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Relationships between trait urgency, smoking reinforcement expectancies, and nicotine dependence

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Abstract

Urgency (i.e. the tendency to act rashly during negative/positive affect) may increase vulnerability to a variety of risky behaviors. This cross-sectional study of non-treatment-seeking smokers examined the relationship between urgency, level of nicotine dependence, and smoking reinforcement expectancies. Both positive and negative urgency were associated with nicotine dependence. Mediational analyses illustrated that smoking reinforcement expectancies significantly accounted for urgency-dependence relations, with negative reinforcement expectancies displaying incremental mediational effects. If replicated and extended, these findings may support the use of treatments that modify beliefs regarding smoking reinforcement outcomes as a means of buffering the risk of nicotine dependence carried by urgency.

Introduction

Urgency – a personality trait that reflects the tendency to act rashly during emotional states – has recently been identified as a unique facet of impulsivity in the personality literature [1, 2]. The propensity to devalue long-term consequences in favor of immediate reinforcement is an important aspect of rash behavior that is prominent in urgency and other impulsive traits [3]. Therefore, high-urgency individuals might be particularly vulnerable to engaging in risky behaviors, especially under conditions of high emotional intensity. Fittingly, emerging literature implicates urgency as a risk factor for various addictive and risky behaviors, including alcohol use [4–9], eating disorders [7, 10], gambling [11, 12], illegal

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drug use [13], risky sexual behavior [13], and smoking [14–16]. While there seems to be a broader urgency construct, urgency is typically broken down into two constructs: positive and negative urgency [17]. Positive urgency reflects the tendency to act rashly during positive emotional states, and negative urgency reflects the tendency to act rashly during negative emotional states.

In contrast with the more extensive literature on urgency and alcohol use [4–9], there has been relatively limited research on urgency and smoking. Spillane et al. (2010) found that the tendency to act rashly during positive emotional states (i.e., positive urgency), but not the corresponding tendency during negative emotional states (i.e., negative urgency), was related to level of nicotine dependence in college students. This study sample included individuals who on average had low levels of nicotine dependence (*M* Fagerström Test of Nicotine Dependence score = 1.61) and were likely early in their smoking career (*M* age = 18.8 years), raising questions as to whether these findings will extend to heavier, more dependent smokers with a longer history of smoking. Other work illustrates that negative urgency is related to higher cigarette craving [14, 15] – a putative marker of dependence. Outside of this limited base of data, the relationship between urgency and smoking has largely remained uninvestigated, and the mechanisms underlying the relationship of urgency to smoking is unknown.

Smoking reinforcement expectancies (i.e., beliefs related to the anticipated beneficial effects smoking has on mood and behavior) are theorized to be a powerful motivational factor driving smoking behavior [18] and could play a role in urgency-smoking relations. Research commonly identifies two subtypes of beliefs about the reinforcing properties of smoking: (1) relief of negative affect (i.e., negative smoking reinforcement expectancies) and (2) production of pleasure and enjoyable sensory experiences (i.e., positive smoking reinforcement expectancies). Individuals who hold stronger smoking reinforcement expectancies related to desirable outcomes may be more likely to act on those beliefs with smoking, which could lead to affirmation of these expectancies and more smoking behavior, ultimately increasing propensity for nicotine dependence [19–21].

Emotion and impulsivity-related processes might play an important role in the development and strengthening of smoking expectancies. In a laboratory based study with lifetime smokers, McKee et al. (2003) found that experimentally induced mood generated state smoking expectancies consistent with the type of mood induction; that is, positive and negative mood inductions increased endorsement of positive and negative reinforcement smoking expectancies, respectively [22]. Other studies have found that experimentally-induced negative mood amplifies the reinforcing properties of smoking [23, 24]. Finally, studies suggest that levels of impulsivity may impact smoking expectancies. Specifically, individuals with high rates of impulsivity experience greater negative reinforcement expectancies following smoking initiation [25], and the negative reinforcing properties of nicotine may be stronger in impulsive individuals [26]. Given these extant findings and the suspicion that high-urgency individuals may be more likely to smoke during emotionally charged states, it is reasonable to predict a mediational pathway whereby high-urgency individuals have strong smoking reinforcement expectancies, which relates to greater severity of nicotine dependence.

