et al., 2014). Latinx persons smoke at lower rates than other racial and ethnic minority groups but experience notable challenges in quitting (Merzel et al., 2015). For instance, Latinx smokers often have more failed quit attempts when compared to non-Latinx Whites smokers (Trinidad et al., 2011), which may be attributable to higher degrees of adverse sociocultural factors (e.g., racial/ethnic discrimination), limited access to care/quality care, emotional distress, and less treatment-seeking behavior (Castro, 2016; Kendzor et al., 2014; Zvolensky et al., 2020). Accordingly, there is a need to increase scientific knowledge about factors involved in the maintenance and relapse of smoking behavior among this tobacco disparities population.

Smoking-specific cognitive processes represent one important element of smoking (Denison, Underland, Mosdøl, & Vist, 2017). Within this realm, smoking outcome expectancies are a specific type of cognitive process involved in smoking that has received empirical attention (Murphy, Martin, Tidey, Colby, & Rohsenow, 2018). Smoking outcome expectancies reflect four domains of negative and positive expectancies, including negative consequences (e.g. “By smoking I risk heart disease), negative reinforcement (e.g. “Cigarettes help me reduce tension”), positive reinforcement (e.g. “When I smoke the taste is pleasant”), and appetite–weight control (e.g. “Smoking helps me control my weight”; Garey, Manning, et al., 2018; Wetter et al., 1994). Emerging data focused expressly on Latinx smokers, has shown effects for smoking outcome expectancies for smoking behavior (Cepeda-Benito & Reig Ferrer, 2000; Shepherd et al., 2022). For example, one investigation found that positive smoking expectancies among Spanish-speaking Latinx smokers in the US were associated with greater cigarette dependence and withdrawal severity (Vidrine et al., 2009). In other research focused on Spanish-speaking smokers from Spain, negative and positive smoking expectancies were related to greater degrees of cigarette dependence (Cepeda-Benito & Reig Ferrer, 2000; Reig-Ferrer & Cepeda-Benito, 2007).

One of the interesting facets of work on smoking outcome expectancies is that these cognitive processes showcase distinct patterns in relation to emotional vulnerability processes among smokers. For instance, negative smoking outcome expectancies have been associated with greater degrees of negative emotionality (Johnson et al., 2008)

and reactivity to aversive interoceptive states (Gregor, Zvolensky, McLeish, Bernstein, & Morissette, 2008). These findings are important from a public health perspective given the pervasive comorbidity that is present among smokers in terms of negative mood states and psychopathology (Ziedonis et al., 2008) and the poorer prognostic outcomes for such smokers (Garey et al., 2020). Among Spanish-speaking Latinx smokers from the US, greater anxiety symptoms have been associated with negative health consequences, negative reinforcement, and appetite-weight control smoking outcome expectancies (Zvolensky, Bakhshaie, et al., 2019). Other research has found that anxiety sensitivity (e.g., belief that anxiety and anxiety-related sensations have harmful personal consequences; Leventhal & Zvolensky, 2015) mediates relations between the severity of anxiety symptoms and positive and negative smoking outcome expectancies among Spanish-speaking Latinx smokers from the US (Shepherd et al., 2022). These data are consistent with other Latinx smoking research highlighting sensitivity to, and tolerance of, aversive internal sensations is an important psychological process in the maintenance of smoking (Kwon et al.; Zvolensky, Shepherd, et al., 2019).

Despite the importance of past work on smoking, smoking expectancies, and negative emotional states, there are notable limitations to this body of work for Latinx smokers. First, past work has not estimated the prevalence of probable anxiety disorder or elevated anxiety sensitivity among an unselected group (i.e., not selected based on a psychiatric characteristic) of Latinx smokers. Such information would help contextualize the extent to which clinical anxiety and related constructs co-occur with smoking among a Latinx smoking sample from the US. Second, previous research on Latinx smoking samples and smoking outcome expectancies has focused exclusively on Spanish-speaking smokers (Zvolensky, Shepherd, et al., 2019). Although an important starting point, research suggests that most (>70%) of Latinx persons in the US have high levels of English proficiency (Krogstad & Noe-Bustamante, 2020). Moreover, extant work has demonstrated differences in health-related outcomes, including smoking behaviors between English-speaking and Spanish-speaking Latinx individuals in the US (DuBard & Gizlice, 2008). Therefore, to test the generalizability of past work on smoking outcome expectancies, it would be useful to sample Latinx English-speaking smokers in the US. Third, data suggest that the overall prevalence rate for any anxiety disorder is approximately 30% among Latinx populations (Alegría et al., 2008). Additional work is needed to validate such base rates among English-speaking Latinx smokers in the US. Finally, both anxiety symptoms and anxiety sensitivity have been implicated in smoking outcome expectancies among Latinx smokers (Shepherd et al., 2022; Zvolensky, Shepherd, et al., 2019). Although anxiety symptoms and anxiety sensitivity are related to one another, they are theoretically and empirically distinct (Jardín et al., 2018). Furthermore, these emotional and cognitive constructs represent distinct intrapersonal factors relevant to better understanding smoking and its comorbidity with psychopathology (Leventhal & Zvolensky, 2015). Thus, it remains unclear, among English-speaking Latinx smokers, if anxiety symptoms and anxiety sensitivity are each related to smoking outcome expectancies when controlling for each other (i.e., concurrently in the same model) and (2) if there is an interactive effect. Because both anxiety symptoms and anxiety sensitivity invoke distinct mechanisms for increased affective disturbance (Norton & Paulus, 2017), it is important to determine the unique explanatory validity of these

constructs relative to one another to refine knowledge about linkages to smoking behavior among Latinx smokers.

