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Reinforcement Sensitivity and Social Anxiety in Combat Veterans

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Abstract

Objective—The present study tested the hypothesis that low behavioral approach system (BAS) sensitivity is associated with social anxiety in combat veterans.

Method—Self-report measures of reinforcement sensitivity, combat exposure, social interaction anxiety, and social observation anxiety were administered to 197 Iraq/Afghanistan combat veterans.

Results—As expected, combat exposure, behavioral inhibition system (BIS) sensitivity, and fight-flight-freeze system (FFFS) sensitivity were positively associated with both social interaction anxiety and social observation anxiety. In contrast, BAS sensitivity was negatively associated with social interaction anxiety only. An analysis of the BAS subscales revealed that the Reward Responsiveness subscale was the only BAS subscale associated with social interaction anxiety. BAS-Reward Responsiveness was also associated with social observation anxiety.

Conclusion—The findings from the present research provide further evidence that low BAS sensitivity may be associated with social anxiety over and above the effects of BIS and FFFS sensitivity.

Keywords

Reinforcement sensitivity theory; BIS; BAS; trauma; social anxiety; veterans

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1. Introduction

The revised Reinforcement Sensitivity Theory (r-RST; Gray & McNaughton, 2000) is a biologically based theory of personality that proposes that variation in three major subsystems of the brain—the behavioral inhibition system (BIS), fight-flight-freeze system (FFFS), and behavioral approach system (BAS)—underlie individual differences in motivation, personality, and psychopathology. The BAS is proposed to be responsible for reward-seeking behavior and to underlie the personality trait of extraversion. The FFFS is posited to be responsible for avoidant and escape behaviors in response to aversive stimuli and to underlie the emotion of fear. The BIS is proposed to be responsible for resolving conflicts (e.g., approach-avoidance conflicts) and to underlie the emotion of anxiety and the personality trait of neuroticism (Gray & McNaughton, 2000). Consistent with the position of Gray and McNaughton (2000) and contemporary research in this area (e.g., Heym et al., 2008; Kimbrel et al., 2012), the current paper takes the position that many self-report inventories originally developed to assess BIS sensitivity and neuroticism actually reflect combined BIS-FFFS sensitivity. Accordingly, we use the term “BIS-FFFS” to refer to findings from earlier studies that used combined measures of BIS-FFFS (e.g., Kimbrel et al., 2010), whereas BIS and FFFS are used to refer to the specific neurobiological systems proposed by Gray.

1.1 The Reinforcement Sensitivity Theory of Social Anxiety

Consistent with Gray and McNaughton’s (2000) basic premise that the BIS and FFFS underlie anxiety and fear, respectively, Kimbrel (2008) proposed that individuals high on BIS and FFFS sensitivity tend to perceive social situations as highly threatening due to biased memory and attention processing. Consequently, individuals high on BIS and FFFS sensitivity are predicted to experience heightened levels of anxiety and fear in response to social stimuli (e.g., public speaking) and to be more likely to develop social anxiety disorder (Kimbrel, 2008). Consistent with this hypothesis, numerous studies have reported that BIS-FFFS sensitivity is positively associated with social anxiety symptomatology (e.g., Coplan et al., 2006; Kashdan & Roberts, 2006; Kimbrel et al., 2008, 2010, 2012; Ly & Gomez, 2014). Kimbrel et al. (2012) further demonstrated that cognitive biases fully mediate the effects of BIS-FFFS sensitivity on state social anxiety in response to a public-speaking task. Thus, the key premise of Kimbrel’s (2008) model of social anxiety (i.e., that BIS and FFFS are key motivational factors underlying social anxiety and that their effects on social anxiety are mediated by cognitive biases) has received consistent support in the literature. In contrast, the role of BAS sensitivity in relation to social anxiety is less clear.

1.2 Low BAS Sensitivity and Social Anxiety

Corr’s (2002) joint-subsystems hypothesis posits that the BIS and BAS are interdependent systems that exert facilitatory and antagonistic effects on each other. Kimbrel’s (2008) model of social anxiety builds upon this hypothesis by proposing that low levels of BAS sensitivity facilitate the effects of BIS-FFFS sensitivity on social anxiety such that individuals high on BIS and FFFS sensitivity and low on BAS sensitivity will experience the highest overall levels of social anxiety. While some studies have failed to find the hypothesized negative

association between BAS and social anxiety (e.g., Kashdan & Roberts, 2006; Kimbrel et al., 2008; Ly & Gomez, 2014), the majority of studies have observed small, yet statistically significant, negative associations between BAS and social anxiety (e.g., Coplan et al., 2006; Kashdan, 2002; Kimbrel et al., 2010, 2012; Booth & Hasking, 2009; Levinson et al., 2011).