This cross-sectional correlational study of regular smokers (≥ 10 cig/day for 2+ years) had two aims: (1) to examine the relationship between urgency and level of nicotine dependence and (2) to investigate smoking reinforcement expectancies as a factor that accounts for (i.e., statistically mediates) the relationship between urgency and nicotine dependence. Because negative or positive mood states may increase the formation of smoking expectancies consistent with type of mood [22], we hypothesized that the relationship between urgency and smoking reinforcement expectancies would show affective specificity. That is, we predicted that: (1) positive urgency would be related to positive smoking reinforcement expectancies; (2) negative urgency would be related to negative smoking reinforcement expectancies; and (3) both of those pathways would mediate corresponding urgency-dependence relations. Although we expected two affectively specific pathways, there is the alternative possibility that both facets of urgency share a common pathway to dependence in which the tendency to act rashly in any type of emotional state (positive or negative) may increase beliefs that smoking generates any type of reinforcing outcome (positive or negative). Hence, we also examined whether positive and negative urgency demonstrated unique or overlapping relationships to nicotine dependence and whether positive and negative reinforcement expectancies illustrated unique or overlapping mediational pathways linking urgency and nicotine dependence.

There is evidence suggesting that men show higher levels of urgency [27]. Furthermore, in the alcohol literature, there is some evidence that only males show significant relationships between urgency, alcohol expectancies, and problem drinking [5]. On the other hand, women are more likely to smoke following experimentally-induced negative mood [28], which might indicate relief from negative affect may be a stronger predictor for smoking in females versus males [29]. These studies suggest that the relationship between urgency, expectancies, and nicotine dependence may be moderated by gender. Given these past findings, we explored moderation of urgency-dependence relationships by gender but proposed no specific hypotheses.

Method

Participants

The current paper reports findings from a secondary analysis of non-treatment seeking daily smokers recruited from the Los Angeles area via advertisements announcing the opportunity to take part in a laboratory study of individual differences in tobacco withdrawal effects [30]. Inclusion criteria required participants to be 18 years of age or older, smoke regularly for at least the past 2 years (≥ 10 cigs/day), and fluent in English. Exclusion criteria included: (1) current *DSM-IV* non-nicotine substance dependence, (2) current *DSM-IV* mood disorder or psychotic symptoms, (3) breath carbon monoxide (CO) levels < 10ppm at intake to prevent admission of individuals over-reporting their smoking in order to participate, (4) use of non-cigarette forms of tobacco or nicotine products, (5) current use of psychiatric or psychoactive medications, (6) current pregnancy, and (7) planning to quit or substantially cut down on smoking in the next 30 days.

After eligibility screening of 343 potential participants, 207 were eligible and completed all questionnaires included in the current study. Participants were compensated $15 to complete

the baseline session. The University of Southern California Internal Review Board approved the protocol.

Procedure

Following a preliminary telephone eligibility screening, participants attended a session involving informed consent, eligibility assessments involving breath alcohol and carbon monoxide analysis and administration of the structured Clinical Interview for DSM-IV Non Patient Edition [31] to assess mood disorders, psychosis, and substance use disorder for eligibility purposes. Eligible participants continued with the remainder of the baseline session, which involved completing the measures described below.

Measures

Demographic and Smoking Questionnaire—An author-constructed questionnaire was used to assess demographic and smoking characteristics (e.g., cigarettes smoked per day and age of smoking onset).

Fagerström Test of Nicotine Dependence (FTND)—The FTND [32] is a widely-used six-item self-report measure of nicotine dependence severity that taps heavy and compulsive smoking behavior (e.g., “How soon after you wake up do you smoke your first cigarette?” and “How many cigarettes per day do you smoke?”). Scores range from 0–10 with higher scores indicating higher levels of dependence. Past work illustrates that FTND demonstrates good reliability and predictive and convergent validity to other measures of nicotine dependence [33] and dependence-relevant processes, including nicotine withdrawal [34], craving [35], biomarkers indicative of tobacco exposure [36], and abstinence following cessation [33, 37, 38].