The present investigation sought to characterize probable anxiety disorder and elevated levels of anxiety sensitivity among English-speaking daily Latinx smokers from the US; and test the explanatory relevance of anxiety symptoms and anxiety sensitivity as an individual difference factors in terms of negative and positive smoking outcome expectancies. Based on prior prevalence estimates, it was expected that at least one-third of the sample would evince probable anxiety disorder and elevated anxiety sensitivity; rates that would be approximately twice that observed in the general population (Alegría et al., 2008; Viana, Trent, & Silva, in press). It also was hypothesized that anxiety symptoms and anxiety sensitivity would each be associated with greater negative and positive smoking outcome expectancies. For the outcome expectancy models, we adjusted for covariates linked to smoking and anxiety in previous Latinx research, including age (Khuder, Dayal, & Mutgi, 1999; Viscusi, 1991), sex (Garey, Peraza, et al., 2018), education (Stewart et al., 2013), nativity (Pérez-Stable et al., 2001), average number of cigarettes smoked per day (Gould, 2010), hazardous drinking (Harrison, Hinson, & McKee, 2009; McKee, Krishnan-Sarin, Shi, Mase, & O'Malley, 2006), and drug abuse problem severity (Lai, Lai, Page, & McCoy, 2000). In exploratory tests, we also tested the hypothesis that Latinx smokers with greater anxiety and anxiety sensitivity may evince higher negative and positive outcome expectancies compared to other groups (e.g., low anxiety and higher anxiety sensitivity).

## Method

### Participants

The current sample included 338 adult English-speaking Latinx daily cigarette smokers ( $M_{age} = 35.53$  years;  $SD = 8.65$ ; age range 18–61; 37.3% female). Participants identified as Latinx and approximately 87% of the sample was born in the US. In terms of race, 72.2% identified as Latinx White, followed by 10.9% other, 7.1% Latinx Black or African American, 4.1% Alaska Native or American Indian, 3.3% Multiracial/more than one race, 1.2% Native Hawaiian or Other Pacific Islander, and 0.9% Asian.

### Procedure

Participants were recruited nationally throughout the US for the current investigation using Qualtrics Panels, an online survey management system which has been implemented in prior research and has been successfully used to target specific populations to gather valid and reliable data (Heen, Lieberman, & Miethel, 2014; Walter, Seibert, Goering, & O'Boyle, 2018). Participants with a Qualtrics Panels account who identified as Latinx and endorsed current cigarette smoking were sent an advertisement. Respondents who expressed interest were then screened for eligibility and directed to an anonymous survey. Eligible participants were at least 18 years of age, identified as Hispanic or Latinx, and reported current daily cigarette smoking (>5 cigarettes per day). Participants provided voluntary informed consent prior to completing the online survey. Upon completion, participants could opt to receive the equivalent of \$10.75 in compensation for the study via cash-based incentives (i.e., gift cards), rewards miles, or rewards points. To ensure valid responses, a speeding check was

included (i.e., one-half the median survey completion time) as well as additional safeguards to prevent multiple attempts to complete the survey by the same respondent (i.e., recording IP addresses and the ‘Prevent Ballot Box Stuffing’ option). The sample size was determined based upon the estimate that at least 300 Latinx persons who smoke would be sufficient for testing the present research questions and permit a scientifically sound sample size for demonstrating sound psychometric properties of the scales. No formal power analysis was employed, as the data collected was not intended to test only one set of hypotheses, but rather to serve as a database that could be employed to explore numerous hypotheses, like approaches taken in epidemiologic work. The study was approved by the Institutional Review Board of the university where the study took place.

## Measures

**Demographics Questionnaire.**—A demographics questionnaire was completed by all participants that included sociodemographic information. In the current study, age, sex assigned at birth (0 = male, 1 = female), education (1 = Less than high school, 2 = Some high school, 3 = Completed high school [or equivalent], 4 = Some college, 5 = Associate’s Degree, 6 = Bachelor’s Degree, 7 = Master’s Degree, 8 = Doctoral Degree, 9 = More than Doctorate), and nativity (0 = US, 1 = other country) were used as covariates.

**Fagerström Test for Cigarette Dependence-Revised (FTCD-R).**—The FTCD-R (Fagerström, 2011; Korte, Capron, Zvolensky, & Schmidt, 2013) is a 6-item scale that assesses degrees of cigarette dependence. Scores range from 0–16, with higher scores reflecting higher levels of physiological dependence on cigarettes. Items 2, 5, and 6 were scored on a 4-point Likert-type scale ranging from 0 (*never*) to 3 (*always*). In the present study, the FTCD-R was used to describe the level of cigarette dependence in the current sample.

