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Anxiety Sensitivity and Negative Urgency: A Pathway to Negative Reinforcement-Related Smoking Expectancies

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Abstract

Objectives—Anxiety sensitivity—fear of anxiety symptoms—may increase motivation to smoke by influencing the development of cognitive expectations regarding smoking’s negative reinforcing effects; yet, the nature and mechanisms of this pathway are unclear. We hypothesized that relations between anxiety sensitivity and negative reinforcement-related smoking expectancies would be mediated by negative urgency, i.e., a trait tendency to act impulsively during negative affect.

Methods—In a cross-sectional design, we administered self-report measures of anxiety sensitivity, negative urgency, and negative reinforcement-related smoking outcome and abstinence expectancies to 205 smokers (10 cig/day, 34% female, *M* age = 44.4 years).

Results—Anxiety sensitivity was associated with stronger expectancies that smoking alleviates negative affect ($\beta = .30, p < .0001$) and smoking abstinence exacerbates aversive withdrawal symptoms ($\beta = .24, p = .0004$). Negative urgency partially mediated the relation between anxiety sensitivity and both types of negative reinforcement-related smoking expectancies ($\beta_s .057, ps .007$). Results remained significant after statistically controlling for anxiety and nicotine dependence symptoms.

Conclusions—Smokers high in anxiety sensitivity tend to display negative urgency, which in turn is related to greater expectations of negative reinforcement consequences of smoking and smoking abstinence. Treatments which mitigate fear of anxiety symptoms and the tendency to act impulsively in response to negative affect (e.g., interoceptive exposure, distress tolerance skills training, and mindfulness training) may be particularly useful in assisting with smoking cessation for high-anxiety sensitivity smokers.

Keywords

anxiety sensitivity; negative reinforcement; negative urgency; smoking outcome expectancies; smoking abstinence expectancies

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Conflicts of Interest

The authors declare no conflict of interest.

Anxiety sensitivity (AS)—fear of anxiety symptoms and their consequences—is a dispositional cognitive characteristic implicated in the etiology of anxiety disorders (Reiss et al., 1986; Naragon-Gainy, 2010). AS has also been identified as a factor that may promote regular cigarette smoking. Indeed, AS has been associated with smoking maintenance indicators among established smokers, such as increased risk of lapse following a cessation attempt (Brown et al., 2001; Zvolensky et al., 2009). Importantly, the relation between AS and smoking persists after statistically controlling for anxiety and negative affectivity (Zvolensky et al., 2007, 2009), indicating that AS is not just a proxy for anxiety pathology that contributes to smoking; rather, AS per se is uniquely associated with smoking. Hence, it is critical to understand the nature of the association between AS and smoking in order to advance theoretical models of psychiatric comorbidity with smoking and shed light on targets for smoking cessation treatments for individuals with emotional vulnerabilities.

Negative reinforcement processes have particular relevance for understanding the relation between AS and smoking. AS is suspected to contribute to anxiety pathology in part because high-AS individuals find anxiety symptoms more aversive and are motivated to avoid experiencing anxiety, which may prevent extinction of anxiety responses and negatively reinforce AS-related fears and anxiety pathology (Taylor, 1999). Therefore, high-AS individuals may be prone to behaviors that facilitate the avoidance and alleviation of anxiety. Smoking is one such behavior that can acutely diminish anxiety via the pharmacological effects of nicotine (Benowitz, 2008; Cohen et al., 2009). Furthermore, anxiety and other negative affective states are among the most common and severe symptoms expressed in regular smokers abstinent from tobacco (Hughes, 2007; Leventhal et al., 2010). Thus, high-AS individuals may be more likely to smoke to ameliorate anxiety and other negative affective states. Because AS is a cognitive construct involving expectations about the effects of anxiety symptoms, AS's influence on negative reinforcement smoking motivation may be most prominently expressed as cognitive expectancies of tobacco's mood-altering effects. Indeed, prior work illustrates that AS is associated with expectancies that smoking reduces negative affect (Brown et al., 2001; Gregor et al., 2007; Leyro et al., 2008) and expectancies that smoking abstinence increases aversive symptoms (Abrams et al., 2011). Given that substance use expectancies are thought to be proximal to motivation to use drugs (Leventhal and Schmitz, 2006; Metrik and Rohsenow, 2013; Niaura et al., 1991), it is important to study the mechanisms linking AS and negative reinforcement-related smoking expectancies (i.e., beliefs that smoking and smoking abstinence alleviate and exacerbate aversive states, respectively). Besides the intrinsic value, such knowledge may lead to a wider variety of treatment options because it may be possible to develop cessation treatment techniques that target the putative precipitating variable (the predictor) as well as the intervening variable (the mediator) on smoking motivation.