UPPS-P Impulsive Behavior Scale (UPPS-P), Negative and Positive Urgency Subscales—The UPPS-P Impulsive Behavior Scale [17, 39] has separate subscales for positive urgency (14 items; e.g., “When I’m in a great mood, I tend to get into situations that could cause me problems” and “I tend to lose control when I am in a great mood”) and negative urgency (12 items; 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 rate statements on a 4-point Likert scale from “disagree strongly” (1 point) to “agree strongly” (4 points) with higher scores indicating higher levels of urgency. An average score per item was computed for both subscales.

Smoking Consequences Questionnaire (SCQ)—The SCQ [21, 40] instructs participants to rate how true various statements describing different expected effects of smoking are on a scale from 1 (“Not true of me at all”) to 7 (“Very true of me”). The SCQ has a negative smoking reinforcement subscale, which contains 11 items related to smoking to relieve aversive states (e.g., “Smoking helps me deal with depression”). The SCQ also has a positive reinforcement subscale, which contains 12 items related to smoking enjoyment and sensory satisfaction (e.g., “I really enjoy a cigarette when I’m relaxed and have nothing to do”).

Data Analysis

Preliminary analyses—Preliminary analyses involved reporting sample descriptives, the internal consistency of key measures and correlations between key measures, demographics, and smoking characteristics.

Primary analyses—We ran linear regression models in which a single urgency subscale served as the predictor and FTND served as the outcome. If an urgency subscale (the predictor) significantly predicted FTND (the outcome), we then moved on to mediational models to explore whether the relationship of urgency to nicotine dependence was mediated by smoking reinforcement expectancies (the mediator). Mediational paths were analyzed by computing the product of the coefficients from two regression models: (a) the "A path" which examined the relationship between the predictor (urgency) to the mediator (smoking reinforcement expectancies); and (b) the "B path" which examined the relationship of the mediator (smoking reinforcement expectancies) to the outcome (nicotine dependence). The product of the coefficients served as the indicator of the strength of the indirect effect, for which significance was determined using PRODCLIN to estimate asymmetric 95% confidence intervals (*CI*s) around the mediational effect [41]. In this approach, the indirect effects are significant if the CI does not include 0. To determine the remaining direct effect of the predictor, linear regression models were run with the predictor (urgency) controlling for the mediator (smoking reinforcement expectancies). In cases where both positive and negative reinforcement expectancies exhibited significant mediational effects, we continued with multiple mediational analyses. Here, we included both positive and negative smoking reinforcement expectancies scales as simultaneous mediators to explore whether mediational paths involving positive and negative reinforcement expectancies exhibited unique or overlapping variance with one another.

Supplemental analyses—We tested combined regression models that paralleled the individual models described above, except that both urgency scales were simultaneously included as predictors to determine whether the effects of positive and negative urgency on dependence remained after controlling for the covariance between the two urgency scales. We also explored gender moderation by looking at the interactive effects of gender and urgency on outcome measures. If the interaction between gender and urgency significantly predicted FTND, we continued on to moderated mediational analyses to explore whether gender moderated the mediational effect of urgency → reinforcement smoking expectancies → FTND.

Significance was set to .05 for all analyses. Results are reported as standardized regression coefficients (β). Demographic or smoking variables that were significantly correlated with either measure of urgency and FTND were entered as covariates in regression analyses.

Results

Preliminary analyses

The sample demographics are reported in Table 1. The 2:1 gender ratio is consistent with Los Angeles County estimates of smoking prevalence 19% to 10% males to females [42].

Though there was quite a bit of variability across participants (see *SD*s in Table 1), on average the sample consisted of moderately-to-heavily nicotine dependent middle-aged smokers who had been regularly smoking for many years. There was good to excellent internal consistency for each measure, with the exception of FTND (see Table 1). Both positive and negative urgency scores did not significantly correlate with demographic variables, cigarettes smoked per day, or age of smoking onset, but were correlated with each other, years of regular smoking, and other key variables (Table 1).

