Negative Urgency Is Associated With Heightened Negative Affect and Urge During Tobacco Abstinence in Regular Smokers

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ABSTRACT. Objective: Negative urgency—the tendency to act rashly during negative affective states—is a risk factor for regular cigarette smoking. This human laboratory study tested a novel theoretical model of the underlying mechanisms linking negative urgency and smoking motivation, which purports that smokers with high negative urgency are at increased susceptibility to abstinence-induced increases in negative affect, which, in turn, provokes the urge to smoke to suppress negative affect. **Method:** Smokers ($N = 180$, >10 cigarettes/day) attended a baseline session at which they completed self-report measures of negative urgency and other co-factors and subsequently attended two counterbalanced within-subject experimental sessions (i.e., 16 hours of smoking abstinence or smoking as usual). At both experimental sessions, self-reported tobacco withdrawal symptoms, affect, and smoking urge were assessed. **Results:** Negative urgency was associated with larger

abstinence-induced increases in tobacco withdrawal symptoms, negative affect, and urge to smoke to alleviate negative affect, both with and without controlling for anxiety, depression, tobacco dependence, and sensation seeking ($\beta_s > .18$, $ps < .05$). The association between negative urgency and abstinence-induced increases in urge to smoke to alleviate negative affect was mediated by greater abstinence-induced increases in negative affect ($\beta_s > .062$, $ps = .01$). **Conclusions:** These results provide initial support of this model by providing evidence that smokers with higher (vs. lower) negative urgency may be more prone to greater negative affect during withdrawal, which in turn may promote urge to smoke to suppress negative emotion. Research extending this model to other settings, measures, and methodological approaches may be fruitful. (*J. Stud. Alcohol Drugs*, 77, 766–773, 2016)

NEGATIVE URGENCY—a personality trait reflecting the tendency to act rashly in response to negative emotions—has been implicated in the etiology of smoking and other addictive behaviors (Cyders & Smith, 2008). Evidence suggests that negative urgency is associated with cigarette craving (Billieux et al., 2007) and tobacco dependence (Pang et al., 2014). Understanding why negative urgency may play a role in smoking dependence and urge is important for enhancing theoretical models that address how personality vulnerabilities increase proneness to tobacco addiction. Such information is also important in advancing treatment development for personalized smoking cessation interventions that offset the etiological mechanisms underlying smoking for particular populations, including smokers with personality vulnerabilities, such as high negative urgency.

One potential way negative urgency may enhance proneness to smoking dependence and urge is by exacerbating reactions to situations or stimuli that either are stressful

or trigger the motivation to smoke. Indeed, smokers high in negative urgency have reported greater negative affect and urge to smoke to relieve negative affect in response to environmental smoking-related stimuli (Doran et al., 2008, 2009). Another situation that may trigger strong reactions in smokers high in negative urgency that has not been investigated in prior research is the response to acute tobacco abstinence—a robust precipitant of negative affect and urge to smoke (Leventhal et al., 2010).

Acute abstinence is a clinically significant circumstance that smokers face during a cessation attempt, during which abstinence-induced symptoms, such as urge to smoke and negative affect, may derail quit attempts (Piper et al., 2011). Abstinence is also an etiological significant circumstance, as brief periods of abstinence and declining nicotine levels may promote a strong drive to reinstate smoking and underlie the maintenance of tobacco dependence (Aguirre et al., 2015). Hence, studying whether negative urgency exacerbates the reaction to abstinence may provide both clinical and theoretical insights.

We propose a novel theoretical model of negative reinforcement processes as key mechanisms linking negative urgency and smoking motivation. This model purports that negative urgency may heighten vulnerability to the affective changes that ensue during acute tobacco abstinence. By definition, individuals high in negative urgency tend to have rash reactions to negative affective states (Cyders & Smith,

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2008). It is therefore plausible that smokers high in negative urgency may react more strongly to the psychosocial stress and neurobiological sequelae of abstinence and consequently experience more severe negative affect on abstinence. In tobacco dependence, states of negative affect are suspected to be principal triggers of the motivation to smoke to quell negative affective states (Baker et al., 2004), which would be subjectively expressed as a strong urge to smoke to alleviate negative affect. Given this logic, the proposed model posits that smokers with higher (vs. lower) negative urgency experience greater negative affect during abstinence, which in turn results in greater urge to smoke to relieve negative affect.

