

## Distress Tolerance as a Correlate of Tobacco Dependence and Motivation: Incremental Relations over and above Anxiety and Depressive Symptoms

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### ABSTRACT

Distress tolerance—the capacity to withstand distressing states—is implicated in the etiology of regular smoking. The present study extends past research by examining whether relations between perceived distress tolerance and smoking-related factors: (1) differ across subdimensions of distress tolerance (Tolerance, Appraisal, Regulation, Absorption); (2) extend across measures of dependence, negative reinforcement smoking, and craving; and (3) are incremental to depressive and anxiety symptoms. Results showed that global distress tolerance was associated with measures of dependence, negative reinforcement, and craving even after controlling for affective symptomatology. Subdimensions of distress tolerance were not uniquely related to smoking outcomes in unadjusted or adjusted models. These findings suggest that: (a) distress tolerance is uniquely implicated in smoking over and above affective symptomatology; and (b) specific subdimensions of distress tolerance do not provide more information about smoking-related characteristics than global dimensions; and (c) addressing distress tolerance in smoking cessation interventions may promote successful cessation.

### KEYWORDS

anxiety; dependence; depression; distress tolerance; nicotine; smoking

### Introduction

Distress tolerance reflects the perceived or actual ability to withstand negative affect or other aversive psychological or physical states and continues to be an area of focus for clinical researchers and practitioners as it has been purported to contribute to several forms of psychopathology including smoking.<sup>1</sup> Researchers have found distress tolerance to have a hierarchical structure with domain general and domain specific properties. Namely, there is a global “experiential distress intolerance” construct with five lower-order constructs tapping the perceived capacity to tolerate distress (frustration intolerance, ambiguity intolerance, physical discomfort intolerance, and intolerance of negative emotions).<sup>2</sup> Provided that distress tolerance has been implicated in the etiology of regular smoking,<sup>3</sup> it would be important to assess how global distress tolerance and its subdimensions differentially relate to aspects of the dependence syndrome including craving and negative reinforcement smoking—two important constructs of the dependence syndrome worthy of further examination.

Existing research has identified how exploring distress tolerance in relation to smoking continues to be

of significant importance. A wealth of literature has identified that low distress tolerance among smokers is associated with greater likelihood of being a lifetime smoker<sup>4</sup> and is related to shorter durations of abstinence from smoking during a quit attempt.<sup>5–7</sup> Theory on substance use behavior and distress tolerance has posited that people with low distress tolerance may be inclined towards substance use to escape/avoid or reduce the aversive state.<sup>8</sup> Indeed, smoking is purported to alleviate negative affect,<sup>9</sup> which may increase vulnerability to smoking persistence and dependence.<sup>5</sup> Measures of tobacco-dependence severity (eg, Fagerström Test of Nicotine Dependence),<sup>4</sup> cigarette craving (ie, subjective desire to smoke),<sup>13</sup> and negative reinforcement smoking<sup>14</sup> are highly relevant factors in smoking behavior because they are strongly predictive of greater likelihood of relapse after cessation.<sup>15</sup> Furthermore, each of these factors are either direct indicators of tobacco addiction, an element of the addiction syndrome (eg, craving is a symptom of DSM-5 tobacco use disorder)<sup>16</sup> or central to theories of tobacco addiction motivation (eg, negative reinforcement is believed to

play a central role in maintaining addictive smoking behavior).<sup>17</sup> Moreover, dependence, craving, and negative reinforcement would presumably reflect the aspect through which low distress tolerance would impact smoking behavior as individuals who are unable to tolerate distress would be driven to smoke in the presence of compulsive physiological-related dependency, strong cravings to smoke, and the motive to alleviate negative affect. Overall this suggests that distress tolerance may be a suitable explanatory model for smoking motive and maintenance.

Based upon these and related findings, subsequent work has sought to 'cultivate' distress tolerance prior to quitting and during treatment in order to facilitate success in remaining abstinent among smokers<sup>10,11</sup> and improve distress tolerance in patients with substance use disorder.<sup>12</sup> Evidence from these studies suggests that distress tolerance as a component in treatment may prove useful for smoking cessation treatment. Therefore modification of distress tolerance via the use of exposure-based and Acceptance and Commitment Therapy-based treatment,<sup>10,11</sup> may be of use in clinical practice. Thus, further clarification of the relation between distress tolerance and smoking is of both theoretical and clinical value.