Primary analyses

In individual regression models, negative urgency predicted negative reinforcement expectancies ($\beta = .35$, $p < .0001$), positive reinforcement expectancies ($\beta = .17$, $p = .01$), and FTND ($\beta = .15$, $p = .03$). Positive urgency also predicted negative reinforcement expectancies ($\beta = .34$, $p < .0001$), positive reinforcement expectancies ($\beta = .15$, $p = .03$), and FTND ($\beta = .16$, $p = .03$).

Separate mediational models illustrated that the relationship of negative urgency to nicotine dependence was significantly mediated by negative (β [95% CI] = .091 [.037 – .158]) and positive (β [95% CI] = .041 [.006 – .088]) reinforcement expectancies. The remaining direct effect of negative urgency on nicotine dependence was no longer significant after controlling for reinforcement expectancies in both models (Table 2). Similarly, the relationship of positive urgency to nicotine dependence was significantly mediated via negative (β [95% CI] = .088 [.038 – .158]) and positive (β [95% CI] = .036 [.002 – .082]) smoking reinforcement expectancies, with no significant remaining direct effect of positive urgency in either case (Table 2).

In multiple mediational models predicting FTND that included both negative and positive reinforcement as simultaneous mediators, the mediational pathways through negative reinforcement expectancies remained significant for paths originating from both negative (β [95% CI] = .063 [.008–.130]) and positive (β [95% CI] = .061 [.008 – .061]) urgency. By contrast, the mediational pathway involving positive reinforcement expectancies was not significant for paths originating from either negative (β [95% CI] = .026 [−.002–.026]) or positive (β [95% CI] = .022 [−.002 – .062]) urgency in these models.

Supplemental analyses

In combined models that included both positive and negative urgency as simultaneous predictors, neither urgency scale was significantly associated with FTND (negative urgency:$\beta = .08$, $p = .35$; positive urgency: $\beta = .10$, $p = .24$), suggesting that their overlapping variance cancelled each other out with respect to predicting FTND. Also, we found no significant interaction between gender and urgency on any of the outcome measures, suggesting that the above mentioned relationships did not differ by gender.

Discussion

This study found that in a sample of moderate-to-heavy chronic smokers both negative and positive urgency were related to severity of nicotine dependence. These findings are partially consistent with Spillane et al. [16], who reported that only positive urgency was

related to nicotine dependence in sample of college students with predominantly low levels of nicotine dependence (FTND score *M* = 1.61). The discordant results across these two samples may indicate that only positive urgency influences level of nicotine dependence early in the developmental process of tobacco addiction. However, among established smokers who are later in the developmental trajectory of tobacco addiction, it is possible that negative urgency becomes increasingly relevant to the expression of nicotine dependence, on par with positive urgency. Fittingly, urgency-dependence correlations were nearly identical for positive and negative urgency in the current sample, and after accounting for the covariance between positive and negative urgency in combined regression models, neither urgency scale was incrementally associated with nicotine dependence. The lack of unique predictive value of positive and negative urgency may reflect the strong correlation between these two constructs and the notion that positive and negative urgency make up a broader urgency construct [1]. Indeed, the two urgency subscales have exhibited sizeable correlations with one another, both in this sample (*r* = .62) and a prior sample of smokers (*r* = .54) [16].

The results of this study also indicate that relationships between urgency and nicotine dependence are accounted for by variance in smoking reinforcement expectancies. These results are consistent with the notion that high-urgency individuals are prone to more severe forms of nicotine dependence because they have greater expectancies that nicotine will counteract negative affect and provide pleasurable sensory experiences. The results of this study align with previous reports in the alcohol literature suggesting that alcohol expectancies mediate the relationship between urgency and alcohol use [5, 43]. By extending these findings to the smoking literature, the results of this study suggest that urgency may confer risk for use and abuse of multiple substances via a common pathway of expected outcomes of substance use.