To test this mediational model, we examined whether individual differences in negative urgency differentiated the extent to which experimentally manipulated acute tobacco abstinence influenced state affect and urge to smoke as well as a secondary outcome measure of tobacco withdrawal symptoms (a cluster of features comprising negative affect and other aversive symptoms; Hughes, 2007). We hypothesized that (a) higher negative urgency would be associated with greater abstinence-induced increases in negative affect, urge to smoke to alleviate negative affect, and overall tobacco withdrawal symptoms and (b) the relation between negative urgency and abstinence-induced provocations in urge to smoke for negative affect reduction would be mediated by heightened levels of negative affect during abstinence.

We also tested the discriminant validity (i.e., specificity) of this model to negative (vs. positive) reinforcement mechanisms by examining whether negative urgency was associated with abstinence-induced changes in positive affect and urge to smoke for pleasure—positive reinforcement-based mechanisms. Based on our model, negative urgency is presumed to play a role in enhancing negative (but not positive) reinforcement smoking motivation; hence, we did not expect negative urgency to be associated with these two outcomes. Second, we examined if key relations between negative urgency, negative affect, and urge to smoke for negative affect relief remained after statistically controlling for tobacco dependence severity, affective disturbance (i.e., anxiety and depressive symptoms), and an indicator of impulsive tendencies putatively distinct from urgency (i.e., sensation seeking).

Method

Participants

This report includes data from an ongoing cohort study of individual difference factors that moderate response to acute tobacco abstinence. Participants were 180 non-treatment-seeking smokers from the Greater Los Angeles area interested in participating in a study on personality and smoking. Inclusion criteria were as follows: (a) at least 18 years of age, (b) regular cigarette smoker for 2 or more years, (c) currently smoking 10 or more cigarettes a day, (d)

normal or corrected-to-normal vision, and (e) fluent in the English language. Exclusion criteria were as follows: (a) current *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (DSM-IV; American Psychiatric Association, 1994), non-nicotine substance dependence; (b) current DSM-IV mood disorder or psychotic symptoms; (c) breath carbon monoxide (CO) levels < 10 ppm; (d) use of non-cigarette forms of nicotine products; (e) current use of psychiatric or psychoactive medications; and (f) pregnancy.

Three hundred twenty-four participants who met inclusion criteria following a preliminary telephone screen were invited for an in-person screening. Of these, 95 were ineligible because of low baseline CO levels ($n = 61$), current psychiatric disorder or use of psychiatric medications ($n = 20$), or other criteria ($n = 14$). Of the 229 eligible participants, 47 dropped out after study entry, and 2 were removed from the study for twice failing to meet abstinence criteria at the abstinent session, leaving a final sample of 180 for analysis.

Of the 47 dropped participants, 36 participants were removed from the study after not attending a scheduled appointment and being unable to be contacted. Of the remaining 11 participants, 7 participants voluntarily dropped from the study for various reasons (e.g., time commitment, compensation), and 4 participants were removed for inability to comply with study procedures.

There were no significant differences in completers versus dropouts on baseline characteristics (completers vs. noncompleters, M [SD] or %, age: 44.5 [11.1] vs. 42.3 [11.9], $t = -1.3$, $p = .20$; negative urgency: $t = -0.58$, $p = .56$; Fagerström Test for Nicotine Dependence [FTND]: 5.3 [1.9] vs. 5.7 [1.9], $t = 1.7$, $p = .10$; cigarettes/day: 16.8 [7.0] vs. 16.3 [6.6], $t = -0.51$, $p = .61$; African American: 49.2% vs. 52.6%; White: 37.4% vs. 35.1%, $\chi^2 = 0.98$, $p = .92$; Male: 68.3% vs. 64.9%, $\chi^2 = 0.2$, $p = .63$). The institutional review board of the University of Southern California approved the protocol.

Design and procedure

Baseline session. Participants were screened over the telephone and then scheduled for an in-person baseline session. Informed consent, breath CO and alcohol analysis, and the mood disorder, psychosis, and substance use disorder modules of the *Structured Clinical Interview for DSM-IV Non-Patient Edition* (SCID-NP; First et al., 2002) were completed to determine study eligibility. Eligible participants continued with the remainder of the baseline session, which included completing self-report measures of personality, psychopathology, and smoking.