One means of elucidating the role of distress tolerance, that is the perceived ability to withstand aversive states, in smoking is to identify which subfacets of distress tolerance are uniquely implicated in smoking. Simons and Gaher<sup>13</sup> developed the Distress Tolerance Scale (DTS), a self-report measure that is posited to reflect an intolerance of negative emotional states by assessing the perceived capacity to tolerate negative psychological states. This scale isolates four unique facets of distress tolerance: (1) *tolerance*, which taps into the perceived inability to tolerate unpleasant or distressing emotional states; (2) *appraisal*, which reflects one's own cognitive assessment of distress, identifying feelings of shame at being distressed, not accepting distress, and feelings of inferiority at one's coping abilities in comparison to others when faced with a potentially aversive state; (3) *regulation*, which is characterized by the mechanism by which individuals cope with the aversive states—avoiding negative emotions and alleviating them through rapid means; and (4) *absorption*, which identifies the level of attention consumed by the distressing emotion and the disruption of functioning during the experience of an aversive state. Exploratory and confirmatory factor analytic studies of the DTS support the hierarchical multidimensional model with a single second-order factor, global distress tolerance, and internally-consistent and convergently-valid four first-order factors.<sup>8,13</sup> Hence, the DTS may be a promising tool for potentially isolating the subfacets of perceived distress

tolerance that are uniquely associated with smoking and shed light on the etiological mechanisms of smoking.

Prior smoking research examining the DTS and its unique facets has shown that smokers scoring low on the DTS total scale are more likely to perceive greater barriers to smoking cessation,<sup>14</sup> and report greater negative affect.<sup>3</sup> In one of the most comprehensive studies to date involving domains of distress tolerance on the DTS in a study of cigarette smokers, Leyro et al.<sup>8</sup> found that lower distress tolerance, as indicated by the total score as well as all subscales, was associated with greater negative reinforcement smoking expectancies (ie, motivation to smoke to alleviate negative affect). Lower scores on the regulation and appraisal subscales as well as the total score were associated with greater nicotine dependence on the Fagerström Test of Nicotine dependence (FTND) while lower tolerance and appraisal scores were related to more years as a smoker. This suggests that distress tolerance may differentially relate to unique aspects of smoking.

However, the concomitant role of depression and anxiety in the relation between distress tolerance and smoking cannot be ignored. Based on a theoretical model proposed by Leventhal and Zvolensky,<sup>15</sup> distress tolerance is a risk factor for the development of both anxiety/depression and smoking, and low distress tolerance influences motivation to smoke over and above one's manifest level of depressive and anxiety symptoms. Specifically, people with low distress tolerance are likely to avert situations involving negative affect, which can negatively reinforce avoidance behavior, and may prevent the development of adaptive coping skills and subsequently increase the risk for anxiety and depression.<sup>16</sup> Depression and anxiety may further interfere with distress tolerance, as depressogenic and anxiogenic cognitions may reduce one's confidence in withstanding distress. We believe that the ability to tolerate affective distress, rather than the severity of affective distress experienced per se, is a 'key ingredient' in the affective etiology of smoking.<sup>17</sup> That is, anxiety and depression may not be core motivators of smoking, rather it is one's reaction to anxiety and depression that may be central to smoking, as it is those that are unable to withstand aversive states who may be most prone to smoking as a means of averting distress. By statistically controlling for anxiety/depression we tested a theoretically-derived hypothesis that posits that although anxiety and depression may be related to smoking behavior, distress tolerance may exhibit a meaningful relation above and beyond the effects of anxiety/depression.

Extant research implicates the relationship between perceived distress tolerance and various smoking outcomes. Therefore the purpose of the present study will aim to replicate Leyro et al.<sup>8</sup> by examining the associations

between the DTS and dependence and negative reinforcement smoking and extend it by examining whether relations between perceived distress tolerance and smoking-related factors: (1) extend across multiple measures of dependence, cigarette craving, and negative reinforcement smoking; (2) differ across distinct subdimensions of distress tolerance (Tolerance, Appraisal, Regulation, Absorption); and (3) are incremental to anxiety/depression. Given that past work has shown that distress tolerance is associated with general indices of tobacco dependence<sup>18</sup> in prior work,<sup>8</sup> we hypothesized that those with lower perceived distress tolerance utilizing the DTS total score will exhibit higher levels on composite measures of tobacco dependence, cigarette craving, and smoking motivation for negative reinforcement with and without controlling for anxiety and depression. Provided the previous findings, it was also hypothesized that Regulation and Appraisal, the two facets of the DTS that were uniquely associated with several smoking variables in Leyro et al<sup>8</sup> would independently relate to dependence, craving, and negative reinforcement over and above variance accounted for the other DTS facets.