Negative urgency is a plausible mediator of the relation between AS and negative reinforcement-related smoking expectancies yet has not been studied in this context. Negative urgency is a personality trait indicative of the tendency to act impulsively during negative affective states, which is likely a reflection of maladaptive efforts to alleviate negative emotions (Cyders and Smith, 2008; Whiteside and Lynam, 2001). Cyders and Smith (2008) proposed that negative urgency may partially result from intense negative emotions increasing one's focus on altering the immediate situation or aversive experience,

thereby disrupting rational decision making and leading to lapses in behavioral regulation. Similarly, because high-AS individuals are especially fearful of experiencing anxiety and anxiety-related sensations, they may devote considerable focus on escaping the emotional experience and internal sensations during negative affective states involving anxiety. As a result of this preoccupation with escaping the aversive experience, high-AS individuals may also tend to display impulsive behavior during negative affective states (i.e., negative urgency), one expression of which may be cigarette smoking. Consistent with this notion, prior research indicates that AS is associated with negative urgency (Weitzman et al., 2011), and negative urgency is related to smoker status (Combs et al., 2012; Spillane et al., 2010) and craving cigarettes for relief from negative affect (Billieux et al., 2007; Doran et al., 2009). Thus, a probable consequence of negative urgency in high-AS smokers is the development of negative reinforcement smoking expectancies.

In the current cross-sectional study of regular cigarette smokers, we examined interrelations between AS, negative urgency, and two types of negative reinforcement-related smoking expectancies: (1) smoking outcome expectancies (i.e., beliefs that smoking alleviates aversive states) and (2) smoking abstinence expectancies (i.e., beliefs that smoking abstinence results in aversive nicotine withdrawal symptoms). We hypothesized that AS would be associated with stronger negative reinforcement-related smoking outcome and abstinence expectancies. We further hypothesized that variation in negative urgency would account for (i.e., statistically mediate) the covariance between AS and both types of negative reinforcement-related smoking expectancies. Lastly, we included measures of smoking heaviness (cigarettes per day) and persistence (proportion of past quit attempts involving abstinence of less than one month) to examine if AS and negative urgency were related to those smoking outcomes similar to relations with smoking expectancies.

METHODS

Participants

Participants were 205 smokers (33.7% female) between the ages of 20 and 66 ($M = 44.4$, $SD = 11.3$), of whom 49.3% were Black, 37.1% were Caucasian, and 13.6% were of another racial background. Participants were recruited from the Los Angeles area via online advertisements and fliers announcing the opportunity to take part in a study on personality and smoking. The current report reflects a secondary analysis of baseline data from a more extensive multi-session laboratory study of smoking abstinence effects, as the baseline session included the primary measures of interest. Inclusion criteria required participants to be fluent in English, 18+ years of age, and a regular smoker of 10+ cigarettes per day during the past 2+ years. Exclusion criteria included current *DSM-IV* non-nicotine substance dependence, current *DSM-IV* mood disorder or psychotic symptoms, breath carbon monoxide (CO) levels < 10 ppm at intake (to prevent the admission of individuals over-reporting their smoking level), use of non-cigarette forms of tobacco or nicotine products, use of psychiatric or psychoactive medications, reported pregnancy, and planning to quit or substantially reduce smoking in the next 30 days.

Of the 343 potential participants who were eligible and agreed to participate, 205 completed the key measures included in the current study. Participants were paid \$15 to travel to the

laboratory and complete the baseline session. The University of Southern California Institutional Review Board approved the protocol.

Procedure

Subsequent to passing the phone screen, participants attended a baseline session involving informed consent, breath CO analysis, and administration of the Structured Clinical Interview for *DSM-IV* Non-Patient Edition (First et al., 2002) to assess eligibility criteria. Eligible participants continued with the remainder of the session, which involved completing the measures described below.

