

## Cognitive and Emotion-Regulatory Mediators of the Relationship Between Behavioral Approach System Sensitivity and Nonsuicidal Self-Injury Frequency

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Nonsuicidal self-injury (NSSI) is highly prevalent among late adolescents and predicts the onset of suicidal ideation and behavior. Although research has established an association between the behavioral approach system (BAS) and NSSI, less research has explored mechanisms underlying this relationship. The authors examined negative and positive emotion regulation patterns, as well as the BAS-relevant cognitive style of self-criticism, as potential mechanisms through which a hypersensitive BAS might be related to NSSI frequency. Late adolescents ( $N = 177$ ) with high and moderate BAS levels completed measures of self-criticism, positive emotion regulation, brooding, and both lifetime and last-year frequency of NSSI. Results indicated that self-criticism and positive emotion dampening independently mediated the relationship between BAS and last-year frequency of NSSI. Self-criticism also mediated the relationship between BAS and lifetime frequency of NSSI. Results suggest that cognitive and emotion-regulatory styles may help to explain why high BAS individuals are likely to engage in NSSI.

It is estimated that between 4% and 6% of the general population have engaged in non-suicidal self-injury (NSSI), the act of intentionally self-injuring without lethal intent

(Nock, 2010). The rate of NSSI is substantially higher among individuals under the age of 30, and lifetime prevalence estimates range from 7% to 38% among college samples (Gratz, Conrad, & Roemer, 2002; Whitlock, Eckenrode, & Silverman, 2006). Given that NSSI serves as a robust predictor of both suicidal ideation and behaviors (Hamza, Stewart, & Willoughby, 2012), recent research has focused on identifying its etiology to better prevent the behavior.

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### BEHAVIORAL APPROACH SYSTEM HYPERSENSITIVITY MODEL

One biobehavioral mechanism that may initiate or maintain NSSI is the behavioral approach system (BAS; Gray,

1991), a neurobiological system proposed to regulate appetitive motivation, or goal-oriented approach behavior. The BAS is theorized to be reactive to both conditioned and unconditioned cues of reward and is responsible for regulating the negative and positive reinforcement value of rewards (Pickering & Gray, 2001). A hypersensitive BAS can lead to excessive activation in response to events that involve goal striving, goal attainment, and rewards, which, in turn, leads to hypomanic/manic symptoms. It also can lead to excessive deactivation in response to nonattainment of goals/rewards and, in turn, depressive symptoms (Alloy & Abramson, 2010). Therefore, it has been proposed that a hypersensitive BAS leads to a low threshold for both BAS activation and deactivation, resulting in mood dysregulation.

#### *BAS Sensitivity and NSSI*

Given the strong association between BAS sensitivity and mood dysregulation, it is surprising that only two known studies have examined the relationship between the BAS and NSSI, a behavior hypothesized to result from severe mood dysregulation (Nock, 2010). In one study, NSSI history and frequency were associated with elevated levels of BAS on the Fun-Seeking dimension (willingness to approach rewards impulsively; Cerutti, Presaghi, Manca, & Gratz, 2012). Additionally, BAS Drive (a general tendency to approach rewards) and BAS Fun Seeking predicted a higher lifetime frequency of NSSI (Jenkins, Seelbach, Conner, & Alloy, 2013).

The Four-Function Model of NSSI (FFM; Nock, 2010) may help explain the relationship between BAS hypersensitivity and NSSI. The FFM asserts that the maintenance of NSSI occurs because of four main functional reinforcement processes. These include automatic negative and positive reinforcement (i.e., intrapersonal) and social negative and positive reinforcement (i.e., interpersonal). Automatic negative reinforcement reflects NSSI's reduction of

distressing affective and/or cognitive states, whereas automatic positive reinforcement reflects NSSI's generation of positive affect or other forms of stimulation. The FFM posits that vulnerabilities to affective and cognitive dysregulation may increase one's risk for NSSI by increasing the desire for the rewarding intrapersonal reinforcement properties of NSSI (Nock, 2010).