**Smoking History Questionnaire (SHQ).**—The SHQ (R. A. Brown, Lejuez, Kahler, & Strong, 2002) measures smoking-related demographic information (e.g., age of regular daily smoking and total number of years smoking daily, number of quit attempts). In the present work, the average number of cigarettes smoked per day was used as a covariate.

**Alcohol Use Disorders Identification (AUDIT).**—The AUDIT (Saunders, Aasland, Babor, De la Fuente, & Grant, 1993) is a 10 item self-report measure that was developed to assess potential problematic alcohol use. Items (e.g., “How often during the last year have you found that you were not able to stop drinking once you started?”) are rated on a 5-point Likert scale ranging from 0 (“*never*”) to 4 (“*daily or almost daily*”). Scores are summed to a total score as well as the three subscales (e.g., hazardous drinking). The hazardous drinking subscale has been utilized in the past as a screener for problem drinking (Bush, Kivlahan, McDonell, Fihn, & Bradley, 1998) and has been successfully implemented in past studies among Latinx smokers (Shepherd et al., 2022). The 3-item hazardous drinking subscale was used as a covariate in the current investigation and demonstrated good internal consistency ( $\alpha = .79$ ).

**Drug Abuse Screening Test (DAST-10).**—The DAST-10 (Yudko, Lozhkina, & Fouts, 2007) is a 10-item measure that assesses drug use problem severity. Individuals respond (0 = no, 1 = yes) to each item (e.g., “Are you always able to stop using drugs when you want to?”). Scores range from 0–10 with lower scores indicating no problems related to drug abuse and high scores indicating severe levels of drug abuse problems (0 = no problems reported, 1–2 = low levels, 3–5 = moderate levels, 6–8 = substantial levels, and 9–10 = severe levels). In the current investigation, the DAST-10 was used as a covariate and had good internal consistency ( $\alpha = .86$ ).

**Overall Anxiety Severity and Impairment Scale (OASIS).**—The OASIS (Norman, Hami Cissell, Means-Christensen, & Stein, 2006) is a 5-item measure that assesses symptoms of anxiety and level of impairment. Participants rate each item (e.g., “In the past week, how much did your anxiety interfere with your ability to do the things you needed to do at work, at school, or at home?”) on a scale ranging from 0–4 with anchors specific to each item (e.g., 0 = *none*; 4 = *extreme*). Prior work has demonstrated that the clinical cutoff score on the OASIS which indicates a probable anxiety disorder diagnosis is greater than or equal to 8 (Norman et al., 2011). The OASIS demonstrated excellent internal consistency ( $\alpha = .94$ ) in the current investigation and was used as a predictor variable.

**Short-Scale Anxiety Sensitivity Index (SSASI).**—The SSASI (Zvolensky, Garey, et al., 2018) is a 5-item measure that measures anxiety sensitivity and was created, in part, from the 18 item Anxiety Sensitivity Index-3 (Taylor et al., 2007). Example items include, “When I tremble in the presence of others, I fear what people might think of me” and “When I notice my heart skipping a beat, I worry that there is something seriously wrong with me.” Items are rated on a 5-point Likert-type scale ranging from 1 (*not at all*) to 5 (*extremely*). Based on the established cut off score for the Anxiety Sensitivity Index-3 (17), a cutoff score of 5 was used to identify individuals with elevated anxiety sensitivity levels on the SSASI (Zvolensky, Garey, et al., 2018). In the current investigation, the SSASI was used as a predictor variable and showed excellent internal consistency ( $\alpha = .91$ ).

**Short Form-Smoking Consequences Questionnaire (S-SCQ).**—The S-SCQ (Myers, MacPherson, McCarthy, & Brown, 2003) is a 21-item self-report measure of cigarette smoking expectancies. Participants are asked to rate the likelihood of each smoking-related consequence occurring on a 10-point Likert scale (0 = *completely unlikely* to 9 = *completely likely*). The S-SCQ consists of four subscales and has well demonstrated psychometric properties (Myers et al., 2003), including among Latinx smokers (Zvolensky, Bakhshaie, et al., 2019). The four subscales include negative consequences (e.g., “Smoking is taking years off my life.”), positive reinforcement (e.g., “When I smoke the taste is pleasant.”), negative reinforcement (e.g., “Cigarettes help me deal with anger.”), and appetite-weight control (e.g., “Cigarettes keep me from eating more than I should.”). In the present work, all four subscales demonstrated good to excellent internal consistency ( $\alpha$ 's = .87–.92) and were utilized as criterion variables.



## Analytic Strategy

First, descriptive statistics and bivariate correlations were examined (see Table 1). Second, base rates of probable anxiety disorder and elevated anxiety sensitivity were computed. Third, to test the main and interactive effects of anxiety symptoms and anxiety sensitivity on smoking outcome expectancies, four hierarchical linear regression analyses were conducted for negative consequences, positive reinforcement, negative reinforcement, and appetite/weight control smoking expectancies. The first step included the following covariates: age (Khuder et al., 1999; Viscusi, 1991), sex (Garey, Peraza, et al., 2018), education (Stewart et al., 2013), nativity (Pérez-Stable et al., 2001), average number of cigarettes smoked per day (Gould, 2010), hazardous drinking (Harrison et al., 2009; McKee et al., 2006), and drug abuse problem severity (Lai et al., 2000). Anxiety symptoms and anxiety sensitivity were then entered simultaneously on the second step followed by an interaction term on the third step. Continuous variables were mean centered, and model fit for each of the steps were evaluated with the F statistic and change in  $R^2$ . Change in  $R^2$  and squared semi-partial correlations ( $sr^2$ ) were used as indices of effect size (interpreted as .01 = small, .09 = moderate, and .25 = large; Cohen, 1988).