Design. Subsequent to the baseline session, all participants completed two experimental sessions as part of a within-subject experimental design factor—an abstinent condition session and nonabstinent condition session. Abstinent sessions required participants to abstain from smoking for

16 hours before their scheduled session. Participants were asked to smoke normally before their nonabstinent session. The two sessions occurred within 2–14 days of each other. The session order was counterbalanced across participants (abstinent first, nonabstinent second vs. nonabstinent first, abstinent second), and order assignment was not significantly associated with any demographic or study variable ($ps > .15$). Because this study examines whether baseline session urgency was associated with response to the experimental manipulation, the within-subject component of the design is integrated within a larger quasi-experimental design involving both a between-subjects nonexperimental factor (i.e., baseline negative urgency) and a within-subject experimental factor (i.e., abstinence condition).

Experimental sessions. Participants began experimental sessions with a breath alcohol analysis. If the reading was positive (breath alcohol concentration $> .000$ g/dl), the experimenter terminated the session and rescheduled for a different day ($n = 0$). Nonabstinent and abstinent session procedures were the same, except that participants were instructed to smoke a cigarette of their preferred brand in the laboratory at the beginning of the nonabstinent session to standardize smoking deprivation. After the breath alcohol analysis, participants were given a CO assessment. Participants with CO measurements greater than 10 ppm at their abstinent session were considered nonabstinent (Leventhal et al., 2010) and were rescheduled for a second attempt to complete their abstinent session requirement ($n = 9$). Participants with CO measurements greater than 10 ppm on their second attempt were disqualified from completing the study ($n = 2$). Following the CO assessment, measures of tobacco withdrawal, urge, and affect at a single time point were given followed by a behavioral task assessing the relative reward value of smoking (see supplementary analyses below; McKee et al., 2006).

Baseline session measures

UPPS-P Impulsive Behavior Scale, Negative Urgency Subscale ($\alpha = .89$). The UPPS-P Impulsive Behavior Scale (Cyders et al., 2007; Whiteside & Lynam, 2001) has a 12-item negative urgency subscale (e.g., “When I feel bad I will often do things I regret later to make myself feel better now” and “When I’m upset I often act without thinking”). Participants rated statements on a four-point Likert scale (1 = *disagree strongly* to 4 = *agree strongly*). This subscale has been shown to have strong internal consistency and good discriminant validity from other impulsivity constructs (Smith et al., 2007).

Covariates. The following covariates were included to determine whether negative urgency predicted abstinence-induced changes in urge and negative affect over and above tobacco dependence severity, emotional symptomatology, and sensation seeking, which in previous studies have been

linked to negative urgency and urge to smoke (Doran et al., 2009; Guillot et al., 2014; Pang et al., 2014; Whiteside & Lynam, 2003). We administered the (a) FTND, a widely used and well-validated six-item self-report measure of tobacco dependence severity (Heatherton et al., 1991); (b) Mood and Anxiety Symptom Questionnaire–Short Form (MASQ), a well-validated self-report measure of anxiety and depressive symptoms during the past week using a five-point Likert scale, which yields Anxious Arousal (MASQ-AA; $\alpha = .91$; e.g., “hands were shaky”; 17 items) and Anhedonic Depression (MASQ-AD; $\alpha = .91$; e.g., “felt nothing was enjoyable”; 22 items) subscales (Watson et al., 1995); and (c) Brief Sensation Seeking Scale-4 (BSSS-4; $\alpha = .79$), a four-item self-report scale measuring thrill and adventure seeking, disinhibition, susceptibility to boredom, and experience seeking that has shown adequate psychometric properties in prior work (Stephenson et al., 2003).

Experimental session outcome measures

The Profile of Mood States. The 72-item Profile of Mood States (POMS; McNair et al., 1971) was used to measure state affect. Participants rated their affect state “right now” using a five-point Likert scale with affect adjectives (0 = *not at all* to 4 = *extremely*). This yields a Positive Affect scale ($\alpha = .93$) calculated by summing the subscale scores for friendliness, vigor, and elation, and a Negative Affect scale calculated by summing the subscale scores for anxiety, anger, depression, fatigue, and confusion. The Negative Affect scale ($\alpha = .96$) was used as the primary outcome, and the Positive Affect scale was analyzed separately to explore potential affective specificity to negative (vs. positive) affect.

