Published in final edited form as:

Addict Behav. 2008 November ; 33(11): 1394–1401. doi:10.1016/j.addbeh.2008.06.018.

THE ROLE OF NEGATIVE AFFECT IN RISK FOR EARLY LAPSE AMONG LOW DISTRESS TOLERANCE SMOKERS

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Abstract

Individual differences in the ability to tolerate negative affect due to psychological and/or physical discomfort (e.g., distress tolerance) are emerging as an important predictor of smoking cessation outcomes. The purpose of this study was to build on existing evidence by exploring the relationship between levels of distress tolerance (DT) and negative affect on quit date in relation to risk for early lapse. Eighty-one smokers (48% female; *M* age = 42.6 years) who completed laboratory-based, behavioral distress tolerance tasks prior to an unaided quit attempt were categorized into low, average, and high persistence on the tasks. Low persistence smokers were significantly more likely to lapse on the assigned quit day. Among smokers able to achieve abstinence on quit day, low persistence smokers demonstrated higher levels of negative affect and urges compared to high persistence smokers. Further, negative affect-related risk for early lapse was strongest among those with low persistence. These findings suggest that smokers low in distress tolerance may be particularly vulnerable to very early lapse to smoking and that increases in negative affect may contribute to the risk for early lapse in this high-risk group of smokers.

Keywords

distress tolerance; early lapse; smoking; negative affect; withdrawal symptoms; smoking cessation

1. Introduction

1.1. The role of negative affect in smoking lapse

Recent attention has been given to the role of negative affect (i.e., negatively perceived affect states) in predicting early lapse to smoking both in terms of depressive mood and withdrawal-related symptomatology. In addition to their association with cigarette smoking, dysphoria and depressive symptoms have consistently been shown to predict smoking cessation failure (Blondal et al., 1999; Burgess et al., 2002; Kinnunen, Doherty, Militello, & Garvey, 1996;

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Ludman et al., 2000). For example, Niaura and colleagues (2001) demonstrated a relationship between symptoms of depression and survival (time to 1st cigarette) in three distinct smoking cessation samples. Despite differing cessation methods (two combined pharmacological-behavioral trials and one self-help trial) and differing measures of depression (Profile of Mood States, Hamilton Rating Scale-Depression, and a one-item measure of anhedonia), current symptoms of depression were consistently associated with earlier time to first lapse.

Recent evidence also supports the primary role of negative affect factors in nicotine withdrawal as strong determinants of early smoking lapse (Kenford et al., 2002; Piasecki et al., 2000). For example, using ecological momentary assessment approaches to track moment-to-moment changes in smokers' experiences throughout the early course of quit attempts, Shiffman and colleagues (2004, 2007) found that rapid increases in negative affect often immediately preceded lapse to smoking. The influence of negative affect on smoking lapse may begin soon after attempts at cessation, as levels of negative affect assessed on quit date have been found to be predictive of smoking lapse (Lerman et al., 2002; McCarthy, Piasecki, Fiore, & Baker, 2006; Westmaas & Langsam, 2005). In addition, individuals who have a history of repeated early lapses have been found to experience large increases in negative affect when deprived of nicotine compared to smokers with histories of sustained quit attempts (Brown, Lejuez, Kahler, & Strong, 2002). Therefore, further study of the relationship of negative affect (including both depressive and withdrawal-related symptoms) and early smoking lapse is important and likely to inform future development of smoking cessation treatments.