## Methods

### Participants and Procedure

Data were collected from current smokers ( $N = 212$ ) enrolled at a southwestern university in the U.S. who were participating in a more extensive study of the effects of tobacco deprivation. Participants were eligible if they: (1) reported normal vision; (2) were  $\geq 18$  years old; and (3) reported smoking  $\geq 5$  cigarettes per day for the past 2 years. Participants were ineligible if they (a) planned to quit in the next 30 days; (b) were currently cutting down substantially on smoking; or (c) were currently using a nicotine-replacement product.

Following an initial eligibility screening, participants were invited to attend a baseline data collection session prior to which the researchers provided no instructions about whether and how much to smoke prior to the appointment. During the baseline session, participants provided written informed consent, completed the measures described below, and then were compensated with course credit and a \$15 gift card. The study was approved by the University's Institutional Review Board.

## Measures

### Distress Tolerance

**Distress Tolerance Scale (DTS).** Similar to Leyro et al<sup>8</sup> a 14-item version of the DTS<sup>13</sup> was utilized. Items are

rated on a 5-point Likert scale (1 = *strongly agree* to 5 = *strongly disagree*) with lower scores corresponding to lower distress tolerance. The DTS has four subscales: Tolerance, (3 items, eg, "I can't handle feeling distressed or upset"); Appraisal, (6 items, eg, "I am ashamed of myself when I feel distressed or upset"); Regulation, (2 items, eg, "I'll do anything to avoid feeling distressed or upset"); and Absorption, (3 items, eg, "When I feel distressed or upset, all I can think about is how bad I feel"). An overall score was also calculated by averaging the four subscales scores.<sup>13</sup> The factor structure, internal consistency, and convergent and discriminant validity of the 14-item DTS has been previously supported in a prior sample of smokers.<sup>13</sup> The internal consistency of the DTS subscales in this sample was adequate (see Table 1).

## Outcomes

**Fagerström Test for Nicotine Dependence (FTND).** The FTND<sup>18</sup> is a widely used 6-item measure that assesses level of nicotine dependence. The measure produces an overall severity score ranging from 0 to 10 with higher scores indicating greater nicotine dependence. Previous research indicates that it has good reliability.<sup>19</sup>

**Nicotine Dependence Syndrome Scale (NDSS).** The NDSS<sup>20</sup> is a 19-item questionnaire, which assesses theoretically-derived aspects of the dependence syndrome, including craving, withdrawal, compulsion to smoke, preference for smoking over other reinforcers, tolerance, and regularity and stereotypy of smoking behavior. An overall score that taps a core index of dependence is calculated using an empirically-derived formula, which assigns each item a unique weight. This scale has shown good discriminant and convergent validity with the FTND.<sup>20</sup>

**Table 1.** Correlations ( $r$ ) Among DTS Subscales and Anxiety and Depression ( $n = 212$ )

	Mean (SD)	1.	2.	3.	4.	5.	6.	7.
1. Tolerance	3.37 (1.05) <sup>a</sup>	(.79)	.75	.62	.54	.87	-.36	-.40
2. Absorption	3.34 (1.16) <sup>a</sup>		(.84)	.69	.52	.89	-.48	-.53
3. Appraisal	3.47 (0.71) <sup>a</sup>			(.83)	.51	.81	-.43	-.46
4. Regulation	3.23 (1.07) <sup>a</sup>				(.67)	.77	-.28	-.23
5. DTS Total	3.35 (0.84) <sup>b</sup>					(.88)	-.46	-.48
6. BAI	15.13 (10.67)						(.90)	.70
7. CESD	16.14 (10.43)							(.90)

Abbreviations: DTS, Distress Tolerance Scale; BAI, Beck Anxiety Inventory; CESD, Center for Epidemiologic Studies Depression Scale.

Notes: All correlations significant at the  $p < .0001$  level. Values on the diagonal represent Cronbach's alpha.

