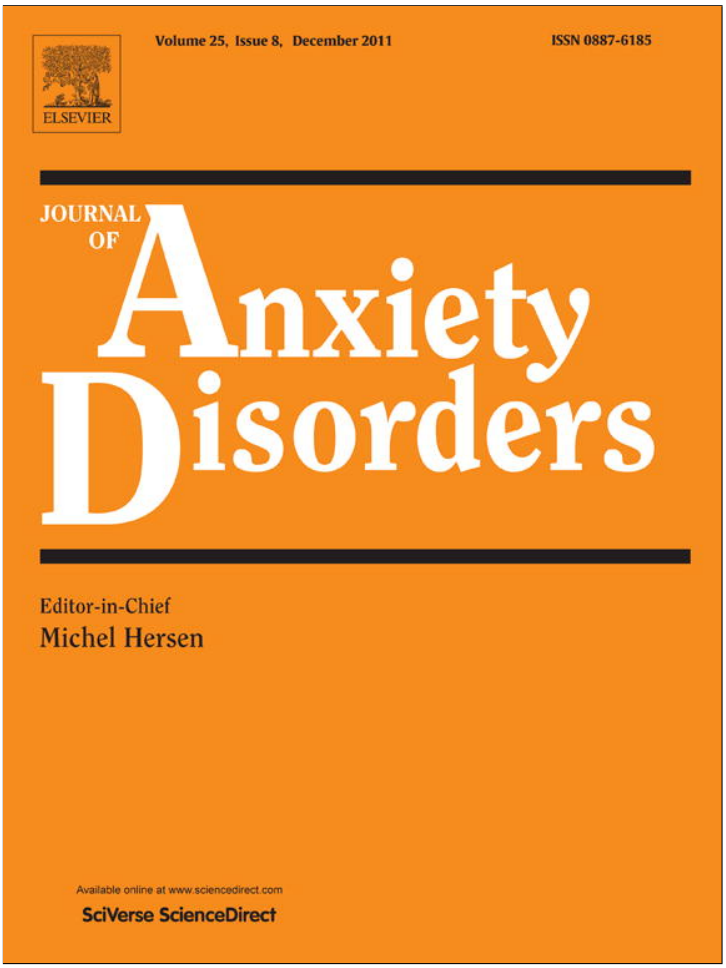

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Experiential avoidance as a moderator of the relationship between behavioral inhibition system sensitivity and posttraumatic stress symptoms

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ABSTRACT

Preliminary evidence suggests that high emotional reactivity, in conjunction with maladaptive self-regulatory processes, increases one's vulnerability to develop psychopathology. In the present study, associations between behavioral inhibition system (BIS) and behavioral activation system (BAS) sensitivity, experiential avoidance (EA) and trauma-related outcomes (i.e., posttraumatic stress symptoms [PTSS]) were examined in a sample ($N = 851$) of female college students who had experienced at least one traumatic event. Positive associations were observed between BIS sensitivity, EA, and PTSS. In addition, EA moderated the relationship between BIS sensitivity and PTSS, with participants high in BIS sensitivity and high in EA reporting significantly more PTSS than participants high in BIS sensitivity and low in EA. No association was observed between BIS sensitivity and PTSS for participants low in EA. These findings suggest that an unwillingness to experience unwanted private events, in conjunction with increased BIS sensitivity, contributes to PTSS severity. Further, there was a positive association and a negative association found between PTSS and BAS-Drive and BAS-Reward Responsiveness, respectively. A marginally significant EA × BAS-Fun Seeking interaction was also observed. Present findings suggests the importance of pursuing an etiological model of posttraumatic stress disorder in which neurobiological factors (i.e., BIS/BAS sensitivity) and self-regulatory processes (i.e., EA) interact to produce psychopathology.