One potential reason for the mixed findings regarding BAS sensitivity and social anxiety is that the magnitude of the association may be dependent upon the manner in which social anxiety symptoms are operationalized (Kimbrel et al., 2010). The existence of two separate, but closely related dimensions of social anxiety (i.e., social observation anxiety and social interaction anxiety) is well-established (e.g., Mattick & Clarke, 1998). Social observation anxiety refers to social anxiety in response to social situations involving direct observation by others (e.g., public speaking), whereas social interaction anxiety refers to social anxiety in response to social situations involving interactions with other people (e.g., a conversation with a stranger).

BAS sensitivity appears to be more strongly associated with the social interaction subdimension of social anxiety (e.g., Kashdan, 2002; Kimbrel et al., 2008, 2010; Levinson et al., 2011). For example, Kimbrel et al. (2010) examined the association between BAS sensitivity and the subdimensions of social anxiety across three samples of undergraduates and found that BAS was negatively associated with social interaction anxiety in all three samples, whereas it was unrelated to social observation anxiety across samples. Notably, this finding is consistent with prior research indicating that social interaction anxiety is strongly associated with low levels of positive affect (e.g., Kashdan, 2002, 2007), a closely related construct (e.g., Carver & White, 1994). However, when Kimbrel and colleagues' (2010) explicitly tested whether positive affect might mediate the effect of BAS on social interaction anxiety, they found that BAS continued to predict social interaction anxiety over and above the effects of positive affect. Thus, low levels of positive affect are unlikely to account for the relationship between BAS and social interaction anxiety. While the latter study likely represents the most systematic study of the relationship between BAS and social interaction anxiety to date, it is noteworthy that BAS has been associated with both general social anxiety and social observation anxiety in other studies (e.g., Booth & Hasking, 2009; Kimbrel et al., 2012).

In an attempt to explain the unique association between BAS and social interaction anxiety, Kimbrel et al. (2010) noted that social interaction anxiety is typically associated with more severe and generalized social anxiety (e.g., Heimberg et al., 1992), which, in turn, is associated with striatal dopaminergic dysfunction (e.g., Sareen et al., 2007; Schneier et al., 2000). Additional support for the role of decreased BAS sensitivity in relation to general social anxiety comes from a recent finding that social anxiety disorder is associated with decreased putamen-anterior cingulate cortex connectivity (Cremers et al., 2015). Moreover, the typical motivational preference for social rewards that was found in control participants was largely absent among individuals with social anxiety disorder (Cremers et al., 2015).

Taken together, these findings suggest that low BAS sensitivity may play a significant role in social anxiety, particularly social interaction anxiety. However, a recent study by Ly and Gomez (2014) suggests that the relationship between BAS and social anxiety may also be

dependent upon the manner in which BAS is conceptualized. Specifically, they examined the Sensitivity to Punishment and Sensitivity Reward Questionnaire (SPSRQ; Torrubia, Avila, Molto, & Caseras, 2001) and the subscales of the BIS/BAS Scales (Carver & White, 1994; Heym et al., 2008) in relation to social interaction and social observation anxiety in a sample of 200 college students and members of the general community. Findings indicated that only the BAS-Fun Seeking subscale was associated with social anxiety. Equally interesting, the BAS-Fun Seeking subscale was associated with both social interaction anxiety and social observation anxiety, whereas the other BAS subscales (Reward Responsiveness and Drive) and the SPSRQ Sensitivity to Reward scale were not. Citing prior research suggesting that the BAS-Fun Seeking subscale may actually better reflect impulsivity/lack of control than BAS/reward sensitivity (Gomez & Corr, 2010; Smillie et al., 2006), Ly and Gomez (2014) reasoned that:

When all the RST findings and interpretations are taken together, it can be concluded that when viewed in terms of the r-RST, the BIS is associated strongly and positively with both social observation anxiety and social interaction anxiety, whereas the associations for the FFFS is relatively low. Also, the BAS is not associated with social anxiety.