<sup>a</sup>Average score per item (range 1–5).

<sup>b</sup>Average of four DTS subscales (range 1–5).

**Wisconsin Inventory of Smoking Dependence Motives (WISDM).** The WISDM<sup>21</sup> is a 68-item, self-report scale that assesses 13 theoretically distinct tobacco-dependence motives in separate subscales. Each item is answered on a 7-point Likert-type scale ranging from 1 (*not true of me at all*) to 7 (*extremely true of me*). In addition to the total scale, two subscales were utilized for the present study: (1) Craving (smoking in reaction to craving or experiencing strong or frequent urges to smoke), and (2) Negative Reinforcement (tendency to smoke to ameliorate a variety of aversive emotional states). The WISDM scales exhibit excellent internal consistency and correspondence with self-report and biochemical dependence assessments.<sup>21</sup>

**Questionnaire of Smoking Urges—Brief (QSU).** The QSU<sup>22</sup> is a 10-item survey requiring ratings from 0 (*strongly disagree*) to 5 (*strongly agree*) on items reflecting smoking urge/craving, which has demonstrated strong psychometric properties.<sup>22</sup> In addition to a total score, two subscales are provided by the QSU: Factor 1 (anticipation of pleasure from smoking and desire and intention to smoke) that is aligned with the construct of cigarette craving, and Factor 2 (expectation of relief from negative affect and nicotine withdrawal and urgent need to smoke) that is aligned with the construct of negative reinforcement-mediated smoking.

**Wisconsin Smoking Withdrawal Scale—Craving Subscale (WSWS).** The WSWS<sup>23</sup> assesses symptoms experienced “so far today” and includes a 4-item craving subscale in which statements of craving experiences are rated from 0 (*strongly disagree*) to 4 (*strongly agree*). The WSWS craving scale has exhibited good internal consistency and construct validity.<sup>23</sup>

### **Affective Symptomatology Covariates**

**Beck Anxiety Inventory (BAI).** The BAI<sup>24</sup> is a 21-item checklist for rating anxiety symptoms experienced in the past week. The BAI has been shown to be reliable, with strong construct validity in past work.<sup>24,25</sup>

**The Center for Epidemiologic Studies Depression Scale (CESD).** The CESD<sup>26</sup> is a 20-item, well-validated survey that yields a sum score of the responses reflecting past-week symptoms, rated from 1 (*rarely or none of the time, less than once a week*) to 4 (*most or all of the time, 5–7 days a week*). The CESD has good factorial and discriminant validity in prior work<sup>27</sup> and has shown excellent reliability with internal consistency of .90 in this sample.

### **Data Analysis Plan**

Preliminary analyses examined correlations between each of the DTS subscales, BAI, and CESD with additional separate correlations between each of the outcome measures. We then conducted a series of multivariate regressions that examined the DTS total score and DTS subscales (Tolerance, Appraisal, Regulation, Absorption) separately in relation to three sets of outcomes reflecting: (a) dependence (composed of the FTND, NDSS, and WISDM total score); (b) craving (composed of the WISDM-Craving, WSWS-Craving, and QSU-Factor 1 subscale); (c) negative reinforcement smoking (composed of the WISDM-Negative Reinforcement and QSU-Factor 2 subscale); and (d) the total set of all eight outcomes. To identify if results remain consistent across all outcome measures, a series of multiple regressions were conducted in secondary analyses predicting each tobacco characteristic by the DTS total score in the first model and the DTS subscales in the second model. Finally in line with our third aim, we included BAI and CESD scores in each model to examine incremental relations with anxiety and depression; therefore, all models were tested twice—once in a baseline model adjusting for age and gender (the only demographics significantly correlated with outcomes) and once in an adjusted model that added BAI and CESD as covariates. All tests were two-tailed.

## **Results**

### **Participants**

The sample was 53.3% female with a total sample mean age of 24.3 (SD = 6.4). Nine percent self-identified as African American, 15% Asian, 64% Caucasian, 7% Hispanic, 3% Middle Eastern, and 2% declined to self-identify. On average, participants began smoking daily at 17.7 years of age (SD = 2.7), smoked an average of 14.9 cigarettes daily (SD = 6.2), and had been regular smokers for 6.5 years (SD = 6.2). Descriptive statistics of smoking-related outcomes are reported in Table 2.