## Transparency and Openness

We report how we determined our sample size, all data exclusions (if any), all manipulations, and all measures in the study, and we follow JARS. All data, analysis code, and research materials will be made available upon request. Data were analyzed using SPSS version 28. This study's design and its analysis were not pre-registered.

## Results

### Descriptive Statistics and Bivariate Correlations

Descriptive statistics and bivariate correlations are presented in Table 1. The average number of years of daily smoking was 14.4 years ( $SD = 9.4$ ). Participants smoked an average of 10.8 ( $SD = 8.8$ ) cigarettes per day and reported an average of 4.9 ( $SD = 6.8$ ) prior failed quit attempts from the SHQ. Based on FTCD-R (Korte et al., 2013), participants average cigarette dependence rate was moderate at 6.7 ( $SD = 3.0$ ).

Anxiety symptoms were positively correlated with anxiety sensitivity, negative consequences, positive reinforcement, negative reinforcement, and appetite/weight control outcome expectancies. Anxiety sensitivity was positively correlated with negative consequences, positive reinforcement, negative reinforcement, and appetite/weight control outcome expectancies.

### Prevalence of Anxiety and Elevated Anxiety Sensitivity

Participants average anxiety symptom severity level was 7.5 ( $SD = 5.8$ ) and 50.9% of the sample met the clinical cutoff score ( $\geq 8$ ) indicating a probable anxiety disorder (Campbell-Sills et al., 2009; Norman et al., 2011). Additionally, 73.4% of the sample met for elevated anxiety sensitivity as evidenced by a cutoff score  $\geq 5$  on the SSASI (Zvolensky, Garey, et al., 2018).

## Smoking Outcome Expectancy Hierarchical Regression Analyses<sup>1</sup>

For negative consequences outcome expectancies, the first step with covariates was statistically significant ( $R^2 = .057$ ,  $F[7, 330] = 2.87$ ,  $p = .006$ ; see Table 2); drug abuse problems were a statistically significant predictor. In step two, the addition of anxiety symptoms and anxiety sensitivity accounted for an additional 3.2% of variance and statistically significant main effects emerged for anxiety sensitivity. The interaction between anxiety symptoms and anxiety sensitivity was not statistically significant.

For negative reinforcement, the first step with covariates was statistically significant ( $R^2 = .090$ ,  $F[7, 330] = 4.64$ ,  $p < .001$ ); education, nativity, and drug abuse problems were statistically significant predictors. In step two, the addition of anxiety symptoms and anxiety sensitivity accounted for an additional 5.1% of variance and statistically significant main effects emerged for anxiety sensitivity. There was not a statistically significant interaction.

For positive reinforcement, the first step with covariates was statistically significant ( $R^2 = .148$ ,  $F[7, 330] = 8.21$ ,  $p < .001$ ) and education, hazardous drinking, and drug abuse problems emerged as statistically significant predictors. In step two, the addition of anxiety symptoms and anxiety sensitivity accounted for an additional 4.2% of variance and statistically significant main effects emerged for anxiety sensitivity. There was not a statistically significant interaction.

For appetite/weight control, the first step with covariates was statistically significant ( $R^2 = .145$ ,  $F[7, 330] = 7.98$ ,  $p < .001$ ) and education and drug abuse problems emerged as statistically significant predictors. In step two, the addition of anxiety symptoms and anxiety sensitivity accounted for an additional 7.1% of variance and statistically significant main effects emerged for anxiety sensitivity. The inclusion of the interaction term in the third step was not statistically significant.

### Post Hoc Analyses

Post hoc analyses were conducted using probable anxiety disorder (versus not probable anxiety disorder) instead of anxiety symptoms for smoking outcome expectancies. Specifically, these tests were carried out to explicate whether probable anxiety disorder would influence the relative explanatory power of anxiety sensitivity in the models. These analyses were performed to further evaluate the severity of clinical anxiety (0 = no probable anxiety disorder and 1 = probable anxiety disorder) relative to anxiety sensitivity in terms of the criterion variables.

For negative consequences outcome expectancies, the addition of probable anxiety disorder and anxiety sensitivity accounted for an additional 2.9% of variance ( $F[9, 328] = 3.43$ ,  $p = .006$ ) and statistically significant main effects emerged for anxiety sensitivity ( $B = .31$ ,  $SE = .11$ ,  $p = .003$ ). For negative reinforcement, the addition of probable anxiety disorder and anxiety sensitivity accounted for an additional 4.7% of variance ( $F[9, 328] = 5.78$ ,  $p < .001$ )

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<sup>1</sup>Additional regression models were conducted which included the 10-item AUDIT total score as a covariate. The pattern of results and magnitude of effect sizes remained consistent with those reported in the original analyses.



and statistically significant main effects emerged for anxiety sensitivity ( $B = .66$ ,  $SE = .18$ ,  $p < .001$ ).