Measures

Key Variables

Anxiety Sensitivity Index (ASI): The ASI (Reiss et al., 1986) is a 16-item questionnaire that evaluates the degree to which an individual is fearful of anxiety symptoms and their consequences. Scores range from 0 to 64, and higher scores indicate higher levels of AS. The ASI has displayed good reliability and discriminant validity from anxiety symptoms and other affective constructs in prior work (Naragon-Gainy, 2010).

Smoking Consequences Questionnaire, Negative Reinforcement Scale (SCQ-NR): The SCQ-NR (Brandon and Baker, 1991; Wetter et al., 1994) is an 12-item self-report measure that assesses the extent to which an individual expects smoking to relieve negative affective states. Scores range from 12 to 84, and higher scores indicate greater negative reinforcement-related smoking outcome expectancies. The SCQ-NR has displayed high internal consistency (Cronbach's $\alpha = .93-.94$) in past studies (Brandon and Baker, 1991; Wetter et al., 1994).

Smoking Abstinence Questionnaire (SAQ), Withdrawal Scale: The SAQ Withdrawal scale (Hendricks et al., 2011) is a 7-item self-report measure that assesses the likelihood an individual expects to experience nicotine withdrawal symptoms after quitting smoking. Scores range from 0 to 42, and higher scores indicate greater negative reinforcement-related smoking abstinence expectancies. The SAQ Withdrawal scale has displayed good internal consistency and convergent validity in prior work (Hendricks et al., 2011).

UPPS Impulsive Behavior Scale (UPPS), Negative Urgency Subscale: The UPPS Negative Urgency subscale (Whiteside and Lynam, 2001; Cyders and Smith, 2008) is a 12-item self-report measure of the tendency to act impulsively during negative affective states. Scores range from 12 to 48, and higher scores indicate higher levels of negative urgency. In prior work (Whiteside and Lynam, 2001), the Negative Urgency subscale displayed good internal consistency and construct validity.

Additional Measures and Covariates

Demographic and Smoking Questionnaire: An author-constructed questionnaire was used to assess demographic and smoking characteristics (e.g., cigarettes smoked per day and proportion of past quit attempts in which individuals were not able to maintain abstinence for at least one month).

Fagerström Test of Nicotine Dependence (FTND): The FTND (Heatherton et al., 1991) is a well-validated 6-item self-report measure of nicotine dependence severity that taps heavy and compulsive smoking behavior. Scores range from 0 to 10, and higher scores indicate higher levels of nicotine dependence.

Mood and Anxiety Symptom Questionnaire, Anxious Arousal Scale (MASQ-AA): The MASQ-AA (Watson et al., 1995) is a well-validated 17-item self-report measure of hyperarousal and somatic symptoms primarily associated with anxiety (i.e., symptoms that are highly distinct to anxiety). Items are rated on a 5-point Likert scale ranging from 1 (*not at all*) to 5 (*extremely*), and higher sum scores indicate higher levels of anxiety symptoms experienced during the past week.

Data Analysis

Alpha was set at .05 for all analyses. We first obtained descriptive statistics and correlations between key measures and smoking characteristics. We then ran linear regression models in which AS served as the predictor and one of the smoking measures served as the outcome. For each outcome, we then tested for mediation by using the product of coefficients from the A and B paths as the indicator of the strength of the indirect effect, for which significance was determined using the RMediation package (Tofighi and MacKinnon, 2011). To determine the effect of AS beyond what is accounted for by mediation (i.e., the remaining direct effect), linear regression models were run examining the relation of AS to a smoking variable after controlling for negative urgency.

Each model was re-tested adjusting for covariates. Because AS and anxiety symptoms are closely related and have both been tied to negative reinforcement-related smoking motives (Gregor et al., 2007), MASQ-AA was included as a planned covariate in order to examine the predictive validity of AS on smoking behavior beyond that of its shared variance with anxiety symptoms. We also included FTND as a planned covariate to determine whether relations between AS were unique from heavy and compulsive smoking and qualitatively specific to other smoking variables. Results are reported as standardized regression coefficients (β s). Effect sizes for mediational analyses were expressed as percent of the total effect, which is the mediated (indirect) effect divided by the total effect (i.e., the indirect effect divided by the sum of the indirect and direct effects; MacKinnon, 2008, pp. 79–82).