The  $M(SD)$  of the DTS scales, CESD, and BAI are presented in Table 1 and suggest adequate variability across the continuums of distress tolerance and affective symptoms. Using Beck et al.’s<sup>24</sup> recommended cutoffs for the BAI, 36% of the sample reported minimal anxiety (score 0–9), 33% reported mild-to-moderate anxiety (score 10–18), and 31% reported moderate or higher levels of anxiety (score  $\geq 19$ ). Using Radloff’s<sup>26</sup> suggested cutoff of a CESD-Total score of 16 or greater to indicate at least mild-to-moderate levels of depressive symptoms, 42% of the sample screened positive for depressive symptoms. Using Heatherton et al.’s<sup>18</sup> cutoffs for the FTND, the



**Table 2.** Correlations (*r*) Among Overall Tobacco Dependence, Overall Craving, and Negative Reinforcement Smoking Variables (*n* = 212)

	Mean (SD)	1.	2.	3.	4.	5.	6.	7.	8.
1. FTND	3.88 (2.12)	(.60)	0.57	0.51	0.51	0.30	0.32	0.33	0.31
2. NDSS – Total	–0.16 (0.94)		(.64)	0.69	0.70	0.45	0.42	0.58	0.47
3. WISDM – Total <sup>a</sup>	4.02 (1.05)			(.97)	0.80	0.56	0.59	0.84	0.60
4. WISDM – Craving <sup>a</sup>	4.41 (1.49)				(.87)	0.55	0.52	0.66	0.52
5. WSWs – Craving	2.09 (0.93)					(.80)	0.53	0.51	0.60
6. QSU Factor 1 <sup>b</sup>	2.14 (1.13)						(.89)	0.55	0.69
7. WISDM – Negative Reinforcement <sup>a</sup>	4.49 (1.36)							(.90)	0.56
8. QSU Factor 2 <sup>b</sup>	1.32 (1.15)								(.88)

Abbreviations: FTND, Fagerström Test of Nicotine Dependence; NDSS, Nicotine Dependence Syndrome Scale; WISDM, Wisconsin Inventory of Smoking Dependence Motives; WSWs, Wisconsin Smoking Withdrawal Scale; QSU, Questionnaire of Smoking Urges—Brief.

Notes: All correlations significant at the  $p < .001$  level. Values on the diagonal represent Cronbach's alpha.

<sup>a</sup>Average score per item (range 1–7).

<sup>b</sup>Average score per item (range 0–5).

sample reported the following severity of nicotine dependence: 27% as very low (score 0–2), 35% as low (score 3–4), 13% as medium, 18% (score 6–7) as high, and 6% (score 8–10) as very high.

### Preliminary Analyses

As illustrated in Table 1, there was a moderate, but not substantially large degree of intercorrelation among the DTS subscales (26% to 56% overlapping variance depending on the subscale pair), suggesting that the subscales were related but not entirely redundant constructs. There were also statistically significant correlations of each DTS scale to BAI and CESD scores. On examining the intercorrelations among the outcome measures (Table 2), each dimension was moderately to strongly associated with its other construct measures (eg, for the dependence set of outcomes, FTND, NDSS, and WISDM total score were moderately associated with each other, sharing 26% to 48% of the variance). There was also some cross-construct association among the outcome measures (all  $r_s \geq .30$ ,  $p_s < .001$ ), supporting the decision to also conduct multivariate regressions using the entire set of outcomes.

Additionally, canonical correlations between the DTS total score and composite measures of dependence, craving, negative reinforcement and all outcome measures were calculated while covarying for age and sex and then again including BAI and CESD scores. The DTS total score was significantly related to measures of dependence ( $r = .43$ ), craving ( $r = .42$ ), and negative reinforcement smoking ( $r = .45$ ), and all outcomes while covarying for demographics (all  $p_s < .0001$ ). After including BAI and CESD scores, correlations with dependence ( $r = .47$ ),

craving ( $r = .52$ ), negative reinforcement smoking ( $r = .51$ ), and all outcome measures ( $r = .59$ ) increased (all  $p_s < .0001$ ). A similar pattern of results were obtained when the DTS subscales were correlated to composite outcome measures adjusting for age and sex such that DTS subscales were significantly associated with dependence ( $r = .46$ ), craving ( $r = .44$ ), negative reinforcement smoking ( $r = .46$ ), and all outcome measures ( $r = .50$ ; all  $p_s < .01$ ). After including BAI and CESD scores, correlations with dependence ( $r = .49$ ), craving ( $r = .53$ ), negative reinforcement smoking ( $r = .55$ ) and all outcome measures ( $r = .55$ ) increased (all  $p_s < .0001$ ).