Given that the BAS responds to both positive and negative reinforcing stimuli (Gray, 1991), we posited that BAS hypersensitivity may increase individuals' sensitivity to NSSI's reinforcing properties. We compared NSSI frequency in individuals with high versus moderate BAS sensitivity at an age of high risk for the behavior and examined potential mechanisms through which a hypersensitive BAS may lead to NSSI. Given that emotional and cognitive dysregulation have been consistently, albeit indirectly, linked with BAS hypersensitivity and are vulnerabilities for NSSI in the FFM (Nock, 2010), we hypothesized that BAS hypersensitivity may indirectly lead to NSSI through its association with emotional and cognitive dysregulation.

#### *Negative Emotion Regulation Style: Brooding*

Ruminative brooding, the comparison of one's current situation with an unachieved standard by turning inward as a means of problem solving, is one style of negative emotion regulation that has received research attention in association with mood dysregulation (Treynor, Gonzalez, & Nolen-Hoeksema, 2003). Individuals with high BAS sensitivity exhibit greater levels of rumination than do individuals with moderate BAS sensitivity (Stange, Shapero, Jäger-Hyman, Grant, Abramson, & Alloy, 2013). Importantly, ruminative brooding is also a vulnerability for NSSI (Armey & Crowther, 2008). We propose that individuals with a highly sensitive BAS may be more likely to ruminate, leading to greater levels of negative affect and emotion dysregulation, and a greater likelihood of employing NSSI as a

means to benefit from its automatic negative reinforcement processes.

*Positive Emotion Regulation Style:  
Dampening*

We propose that the positive emotion regulation strategy of dampening, a strategy aimed at cognitively diminishing any positive moods elicited from stimuli, also may help to explain the relationship between BAS hypersensitivity and NSSI (Feldman, Joormann, & Johnson, 2008). A daily diary study found that undergraduates with a history of NSSI experience positive affect less often and with lower inertia (i.e., a higher rapidity of returning to homeostasis after experiencing affect) than those without any NSSI (Bresin, 2013). This pattern of results potentially could be explained by the employment of dampening strategies, which could lower levels of both the occurrence and the inertia of positive affect. Thus, we hypothesized that individuals with a highly sensitive BAS would maladaptively regulate their positive emotions via dampening, which may reduce the occurrence and the inertia of their positive affect, and in turn, increase likelihood to engage in NSSI as a means of automatic positive reinforcement.

*Self-Criticism, BAS, and NSSI*

In addition to examining emotion regulation strategies as mechanisms through which BAS hypersensitivity leads to NSSI, we also examined self-criticism as a possible mechanism. Self-criticism is a cognitive style associated with heightened negative cognitive appraisals of the self (Claes, Houben, Vandereycken, Bijttebier, & Muehlenkamp, 2010). Notably, self-criticism has been identified as a BAS-relevant cognitive style found to predict a greater likelihood of hypomanic and manic episodes among high BAS individuals (Alloy et al., 2009). In addition, research has demonstrated that self-criticism is an important risk factor for NSSI across development (Claes et al., 2010; Glassman,

Weierich, Hooley, Deliberto, & Nock, 2007). In line with our hypotheses that BAS sensitivity may predict NSSI frequency through emotional dysregulation (via brooding and dampening), we hypothesized that those with a hypersensitive BAS would be more likely to engage in self-criticism, which, in turn, increases one's likelihood to engage in NSSI as a means of automatic negative reinforcement.

*Current Study*

Thus, we investigated differences in NSSI frequency between individuals with a hypersensitive and moderately sensitive BAS and tested potential mechanisms for this relationship.

## METHOD

*Participants and Procedure*

*Sample Recruitment.* Participants for this study were recruited as part of a behavioral high-risk longitudinal study designed to examine characteristics of individuals hypothesized to be at high versus low risk for first onset of bipolar disorder based on BAS sensitivity (see Alloy et al., 2012). Adolescents (ages 14–19) were recruited from Philadelphia-area public high schools and colleges. In Phase I of screening, students ( $N = 9,991$ ) completed two self-report measures of BAS sensitivity. Students who scored in the highest 15th percentile on *both* measures were categorized as High BAS (HBAS), whereas those who scored between the 40th and 60th percentiles on both measures were categorized as Moderate BAS (MBAS). A random subset of adolescents screened in Phase I who met inclusion criteria for the HBAS or MBAS groups participated in Phase II of screening (see Alloy et al., 2012, for further details regarding study recruitment and eligibility). In Phase II, participants completed questionnaires assessing NSSI frequency, self-criticism, ruminative brooding, and responses to positive affect.