Questionnaire of Smoking Urges–Brief. The 10-item Questionnaire of Smoking Urges–Brief (QSU; Cox et al., 2001) was used to measure urge to smoke. Participants rated how much they agreed with each statement using a six-point Likert scale (0 = *strongly disagree* to 5 = *strongly agree*). Factor analytic work supports the computation of two QSU subscales: (a) the desire for relief of negative affect and an urgent need to smoke (Factor 2; five items; $\alpha = .80$), which served as our primary outcome; and (b) desire for the positive effects of smoking and intention to smoke (Factor 1; five items; $\alpha = .91$), which was a supplemental outcome to explore potential specificity of smoking urge to negative affect reduction (vs. desire for positive effects).

The Minnesota Nicotine Withdrawal Scale ($\alpha = .85$). An 11-item variant of the Minnesota Nicotine Withdrawal Scale (MNWS; Hughes & Hatsukami, 1986) was used to measure tobacco withdrawal symptoms experienced “so far today” on a six-point scale (0 = *none* to 5 = *severe*). A composite mean sum score across the 11 symptoms (e.g., anxiety, depression, craving, hunger, and concentration difficulty) is reported. The MNWS was used as a supplemental outcome to examine if results were extended to a composite index of tobacco

TABLE 1. Descriptive statistics and correlations with negative urgency ($N = 180$)

Variable	M (SD) or %	Correlation with negative urgency (r)
Negative urgency	26.68 (8.03) ^a	—
Age	44.52 (11.06)	-.07
FTND	5.26 (1.90)	.13
Male gender	68%	-.10 ^b
Race/ethnicity		.09 ^c
Black	49.16%	
White	37.43%	
Hispanic	8.94%	
Other	4.47%	
Age at smoking onset	20.03 (6.15)	-.11
Cigarettes per day	16.79 (6.98)	.13
MASQ-AA	22.04 (7.43) ^a	.30 [†]
MASQ-AD	54.80 (14.32) ^a	.23**
BSSS-4	12.12 (3.84) ^a	.17*

Notes: FTND = Fagerström Test for Nicotine Dependence; MASQ-AA = Mood and Anxiety Symptom Questionnaire, Anxious Arousal (possible range: 1 = *not at all* to 5 = *extremely*); MASQ-AD = Mood and Anxiety Symptom Questionnaire, Anhedonic Depression (possible range: 1 = *not at all* to 5 = *extremely*); BSSS-4 = Brief Sensation Seeking Scale (possible range: 1 = *strongly disagree* to 5 = *strongly agree*). ^aSum scores given for Negative Urgency, MASQ-AA, MASQ-AD, and BSSS-4; ^bpoint biserial correlation (male = 1, female = 0); ^cpoint biserial correlation (Black = 1, other race/ethnicity = 0).

* $p < .05$; ** $p < .01$; [†] $p < .0001$.

withdrawal that includes negative affective states and other symptoms.

Data analysis plan

Preliminary analyses involved reporting sample descriptives, the internal consistency of key measures and correlations between key measures, demographics, and smoking characteristics. We also conducted paired sample t tests to examine whether abstinence condition (abstinent vs. non-abstinent) significantly affected affect, urge, and withdrawal symptoms.

Primary analyses involved linear regression models in which baseline negative urgency served as the predictor variable and an abstinence effect score (abstinent – nonabstinent) was used as the outcome variable, with separate models for each outcome (POMS-Positive Affect, Negative Affect, QSU-Factor 2, QSU-Factor 1, and MNWS) and each model controlling for the respective score during the nonabstinent condition to partial out nonabstinent variance. We then tested mediational models to explore whether the relationship of negative urgency to abstinence-induced changes in urge to smoke for negative affect reduction (QSU-Factor 2) was mediated by abstinence-induced changes in negative affect (POMS-Negative Affect).

Mediational paths were analyzed with the RMediation package (Tofghi & MacKinnon, 2011) by computing the product of the coefficients from two regression models: (a) the “a path,” which examined the relationship between the predictor (Negative Urgency) and the mediator (abstinence-

induced changes in POMS-Negative Mood); and (b) the “b path,” which examined the relationship of the mediator (abstinence-induced changes in POMS-Negative Affect) to the outcome (abstinence-induced changes in QSU-Factor 2) controlling for the predictor (Negative Urgency). The remaining direct effect of negative urgency on abstinence-induced changes in QSU-Factor 2 that was not mediated by abstinence-induced changes in negative mood (“c’ path”) was also reported.

We re-tested all regression models and mediational results after controlling for a priori covariates (MASQ-AA, MASQ-AD, BSSS-4, and FTND). Results are reported as standardized regression coefficients (β) and overall model proportion variance accounted for (R^2), and statistical significance was set to .05 (two tailed).