### Primary Analyses

#### Multivariate Models

In the multivariate models with the DTS total score regressed onto each set of measures of tobacco dependence, craving, and negative reinforcement smoking both in the unadjusted and adjusted models, the DTS total score exhibited significant associations with each set of composite measures in the baseline and adjusted models (Table 3). Additional multivariate regressions revealed that the DTS total score showed significant associations with the entire set of eight outcomes after adjusting for age and sex in both the unadjusted and adjusted models (Table 3).

In the multivariate models simultaneously including all four DTS subscales regressed onto the separate sets of dependence, craving, and negative reinforcement outcomes, the overall models were significant; however, no DTS subscales exhibited unique effects on composite outcomes ( $p_s > .39$ ) in either the unadjusted or adjusted models (Table 3). The same pattern was observed for multivariate regressions of the entire set of eight outcomes for both unadjusted and adjusted models (Table 3).

#### Secondary Analyses

As illustrated in Table 4, multiple regression analyses of the individual outcomes indicated that the DTS total score was uniquely related to all outcomes; however, only those related to the craving and negative reinforcement subscales of the WISDM as well as the WISDM total score remained significant when accounting for BAI and CESD (Table 4). Given the non-significant findings of the multivariate models that included the DTS subscales, follow-up univariate models were not conducted.

### Discussion

In this cross-sectional study of young adult daily smokers, we found that a global measure of perceived distress

**Table 3.** Multivariate Regressions of DTS Subscales Predicting Composite Measures of Tobacco Dependence, Craving, Negative Reinforcement Smoking, and All Outcome Measures ( $n = 212$ )

Predictors	Set of Dependence Outcomes	Set of Craving Outcomes	Set of Negative Reinforcement Outcomes	All Outcomes
Models including DTS total score				
Overall Model <sup>a</sup>	0.19*	0.21*	0.23**	0.32*
DTS total score	0.12*	0.12*	0.15**	0.17*
Overall Model <sup>b</sup>	0.28*	0.31**	0.35**	0.52**
DTS total score	0.07*	0.04	0.07*	0.10*
BAI	0.04	0.05*	0.02	0.08
CESD	0.02	0.02	0.04*	0.05
Models including 4 DTS subscales				
Overall Model <sup>a</sup>	0.23*	0.24*	0.25**	0.39*
Tolerance	0	0.01	0.01	0.03
Appraisal	0.04	0.04	0.03	0.05
Regulation	0	0	0	0.01
Absorption	0.01	0.01	0.01	0.02
Overall Model <sup>b</sup>	0.31*	0.34**	0.38**	0.60*
Tolerance	0	0.01	0.02	0.03
Appraisal	0.04	0.03	0.02	0.05
Regulation	0.01	0	0	0.02
Absorption	0.01	0.01	0.02	0.03
BAI	0.04	0.05*	0.02	0.08
CESD	0.03	0.02	0.05*	0.08

Abbreviations: DTS, Distress Tolerance Scale; BAI, Beck Anxiety Inventory; CESD, Center for Epidemiologic Studies Depression Scale.

Note: All values represent Pillai's Trace; all models include age and sex.

<sup>a</sup>Benjamini and Hochberg corrected significance of  $p = .05$  for overall model and predictors.

<sup>b</sup>Benjamini and Hochberg corrected significance of  $p = .027$  for overall model and predictors.

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

tolerance was associated with self-reported tobacco dependence, cigarette craving, and negative reinforcement-related smoking motivation. We replicated Leyro and colleagues<sup>8</sup> finding that lower distress tolerance was associated with FTND scores and negative reinforcement smoking motivation. We further extend these findings by showing that low distress tolerance was associated with other multifaceted measures of dependence, several aspects of negative reinforcement smoking, and measures of craving. It is notable that the strongest associations with individual smoking outcomes were found with the WISDM craving and negative reinforcement subscales as well as the WISDM total score, which could suggest that the broad dependence construct of the

WISDM may tap several dependence facets including craving and negative reinforcement smoking that are related to distress tolerance, whereas the other outcome measures may tap more narrow aspects of the constructs.