*Study Sample.* This study sample consisted of 177 adolescents (113 HBAS; 64 MBAS) who completed the Phase I and II screening assessments. The sample was 18.69 years old ( $SD = 0.84$ ), 72% female, and 69.5% Caucasian, 14.1% African American, 6.8% Hispanic/Latino, 7.3% Asian American, 1.7% Native American, and 0.6% Multiracial (see Table 1 for sample demographics by BAS status).

### Measures

*BAS Sensitivity.* The BIS/BAS Scale (Carver & White, 1994) and Sensitivity to Punishment Sensitivity to Reward Questionnaire (SPSRQ; Torrubia, Avila, Molto, & Caseras, 2001) were the two self-report measures used to determine group selection. A BAS total score was calculated, which has

demonstrated good internal consistency ( $\alpha = .80$  in this study) and retest reliability (Carver & White, 1994). The SPSRQ (Torrubia et al., 2001) assesses sensitivity to reward and punishment. We used the 24-item Sensitivity to Reward (SR) subscale, which has demonstrated good internal consistency ( $\alpha = .76$  in this study) and retest reliability (Torrubia et al., 2001).

*Self-Criticism.* The Depressive Experiences Questionnaire (DEQ; Blatt, D'Afflitti, & Quinlan, 1976) is a self-report measure used to evaluate self-criticism (SC; e.g., "I have a difficult time accepting weaknesses in myself") with relevance to the BAS (Stange, Shapero, et al., 2013) and an association with NSSI (Glassman et al., 2007). The SC subscale has shown good internal consistency ( $\alpha = .80$  in this study), retest reliability, and construct validity (Blatt et al., 1976).

**TABLE 1**  
*Demographics*

	High BAS ( $n = 113$ )	Moderate BAS ( $n = 64$ )	$t$ or $\chi^2$
Age	18.55 (.12)	18.82 (.09)	-1.25
Sex	69% female	77% female	1.08
Race	69% Caucasian	72% Caucasian	11.31
	17% African American	17% African American	
	9% Asian/Pacific Islander	7% Asian/Pacific Islander	
	3% Biracial	2% Biracial	
	2% Other	2% Other	
Ethnicity	8% Hispanic	7% Hispanic	.72
DEQ-SC	-.03 (.09)	-.54 (.12)	3.85***
RRS-BR	12.75 (.35)	10.23 (.34)	5.06***
RPAS Dampening	15.67 (.54)	13.42 (.57)	3.11***
NSSI—Lifetime	44% None	59% None	2.83**
	7% 1 time	8% 1 time	
	11% 2–5 times	10% 2–5 times	
	19% 6–20 times	14% 6–20 times	
	19% 20 + times	9% 20 + times	
NSSI—Past Year	61% None	79% None	4.25***
	11% 1 time	8% 1 time	
	11% 2–5 times	10% 2–5 times	
	8% 6–20 times	3% 6–20 times	
	9% 20 + times	0% 20 + times	

*Notes:* Standard deviations are in parentheses.

DEQ-SC, Depressive Experiences Scale–Self-Criticism (Standard Scores); RRS-BR, Ruminative Responses Scale–Brooding; RPAS, Responses to Positive Affect Scale; NSSI, nonsuicidal self-injury.

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

*Positive Emotion Regulation.* The Responses to Positive Affect Scale (RPAS; Feldman et al., 2008) was used to assess dampening of positive affect (e.g., “Think about things that could go wrong”) because of its theoretical relevance to NSSI. The RPAS Dampening subscale has been found to have good internal consistency and construct validity (Feldman et al., 2008). In this study, it demonstrated good internal consistency ( $\alpha = .85$ ).

*Ruminative Brooding.* The Ruminative Responses Scale (RRS; Treynor et al., 2003) Brooding subscale (RRS-BR) contains five items that assess brooding rumination in response to a dysphoric mood. It has demonstrated good internal consistency and test-retest reliability (Treynor et al., 2003) and had good internal consistency ( $\alpha = .85$ ) in this study.