1.2 Distress tolerance and early lapse

Baker and colleagues propose that the desire to escape or avoid negative affect during withdrawal is a primary motivator for resumption of addictive drug use (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004). Consistent with this negative reinforcement model of addiction, Brown and colleagues (2005) have argued that examining individual differences in how a smoker responds to negative affect may increase our understanding of the risks for early lapse following a smoking cessation attempt. We have used the term "distress tolerance" to describe the behavioral tendency to pursue a goal despite encountering affective discomfort, which may be in response to perceived physical and/or psychological distress, such as remaining abstinent from smoking in the face of uncomfortable withdrawal symptoms (Brown et al., 2005). For example, whereas many smokers quit smoking successfully despite high levels of discomfort, a low threshold for tolerating such distress would be associated with difficulty quitting smoking (Brown et al., 2005). Distress tolerance has also been conceptualized in terms of emotional vulnerability and found to be related to such constructs as neuroticism, negative affectivity, anxiety sensitivity and emotional dysregulation (Zvolensky & Otto, 2007). Others have referred to the behavioral aspect of distress tolerance as "task persistence" (Brandon et al., 2003; Quinn, Brandon, & Copeland, 1996). Across a number of experimental studies (Brandon et al., 2003; Brown et al., 2002; Hajek, Belcher, & Stapleton, 1987), smokers' inability to persist with a physically and/or psychologically distressing task has been associated with a history of early smoking lapse.

In initial prospective examinations, Brandon and colleagues (Brandon et al., 2003) demonstrated that smokers with higher levels of persistence on a frustrating behavioral task involving mirror tracing were more likely to sustain longer periods of abstinence. In a more recent study, Brown and colleagues (Brown, Lejuez et al., in press) conducted a prospective examination of distress tolerance and early smoking lapse in 81 self-quitters. We found that low distress tolerance smokers, as characterized by low duration in breath holding and carbon dioxide-enriched air challenge tasks, lapsed significantly earlier than high distress tolerance smokers. The results of this study support the predictive validity of distress tolerance and suggest processes that may operate independently from other factors that convey risk for early

lapse such as nicotine dependence. Thus understanding processes related to distress tolerance may inform our understanding of early lapse following a smoking cessation attempt.

1.3 The present study

Theoretical models of distress tolerance suggest that early smoking lapsers may be characterized by the tendency to experience heightened levels of negative affect during nicotine withdrawal and by their difficulty in tolerating the discomfort associated with the negative affect (Brown et al., 2005). The present study is intended to examine affective mechanisms by which low distress tolerance was a significant predictor of early smoking lapse in our prospective study (Brown, Lejuez et al., in press). Specific questions to be examined include whether low distress tolerance smokers experience increases in negative affect, urges, and nicotine withdrawal upon quitting and whether these changes may render them vulnerable to early lapse compared to high distress tolerance smokers. In this study, levels of distress tolerance were determined based on the extent to which participants were able to persist on each laboratory-based, behavioral challenge task. Thus the term “persistence” will be used as an indicator of distress tolerance. Specifically, we hypothesized that, compared to high persistence smokers, low persistence smokers would demonstrate: 1) higher odds of lapsing on quit date, 2) greater increases in negative affect and depressive symptoms on quit date, 3) higher levels of urges to smoke and nicotine withdrawal on quit date, and 4) an increased risk for lapse even after controlling for negative affect, depressive symptoms, urges to smoke and nicotine withdrawal.

2. Method

2.1 Participants

Participants were 81 adult smokers recruited through newspaper advertisements targeted at smokers planning to quit smoking without assistance (i.e., no pharmacotherapy or psychosocial treatment). The sample included 42 males and 39 females, all aged between 19 - 65 years ($M = 42.6$; $SD = 12.20$). 88.5% of participants were Caucasian, 3.8% were African American, 2.6% Hispanic and 5.1% indicated belonging to an “other” racial/ethnic group.

2.2 Procedure

Interested and eligible participants were instructed to select the day they would attempt to quit smoking (quit day) and were scheduled for the baseline assessment session. The baseline assessment was required to occur at least 3 days, but no more than 14 days, prior to the participant’s selected quit day. This study was approved by the Institutional Review Board of Butler Hospital in Providence, RI. For a complete and detailed description of the study’s procedures see (Brown, Lejuez et al., in press).

Baseline assessment session—The baseline assessment included written informed consent followed by a diagnostic screening interview using the Structured Clinical Interview-Non-Patient Version for DSM-IV (SCID-NP; First, Spitzer, Gibbon, & Williams, 1995). After a 15-min break, during which participants were given the option to smoke a cigarette, eligible individuals completed the laboratory challenge tasks.