For positive reinforcement, the addition of probable anxiety disorder and anxiety sensitivity accounted for an additional 4.3% of variance ( $F[9, 328] = 8.59$ ,  $p < .001$ ) and statistically significant main effects emerged for anxiety sensitivity ( $B = .51$ ,  $SE = .13$ ,  $p < .001$ ). For appetite/weight control, the addition of probable anxiety disorder and anxiety sensitivity accounted for an additional 7.2% of variance ( $F[9, 328] = 10.06$ ,  $p < .001$ ) and statistically significant main effects emerged for anxiety sensitivity ( $B = .66$ ,  $SE = .13$ ,  $p < .001$ ). Across the post hoc analyses, there was no significant interaction between probable anxiety disorder and anxiety sensitivity.

## Discussion

Latinx smokers are a tobacco disparities group in the US (Nguyen-Grozavu et al., 2020). Despite the recognition that smoking frequently co-occurs with negative mood states and psychopathology (Zvolensky, Jardin, et al., 2018), little work has documented the prevalence of anxiety disorders among Latinx smokers. Further, there has not been an evaluation of the concurrent relative predictive power for anxiety symptoms and anxiety sensitivity for smoking outcome expectancies in one overarching model among English-speaking Latinx smokers from the US. Therefore, the present study documented the prevalence of probable anxiety disorder and elevated anxiety sensitivity and tested the extent to which anxiety symptoms and anxiety sensitivity explained unique variance in negative and positive outcome expectancies among Latinx smokers from the US.

In the current sample of Latinx smokers from the general population without inclusionary/exclusionary consideration to mental health, participants evinced significant levels of anxiety psychopathology. Specifically, almost 51% of the sample met criteria for probable anxiety disorder using a validated assessment (Norman et al., 2006). Inspection of the cognitive construct of anxiety sensitivity also revealed that approximately 73% of the sample had clinical elevations in this construct (Zvolensky, Garey, et al., 2018). These data are consistent with past work among Spanish-Speaking Latinx smokers (Shepherd et al., 2022) and English-speaking Latinx smokers in the US that showcase high levels of emotional vulnerability (Kwon et al.), and the prevalence of probable anxiety disorder observed in the current investigation is higher than that reported among non-smoking Latinx samples (Alegría et al., 2008). Because the current study was employing a within population test, differences between this sample and other groups of smokers from racial/ethnic groups for anxiety symptoms and anxiety sensitivity were not possible. Future work could test how emotional characteristics, such as anxiety-related factors, differ between age and sex-matched smokers in the US from different racial/ethnic backgrounds to better understand variability in the emotional comorbidity patterns.

Results for the outcome expectancy variables were partially consistent with prediction. Specifically, anxiety sensitivity, across all smoking outcome expectancy models, was a statistically significant predictor. However, unexpectedly, anxiety symptoms were not similarly a significant predictor in the context of anxiety sensitivity. The anxiety sensitivity

effects were small in effect size (range: 3.2% to 7.1% variance) but evident in the context of shared variance with anxiety symptoms and were incremental to the variance explained by a wide range of sociocultural (e.g., age, sex, education, and nativity) and substance use behavior (e.g., cigarettes smoked per day; hazardous drinking and drug abuse problem severity). These findings are therefore apt to be clinically significant (Abelson, 1985). Additionally, post hoc analyses indicated that when probable anxiety disorder was utilized as the anxiety phenotype predictor instead of the dimensional variable of anxiety symptom severity, the results remained consistent. Past research among Spanish speaking Latinx smokers has found anxiety sensitivity to be related to negative and positive smoking outcome expectancies (Shepherd et al., 2022; Zvolensky, Bakhshaie, et al., 2019). The present findings extend such work to an English-speaking Latinx sample, distinguish the anxiety sensitivity effects from anxiety phenotypes (anxiety symptoms or probable anxiety disorder), and empirically document incremental validity relations. Among Latinx smokers, anxiety sensitivity showcases a wide range of relations to smoking outcome expectancies, which is typically less evident among non-Latinx White smoking samples (Zvolensky et al., 2004).

There was no evidence for an interaction between anxiety symptoms and anxiety sensitivity for negative or positive smoking outcome expectancies. These exploratory findings suggest that there is no synergistic effect between these emotional and cognitive vulnerability factors for anxiety in regard outcome expectancies among Latinx smokers. Future research could benefit by trying to isolate theoretically relevant variables that may interplay with anxiety or anxiety sensitivity for smoking expectancies. For example, given evidence that smoking expectancies can vary as a function of subgroups of Latinx smokers (Hanson & Laffrey, 1999; Wainwright, Perrotte, Bibriescas, Baumann, & Garza, 2019), there may be utility in exploring if anxiety sensitivity is moderated by ethnic status in terms of smoking expectancies.