Results

Preliminary analyses

Descriptive statistics and correlations with negative urgency are reported in Table 1. Negative urgency was associated with anxiety, depression, and sensation seeking. None of the demographic or smoking characteristics were significantly correlated with negative urgency.

Means and standard deviations for outcome variables across experimental sessions and abstinence effects are reported in Table 2. Abstinence modulated each outcome in the expected direction (i.e., increased withdrawal, urge, and negative affect; reduced positive affect).

Primary analyses

As illustrated in Table 3, higher negative urgency was associated with larger abstinence-induced increases in negative affect, urge to smoke to alleviate negative affect, and the secondary outcome, tobacco withdrawal symptoms, with and without controlling for baseline anxiety, depression, tobacco dependence, and sensation seeking; all regression models included the respective nonabstinent score as an additional covariate. Negative urgency was not significantly associated with abstinence-induced changes in the positive reinforcement mechanism—implicated outcomes examined for discriminant validity purposes—positive affect or urge to smoke for pleasure.

With the exception of FTND and unexpected associations between MASQ-AA and lower abstinence-induced increases in urge to smoke to alleviate negative affect and lower abstinence-induced reductions in positive affect, there were no other significant associations between any of the covariates and the study outcomes in the adjusted models (see β parameters for covariates in Table 3).

As illustrated in Figure 1, mediational analyses showed that the association between negative urgency on abstinence-

TABLE 2. Descriptive statistics and comparisons of outcome variables by abstinence condition ($N = 180$)

Variable	Nonabstinent <i>M (SD)</i>	Abstinent <i>M (SD)</i>	Abstinence effect, <i>t</i>
MNWS	12.09 (10.07)	20.03 (12.06)	8.96 [†]
QSU Factor 1	6.73 (6.77)	20.76 (4.84)	24.86 [†]
QSU Factor 2	4.14 (5.46)	12.67 (6.64)	18.56 [†]
POMS–Positive Affect Scale	47.32 (18.56)	40.23 (19.72)	-5.61 [†]
POMS–Negative Affect Scale	37.27 (37.98)	45.79 (43.43)	3.33**

Notes: MNWS = Minnesota Nicotine Withdrawal Scale; QSU = Questionnaire of Smoking Urges; POMS = Profile of Mood States.

** $p < .01$; [†] $p < .0001$.

induced increases in urge to smoke to alleviate negative affect was mediated by greater abstinence-induced increases in negative affect (indirect mediated effect: β [95% CI] = .062 [.015, .134], $p = .01$). Mediation results remained significant after we controlled for anxiety, depression, dependence,

and sensation seeking (β [95% CI] = .063 [.0004, .129], $p = .01$; Figure 1). The percentage of the total effect for the association between negative urgency and urge to smoke to alleviate negative affect accounted for by the mediational pathway was 33% and 30% in the unadjusted and adjusted

TABLE 3. Association of negative urgency and covariates with abstinence-induced changes in study outcomes in regression models ($N = 180$)

Variable	Unadjusted models without covariates ^a		Adjusted models with covariates ^b	
	β [95% CI] ^c	R^2 ^d	β [95% CI] ^c	R^2 ^d
Primary outcomes				
Outcome: QSU Factor 2		.16		.24
Negative Urgency	.19 [.04, .34]*		.21 [.07, .35]**	
FTND	—		.27 [.08, .26] [†]	
MASQ-AA	—		-.16 [-.81, -.04]*	
MASQ-AD	—		.10 [-.08, .44]	
BSSS-4	—		-.06 [-.25, .10]	
Outcome: POMS–Negative Affect		.18		.18
Negative Urgency	.23 [.10, .39]***		.21 [.07, .37]**	
FTND	—		.03 [-.04, .06]	
MASQ-AA	—		.11 [-.07, .38]	
MASQ-AD	—		-.05 [-.21, .11]	
BSSS-4	—		.03 [-.08, .12]	
Secondary outcome				
Outcome: MNWS		.20		.21
Negative Urgency	.22 [.13, .58]**		.18 [.06, .53]*	
FTND	—		.13 [-.001, .16]	
MASQ-AA	—		-.01 [-.37, .35]	
MASQ-AD	—		.11 [-.06, .41]	
BSSS-4	—		.02 [-.13, .19]	
Discriminant validity outcomes				
Outcome: QSU Factor 1		.60		.63
Negative Urgency	.03 [-.14, .28]		.04 [-.14, .31]	
FTND	—		.18 [.06, .22] [†]	
MASQ-AA	—		-.09 [-.64, -.02]	
MASQ-AD	—		.01 [-.20, .24]	
BSSS-4	—		.001 [-.15, .15]	
Outcome: POMS–Positive Affect		.17		.23
Negative Urgency	-.09 [-.27, .06]		-.10 [-.29, .05]	
FTND	—		-.04 [-.08, .04]	
MASQ-AA	—		.16 [.03, .54]*	
MASQ-AD	—		-.28 [-.54, -.14]	
BSSS-4	—		.11 [-.03, .20]	