RESULTS

On average, participants displayed a moderate level of nicotine dependence on the FTND ($M = 5.3$, $SD = 1.9$) and reported that they had been regularly smoking for 24.7 years ($SD = 12.2$). Cronbach's alphas, means, and standard deviations for and Pearson correlation coefficients between measures are displayed in Table 1.

In individual regression models, AS was significantly associated with smoking outcome ($\beta = .30$, $p < .0001$) and abstinence expectancies ($\beta = .24$, $p = .0004$) and proportion of quit attempts involving abstinence of less than one month ($\beta = .18$, $p = .035$) but not with cigarettes per day ($\beta = -.01$, $p = .89$). After controlling for anxious arousal and severity of nicotine dependence, AS was still significantly associated with smoking outcome ($\beta = .24$, p

= .001) and abstinence expectancies ($\beta = .20, p = .006$) but not with proportion of quit attempts in which abstinence could not be maintained for at least one month ($\beta = .15, p = .12$).

The relation of AS to smoking outcome expectancies was significantly mediated by negative urgency (unadjusted: β [95% CI] = .106 [.051 – .172], 33% of total effect; adjusted for MASQ-AA and FTND: β [95% CI] = .078 [.025 – .142], 29% of total effect), and the remaining direct effect of AS on smoking outcome expectancies was significant (Table 2). Similarly, the relation of AS to smoking abstinence expectancies was significantly mediated by negative urgency (unadjusted: β [95% CI] = .057 [.014 – .112], 22% of total effect; adjusted: (β [95% CI] = .042 [.008 – .090], 19% of total effect), and the remaining direct effect of AS on smoking abstinence expectancies was significant (Table 2). The relation of AS to proportion of quit attempts involving abstinence of less than one month was significantly mediated by negative urgency only when not adjusting for covariates (β [95% CI] = .063 [.012 – .128], 33% of total effect), and the remaining direct effect of AS on proportion of quit attempts involving abstinence of less than one month was not significant ($\beta = .13, p = .17$).

To examine alternatives regarding the directionality of mediational pathways, we conducted reverse mediation analyses (in which negative urgency was the predictor and AS was the mediator). In individual regression models, negative urgency was significantly associated with smoking outcome ($\beta = .35, p < .0001$) and abstinence expectancies ($\beta = .19, p = .007$) and proportion of quit attempts involving abstinence of less than one month ($\beta = .21, p = .015$) but not with cigarettes per day ($\beta = .11, p = .12$). After controlling for anxious arousal and severity of nicotine dependence, negative urgency was still significantly associated with smoking outcome expectancies ($\beta = .29, p < .0001$) but not with smoking abstinence expectancies ($\beta = .11, p = .10$), proportion of quit attempts in which abstinence could not be maintained for at least one month ($\beta = .15, p = .07$), or cigarettes per day ($\beta = .02, p = .74$). Reverse mediation analyses revealed a similar pattern of results to the initial mediational analyses for smoking outcome expectancies (unadjusted: β [95% CI] = .092 [.041 – .155]; adjusted: (β [95% CI] = .059 [.018 – .111]) and proportion of quit attempts involving abstinence of less than one month (unadjusted only: β [95% CI] = .063 [.012 – .128]); contrary to initial mediational analyses, however, only unadjusted reverse mediation analyses were significant for smoking abstinence expectancies (β [95% CI] = .074 [.028 – .133]).

DISCUSSION

To the best of our knowledge, this is the first study to examine interrelations between AS, negative urgency, and negative reinforcement-related smoking expectancies. In accord with hypotheses, AS was associated with stronger expectancies that smoking attenuates negative affect and smoking abstinence increases aversive states. These results are consistent with past work in predominately white smokers (Brown et al., 2001; Gregor et al., 2007; Leyro et al., 2008) and extend them to an ethnically heterogeneous sample of moderate-to-heavy chronic smokers. This study also extends the only prior study we are aware of that examined bivariate relations between AS and smoking abstinence expectancies (Abrams et al., 2011),

as here we show that the relation of AS and smoking expectancies remained after controlling for anxiety symptoms and severity of nicotine dependence, which had not been previously explored.