Quit Day and Follow-up Assessments—Participants returned to the laboratory on their quit day and 3, 7, 14, and 28 days post-cessation to verify abstinence using carbon monoxide analysis [10 ppm cutoff, using a CMD/CO Carbon Monoxide Monitor (Model 3110), Spirometrics, Inc. Auburn, ME] and to complete self-report measures of withdrawal symptoms, mood and depressive symptoms. They were informed that they would receive \$25 for completing self-report measures on each of the three quit-week visits. Further, if CO readings verified that they had abstained from smoking for at least 12 hours prior, they would earn \$30

at quit day, \$40 at day 3 and \$50 at day 7 assessments after their quit date. As established previously (Heil, Tidey, Holmes, Badger, & Higgins, 2003), this type of contingent payment program was used to provide incentive to participants for making a quit attempt on their chosen quit day and to keep a large number of participants abstinent long enough to acquire data on withdrawal symptoms, mood and depressive symptoms.

In addition to carbon monoxide verification of abstinence, saliva was gathered for cotinine analysis on days 7, 14, and 28. Participants who did not provide CO verification or saliva for cotinine analysis or whose biochemical measures contradicted self-report were considered lapsed at the last session at which they had verified abstinence.

2.3 Laboratory Tasks

Three laboratory challenge tasks were conducted: 1) computerized version of the Paced Auditory Serial Addition Task (PASAT; Lejuez, Kahler, & Brown, 2003); 2) duration of breath holding, and 3) inhalation of carbon dioxide-enriched air (CO₂). A series of single-item self-report questions, rated on a Likert scale ranging from 0 (*none*) to 100 (*extreme*), were administered before and after each task to assess levels of (a) anxiety, (b) irritability, (c) difficulty concentrating, (d) bodily discomfort, (e) urge to smoke, and (f) frustration. In the PASAT, numbers were sequentially flashed on the screen. Participants summed the most recent number with the previous number and used the computer's mouse to click on the correct answer using a keyboard provided on the computer screen. There were 3 levels of increasing difficulty. On the last level, participants were given the option to terminate the test whenever they wanted. To provide incentive to complete the task to the best of their abilities, participants were told that they would receive a gift certificate worth \$5 if their total number of points earned was greater than the average score of the other participants. In actuality, all subjects were mailed the \$5 payment following participation.

During the breath holding challenge, participants were asked to take a deep breath and hold it for as long as they could, while the duration of breath holding was recorded with a stopwatch. The CO₂ challenge task (Lejuez, Forsyth, & Eifert, 1998) lasted 15-minutes and included 2 CO₂ presentations set to occur at 7 minutes and 12 minutes. An apparatus for providing participants with either room air or a mixture of 20% CO₂ (20% CO₂, 21% O₂, 59% N₂). CO₂ was stored in a 101-cm cylinder and fed through a 5-cm by 5-cm hole via aerosol tubing from the experimenter room to a positive-pressure downs C-pap mask worn by the participant. An automated apparatus, described in Lejuez, Forsyth, and Eifert (1998), was used for CO₂ delivery. The first presentation lasted 25 seconds, and during the second presentation, participants could press a button on the provided computer keyboard to terminate the challenge immediately. See (Brown, Lejuez et al., in press) for more procedural details regarding the laboratory challenge tasks in the current study.

Levels of distress tolerance were determined based on the extent to which participants were able to persist on each task. In the primary outcome study (Brown, Lejuez et al., in press), we examined continuous indicators of persistence (for the PASAT and breath holding) on each task in relation to early lapse. Because of the severely truncated distribution of the CO₂ persistence variable, we dichotomized this variable as high vs. low using a median split prior to analysis. While the PASAT was not predictive of early lapse, CO₂ and breath holding separately predicted outcome (Brown, Lejuez et al., in press). In entering both of these variables simultaneously into a regression model predicting early lapse, breath holding persistence was also dichotomized so that both variables would be on similar metric. Given the significant difference in the length of breath holding ($t(1,78.7) = 3.54, p < .01$) and CO₂ persistence ($t(1, 61.2) = 2.17, p < .01$) times for men and women, we created median splits using gender specific values for men (breath holding median = 45, and median CO₂ = 52) and women (breath holding

median = 31, and CO₂ = 39). Examined together, it appears that both measures of persistence, CO₂ and breath holding uniquely predict early lapse (Brown, Lejuez et al., in press).