*NSSI.* The Form and Function Self-Injury Scale (FAFSI; Jenkins & Schmitz, 2012) was used to assess NSSI. The FAFSI assesses the frequency of 13 distinct forms of NSSI engaged in over the past year and over one’s lifetime (e.g., cutting, burning, biting). We minimized the variability of NSSI frequency by classifying NSSI into five categories (0, 1, 2–5, 6–20, and 20 + NSSI acts) (Whitlock et al., 2013). Internal consistency of the dichotomous items was  $\alpha = .77$ .

#### *Statistical Analysis*

To evaluate whether the emotion regulatory and cognitive styles accounted for the relationship between BAS group and NSSI frequency, we conducted mediation analyses with bootstrapping ( $N = 1,000$  bootstrap resamples and a 95% confidence interval) to assess indirect effects (Preacher & Hayes, 2008). BAS group was the predictor, lifetime and past year NSSI frequency were outcome variables, and each emotion regulatory and cognitive style served as mediators in separate analyses and in a combined analysis. We proceeded with mediation analyses when each component of the proposed mediation model was significant.

## RESULTS

### *Preliminary Analyses*

Descriptive statistics and correlations between study variables are displayed in Tables 1 and 2. In our overall sample, 57% of late adolescents reported a positive history of NSSI. Thirty-one percent engaged in NSSI acts greater than five times over their lifetime (31% of females; 36% of males) and 12% engaged in NSSI acts more than 5 times over the past year (12% of females; 16% of males). Furthermore, 15% reported engaging in over 20 acts of NSSI over their lifetime (17% of females; 11% of males) and 6% reported engaging in over 20 acts of NSSI over the past year (4% of females; 9% of males). There were no significant gender differences in frequency of NSSI over the past year ( $t = 1.89, p > .05$ ) and over the lifetime ( $t = 1.50, p > .05$ ).

As hypothesized, NSSI lifetime and past year frequency, as well as brooding, dampening, and self-criticism, were each higher in the HBAS group than the MBAS group. Brooding, dampening, and self-criticism also were significantly positively correlated with NSSI lifetime and past year frequency and were each significantly positively correlated with one another.

### *Predicting Lifetime NSSI Frequency*

Bootstrapping analyses (Table 3) indicated the presence of significant indirect effects of BAS group on lifetime NSSI frequency for self-criticism, but not for dampening and brooding. When these variables were simultaneously entered into one model, the indirect effect of BAS group on lifetime NSSI frequency remained significant for self-criticism, and dampening and brooding remained nonsignificant.

### *Predicting Past Year NSSI Frequency*

There were significant indirect effects of BAS group on past year NSSI frequency for self-criticism and dampening, but not



TABLE 2

*Descriptive Statistics and Correlations Between Study Variables*

Variable	1	2	3	4	5	6
1. BAS Group	—					
2. NSSI Lifetime Frequency	.23**	—				
3. NSSI Last-Year Frequency	.17*	.79**	—			
4. Brooding	.20**	.16*	.18*	—		
5. Dampening	.14**	.17*	.22**	.46**	—	
6. Self-Criticism	.16**	.30**	.28**	.55**	.52**	—
Mean	—	1.41	.75	11.84	14.86	-.21
SD	—	1.60	1.24	3.67	5.39	.98

Notes: BAS, behavioral approach system sensitivity risk group (0 = *moderate BAS*, 1 = *high BAS*); NSSI, nonsuicidal self-injury; CI, confidence interval.

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

for brooding. When these potential mediators were entered into one model simultaneously, the indirect effect of BAS group on past year NSSI frequency remained significant for self-criticism, but dampening and brooding were not significant.

## DISCUSSION

The goal of this study was to determine whether high BAS sensitivity serves as a vulnerability for nonsuicidal self-injurious behaviors. We also examined potential mediators of the relationship between the BAS and NSSI, a novel contribution to the literature, as no studies to our knowledge have attempted to explain *why* heightened approach motivation may lead to greater NSSI frequency. Results indicated that self-criticism and positive emotion dampening mediated the relationship between BAS and last-year NSSI frequency and that self-criticism mediated the relationship between the BAS and lifetime NSSI frequency.