Most of the research on anxiety sensitivity and substance use behavior has been oriented from a negative reinforcement theoretical perspective (Richard A Brown, Kahler, Zvolensky, Lejuez, & Ramsey, 2001; Guillot, Pang, & Leventhal, 2014). That is, persons more likely to evaluate internal sensations as personally dangerous may be at higher likelihood for more intense emotional experiences, which in turn, leads to substance use to downregulate such perturbation (Zvolensky, Kauffman, Garey, Viana, & Matoska, 2022). The current results are in line with these observations, highlighting linkages to negative reinforcement and negative consequences expectancies. Similarly, the present findings, along with the limited previous research (Shepherd et al., 2022), document equally robust relations to positive reinforcement outcome expectancies and expectancies for appetite-weight control. That is, Latinx smokers higher in anxiety sensitivity demonstrate stronger beliefs that smoking yields pleasurable effects (e.g., smoking is positively reinforcing) and maintain the perception that smoking may influence appetite and facilitate weight manageability. Future research could benefit by testing distinct negative and positive reinforcement learning pathways between anxiety sensitivity and smoking outcome expectancies and perhaps other smoking processes (e.g., motivational basis for use).

Although not a primary study aim, a brief observation warrants comment. Specifically, the severity of drug use problems was a consistent predictor of negative and positive smoking outcome expectancies. Past work has shown Latinx smokers are at greater risk for the co-use of other substances (Kouyoumdjian, Guzmán, & Leon, 2015). The current data build from that research and are the first to highlight an interconnection between the co-use of substances among Latinx smokers and smoking outcome expectancies. Future research could seek to test the mechanisms that may underlie such relations, including such processes as emotion regulation (Weiss et al., 2022) and health literacy (Degan, Kelly, Robinson, Deane, & Smith, 2021).

There are clinical implications to the present work. There is a general recognition that smoking co-occurs with psychological distress and psychopathology (Zvolensky, Jardin, et al., 2018) and the results from the present research align with such observations. Yet, transdiagnostic models of psychopathology and addictive behavior posit basic psychological mechanisms underpin such patterns of comorbidity (Kim & Hodgins, 2018; Leventhal & Zvolensky, 2015). Findings in the present study are in line with this perspective, and therefore, assessment and intervention programming for anxiety-smoking comorbidity among Latinx smokers could usefully be focused on anxiety sensitivity, and presumably, other basic psychological mechanisms (e.g. anhedonia; Haslam et al., 2018; Zvolensky et al., 2021; emotion dysregulation; Zvolensky, Shepherd, et al., 2019) linked to smoking among this population. There have been integrated approaches for smoking cessation that specifically engage anxiety sensitivity in efforts to decrease interoceptive perturbation, increase smoking cessation success, and improve mental health (Smits et al., 2021; Zvolensky, Borgiaizian, Salazar, Farris, & Bakhshaei, 2014; Zvolensky, Garey, Kauffman, & Manning, 2019). Based on such data, there may be utility in employing such integrative programs for Latinx smokers with heightened anxiety sensitivity to facilitate changes in positive and negative outcome expectancies, thereby improving the opportunity to reduce or quit smoking and concurrently reduce the severity of anxiety symptoms.

The study has several limitations. First, the cross-sectional design does not permit testing of causal relations. There is a need to build from this research and employ laboratory methodologies that can experimentally manipulate smoking expectancies (Copeland & Brandon, 2000) and longitudinal tactics that explicate the interplay between anxiety, anxiety sensitivity, and smoking outcome expectancies such as Ecological Momentary Assessments (Garcia, Zhang, Holt, Hardeman, & Peterson, 2014). Indeed, such work would permit explication of the direction of the observed effects and interplay over time, offering insights into the mechanisms linking anxiety sensitivity-smoking outcome expectancies. Second, the sample included adult English-speaking Latinx daily smokers because they are the largest tobacco-using segment of this racial/ethnic group (Castro, 2016) and 72% of Latinx persons in the US have high levels of English proficiency (Krogstad & Noe-Bustamante, 2020). The generalizability of the present models could be further evaluated among adolescent and older adult Latinx smokers as well as non-daily Latinx smokers from the US. Third, we adjusted for sociocultural and co-occurring substance use behavior in our models. Still, there are many other possible sources of influence for smoking outcome expectancies. Future research could explore other social determinants of health (e.g., racial discrimination; Rahman et al., 2022) and coping behaviors (e.g., religious coping; McIntosh, Ironson, & Krause, 2021) that

have been identified as important factors in previous work on behavioral health problems among Latinx persons. Fourth, the current study utilized a unidimensional measure of anxiety sensitivity (SSASI) in which optimal cut-off scores for elevated anxiety sensitivity are not established. Future work may benefit from incorporating a multidimensional measure (e.g., Anxiety Sensitivity Index-3; Taylor et al., 2007) to examine sub-facets of anxiety sensitivity and smoking outcome expectancies. Indeed, past work has found some evidence of differential effects of anxiety sensitivity lower-order factors and substance use (Guillot, Leventhal, Raines, Zvolensky, & Schmidt, 2016; Guillot, Zvolensky, & Leventhal, 2015). Fifth, data were collected between February 2021 and July 2021 during the COVID-19 pandemic, as has been documented in the literature (Zvolensky et al., 2022). Thus, high rates of probable anxiety disorder may be a function of or exacerbated by COVID-19-related stress. Sixth, the current study utilized the most commonly used cut-off score for probable anxiety disorder (i.e., 8; Norman et al., 2011) which may not reflect the optimal cut-off score for all groups, including Latinx individuals (Sandora et al., 2021). Finally, we measured race and the majority (87%) of the sample was born in the US. Future research could consider documenting ethnicity and include a greater percentage of Latinx persons born outside the US. This type of work could help elucidate if there are differences in smoking outcome expectancies across race and ethnicity as well as nativity status.