Next, in an effort to create a single indicator of persistence, we created a composite score for the physical indices of DT including breath holding and CO₂ persistence by adding the two dichotomized variables to form three groups. This generated three groups: low persistence (low persistence on both tasks; $n = 21$), average persistence (high persistence on one of the tasks; $n = 37$), and high persistence (high persistence on both tasks; $n = 23$). Participants with low persistence were significantly more at risk for early lapse than those with high persistence (Brown, Lejuez et al., in press). In the current study, we extend the findings of this work, by conducting a secondary data analysis and utilizing these established groupings to examine changes in negative affect in relation to early lapse across different levels of task persistence.

2.4 Measures

Psychiatric Screen—The *SCID-NP* (First et al., 1995) was utilized to assess psychiatric history, including Major Depressive Disorder. Specifically, current (i.e., diagnostic exclusions) and lifetime prevalence of Axis I diagnoses were determined using the SCID-NP.

Smoking History—Smoking history and pattern were assessed with the *Smoking History Questionnaire (SHQ)* (Brown et al., 2002) which includes items pertaining to smoking rate, age of onset at initiation, and years of being a daily smoker.

Nicotine Dependence—The *Fagerström Tolerance Questionnaire (FTQ)* was used as a continuous measure of nicotine dependence (Fagerstrom, 1978). Specifically, we administered the FTQ and scored it as the *Fagerström Test for Nicotine Dependence (FTND)*; see Heatherton et al. (Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991) for scoring details.

Negative Affect—Changes in negative affect were assessed with the *Positive and Negative Affect Schedule (PANAS)* (Watson, Clark, & Tellegen, 1988). The PANAS is a 20-item self-report scale that has demonstrated good psychometric properties (Watson et al., 1988). The Negative Affect scale consists of the sum of 10 items, each rated on a 5-point scale.

Depressive symptoms—The Center for Epidemiological Studies-Depression Scale [CES-D; Radloff, 1977] is a 20-item measure of depressive symptoms. Respondents indicate how often within the last week they experienced the symptom in question, responding: “rarely or none of the time”; “some or little of the time”; “occasionally or a moderate amount of the time”; or “most or all of the time.”

Nicotine Withdrawal Symptoms—The *Nicotine Withdrawal Scale* (Piasecki et al., 2000) is a reliable and sensitive scale adapted, in part from the Minnesota Withdrawal Scale (Hughes & Hatsukami, 1986). This measure allows for the assessment of the frequency, duration, severity and temporal variability in Urges to Smoke (4 items), Negative Affect (6 items), and Sleep Disturbance (6 items) withdrawal symptoms. For the purposes of this study, the Urges to Smoke scale was used to index craving or urges to smoke and was examined separately from other withdrawal symptoms.

2.4 Data Analysis Plan

We used chi square analyses and univariate analysis of variance to evaluate baseline differences across persistence groups. Baseline characteristics are listed in Table 1. To test the primary aims we created a set of dummy codes to evaluate a) low persistence versus the high persistence groups and b) low persistence versus average persistence groups. These contrast terms are entered into regression models along with a set of primary covariates that included: level of

dependence (FTND), gender, history of MDD, and years of education. Baseline values for dependent variables assessed on quit date are also included in models.

3. Results

3.1 Smoking Lapse on Quit Day

To determine if smokers with low persistence had higher odds of lapsing on quit date, we used a logistic regression model with a binary indicator of smoking status on the assigned quit date as the dependent variable. We entered primary covariates along with the two dummy codes designating persistence group comparisons when predicting the odds of lapsing on quit day. Overall 25 of 77 smokers lapsed on quit day representing 45%, 41% and 9% of smokers in the low, average, and high persistence groups respectively. Overall, rates of lapsing on quit day were significantly different across persistence groups ($X^2=8.53$, $df=2$, $p < .02$) and were higher among men ($B = 1.61$, $SE = 0.65$, $p < .02$) and smokers with fewer years of education ($B = -0.55$, $SE = 0.18$, $p < .01$). See Table 2. Smokers in the low persistence group were significantly more likely to lapse on quit day than those in the high persistence group ($OR = 9.22$; $95CI = 1.41-60.41$, $p < .03$) and were similar to those in the average persistence group ($OR = 1.22$, $95CI = 0.33 - 4.41$, $p > .10$).