(Ly & Gomez, 2014, p. 24).

Ly and Gomez' (2014) conclusion that the BAS is not associated with social anxiety appears to be based primarily upon their finding that only one of the three BAS subscales (Fun Seeking) from the BIS/BAS Scales (Carver & White, 1994) was associated with social anxiety, whereas the BAS-Reward Responsiveness, BAS-Drive, and Sensitivity to Reward scales were not. Such a conclusion is understandable based on their findings alone; however, it overlooks findings from at least six previous studies that demonstrate broad support for a negative association between BAS and social anxiety across a variety of BAS and social anxiety measures (Booth & Hasking, 2009; Coplan et al., 2006; Kashdan, 2002; Kimbrel et al., 2010, 2012; Levinson et al., 2011). For example, as noted above, Kimbrel and colleagues (2010) found that a composite BAS factor derived from both the BIS/BAS Scales and the SPSRQ was reliably associated with social anxiety across three independent samples of undergraduates. Levinson et al. (2011) found that each of the three BAS subscales from the BIS/BAS Scales was negatively associated with social anxiety in a sample of 723 undergraduates. Booth and Hasking (2009) found that both BAS Fun Seeking and BAS Drive were negatively associated with social anxiety in a sample of 454 undergraduates. Kimbrel et al. (2012) found that the SPSRQ Sensitivity to Reward subscale was negatively associated with trait social anxiety and that it predicted social anxiety-related cognitive biases over and above the effects of the Sensitivity to Punishment subscale. Together, these studies provide substantial support for the hypothesis that low BAS sensitivity is associated with social anxiety; however, additional research aimed at delineating the exact nature of this association is needed, particularly in non-college student samples.

1.3 Study Objective and Hypothesis

The primary objective of the present research was to test the hypothesis that low BAS sensitivity is associated with social interaction anxiety. Because the vast majority of prior research on the association between BAS and social anxiety has been conducted in non-

clinical college samples (e.g., Kashdan, 2002; Kimbrel et al., 2010, 2012; Booth & Hasking, 2009; Levinson et al., 2011), we chose to study this question in a sample of combat veterans, a trauma-exposed population that is known to be at increased risk for a wide range of clinical conditions, including social anxiety (e.g., Hofman et al., 2003; Kashdan et al., 2006; Kimbrel et al., 2015). Moreover, while social anxiety is fairly common among veterans, this important clinical issue has been largely overlooked within this population to date, perhaps due to it being overshadowed by other mental health problems, such as posttraumatic stress disorder (PTSD). Notably, we have previously demonstrated that combat exposure is specifically associated with social anxiety symptoms among combat veterans (Kimbrel et al., 2015). Accordingly, in order to make the analyses as rigorous as possible, combat exposure was included as a covariate in all of the regression analyses in order to assess if BAS would be associated with social anxiety over and above the effects of other personality factors (i.e., BIS and FFFS) and a potent environmental stressor (i.e., combat exposure). Consistent with prior studies of college students, we expected that BIS and FFFS would be positively associated with social observation anxiety and social interaction anxiety, with BIS having the strongest overall association. In contrast, we expected that BAS would be uniquely and negatively associated with social interaction anxiety, but unrelated to social observation anxiety.

In order to determine which, if any, facets of BAS sensitivity might be associated with social anxiety over and above BIS, FFFS, and combat exposure, a follow-up analysis was conducted in which the three BAS subscales were examined in relation to the two subdimensions of social anxiety. We expected that one or more of the three BAS subscales would be associated with social interaction anxiety in this model; however, because all of the BAS subscales have been associated with social anxiety in at least one previous study (e.g., Booth & Hasking, 2009; Levinson et al., 2011; Ly & Gomez, 2014), we did not make specific hypotheses about which of the BAS subscales would have the strongest effect on social interaction anxiety.