Also consistent with hypotheses, negative urgency partially mediated the relation between AS and both types of negative reinforcement-related smoking expectancies. Although we are unaware of any extant study of this three-variable mediational pathway, the first portion of this pathway is consistent with a previous study (Weitzman et al., 2011), which found that AS was correlated with negative urgency in samples of predominately non-smokers. The second portion of this pathway is concordant with a prior study of college students that reported an association between negative urgency and negative reinforcement smoking expectancies (Doran et al., 2012). The current study advances past work by documenting the interrelation across this set of variables in mediational pathways in a sample of moderate-to-heavy chronic smokers.

The mediational results suggest that smokers high in AS tend to act more impulsively in response to negative affect, which in turn is related to greater expectations of negative reinforcement consequences of smoking and smoking abstinence. Perhaps high-AS individuals perceive anxiety-related states (triggered by any stimulus, including nicotine withdrawal) as being more harmful and consequently are more prone to act on impulse in order to reduce those states (such as by smoking), which is manifested in the form of beliefs that smoking alleviates negative affect and abstinence exacerbates it. Indeed, high-AS smokers report stronger affective reactions to affect-eliciting stimuli, including nicotine withdrawal (Sirota et al., 2013) and a CO₂ challenge during tobacco abstinence (Vujanovic and Zvolensky, 2009). Another possibility is that smoking reduces anxiety to a greater extent for high-AS individuals, which increases impulsive smoking and in turn strengthens negative reinforcement-related smoking expectancies. Consistent with this hypothesis, high-AS individuals report greater negative affect reduction from smoking in response to social stress (Evatt and Kassel, 2010; Perkins et al., 2010). It is also worthwhile to note that the remaining direct effects of AS on negative reinforcement smoking expectancies persisted after controlling for negative urgency, suggesting additional mechanisms underpin AS-smoking relations and should be studied in future work.

Regarding other outcomes, AS was not related to cigarettes per day. Further, there was a relation between AS and proportion of quit attempts in which abstinence could not be maintained for at least one month, which was mediated by negative urgency, but these relations did not survive adjustment for covariates. Regardless, demonstrating relations to negative reinforcement smoking expectancies is of clinical significance irrespective of overlap with other outcomes. Indeed, prior work has shown that smoking cessation failure is predicted by negative reinforcement-related smoking outcome (Wetter et al., 1994) and abstinence expectancies (poster presented by Hendricks, Clark, Lawler, Thorne, and Cropsey at the 2012 Society for Research on Nicotine and Tobacco annual meeting).

Some limitations of the current study should be noted. First, the use of a cross-sectional design precludes us from determining causality. Although we posited that the mediational pathway goes from AS to negative urgency to negative reinforcement-related smoking

expectancies, it is instead possible that AS mediates the relationship between negative urgency and negative reinforcement-related smoking expectancies, which is a possibility that we were unable to rule out altogether with reverse mediation analyses. However, reverse mediation analyses were not significant for smoking abstinence expectancies when adjusting for covariates. Furthermore, we see this possibility as being unlikely because AS is conceptualized as preceding and influencing the development of anxiety (see McLaughlin and Hatzenbuehler, 2009 for a review of the evidence), whereas negative urgency is the tendency to act impulsively in response to negative affective states, such as anxiety, and should therefore follow the development of negative emotions. One question that we were unable to address is the temporal order of smoking behavior and expectancies. It is possible that the relation of AS to smoking expectancies exists prior to smoking initiation and may reflect expectations born out of factors other than direct smoking experience (e.g., modeling by peers and experiences regarding the negative reinforcing effects of other behaviors). Future longitudinal studies will be able to better address this question. Another limitation is that the study's correlational nature leaves open the possibility that an unknown extraneous variable is responsible for the described interrelations. However, this concern is somewhat offset by statistical control in adjusted analyses. Finally, exclusion criteria included non-nicotine substance dependence, current mood disorder or psychotic symptoms, use of non-cigarette forms of tobacco, and planning to quit smoking. Hence, implications of these findings to the wider population of smokers who may experience psychiatric comorbidities or may be interested in quitting smoking should be drawn with this caveat in mind. For example, excluding individuals with non-nicotine substance dependence may have restricted the range of negative urgency, thereby weakening relations with negative urgency and potentially obscuring significant mediational pathways beyond those found in the current study.