Notes: QSU = Questionnaire of Smoking Urges; FTND = Fagerström Test for Nicotine Dependence; MASQ-AA = Mood and Anxiety Symptom Questionnaire, Anxious Arousal; MASQ-AD = Mood and Anxiety Symptom Questionnaire, Anhedonic Depression; BSSS-4 = Brief Sensation Seeking Scale; MNWS = Minnesota Nicotine Withdrawal Scale; POMS = Profile of Mood States. ^aResults from linear regression models examining negative urgency as a predictor of abstinence-induced changes (score while abstinent – score while nonabstinent) in the respective outcome variable controlling for the respective nonabstinent score; ^bmodels including the additional covariates of FTND, MASQ-AD, MASQ-AA, and BSSS-4; ^cstandardized regression parameter; ^doverall variance in the respective outcome variable accounted for by all regressor variables in the model including the respective nonabstinent score.

* $p < .05$; ** $p < .01$; *** $p < .001$; [†] $p < .0001$.

FIGURE 1. Individual unadjusted/adjusted mediational model. *a* = path from the independent variable (i.e., negative urgency) to the mediator (i.e., abstinence-induced changes in negative affect). *b* = path from the mediator (i.e., abstinence-induced changes in negative affect) to the dependent variable (i.e., abstinence-induced changes in urge to smoke for negative affect relief) after controlling for the effect of the independent variable. $a \times b$ = the indirect effect of the independent variable on the dependent variable that occurs through the mediator, which equals the product of the “*a*” path and “*b*” path. *c*′ = the direct effect of the independent variable on the dependent variable that is not carried through the mediator, which equals the effect of the independent variable on the dependent variable after controlling for the mediator. The total effect (*c*) = the sum of the indirect effect ($a \times b$) and direct effect (*c*′), which equals the effect of the independent variable on the dependent variable. Total effect: unadjusted [$\beta = .19, p = .01$]; adjusted [$\beta = .21, p = .004$].

§ $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$; † $p < .0001$.

results, respectively. After parsing out the effect channeled through the mediator by adjusting for POMS-Negative Affect, the remaining direct effect for the association between negative urgency and the urge to smoke to alleviate negative affect (*c*′) was a nonsignificant trend in the unadjusted model and a significant effect in the adjusted model (Figure 1).

Supplementary analyses

In addition to the primary withdrawal measures, participants also completed a behavioral task assessing the reward value of reinstating smoking during which participants could earn \$.20 for each 5-minute increment they delayed smoking up to 50 minutes (McKee et al., 2006), with minutes delayed (range: 0–5) being the primary outcome. As a supplemental analysis, we used the same modeling strategy as above to test the relation between negative urgency and abstinence-induced changes in smoking delay, which yielded no significant association (β [95% CI] = .04 [−3.39, 5.84], $p = .60$) and suggests the results here are specific to withdrawal symptoms per se and does not extend to this analogue measure of smoking motivation.

Discussion

Concordant with our hypotheses, negative urgency was associated with larger abstinence-induced increases in negative affect, urge to smoke to alleviate negative affect, and overall tobacco withdrawal symptoms. The current study extends prior findings indicating that smokers high in negative urgency are hyper-reactive to environmental smoking-related stimuli (Doran et al., 2008, 2009) by demonstrating that such smokers are also hypersensitive to the effects of acute tobacco abstinence, in terms of their expression of negative affect and urge to smoke to alleviate negative affect. These results remained after controlling for tobacco dependence severity, anxiety, depression, and sensation seeking, and the existence and magnitude of relations of negative urgency were generally more consistent and robust than the other covariates (with the exception of tobacco dependence severity).