### *BAS Sensitivity and Frequency of NSSI*

Consistent with prior studies (Cerutti et al., 2012; Jenkins et al., 2013), BAS hypersensitivity was predictive of last year and lifetime frequency of NSSI. Furthermore, BAS hypersensitivity may make individuals more susceptible to the effects of

NSSI's positively and negatively reinforcing characteristics, thereby playing a significant role in NSSI continuation (and therefore, frequency). These results are in line with research investigating the reinforcement qualities of other maladaptive behaviors including alcohol use (Wardell, Read, Colder, & Merrill, 2012). Indeed, 66% of the HBAS group engaged in at least one act of NSSI over their lifetime, whereas only 41% of the MBAS group reported a positive history of any NSSI. The divergence between HBAS and MBAS groups appears to amplify as NSSI frequency increases, suggesting that BAS hypersensitivity may play a greater role as NSSI severity increases.

Research suggests that those who engage in over five NSSI acts experience significantly more psychopathology and suicide risk than those who engage in fewer than five acts (Whitlock et al., 2013; You, Leung, Fu, & Lai, 2011). That the divergence in likelihood of engaging in NSSI between groups expands at greater severity levels of NSSI demonstrates that BAS hypersensitivity may confer higher risk for exhibiting a clinical presentation of NSSI. Thus, our behavioral high-risk design allowed us to replicate and extend previous research (Cerutti et al., 2012; Jenkins et al., 2013) demonstrating a relationship between heightened approach motivation and NSSI. It is important to note that our results were significant despite being based on a rather conservative test of our

**TABLE 3**  
*Mediation Analyses with Emotion Regulatory and Cognitive Styles Mediating Associations Between BAS Group and Lifetime and Past Year Nonsuicidal Self-Injury*

Model	Independent variable (IV)	Mediating variable (M)	Dependent variable (DV)	Effect of IV on M	Effect of M on DV	Direct effect of IV on DV	Total effect of IV on DV	Indirect effect	CI of indirect effect
Predicting Lifetime NSSI Frequency									
1.	BAS Risk Group	Brooding	Lifetime NSSI Frequency	2.52	.05	.46	.59	.12	-.05-.31
2.	BAS Risk Group	Dampening	Lifetime NSSI Frequency	2.22	.04	.49	.59	.09*	.01-.27
3.	BAS Risk Group	Self-Criticism	Lifetime NSSI Frequency	.51	.44	.36	.59	.22*	.09-.46
4.	BAS Risk Group	Brooding	Lifetime NSSI Frequency	2.52	-.02	.48	.63	-.05	-.24-.14
		Dampening	Lifetime NSSI Frequency	2.26	.02			.05	-.03-.23
		Self-Criticism	Lifetime NSSI Frequency	.51	.26			.14*	.01-.35
Predicting Past Year NSSI Frequency									
1.	BAS Risk Group	Brooding	Past Year NSSI Frequency	2.52	.04	.54	.63	.09	-.03-.28
2.	BAS Risk Group	Dampening	Past Year NSSI Frequency	2.25	.04	.54	.63	.10*	.01-.25
3.	BAS Risk Group	Self-Criticism	Past Year NSSI Frequency	.51	.30	.48	.63	.15*	.03-.35
4.	BAS Risk Group	Brooding	Past Year NSSI Frequency	2.52	-.02	.39	.59	-.05	-.33-.14
		Dampening	Past Year NSSI Frequency	2.25	.01			.01	-.09-.16
		Self-Criticism	Past Year NSSI Frequency	.51	.46			.24*	.07-.52

Notes: BAS, behavioral approach system sensitivity risk group (0 = moderate BAS, 1 = high BAS); NSSI, nonsuicidal self-injury; CI, confidence interval.

\* $p < .05$ .

hypothesis, given that we compared a high BAS group to a moderate BAS group, as opposed to a low BAS group. Our analyses suggest that BAS hypersensitivity may be an important part of the phenotypic definition of the proposed NSSI disorder.