In contrast to our hypotheses, the relationships between urgency and smoking reinforcement expectancies did not show affective specificity. Both types of urgency were associated with both positive and negative reinforcement smoking expectancies. Furthermore, after accounting for the overlap between both mediational pathways, only negative smoking reinforcement expectancies emerged as a significant factor that accounted for the covariance between urgency and nicotine dependence. Differences in how urgency relates to positive versus negative reinforcement smoking expectancies may suggest that negative reinforcement is more important in influencing smoking among those with emotional-impulsive personality traits. Indeed, a previous report showed that negative reinforcement smoking expectancies mediated the relationship between negative urgency and smoking initiation [44]. Furthermore, research also suggests that nicotine may be a particularly strong negative reinforcer in impulsive daily smokers [26].

Lastly, we did not find any gender differences in the associations between urgency, smoking reinforcement expectancies, and nicotine dependence. Although this is a bit surprising given the literature showing higher urgency in men [27], another set of studies suggests that women may be more prone to smoke during negative affective states [28, 29]. The current results suggest that urgency is associated with smoking reinforcement expectancies and nicotine dependence independent of gender.

Some limitations to this study should be noted. For one, the cross-sectional nature of this study does not allow us to draw causal interpretations. Though we hypothesized that the direction of the mediational pathway works from urgency to smoking reinforcement expectancies to nicotine dependence, it could be the case that longer histories of smoking in nicotine-dependent individuals allow for the accumulation of stronger reinforcement learning experiences from smoking. Additionally, chronic nicotine exposure could induce neuroadaptations in circuits involving impulse and emotion [45], such that dependence could intensify levels of trait urgency. This latter explanation is somewhat unlikely considering that both positive [16] and negative urgency [44] have been associated with smoking behavior among young adults early in their smoking career. Additionally, prior work suggests that urgency is a stable trait over time [27], which is inconsistent with the notion that urgency is a consequence of smoking. Also, although we found that urgency was not associated with any demographic characteristics and the data supported an apriori mediational hypothesis involving three separate variables, the correlational nature of this study leaves open the possibility that an unmeasured extraneous variable explains the relationships demonstrated herein. Additionally, this study only included self-report measures; thus method variance may have contributed to the relationships identified here. Future studies could address this by including behavioral measures of urgency, impulsivity, and emotional reactivity and biochemical indicators of smoking in conjunction with standard self-report indices like those used here. Relatedly, we did not include any other additional measures of impulsivity outside of urgency. Hence we cannot elucidate whether urgency has incremental predictive validity for explaining nicotine dependence over and above other impulsive traits (e.g., lack of premeditation, sensation seeking), which is an important question to be addressed in future work. Finally, FTND exhibited modest internal consistency in this sample (Cronbach's $\alpha = .53$), which is concordant with some prior psychometric analyses of the FTND [36, 46]. Hence, measurement error might have led to an underestimation of the strength of relationships to nicotine dependence reported in this study.

Despite these limitations, this study expands the literature on urgency and nicotine dependence in several ways. The current study provides novel evidence that is consistent with the notion that urgency may increase risk of progressing to more severe forms of nicotine dependence within the population of long-term daily smokers. This is an important finding because this subpopulation of smokers: (1) have likely accumulated an extensive history of smoking reinforcement experiences and perhaps stronger emotional precipitants underlying their smoking [47]; and (2) reflect the subgroup of smokers who may have particularly difficulty quitting smoking and thus are a public health priority. This is also the first study examining a putative mechanism linking urgency and nicotine dependence, which is important in advancing theory on the motivational processes underlying nicotine dependence among individuals with psychological vulnerability factors (e.g., urgency). Following replication and extension to longitudinal and experimental designs, the current line of research identifies smoking reinforcement expectancies as specific targets for interventions designed to buffer the risk of nicotine dependence carried by urgency. Cognitive interventions that challenge smoking expectancies and attempt to change them have been shown to alter smoking motivation and ultimately reduce smoking behavior [48,

49]. Thus, interventions that challenge smoking reinforcement expectancies could prove to be particularly effective in treating nicotine dependence among high-urgency individuals.