3.2 Levels of Negative Affect on Quit Day

To determine if smokers with low persistence had greater increases in negative affect (NA) on quit day, we used linear regression to predict square-root-transformed quit day negative affect scores. We included only smokers ($n = 52$) who were CO-verified as not smoking on the quit day assessment. We included the set of primary covariates as well as the baseline NA scores. Observed mean scores on quit day were 16.9 ($SD = 5.59$), 16.1 ($SD = 6.56$) and 15.18 ($SD = 4.91$), for smokers in the low, average, and high persistence groups respectively (see Figure 1). With an overall significant model ($F(7,39) = 3.88$, $p < .01$), smokers across persistence groups had different levels of NA on quit day ($F(2,39) = 3.99$, $p < .03$). Of the primary covariates, only level of nicotine dependence was statistically significant, with higher scores on the FTND being associated with higher levels of NA ($B = .10$, $SE = 0.03$, $p < 0.01$). After controlling for covariates, low persistence smokers had higher NA scores on quit day than high persistence smokers ($B = .58$, $SE = 0.21$, $p < 0.01$) and average persistence smokers ($B = .47$, $SE = 0.21$, $p < 0.03$).

3.3 Levels of Depressive Symptoms on Quit Day

To determine if smokers with low persistence had greater increases in depressive symptoms on quit day, we used linear regression to predict square-root-transformed quit day CES-D scores. We included only smokers ($n = 52$) who CO-verified as not smoking on the quit day assessment. We included the set of primary covariates as well as baseline CES-D scores. Observed mean scores on quit day were 8.83 ($SD = 6.67$), 9.22 ($SD = 8.37$) and 8.62 ($SD = 8.05$) for smokers in the low, average, and high persistence groups respectively. With an overall significant model ($F(7,42) = 6.14$, $p < .01$), smokers did not differ on levels of depressive symptoms ($F(2,43) = 1.71$, $p > .10$). Of the primary covariates, higher scores on the FTND ($B = .16$, $SE = 0.06$, $p < 0.02$) and having a history of MDD ($B = .64$, $SE = 0.29$, $p < 0.04$) were associated with higher CES-D scores on quit day. Planned contrasts suggested that low persistence smokers had similar CES-D scores to high persistence smokers ($B = .48$, $SE = 0.36$, $p > 0.10$) and average persistence smokers ($B = .43$, $SE = 0.36$, $p > 0.10$) on quit day.

3.4 Levels of Urges and Nicotine Withdrawal on Quit Day

We used linear regression to determine if smokers with low persistence had greater urges and nicotine withdrawal symptoms on quit day. We included only smokers ($n = 52$) who CO

verified as not smoking on the quit day assessment. For these analyses we first included the set of primary covariates prior to persistence contrasts codes. Observed mean level of urges on quit day were 18.33 ($SD = 5.69$), 19.00 ($SD = 5.41$) and 15.67 ($SD = 5.88$) and withdrawal scores were 6.88 ($SD = 4.91$), 6.93 ($SD = 5.60$), and 5.36 ($SD = 3.48$) for smokers in the low, average, and high persistence groups respectively. With an overall significant model ($F(6,43) = 4.81, p < .01$), smokers across persistence groups differed on levels of urges ($F(2,43) = 3.85, p < .03$) and did not differ significantly in levels of withdrawal symptoms ($F(2,43) = 2.33, p > .10$). Of the primary covariates, higher levels of FTND were related to increased urges ($B = .17, SE = 0.04, p < 0.01$) and withdrawal symptoms ($B = .98, SE = 0.24, p < 0.01$). Planned contrasts suggested that low persistence smokers had higher urges ($B = .52, SE = 0.23, p < 0.03$) and a trend towards higher withdrawal scores ($B = 2.80, SE = 1.43, p < 0.06$) on quit day than high persistence smokers. Low persistence smokers and average persistence smokers had similar levels of urges ($B = 0.05, SE = 0.23, p > 0.10$) and withdrawal scores ($B = 0.83, SE = 1.44, p > 0.10$).