#### *Mediators of the BAS and NSSI Frequency*

Consistent with hypotheses, we found that brooding, dampening, and self-criticism were significantly higher in the HBAS than the MBAS group (see also Stange, Boccia, et al., 2013a; Stange, Shapero, et al., 2013) and were significantly positively associated with NSSI frequency over the lifetime and past year. These correlational findings support prior work suggesting that both self-criticism and brooding are positively related to NSSI (Armey & Crowther, 2008; Claes et al., 2010; Glassman et al., 2007). However, our study is the first to find evidence for a relationship between NSSI and the positive emotion-regulatory style of dampening, which highlights response to positive affect as an original target for intervention.

These results indicate potential mechanisms through which BAS status may lead to NSSI. The FFM suggests that NSSI is a product of multiple positive and negative reinforcement pathways (Nock, 2010). Although cross-sectional, our findings suggest that BAS hypersensitivity may lead to emotional and cognitive dysregulation via dampening and self-criticism, thereby increasing susceptibility to NSSI's automatic positive and negative reinforcement.

The finding that only self-criticism remained a significant mediator when emotion regulatory and cognitive styles were entered simultaneously in lifetime and last-year NSSI frequency models is consistent with prior findings in the literature, suggesting that self-criticism is a potent vulnerability for NSSI onset and frequency (Cohen et al., in press; Glassman et al., 2007; You, Lin, & Leung, 2014). Our findings further highlight the strength of the relationship between self-criticism and

NSSI beyond the impact of other cognitive and emotional vulnerabilities. It is possible that self-criticism leads to negative affect, and NSSI is subsequently employed as a negative affect regulation strategy. Alternatively, self-criticism may lead to unclear thinking and decreased information processing abilities, which may be relieved through engaging in NSSI (Franklin et al., 2010). Furthermore, other research has found that self-criticism may cause individuals to desire self-punishment, and a portion of individuals engaging in NSSI has confirmed this motivating factor (Klonsky, 2007).

#### *Clinical Implications*

This study has important clinical implications. First, clinicians may benefit from assessing hypersensitive BAS to determine late adolescents' level of risk for NSSI. Further, it may be important to target BAS sensitivity in both pharmacotherapy and psychotherapy. Drugs developed to reduce NSSI may benefit from targeting the incentive-reward motivation neural network involving dopaminergic activity between the limbic system and the frontal cortex, which is theorized to be a biological mechanism underlying the BAS (Depue & Iacono, 1989). Cognitive behavioral therapies for NSSI (e.g., Newman, 2009) may benefit from addressing self-criticism. Indeed, recent research indicates a brief cognitive intervention aimed at improving self-worth can reduce pain endurance among those with a history of NSSI compared to controls (Hooley & St. Germain, 2014). These findings suggest that self-criticism may be malleable and thus a rich target for intervention. Psychosocial treatments for NSSI may further benefit from addressing the maladaptive emotion regulation strategy of dampening.

#### *Strengths, Limitations, and Future Directions*

Overall, this study benefitted from several strengths, including its employment of a behavioral high-risk design, its use of



two measures to determine BAS sensitivity, and the comparison of several constructs hypothesized to account for the relationship between BAS sensitivity and NSSI. However, this study was limited by its cross-sectional design, prohibiting the determination of the direction of relationships in our mediation models. Furthermore, this study was limited by the use of self-report measures, which inherently may be influenced by social desirability and memory biases.

In summary, the current investigation indicates that individuals with BAS hypersensitivity are likely to have a positive NSSI history and to have engaged in more acts of NSSI in the last year and over their lifetimes. Moreover, our mediation results support a growing body of research suggesting the centrality of self-criticism as a risk factor for NSSI and further suggest that its strong link with both BAS sensitiv-

ity and with NSSI may partially explain the relationship between this biobehavioral vulnerability and self-injury. Our findings further suggest that BAS hypersensitivity may be related to NSSI frequency through its role in increasing cognitive and emotional dysregulation, leading one to desire the intrapersonally negative and positive reinforcing qualities of NSSI. However, given that BAS hypersensitivity remained a significant predictor of lifetime NSSI frequency even after accounting for self-criticism as a mediator, the impact of BAS dysregulation and its close association with reinforcement sensitivity is worth further evaluating in its own right. BAS sensitivity may be a rich target for clinical intervention, in addition to targeting adolescents' dysfunctional cognitive style of self-criticism and emotion regulation pattern of dampening.

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