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Table 1

Correlation Matrix showing correlations between the study measures and sample demographics and smoking patterns.

		M (*SD*) or %	Range	1	2	3	4	5	6	7	8	9	10
1	UPPS-P Negative Urgency	2.21 (.66)	1–4	(.89)									
2	UPPS-P Positive Urgency	1.71 (.69)	1–4	.62***	(.94)								
3	SCQ Negative Reinforcement	4.38 (1.76)	1–7	.35***	.34***	(.96)							
4	SCQ Positive Reinforcement	4.58 (1.21)	1–7	.17*	.15*	.54***	(.88)						
5	FTND	5.28 (1.86)	1–10	.15*	.16*	.26***	.24***	(.53)					
6	Age	44.54 (11.29)	20–66	−.07	.10	−.02	−.12	.16*					
7	Gender (% Female)[a]	33.3		−.10	−.01	−.26***	.06	−.04	.12				
8	Race (% Black)	49.3		−.08	−.09	−.07	.06	−.08	−.24***	.03			
9	Cigarette smoked per day	16.53 (6.68)	10 – 60	.11	.06	.06	.07	.45**	.10	−.04	.13		
10	Age of Onset of Regular Smoking	19.8 (6.15)	8–47	−.09	−.12	−.10	−.23**	−.15*	.13	.01	−.07	.05	
11	Years of Regular Smoking	24.73 (12.17)	2–50	−.03	.14*	.02	−.05	.21*	.87***	.11	−.20**	.06	−.38***

Note. Cronbach's alphas shown in parentheses on the diagonal. Correlations among continuous variables are Pearson correlation coefficients. Correlations between continuous and dichotomous variables are point-biserial correlation coefficients. Correlations among dichotomous variables are Spearman rho coefficients. *M* = Mean; *SD* = Standard Deviation; UPPS-P = UPPS-P Impulsive Behavior Scale; SCQ = Smoking Consequences Questionnaire; FTND = Fagerström Test of Nicotine Dependence.

[a]Females coded as 0, males coded as 1.

*p < .05,

**p < .01,

***p<.001

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Table 2

Mediation analyses examining smoking reinforcement expectancies as factors that explain the relationship between urgency and nicotine dependence

	β^a	*p*
Negative Urgency via Negative Smoking Reinforcement Expectancies Mediator Model		
A Path: Negative Urgency → Negative Smoking Reinforcement Expectancies	.35	<.001
B Path: Negative Smoking Reinforcement Expectancies → Nicotine Dependence	.26	<.001
Indirect Mediated Effect	.09[b]	<.001
Remaining Direct Effect	.07	.358
Negative Urgency via Positive Smoking Reinforcement Expectancies Mediator Model		
A Path: Negative Urgency → Positive Smoking Reinforcement Expectancies	.17	.014
B Path: Positive Smoking Reinforcement Expectancies → Nicotine Dependence	.24	.001
Indirect Mediated Effect	.04	<.050
Remaining Direct Effect	.11	.108
Positive Urgency via Negative Smoking Reinforcement Expectancies Mediator Model		
A Path: Positive Urgency → Negative Smoking Reinforcement Expectancies	.34	< .001
B Path: Negative Smoking Reinforcement Expectancies → Nicotine Dependence	.26	< .001
Indirect Mediated Effect	.09[b]	<.001
Remaining Direct Effect	.08	.271
Positive Urgency via Positive Smoking Reinforcement Expectancies Mediator Model		
A Path: Positive Urgency → Positive Smoking Reinforcement Expectancies	.15	.029
B Path: Positive Smoking Reinforcement Expectancies → Nicotine Dependence	.24	.001
Indirect Mediated Effect	.04	<.050
Remaining Direct Effect	.12	.074

Note.

[a] Standardized regression coefficient.

[b] Signifies that the mediational effect remained significant (p <.05) in a multiple mediational model including both positive and negative reinforcement as simultaneous mediators of nicotine dependence.