CONCLUSIONS

Identifying negative urgency as a mechanism linking AS and negative reinforcement-related smoking expectancies innovates theory on the motivational processes underlying smoking behavior among individuals with psychological vulnerabilities. Furthermore, these results provide clues to specific smoking cessation treatment options that may be particularly effective in targeting emotional factors involved in smoking maintenance. Interoceptive exposure (Zvolensky et al., 2008), which can be combined with other smoking cessation strategies (e.g., psychoeducation and cognitive restructuring), may be useful in reducing reactivity to anxiety-related sensations that motivate negative-reinforcement smoking in high-AS smokers. Distress tolerance skills training may assist in teaching smokers high in negative urgency to respond more adaptively to negative affective states by promoting engagement in healthy alternative behaviors, rather than acting on impulses to smoke (Cyders and Smith, 2008). Lastly, mindfulness training may be useful in treating smokers who are high in AS or negative urgency because it encourages individuals to focus on and accept aversive states rather than avoid them (Brewer et al., 2013; Zvolensky et al., 2008).

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Table 1
Means, Standard Deviations, and Cronbach's Alphas For and Pearson Correlation Coefficients Between Measures

	<i>M (SD)</i>	1	2	3	4	5	6	7
1 ASI	21.2 (14.2)	(.93)						
2 UPPS Negative Urgency	26.5 (7.9)	.31***	(.89)					
3 SCQ Negative Reinforcement	52.3 (21.0)	.30***	.35***	(.96)				
4 SAQ Withdrawal	26.4 (9.8)	.24***	.19**	.60***	(.87)			
5 MASQ Anxious Arousal	22.3 (7.7)	.44***	.27***	.20**	.14	(.90)		
6 FTND	5.3 (1.9)	.08	.14*	.25***	.38***	.03	(.53)	
7 Cigarettes per day	16.5 (6.7)	-.01	.11	.06	.25***	.10	.45***	
8 Proportion QA < 1 month	.72 (.37)	.18*	.20**	.29***	.31***	.12	.31***	.18*

Note. Cronbach's alphas are shown in parentheses along the diagonal. ASI = Anxiety Sensitivity Index; UPPS = UPPS Impulsive Behavior Scale; SCQ = Smoking Consequences Questionnaire; SAQ = Smoking Abstinence Questionnaire; MASQ = Mood and Anxiety Symptom Questionnaire; FTND = Fagerström Test of Nicotine Dependence; Proportion QA < 1 month = proportion of quit attempts that involved abstinence of less than one month.

* $p < .05$,
 ** $p < .01$,
 *** $p < .001$

Table 2

Mediational Analyses Examining Negative Urgency as a Factor Explaining the Relation between Anxiety Sensitivity and Negative Reinforcement-Related Smoking Outcome and Abstinence Expectancies

	β	SE	p
<i>Unadjusted</i>			
A Path: anxiety sensitivity → negative urgency	.306	.067	< .0001
B Path: negative urgency → smoking outcome expectancies	.345	.066	< .0001
Indirect (Mediated) Effect	.106	.031	< .0001
Remaining Direct Effect	.214	.068	.002
<i>Adjusted for anxious arousal and severity of nicotine dependence</i>			
A Path: anxiety sensitivity → negative urgency	.225	.074	.003
B Path: negative urgency → smoking outcome expectancies	.345	.066	< .0001
Indirect (Mediated) Effect	.078	.030	.003
Remaining Direct Effect	.188	.072	.01
<i>Unadjusted</i>			
A Path: anxiety sensitivity → negative urgency	.306	.067	< .0001
B Path: negative urgency → smoking abstinence expectancies	.187	.069	.007
Indirect (Mediated) Effect	.057	.025	.007
Remaining Direct Effect	.205	.071	.004
<i>Adjusted for anxious arousal and severity of nicotine dependence</i>			
A Path: anxiety sensitivity → negative urgency	.225	.074	.003
B Path: negative urgency → smoking abstinence expectancies	.187	.069	.007
Indirect (Mediated) Effect	.042	.021	.01
Remaining Direct Effect	.180	.073	.01

Note. N = 205. β = standardized regression coefficient; SE = standard error.