Overall, the present investigation found high rates of probable anxiety disorder and anxiety sensitivity among English-speaking Latinx smokers from the US. Anxiety sensitivity was a relatively more consistent and robust predictor of negative and positive outcome expectancies relative to anxiety symptoms and probable anxiety disorder. Future research is needed to build from this work and explicate the interplay between smoking outcome expectancies, anxiety, and anxiety sensitivity over time among Latinx smokers.

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Data will be made available upon request.

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**Public significance statement:**

This study underscores the strong link between smoking, anxiety, and anxiety sensitivity, particularly among Latinx individuals. High levels of anxiety sensitivity correspond to smokers' outcome expectancies, which may inform their attitude about quitting smoking.

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Table 1.

Descriptive statistics and bivariate correlations (N = 338)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Age <sup>d</sup>	--												
2. Sex <sup>d</sup>	.05	--											
3. Education <sup>d</sup>	.06	-.26*	--										
4. Nativity <sup>d</sup>	.04	.04	.04	--									
5. Cigarettes per Day <sup>d</sup>	.10	-.02	-.08	-.09	--								
6. Hazardous Drinking <sup>d</sup>	-.12*	-.17**	.20**	.01	.001	--							
7. Drug Abuse Problems <sup>d</sup>	-.15**	-.08	.07	-.02	-.004	.41**	--						
8. Anxiety Symptoms <sup>b</sup>	-.17**	-.07	.12*	.01	-.03	.33**	.51**	--					
9. Anxiety Sensitivity <sup>b</sup>	-.13*	-.05	.17**	<.001	-.03	.31**	.50**	.70**	--				
10. Negative Consequences <sup>c</sup>	.04	-.05	.10	-.09	.05	.05	.18**	.20**	.24**	--			
11. Positive Reinforcement <sup>c</sup>	.003	-.11*	.28**	-.09	.03	.25**	.22**	.24**	.33**	.53**	--		
12. Negative Reinforcement <sup>c</sup>	-.06	-.05	.17**	-.12*	.02	.19**	.20**	.28**	.32**	.72**	.74**	--	
13. Appetite/Weight Control <sup>c</sup>	-.07	-.10	.29**	.004	.02	.23**	.24**	.31**	.39**	.55**	.72**	.72**	--
<b>Mean/N</b>	35.53	126	5.30	295	10.78	4.88	2.98	7.52	8.65	24.13	27.49	40.33	26.10
<b>SD%</b>	8.65	37.3%	1.61	87.3%	8.77	3.08	2.90	5.79	5.65	8.68	11.45	14.79	11.33

Note.

\*\*  $p < .01$ \*  $p < .05$ .<sup>d</sup>Covariate<sup>b</sup>Predictor<sup>c</sup>Criterion

Sex % listed as females (Coded: 0 = male, 1 = Female); Education (Coded: 1 = Less than High School, 2 = Some High School, 3 = Completed High School (or equivalent), 4 = Some College, 5 = Associate's Degree, 6 = Bachelor's Degree, 7 = Master's Degree, 8 = Doctoral Degree, 9 = More than Doctorate); Nativity: % listed as Born in the US; Hazardous Drinking = AUDIT Hazardous Drinking Subscale (Saunders et al., 1993); Drug Abuse Problems = DAST-10 Total Score (Yudko et al., 2007); Anxiety = OASIS Total Score (Norman et al., 2006); Anxiety Sensitivity = SSASI Total Score

(Zvolensky, Garey, et al., 2018); Negative Consequences = S-SCQ negative consequences subscale (Myers et al., 2003); Positive Reinforcement = S-SCQ positive reinforcement subscale (Myers et al., 2003); Negative Reinforcement subscale = S-SCQ negative reinforcement subscale (Myers et al., 2003); Appetite/Weight Control = S-SCQ appetite/weight control subscale (Myers et al., 2003).

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Main and interactive effect of anxiety and anxiety sensitivity in relation to negative consequences, positive reinforcement, negative reinforcement, and appetite/weight control (N=338).