We also extend Leyro et al.<sup>8</sup> and other research by exploring the unique effects of each subdimension of the DTS after extracting the subscale covariance. The current study's pattern of results suggest that the individual facets of distress tolerance offer no unique explanatory value in terms of smoking-related factors when compared to the higher-order construct that might be tapped by the total scale. While the subfacets of the DTS do well in differentially associating with various smoking outcomes, also shown by Leyro

**Table 4.** Multiple Regression Models of DTS Total Score Regressed Onto Smoking Outcomes ( $n = 212$ )

	FTND	NDSS	WISDM-Total	WISDM-Craving	WSWS-Craving	QSU-Factor 1	WISDM-NR	QSU-Factor 2
Predictor	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$
Model 1 <sup>a,c</sup>								
DTS total score	—	0.19*	-0.33 <sup>†</sup>	-0.30 <sup>†</sup>	-0.30 <sup>†</sup>	-0.29 <sup>†</sup>	-0.35 <sup>†</sup>	-0.35 <sup>†</sup>
Model 2 <sup>b,d</sup>								
DTS total score	0.06	-0.07	-0.23**	-0.20*	-0.14	-0.17	-0.29**	-0.17
BAI	0.20*	0.16	0.27**	0.24*	0.26*	0.20	0.14	0.18
CESD	0.09	0.12	0.02	0.01	0.13	0.36	0.01	0.24*

Abbreviations: DTS, Distress Tolerance Scale; BAI, Beck Anxiety Inventory; CESD, Center for Epidemiologic Studies Depression Scale; FTND, Fagerström Test of Nicotine Dependence; NDSS, Nicotine Dependence Syndrome Scale; WISDM, Wisconsin Inventory of Smoking Dependence Motives; WISDM-NR, WISDM-Negative Reinforcement subscale; WSWS, Wisconsin Smoking Withdrawal Scale; QSU, Questionnaire of Smoking Urges—Brief.

Note: All values represent standardized regression parameters.

<sup>a</sup> Regression model adjusting for age and sex.

<sup>b</sup> Regression model adjusting for age, sex, BAI, and CESD.

<sup>c</sup> Benjamini and Hochberg corrected significance of  $p = .046$ .

<sup>d</sup> Benjamini and Hochberg corrected significance of  $p = .015$ .

\*  $p < .05$ \*\*  $p < .01$ <sup>†</sup>  $p < .0001$ .

et al.,<sup>8</sup> they do little in explaining what distinct aspects of distress tolerance contribute to these smoking-related factors and buttress the notion that the overall inability to tolerate distress may be more important. Overall, these findings provide little support for a unique role of distress tolerance subfacets and greater support for a global, unidimensional construct, in line with views by Leyro and colleagues.<sup>8</sup>

Another important finding was novel evidence that global distress tolerance was concurrently predictive of dependence, craving, and negative reinforcement smoking motivation over and above anxiety and depression. This pattern is generally in line with Leventhal and Zvolensky's model<sup>15</sup> that distress tolerance per se plays a unique role in smoking over and above symptom severity of anxiety and depression. That is, our findings suggest that it is the incapacity to tolerate affective distress (rather than the frequency and severity of the distress experience) that may specifically associate with more severe forms of dependence, more intense craving, and a stronger motivation to smoke to offset aversive feelings. However, given the generally significant unique effects of anxiety on measures of craving as well as the significant effects of depression on negative reinforcement smoking suggest that anxiety and depression may play a more important role in these smoking domains than previously thought. Additionally, the finding that the inclusion of anxiety and depression did not add significantly in models of dependence or all smoking outcomes might suggest that the role of negative affect in relation to dependence may be localized to negative reinforcement smoking to regulate affect rather than dependence more broadly. Thus, how one tolerates affective distress is more broadly important for smoking dependence while anxiety and depression may play a unique role in negative reinforcement smoking. Given these findings, future research should aim to further investigate the role of distress tolerance as potential mediators or moderators of the relation between anxiety and depression and similar smoking outcomes.