1. Introduction

Evidence suggests that experiential avoidance (EA) is associated with posttraumatic stress symptoms (PTSS) following trauma (Marx & Sloan, 2005; Orcutt, Pickett, & Pope, 2005) and additional evidence suggests that EA may play an etiological role in the development of posttraumatic stress disorder (PTSD; Plumb, Orsillo, & Luterek, 2004). PTSD is a disorder that develops subsequent to a traumatic event and is characterized by distressing recollections of the traumatic event, exaggerated bodily responses, avoidance of trauma reminders, and decreased emotional reactivity (American Psychiatric Association [APA], 2000). Given that an estimated 70% of civilians will experience a traumatic event over the course of a year (Breslau, Davis, Andreski, & Peterson, 1991; Kilpatrick, Saunders, Best, & Von, 1987; Resnick, Kilpatrick, Dansky, Saunders, & Best, 1993) and approximately 18–25% of these individuals will subsequently develop PTSD (Breslau et al., 1991; Resnick et al., 1993), it is important to further understand the role of EA in the development of PTSD. Recent conceptualizations suggest examining the contexts in which engaging in self-regulatory processes, such as EA, may increase the risk for psychopathology (see e.g., Bijttebier, Beck, Claes, & Vandereycken, 2009). Therefore, in the current study we investigated sensitivity of the behavioral inhibition and behavioral activation systems (BIS and BAS, respectively) in relation to both EA and PTSS in a sample of college women reporting at least one traumatic event.

Experiential avoidance has been conceptualized as a functional class of maladaptive strategies aimed at reducing the occurrence of unwanted private events, such as thoughts, emotions, memories or bodily sensations (Hayes, Wilson, Gifford, Follette, & Strosahl, 1996). There is abundant research supporting the proposition that rigid and inflexible use of EA strategies may lead to a wide variety of negative outcomes (for a review see e.g., Chawla & Ostafin, 2007). Of specific relevance to the current paper are the associations that have been observed between EA and anxiety-related difficulties (Kashdan, Barrios, Forsyth, & Steger, 2006), including the development of PTSS and PTSD (Boeschen, Koss, Figueredo, & Coan, 2001; Marx & Sloan, 2005; Orcutt et al., 2005; Orsillo & Batten, 2005). Although the use of EA strategies has been described as a natural

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developmental process (Hayes et al., 1996; Hayes, Barnes-Holmes, & Roche, 2001), understanding contexts in which these strategies are enacted may provide important information regarding the association between EA and negative outcomes (e.g., mood, anxiety, and substance use disorders), and may aid in the development of techniques to prevent such outcomes. Further, the Reinforcement Sensitivity Theory (RST; Corr, 2004; Gray & McNaughton, 2000) may provide insight into the neurobiological subsystems involved in this process.

1.1. Reinforcement sensitivity theory

The RST posits that individual differences observed in personality, emotional reactivity, psychopathology, and motivation for reinforcement are mediated by neurobiological subsystems (Corr, 2004). The current RST conceptualization recognizes three subsystems (i.e., BAS, BIS, Fight-Flight-Freeze system [FFFS]; Gray & McNaughton, 2000). The BAS is responsible for appetitive behaviors motivated by rewarding stimuli (Corr, 2004; Gray & McNaughton, 2000), while the FFFS is responsible for avoidance and/or escape behaviors motivated by fearful or threatening stimuli (Corr, 2004; Gray & McNaughton, 2000). While the BAS is theorized to underlie positive motivational behaviors and positive emotional states, the emotion primarily associated with the FFFS is fear (Corr, 2004; Gray & McNaughton, 2000). The BIS is thought to be responsible for mediating approach behaviors of the BAS and escape/avoidance behaviors of the FFFS when there is a conflict between these two systems (Corr, 2004; Gray & McNaughton, 2000). The BIS may simultaneously inhibit behavior and search the environment and other brain systems (e.g., memory) for a balance between reinforcement of reward and punishment (Corr, 2004). Attempts to resolve these conflicts may result in anxiety reactions (Corr, 2004; Gray & McNaughton, 2000). Strength of an anxiety reaction is thought to be determined by (a) the extent to which the BAS and FFFS are in conflict and (b) the degree of BIS sensitivity associated with motivational conflict. Therefore, a high degree of conflict and higher BIS sensitivity would be expected to result in heightened anxiety (Corr, 2004). Although the revised RST posits that the FFFS and BIS are separate systems, the separate systems theory has not been strongly supported with psychometric data (Heym, Ferguson, & Lawrence, 2008; Tull, Gratz, Latzman, Kimbrel, & Lejuez, 2010; Vervoort et al., 2010). The most commonly used measures of BIS/BAS sensitivity (such as the BIS/BAS Scales used here; Carver & White, 1994) are derived from the original RST theory, in which the FFFS and the BIS were represented as one construct (i.e., BIS). Using the Carver and White (1994) measure, efforts to identify two factors (i.e., 3-item FFFS and 4-item BIS scales) representing the separate systems have been minimally successful (Heym et al., 2008; Vervoort et al., 2010). Specifically, only one study has supported a two factor solution with acceptable psychometric data; however, the sample was of questionable size given the analytic strategy conducted (Heym et al., 2008). Other studies have not found acceptable psychometric support for a two factor model (Tull et al., 2010; Vervoort et al., 2010), including the current study. Given that an unacceptable internal consistency for the 3-item FFFS scale was observed in the current sample (Cronbach's $\alpha = .47$) and previous research has supported use of Carver and White's (1994) BIS scale as a measure of combined BIS and FFFS sensitivity (Corr, 2004; Smillie, Pickering, & Jackson, 2006), any subsequent reference to the BIS scale will be made assuming the combined measurement of BIS and FFFS sensitivity.