3.5 Levels of Affect, Urges and Nicotine Withdrawal in relation to Smoking Lapse

To determine if levels of NA on quit day predicted time to lapse among smokers who were confirmed abstinent on quit day, we used survival analysis. We entered standard covariates into a Cox Proportional Hazards regression model along with baseline levels of NA and a score reflecting NA assessed on quit day. Of the primary covariates, FTND ($B = .20, SE = 0.09, p < 0.04$) and a history of MDD ($B = 1.15, SE = 0.37, p < 0.01$) were related to the time to smoking lapse. After controlling for the set of primary covariates and initial levels of NA, levels of NA on quit day were significantly predictive of time to smoking lapse ($B = 0.51, SE = 0.24, p < 0.04$). For every standard deviation unit increase in NA, the risk of earlier lapse increased by $RR = 1.66$ (95CI = 1.03 - 2.67). We ran similar models evaluating depressive symptoms, urges, and withdrawal symptoms. Of these, only urges were related significantly to time to smoking lapse (p 's $< .05$). Higher urges on quit day were related to smoking lapse ($B = 0.80, SE = .35, RR = 2.22, 95CI = 1.11 - 4.41, p < .03$).

We next evaluated whether the relationship between higher levels of NA and higher levels of urges to smoke on quit day and early lapse differed across persistence groups. We hypothesized that among smokers who sustain at least 24-hours of continuous abstinence, negative affect-related risk for early lapse would be strongest among those with low persistence. Building upon the survival model above, we added the persistence group contrasts terms and the interaction between each persistence group contrast and quit day level of NA. Smokers low in persistence who had increases in NA relative to high persistence smokers were at significantly higher risk for early lapse ($B = 1.36, SE = 0.67, p < 0.05$). Smokers low in persistence compared to those with average persistence had no significant risk associated with increases in NA on quit date ($B = 0.30, SE = 0.71, p > 0.10$). In models assessing the interaction between persistence group contrasts and CES-D, urges to smoke, and withdrawal symptoms, we did not find stronger relationships for these risk factors among smokers with low persistence (p 's $> .10$).

4. Discussion

The purpose of this study was to determine if individual differences in distress tolerance were related prospectively to greater increases in negative affect during a quit attempt and whether levels of distress tolerance and changes in affect conveyed risk for early smoking lapse. Consistent with the proposed theoretical model of distress tolerance, compared to smokers high in task persistence, smokers low in persistence: 1) were more likely to smoke on quit day, 2) had higher levels of negative affect and urges on quit day, and 3) evidenced a stronger relationship between negative affect and early lapse. The results of this study are consistent

with recent theory and empirical findings examining the role of negative affect in early lapse smokers (Kenford et al., 2002; Piasecki et al., 2000).

Almost half of smokers demonstrating low persistence on the distress tolerance challenges smoked on quit day despite financial incentive. We observed significantly higher levels of negative affect and urges among the low persistence smokers who did abstain on quit day in comparison to high persistence smokers. While negative affect and smoking urges were predictive of early lapse, this relationship was particularly evident among those with low persistence, relative to high persistence groups. Interestingly, there were relatively few differences between low and average persistence groups. Thus, persistence on a single distress tolerance task would not be sufficient to identify smokers who would have difficulty quitting. Future work will be necessary to develop distress tolerance assessment approaches that may effectively identify smokers at risk for early lapse.

In addition, the findings of this study reinforce the notion that early lapse is an important phenomenon of smoking cessation and merits continued research attention, including a focus on treatment development. Existing cognitive-behavioral and relapse prevention models may not be ideally suited for addressing risk factors of early lapse. These traditional approaches focus on situational precipitants of relapse occurring over a period of weeks or months following cessation while not devoting sufficient attention to the cognitive affective experiences during the first few hours and days of quitting (Brown et al., 2005). Thus, the development of a specialized, efficacious treatment for early lapse smokers would have important clinical and public health significance in decreasing the overall prevalence of cigarette smoking (Brown, Palm et al., in press).