2. Methods

2.1 Participants & Procedures

Participants included 197 U.S. veterans of the wars in Iraq and Afghanistan. Consistent with the demographics of the U.S. military, most participants were male (92%) and Caucasian (66%). In addition, 26% of the sample identified as African American, 5% as American Indian/Alaskan Native, and 3% as Asian American. With respect to ethnicity, 18% of the sample identified as Latino. The average age of participants was 39.9 ($SD = 10.4$). The majority of the sample was comprised of veterans of the U.S. Army (86%). Ninety-one percent of the sample had served in Iraq; 17% had served in Afghanistan (categories were not mutually exclusive). Following informed consent, participants completed self-report measures of BIS, FFFS, BAS, combat exposure, and social anxiety in private offices at a VA medical center.

2.2 Measures

The Critical Warzone Experiences scale (CWE; Kimbrel et al., 2014) is a 7-item measure of warzone experiences that are strongly associated with the development of psychopathology in Iraq/Afghanistan-era veterans. The CWE has good internal consistency, test-retest reliability, validity, and factor structure (Kimbrel et al., 2014). In addition, Kimbrel et al. (2015) have demonstrated that CWE scores are positively associated with a general measure of social anxiety symptomatology ($r = 0.36$, $p < .001$) among Iraq/Afghanistan-era veterans. Accordingly, combat exposure was included as a covariate in the current analyses.

The BIS/BAS Scales (Carver & White, 1994) were used to assess BIS and BAS sensitivity. These scales contain a total of 20 items that are endorsed on a four-point Likert scale. The BIS/BAS Scales are widely used and have acceptable levels of internal consistency. They also have good convergent, divergent, and predictive validity when compared to other pertinent scales (Carver & White, 1994). The current study used the revised scoring developed by Heym and colleagues (2008) in order to examine the effects of BIS and FFFS separately.

The Social Phobia Scale (SPS; Mattick & Clarke, 1998) and the Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998) assessed social observation anxiety (e.g., public-speaking) and social interaction anxiety (e.g., speaking with someone that you are attracted to), respectively. Both measures are scored on a five-point Likert scale, and both have strong psychometric properties (e.g., Mattick & Clarke, 1998).

2.3 Data Analysis Plan

Hierarchical linear regression analyses were used to test the hypotheses that BIS and FFFS sensitivity would be positively associated with both social observation and social interaction anxiety, and that BAS sensitivity would be negatively associated with social interaction anxiety. SPS scores served as the index of social observation anxiety in the first regression model, whereas SIAS scores served as the index of social interaction anxiety in the second model. Both models were constructed in the following manner: gender, age, race, and ethnicity were entered in the first step; combat exposure was entered in the second step; BIS and FFFS were entered in the third step; and BAS was entered in the fourth step. Two additional regression models were conducted to assess the unique contributions of each of the BAS subscales. These models were identical to the first two models with the exception that the three BAS subscales (Fun Seeking, Reward Responsiveness, and Drive) were included in the final step of these models instead of the BAS total score.

3. Results

Descriptive statistics are provided for all measures in Table 1. In the first linear regression model in which SPS served as the dependent variable (Table 2), race ($\beta = 0.19$, $p < 0.01$; coded 0 = white; 1 = non-White) was the only demographic variable significantly associated with social observation anxiety in step 1. As expected, combat exposure ($\beta = 0.31$, $p < 0.001$) was a significant predictor of social observation anxiety in step 2. BIS ($\beta = 0.19$, $p <$

0.01) and FFFS ($\beta = 0.29, p < 0.001$) were significant predictors in step 3. In contrast, total BAS ($\beta = -0.02, ns$) was unrelated to social observation anxiety in step 4.

In the second linear regression model in which SIAS served as the dependent variable (Table 2), age ($\beta = -0.20, p < 0.01$) was the only demographic variable associated with social interaction anxiety in step 1. As expected, combat exposure ($\beta = 0.26, p < 0.001$) was a significant predictor of social interaction anxiety in step 2. BIS ($\beta = 0.27, p < 0.001$) and FFFS ($\beta = 0.25, p < 0.01$) were significant predictors in step 3. Finally, consistent with our main hypothesis, total BAS was negatively associated with social interaction anxiety in step 4 ($\beta = -0.21, p < 0.01$).

In the third linear regression model in which SPS served as the dependent variable and the three BAS subscales served as the independent variables of interest (Table 3), race ($\beta = 0.19, p < 0.01$) was a significant predictor in step 1, combat exposure ($\beta = 0.31, p < 0.001$) was a significant predictor in step 2, BIS ($\beta = 0.19, p < 0.01$) and FFFS ($\beta = 0.29, p < 0.001$) were significant predictors in step 3, and BAS-Reward Responsiveness ($\beta = -0.20, p < 0.05$) was a significant predictor in step 4.