It is also worth noting that all measures of dependence, craving, and negative reinforcement smoking were significantly correlated with each other regardless of the composite category that they were placed into. These results are in keeping with those by Leyro and colleagues<sup>8</sup> who similarly found a significant relationship between the FTND and a measure of negative reinforcement smoking as well as those by Piper et al.<sup>28</sup> who identified associations between the FTND and measures of nicotine dependence, craving, and negative reinforcement smoking on the NDSS and WISDM. Nicotine dependence is maintained in part because smoking helps reduce or prevent the

experience of aversive states,<sup>29</sup> including those associated with craving.<sup>30</sup> This suggests that while negative reinforcement and craving are distinct constructs, they are also empirically and theoretically associated with the broader construct of nicotine dependence. In fact, it is posited that the association between all three constructs is strengthened over time as greater dependence is likely to yield more intense craving and thus greater need for negative reinforcement smoking in order to reduce these aversive states.<sup>30</sup> Overall, these findings help validate the importance of craving and negative reinforcement smoking of the dependence syndrome.

The findings of this study add credence to addressing distress tolerance in smoking cessation clinical settings. In practice, the scale may be utilized to help identify those who might be most prone to relapse as noted in prior research,<sup>17,31</sup> and that this scale could be useful over and above traditional measures of anxiety and depression in screening. Interventions that aim to improve distress tolerance by providing skills on how to tolerate emotional and physical distress as well as controlling behaviors in the context of that distress have been successful in increasing tolerance to both physically and emotionally aversive states.<sup>12</sup> Similarly, acceptance and commitment therapies might prove useful in accepting the aversive states associated with smoking abstinence and learning not to act upon these states through smoking, which can also aid in smoking cessation maintenance. Other treatment approaches that are designed to help individuals enhance their acceptance of these negative emotions have also shown promise for promoting smoking cessation.<sup>8</sup>

There are limitations to the current study that should be noted. The present study relied on self-report measures. Although self-report measures of tobacco dependence have adequate convergent validity with other measures of dependence, it would have been preferable to include other objective measures of tobacco exposure such as carbon monoxide readings and cotinine to aid in smoking verification. Relatedly, only one self-report measure of distress tolerance was used. While this measure was selected to address our aim of applying Simon and Gaher's<sup>13</sup> four-factor model to tobacco use, it would have been informative to include alternate self-report measures such as the Distress Intolerance Scale to capture a wider variety of the manifestations and characteristics related to distress tolerance. This study also did not examine the role of general negative affect. As a result, alternative measures that reflect negative affective distress, including additional psychopathological indices (eg, trauma-related disorders),

personality traits (eg, negative affectivity, neuroticism), and affect states (eg, positive and negative affect schedule), should be included in future work focused on distress tolerance and smoking in order to examine the specificity of distress tolerance's role in smoking over and above various manifestations of distress. It is also important to note that this study was cross-sectional and correlational, which precludes causal and temporal interpretations of the relationships presented herein. Also, the sample was comprised of college students who smoked regularly for at least 2 years, but were not trying to quit. Therefore, it remains unclear whether these findings will generalize to older smokers, individuals from different educational and social backgrounds, and smokers interested in quitting. Additionally, recency of ad lib smoking prior to the baseline visit was not considered. Given that smokers with a greater recency of ad lib smoking are likely to have less negative affect and exhibit lower levels of craving, this would likely reduce the strength of the associations with the craving and negative reinforcement measures and as such future studies should aim to incorporate this into their analyses. Additionally, the generally lower internal consistency of the Regulation subscale may have precluded the strength of the associations (or lack thereof) with the outcomes. Also, given that craving did not highly correlate with smoking behavior, future work should also incorporate smoking analogue studies that may have greater generalizability to smoking cessation. Furthermore, the current sample excluded smokers intending to quit in the next 30 days and thus may limit the generalizability to treatment seeking smokers. Lastly, while BAI and CESD scores yield some information regarding the level of affective psychopathology, the psychiatric status of participants was not formally evaluated using structured interviews or other clinical assessment tools, which would provide a more comprehensive assessment.

## Conclusions

In sum, the present study illustrates that overall distress tolerance is associated with tobacco-dependence severity, cigarette craving, and negative reinforcement-related smoking motivation over and above affective symptomatology. However, the subdimensions of the DTS are not independently associated with smoking-related outcomes in either unadjusted or adjusted models including anxiety and depression. These findings suggest that it may behoove clinicians to assess distress tolerance in patients irrespective of emotional status, as such information could be informative to tobacco-dependence treatment.

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