1.1.1. RST and psychopathology

The various iterations of the RST have implicated both the BIS and BAS in the development of psychopathology (Corr, 2004; Gray & McNaughton, 2000). The theoretical assumptions for the BIS and BAS have been empirically supported in relation to anxiety, mood, eating and substance-related disorders and have been associated with emotion regulation difficulties noted in personality disorders (see Bijttebier et al., 2009 for a review). Of specific relevance to the current study, the relationship between BIS sensitivity and anxiety symptoms has evidenced strong empirical support; whereas the relationship between BAS sensitivity and anxiety symptoms is less clear. Specifically, higher BIS sensitivity has been shown to be related to higher general anxiety symptoms (Beevers & Meyer, 2002; Campbell-Sills, Liverant, & Brown, 2004; Johnson, Turner, & Iwata, 2003; Jorm et al., 1999; Kimbrel, Nelson-Gray, & Mitchell, 2007), social anxiety disorder (Coplan, Wilson, Frohlick, & Zelenski, 2006) and obsessive–compulsive disorder (Fullana et al., 2004a,b). As for the limited evidence suggesting an association between BAS sensitivity and anxiety symptoms, it appears that lower BAS sensitivity may be related to a severe form of generalized social anxiety and related to a specific dimension of social anxiety labeled social interaction anxiety (Kashdan, 2002; Kimbrel, Mitchell, & Nelson-Gray, 2010). With regard to trauma-related pathology, to our knowledge, there has been no research examining the relation of the BIS or BAS to PTSS or PTSD.

1.1.2. RST and self-regulatory mechanisms

Recently, researchers have begun to examine mechanisms accounting for the relationship between various dimensions of personality and the development of psychopathology. Bijttebier et al. (2009) highlight the importance of explaining the personality/psychopathology association instead of repeatedly reporting the correlations between the two. Although there is strong evidence to suggest specific patterns of association between personality and problematic outcomes, there are also significant variations that need further investigation. Specifically, a mental health diagnosis has been observed to account for only 10% of the variance associated with temperamental vulnerability (i.e., BIS/BAS; Johnson et al., 2003), which supports the examination of intervening mechanisms. Self-regulatory processes, which would broadly include EA strategies (see e.g., Kashdan et al., 2006a), have been suggested as intervening mechanisms (i.e., mediators or moderators) of the relationship between temperament dispositions and the development of psychopathology (Aldao, Nolen-Hoeksema, & Schweizer, 2010).