In the fourth linear regression model in which SIAS served as the dependent variable and the three BAS subscales served as the independent variables of interest (Table 3), age ($\beta = -0.20, p < 0.01$) was a significant predictor in step 1, combat exposure ($\beta = 0.26, p < 0.001$) was a significant predictor in step 2, BIS ($\beta = 0.27, p < 0.001$) and FFFS ($\beta = 0.25, p < 0.01$) were significant predictors in step 3, and BAS-Reward Responsiveness ($\beta = -0.19, p < 0.05$) was a significant predictor in step 4.

4. Discussion

The present research adds to the literature concerning BAS sensitivity and social anxiety by demonstrating that BAS sensitivity is negatively associated with social anxiety in a sample of combat-exposed veterans, as past studies have primarily relied on college student samples. As expected, combat exposure, BIS, and FFFS were positively associated with both social interaction anxiety and social observation anxiety across analyses. The finding that low BAS continued to contribute to social interaction anxiety even after BIS, FFFS, combat exposure, and demographic variables were taken into account is consistent with Kimbrel et al.'s (2010) prior finding that low BAS remained significantly associated with social interaction anxiety after accounting for BIS, negative affect, and positive affect.

BAS-Reward Responsiveness—but not BAS-Fun Seeking—was the BAS subscale most strongly associated with both social interaction and social observation anxiety, which contrasts with Ly and Gomez's (2014) finding that BAS Fun Seeking was the BAS subscale most strongly associated with social anxiety; however, it is consistent with Levinson and colleagues' (2011) previous finding associating all three BAS subscales (including Reward Responsiveness) with social anxiety symptomatology. Taken together, results from the present study—in conjunction with prior research in this area (Booth & Hasking, 2009; Coplan et al., 2006; Kashdan, 2002; Kimbrel et al., 2010, 2012; Levinson et al., 2011)—

provide consistent support for the hypothesis that low BAS sensitivity is associated with social anxiety over and above the effects of BIS and FFFS.

The current findings also expand the literature on BAS and social anxiety by demonstrating for the first time that the effect of low BAS on social anxiety remains statistically significant, even after accounting for combat exposure. That BAS sensitivity remained significantly associated with social interaction anxiety over and above the effects of trauma exposure, BIS, FFFS, and demographic variables, increases confidence that BAS sensitivity is uniquely associated with social anxiety.

4.1 Strengths and Limitations

Prior research aimed at examining the relationship between BAS and social anxiety symptoms has been largely confined to samples of college students. Thus, significant strengths of the current study were: (1) the use of a veteran sample that had experienced high rates of combat exposure (a known predictor of social anxiety), and (2) accounting for the impact of combat exposure on social anxiety symptoms in the statistical analyses. The present study also had several limitations that should be considered when interpreting these findings. First, the current study was cross-sectional. Thus, causality between BAS sensitivity and social interaction anxiety cannot be inferred. A second limitation concerns our reliance on self-report to assess BAS and social interaction anxiety. Future research that incorporates behavioral or biological measures of BAS would significantly advance this area of research. A third limitation concerns our sample composition, which was comprised entirely of Iraq/Afghanistan veterans enrolled in VA healthcare. As a result, the degree to which the present findings might generalize to the general population or to other clinical populations is unclear. Additional work aimed at examining the association between BAS and social interaction anxiety in clinical samples of patients with social anxiety disorder is still needed.

4.2 Conclusion

In summary, the present research replicates and expands upon the existing literature by confirming the negative association between BAS sensitivity and social interaction anxiety in a sample of combat veterans for the first time. Our findings further indicate that the association between BAS and social interaction anxiety is not due to combat exposure, BIS, FFFS, or demographic variables. Rather, the present findings provide further support for the idea that a complete motivational account of social anxiety should include both BIS-FFFS and BAS. However, additional research aimed at identifying the specific genetic and biological bases of this association is still needed.

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views expressed in this article are those of the authors and do not necessarily reflect the position or policy of the Department of Veterans Affairs or the United States government.