In addition to the pursuit of treatment development endeavors, the results from this study may provide guidance toward continued theoretical understanding of distress tolerance in smoking cessation. For example, this study suggests that affective processes and behavioral responses to the initial experiences of abstinence may have potent effects on drug reinstatement in the minutes or hours following attempts at cessation. Although typical treatments deliver interventions on quit day early lapse smokers may need support very early on in their quit attempts. Another potential area of further research involves a more careful examination of the time course and influence of changes in negative affect, depressive symptoms, and urges and withdrawal symptoms days or weeks prior to a scheduled quit date. In one study (McCarthy et al., 2006), escalating negative affect prior to a quit date was associated with poorer smoking outcomes. It is possible smokers' anticipatory reactions to quitting may differ across individual levels of distress tolerance, serving to set the stage for a difficult experience on quit day. Given how much has been learned about negative affect and smoking lapse from the use of ecological momentary assessment, utilizing this type of approach with low and high distress tolerance smokers may contribute toward an understanding of the potentially differential mechanisms occurring just prior to and during quit day, and in the early stages of quitting.

This study is limited by its small, homogenous sample of psychologically healthy adult smokers. In addition, we were limited in our ability to examine differences in negative affect, depressive symptoms, urges to smoke and withdrawal across persistence groups, because almost half of the low and average persistence groups lapsed on their quit day. As mentioned, moment-to-moment assessments may help address this issue in future studies. Lastly, we did not perform all possible statistical comparisons across persistence groups such that future work will benefit from the development of more continuous measures of distress tolerance.

Despite these limitations, this study contributes to the existing literature on distress tolerance in several ways. First, it corroborates the predictive validity of physical challenges (i.e., breath holding and inhalation of CO₂-enriched air) for early smoking lapse. Secondly, through the

use of a prospective design, and consistent with theoretical models, this study demonstrates that compared to high distress tolerance smokers, those with low distress tolerance do indeed experience more affective and withdrawal difficulties on quit day. Third, these findings point to the unique challenges low distress tolerance smokers experience when quitting, and thus reinforce the idea of specialized treatments for this subpopulation of smokers. Lastly, this work builds on the emerging evidence for the importance of the distress tolerance construct in our understanding of smoking relapse.

Acknowledgements

This research was supported by Grant 1R21CA88297 from the National Cancer Institute to Richard A. Brown, Ph.D.

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Figure 1.
Changes in negative affect from baseline to quit day across levels of persistence.

Table 1
Demographic Characteristics across Levels of Distress Tolerance

	Low Persistence (n=21)	Average Persistence (n=37)	High Persistence (n=23)
Gender (% Female)*	47.6%	48.6%	47.8%
Age	44.4 (13.7)	41.0 (11.7)	41.6 (11.7)
Race			
Caucasian	100%	78.4%	95.7%
African-American	0%	8.1%	4.5%
Hispanic	0%	5.4%	0%
Other	0%	8.1%	4.3%
Years of Education	13.62 (2.2)	13.78 (1.8)	14.61 (1.8)
Nicotine Dependence (FTND score)	3.9 (2.3)	4.1 (2.1)	4.3 (2.3)
Years Smoked	26.6 (14.1)	21.5 (11.5)	20.2 (10.9)
History of Major Depression	23.8%	36.1%	30.4%

* Chi square = 7.14, df=2, p<.05

Table 2

Demographic Characteristics of Quit Day lapsed and abstainers

	Quit Day Lapsed (n=25)	Quit Day Abstainers (n=52)
Gender (% Female)*	32.0%	55.8%
Age	42.7(13.1)	41.7(11.7)
Race		
Caucasian	91.3%	86.5%
African-American	0%	5.8%
Hispanic	4.3%	1.9%
Other	4.3%	5.8%
Years of Education**	13.0(1.7)	14.5(1.9)
Nicotine Dependence (FTND score)	4.2(1.9)	4.1(2.4)
Years Smoked*	27.8(11.9)	22.1(11.8)
History of Major Depression	28.0%	32.7%

*
p=.05**
p<.01