Hence, the results suggest that negative urgency is not solely a proxy for other clinical, emotional, or personality vulnerabilities that may exacerbate reactions to tobacco abstinence, and it may perhaps play a more prominent role in abstinence reactions than some of these other factors.

Furthermore, the results provide evidence in support of the discriminant validity of the hypothesized conceptual model, with negative urgency playing a role in amplifying negative (but not positive) reinforcement smoking motivation, as negative urgency was not associated with abstinence-related changes in positive affect or urge to smoke for pleasure.

In accord with our overarching conceptual model, the relation between negative urgency and abstinence-induced changes in urge to smoke to relieve negative affect was partially mediated by abstinence-induced negative affect. The mediational results suggest that smokers high in negative urgency tend to experience more intense negative affect in response to tobacco withdrawal, which in turn is related to greater urge to smoke to alleviate negative affect. Perhaps certain individuals are high in negative urgency (at least in part) because they are prone to experiencing greater negative emotion in response to aversive environmental stimuli or internal states (including tobacco withdrawal), which increases the urge for action (e.g., urge to smoke) focused on altering the immediate situation or aversive experience. The mediational pathway accounted for about a third of the relation between negative urgency and abstinence-induced changes in urge to smoke to alleviate negative affect, suggesting that a meaningful (but not exhaustive) portion of the pathway was channeled by the mediational process.

The current study has some limitations. Our exclusion criteria excluded smokers with current drug or alcohol dependence (non-nicotine substance dependence), mood or psychiatric medication use, and those planning to quit smoking. Therefore, our findings may not generalize to wider smoking populations interested in quitting or with psychiatric comorbidities. Similarly, this study required 16 hours of temporary abstinence, which is different from an actual cessation attempt in which smokers go in to abstinence believing that they may never smoke again.

Further, the measure of the mediator and outcome were temporally concurrent. Hence, it is unknown whether negative affect preceded the urge to smoke to alleviate negative affect, as hypothesized in our theoretical model, although it makes strong conceptual sense that negative affect would precede the urge to smoke for negative affect relief. Finally, participants completed only a personality-based self-report measure of negative urgency, and behavioral measures of impulsivity, negative affect, and smoking motivation were not included. Thus, it is unclear the extent to which mono-method biases influenced results, although the quasi-experimental design isolated responses to an experimental manipulation and rules out the possibility that findings reflect a consistent reporting bias that generalizes across measures and settings.

This study provides new evidence of an etiologic risk pathway whereby smokers with higher (vs. lower) negative urgency are prone to greater negative affect during tobacco withdrawal, which in turn heightens urge to smoke

to suppress negative emotion. As the first examination of this theoretical model, this study sets the stage for future research on the generalizability of this etiological pathway to other measures, methodologies, populations, and settings. Incorporating behavioral measures of other constructs within the overarching domain of impulsive behaviors in future designs may be enlightening (e.g., response inhibition and delay discounting). Such measures could be interpreted as covariates (to determine whether negative urgency per se or other impulsive behaviors amplify negative affect and urge to smoke to alleviate negative affect during abstinence) or alternate predictors (to examine the generalizability of this negative reinforcement-based etiological pathway to other manifestations of impulsive behavior).

Given that about a third of the relation between negative urgency and abstinence-induced increases in urge to smoke to alleviate negative affect was accounted for by subjective negative affect, further research on other mediating mechanisms that could account for this relation may be useful, including unconscious affective processes that could elicit urge to suppress negative affect in the absence of conscious negative affect (Baker et al., 2004). Eye-tracking and reaction-time-based tasks that assess unconscious, implicit affective processes (Wiers & Stacy, 2006) may be promising avenues for such efforts.

From a clinical perspective, these results suggest that it may be fruitful to examine this etiologic model within the context of smoking cessation to explore whether, on their quit day, smokers with higher negative urgency experience strong negative affective reactions and urge to suppress such reactions by lapsing back to smoking. These types of future avenues could prove useful in identifying a subgroup of smokers (i.e., those high in negative urgency) that may require a tailored smoking cessation treatment plan.

For instance, distress tolerance skills training may help teach smokers high in negative urgency to respond to negative affective states in healthier ways rather than smoking under pressure as they may usually do (Brown et al., 2008). Similarly, mindfulness training also may be advantageous to treat smokers high in negative urgency because it promotes acceptance of unpleasant experiences rather than attempts to avoid them (Brewer et al., 2013; Zvolensky et al., 2008).

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