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Table 1

Descriptive Statistics

Measure	Mean	SD	α
Social Interaction Anxiety Scale (SIAS)	22.2	15.3	0.94
Social Phobia Scale (SPS)	13.3	15.9	0.96
Critical Warzone Experiences (CWE)	6.6	6.5	0.85
Behavioral Inhibition System (BIS)	10.7	2.6	0.77
Fight-Flight-Freeze System (FFFS)	7.3	1.8	0.40
Behavioral Approach System (BAS) - Total	36.2	6.4	0.87
BAS - Drive	10.1	2.5	0.77
BAS - Fun Seeking	10.5	2.5	0.72
BAS - Reward Responsiveness	15.6	2.6	0.78

Table 2

Summary of the Linear Regressions Predicting Social Anxiety Using the Total BAS Score

	<u>Social Observation Anxiety</u>		<u>Social Interaction Anxiety</u>	
	R²	β	R²	β
Step 1	0.06 [*]		0.06 [*]	
Gender		−0.08		−0.09
Age		−0.14		−0.20 ^{**}
Ethnicity		−0.05		−0.05
Race		0.19 ^{**}		0.07
Step 2	0.09 ^{***}		0.07 ^{***}	
Gender		−0.13		−0.13
Age		−0.11		−0.17 [*]
Ethnicity		−0.04		−0.05
Race		0.20 ^{**}		0.08
Combat		0.31 ^{***}		0.26 ^{***}
Step 3	0.15 ^{***}		0.17 ^{***}	
Gender		−0.02		0.00
Age		−0.12		−0.19 ^{**}
Ethnicity		−0.03		−0.04
Race		0.15 [*]		0.03
Combat		0.34 ^{***}		0.30 ^{***}
BIS		0.19 ^{**}		0.27 ^{***}
FFFS		0.29 ^{***}		0.25 ^{**}
Step 4	0.00		0.04 ^{**}	
Gender		−0.01		0.03
Age		−0.12		−0.23 ^{**}
Ethnicity		−0.03		−0.05
Race		0.15 [*]		.06
Combat		0.34 ^{***}		0.28 ^{***}
BIS		0.20 ^{**}		0.35 ^{***}
FFFS		0.29 ^{***}		0.19 ^{**}
BAS		−0.02		−0.21 ^{**}
Total R²	0.30		0.32	

Note: BIS = Behavioral Inhibition System; FFFS = Fight-Flight-Freeze System; BAS = Behavioral Approach System; Standardized regression coefficients displayed;

*
< 0.05;

**
< 0.01;

< 0.001

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Table 3

Summary of the Linear Regressions Predicting Social Anxiety Using the BAS Subscales>

	<u>Social Observation Anxiety</u>		<u>Social Interaction Anxiety</u>	
	R²	β	R²	β
Step 1	0.06 *		0.06 *	
Gender		−0.08		−0.09
Age		−0.14		−0.20 **
Ethnicity		−0.05		−0.05
Race		0.19 **		0.07
Step 2	0.09 ***		0.07 ***	
Gender		−0.13		−0.13
Age		−0.11		−0.17 *
Ethnicity		−0.04		−0.04
Race		0.20 **		0.08
Combat		0.31 ***		0.26 ***
Step 3	0.15 ***		0.17 ***	
Gender		−0.02		0.00
Age		−0.12		−0.19 **
Ethnicity		−0.03		−0.04
Race		0.15 *		0.03
Combat		0.34 ***		0.30 ***
BIS		0.19 **		0.27 ***
FFFS		0.29 ***		0.25 **
Step 4	0.03		0.05 **	
Gender		−0.03		0.04
Age		−0.13		−0.23 ***
Ethnicity		−0.03		−0.04
Race		0.17 *		0.06
Combat		0.33 ***		0.26 ***
BIS		0.20 **		0.38 ***
FFFS		0.31 ***		0.19 **
BAS-Drive		0.05		0.07
BAS-Fun Seeking		0.13		−0.12
BAS-Reward Responsiveness		−0.20 *		−0.19 *
Total R²	0.33		0.34	

Note: BIS = Behavioral Inhibition System; FFFS = Fight-Flight-Freeze System; BAS = Behavioral Approach System; Standardized regression coefficients displayed;

*
< 0.05;
**
< 0.01;

< 0.001

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