**Table 2.**

	<b>B</b>	<b>SE</b>	<b>t</b>	<b>P</b>	<b>95% Bootstrapped CI</b>	<b>sr<sup>2</sup></b>	<b>R<sup>2</sup> Change</b>
<b>Negative Consequences</b>							
Step 1							
Age	0.05	0.06	0.95	.344	-0.06	0.16	.003
Sex	-0.27	1.01	-0.27	.788	-2.25	1.71	<.001
Education	0.53	0.31	1.75	.081	-0.07	1.14	.009
Nativity	-2.38	1.40	-1.70	.090	-5.13	0.38	.008
Cigarettes per Day	0.05	0.05	0.92	.357	-0.06	0.16	.002
Hazardous Drinking	-0.13	0.17	-0.79	.431	-0.47	0.2	.002
Drug Abuse Problems	0.59	0.18	3.35	<.001	0.24	0.94	.032
Step 2							.057
Anxiety Symptoms	0.11	0.12	0.92	.360	-0.12	0.33	.002
Anxiety Sensitivity	0.25	0.12	2.10	.036	0.02	0.48	.012
Step 3							.032
Anxiety Symptoms x Anxiety Sensitivity	0.01	0.01	0.83	.410	-0.02	0.04	<.001
							.002
<b>Negative Reinforcement</b>							
Step 1							
Age	-0.05	0.09	-0.57	.567	-0.23	0.13	.001
Sex	0.93	1.68	0.55	.583	-2.38	4.24	.001
Education	1.42	0.51	2.77	.006	0.41	2.42	.021
Nativity	-5.20	2.34	-2.22	.027	-9.81	-0.60	.014
Cigarettes per Day	0.05	0.09	0.58	.561	-0.13	0.23	.001
Hazardous Drinking	0.51	0.28	1.78	.076	-0.52	1.06	.009
Drug Abuse Problems	0.73	0.29	2.47	.014	0.15	1.31	.017
Step 2							.090
Anxiety Symptoms	0.24	0.19	1.25	.214	-0.14	0.61	.004
Anxiety Sensitivity	0.53	0.19	2.73	.007	0.15	0.91	.019
							.051

Negative Consequences		B	SE	t	P	95% Bootstrapped CI	sr <sup>2</sup>	R <sup>2</sup> Change
Step 3								
Anxiety Symptoms x								
Anxiety Sensitivity		-0.02	0.02	-0.71	.481	-0.06	0.03	.001
Positive Reinforcement								
Step 1								
Age		0.04	0.07	0.56	.574	-0.10	0.18	.001
Sex		-0.23	1.26	-0.18	.857	-2.71	2.25	<.001
Education		1.72	0.38	4.49	<.001	0.96	2.47	.052
Nativity		-3.40	1.76	-1.94	.053	-6.85	0.10	.010
Cigarettes per Day		0.05	0.07	0.76	.448	-0.081	0.18	.001
Hazardous Drinking		0.54	0.21	2.54	.011	0.12	0.96	.017
Drug Abuse Problems		0.59	0.22	2.65	.008	0.15	1.02	.148
Step 2								
Anxiety Symptoms		-0.01	0.14	-0.08	.940	-0.29	0.27	<.001
Anxiety Sensitivity		0.50	0.15	3.41	.001	0.21	0.79	.029
Step 3								
Anxiety Symptoms x								
Anxiety Sensitivity		0.01	0.02	0.64	.523	-0.02	0.03	.001
Appetite/Weight Control								
Step 1								
Age		-0.07	0.07	-1.05	.296	-0.21	0.06	.003
Sex		0.12	1.25	0.95	.925	-2.34	2.58	<.001
Education		1.83	0.38	4.83	<.001	1.09	2.58	.061
Nativity		0.05	1.74	0.03	.978	-3.37	3.47	<.001
Cigarettes per Day		0.06	0.07	0.87	.386	-0.7	0.19	.002
Hazardous Drinking		0.39	0.21	1.86	.063	-0.02	0.81	.009
Drug Abuse Problems		0.67	0.22	3.05	.002	0.24	1.10	.024
Step 2								
Anxiety Symptoms		0.07	0.14	0.49	.628	-0.21	0.34	.001
Anxiety Sensitivity		0.59	0.14	4.14	<.001	0.31	0.87	.041

Negative Consequences	B	SE	t	P	95% Bootstrapped CI	sr <sup>2</sup>	R <sup>2</sup> Change
Step 3							
Anxiety Symptoms x							
Anxiety Sensitivity	0.003	0.02	0.17	.866	-0.03	0.037	<.001

Note. Age = age in years; Sex % listed as females (Coded: 0 = male, 1 = Female); Education (Coded: 1 = Less than High School, 2 = Some High School, 3 = Completed High School (or equivalent), 4 = Some College, 5 = Associate's Degree, 6 = Bachelor's Degree, 7 = Master's Degree, 8 = Doctoral Degree, 9 = More than Doctorate); Nativity (0=U.S., 1=other); Hazardous Drinking = AUDIT Hazardous Drinking Subscale (Saunders et al., 1993); Drug Abuse Problems = DAST-10 Total Score (Yudko et al., 2007); Anxiety = OASIS Total Score (Norman et al., 2006); Anxiety Sensitivity = SSASI Total Score (Zvolensky, Garey, et al., 2018); Negative Consequences = S-SCQ negative consequences subscale (Myers et al., 2003); Positive Reinforcement = S-SCQ positive reinforcement subscale (Myers et al., 2003); Negative Reinforcement subscale = S-SCQ negative reinforcement subscale (Myers et al., 2003); Appetite/Weight Control = S-SCQ appetite/weight control subscale (Myers et al., 2003).