There is evidence to suggest that self-regulatory mechanisms may contribute to development of psychopathological reactions, especially within the context of a personality dimension associated with strong emotional reactivity (see Bijttebier et al., 2009, for a review). Specifically, high emotional reactivity in conjunction with maladaptive self-regulatory processes increases one's vulnerability to develop psychopathology (e.g., Calkins & Fox, 2002; Lonigan & Phillips, 2001). Therefore, it would be important to investigate self-regulatory mechanisms as mediating or moderating factors in this relationship. To date, only one study has investigated the relationship between BIS and BAS sensitivity and self-regulatory mechanisms (i.e., emotion regulation difficulties). Tull et al. (2010) observed a positive relationship between self-reported BIS sensitivity and emotion regulation difficulties; whereas BAS sensitivity findings were less clear. BAS-Fun Seeking (i.e., seeking new rewards or approaching potential rewards hastily) was positively associated with self-reported emotion regulation difficulties and BAS-Reward Responsiveness (i.e., experience of positive emotion from rewards or expectation of rewards) was negatively associated with self-reported emotion regulation difficulties (Tull et al., 2010). These findings are an important first step in understanding the relationship between BIS and BAS sensitivity and problematic self-regulatory mechanisms; however, there are no published studies examining the interaction of BIS and BAS sensitivity and self-regulatory mechanisms in relation to psychopathological outcomes. The current study addresses this gap in the literature.

1.2. The present study

The current study is the first to examine BIS and BAS sensitivity in relation to trauma-related outcomes, as well as to investigate the impact that EA, a self-regulatory mechanism, may have on this relationship. In a cross-sectional sample of female college students reporting at least one traumatic event, the relation between BIS and BAS sensitivity, EA, and PTSS was investigated. Because there is a lack of previous research in this specific area, hypotheses were exploratory and based on the findings of related constructs. Consistent with findings from previous research (Marx & Sloan, 2005; Orcutt et al., 2005; Plumb et al., 2004), it was hypothesized that EA would be positively related to PTSS. Given that previous literature has suggested a relationship between BIS sensitivity and anxiety symptomology (for a review see Bijttebier et al., 2009), it was hypothesized that BIS sensitivity would be positively related to PTSS. Further, recent research has suggested a relationship between BIS sensitivity and self-regulatory difficulties (i.e., emotion regulation difficulties, Tull et al., 2010). Therefore, it was hypothesized that BIS sensitivity would be positively related to EA. Lastly, it was hypothesized that EA would moderate the relationship between BIS sensitivity and PTSS with EA differentiating between those high and low in BIS sensitivity on scores of PTSS. It was expected that those highest in EA and BIS sensitivity would have the highest PTSS scores, followed by those high in EA and low in BIS sensitivity. Those lowest in EA, regardless of BIS sensitivity, were expected to be lowest in PTSS scores.

The relationship between BAS sensitivity and anxiety symptoms is less clear, and thus, our hypotheses regarding an association between BAS sensitivity and PTSS were limited. Based on previous research suggesting a positive relationship between BAS-Fun Seeking and difficulties with emotion regulation (Tull et al., 2010), we hypothesized that there may be a positive relationship between BAS-Fun Seeking and EA. Further, previous research has suggested a negative relationship between BAS-Reward Responsiveness and difficulties with emotion regulation (Tull et al., 2010); therefore, we expected that results would show a negative relationship between BAS-Reward Responsiveness and EA.

2. Method

2.1. Participants

Participants were 1037 female college students who received partial course credit in an introductory psychology course for participation in departmental research at a large Midwestern university. Of these participants, 851 (82%) reported having experienced at least one traumatic event as defined by Criterion A1 (i.e., exposure to a potentially traumatic event) and A2 (i.e., the subjective experience of fear, helplessness, or horror) for PTSD as defined by the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR; APA, 2000), and thus, met criteria for inclusion in the present study. Average age of our sample ($n = 851$) was 19.5 ($SD = 2.4$). Most participants were freshman (70%), and 63.7% identified as Caucasian, 21.9% as Black, 3.1% as Asian, 0.4% as American Indian or Alaska Native, 0.5% as Native Hawaiian or other Pacific Islander, 9.6% endorsed "other", while 0.9% preferred not to respond. Additionally, 8.6% of participants identified their ethnicity as Hispanic or Latino.

2.2. Procedure

Participants provided written informed consent prior to completing a battery of questionnaires as part of a larger study on sexual victimization. For the purposes of this study, a subset of questionnaires specifically focusing on PTSS, EA, and BIS/BAS was examined. Requirements for participation in this study were that participants be female, over the age of 18, and fluent in English; a history of sexual victimization was not a selection criteria. Additionally, as mentioned above, participants had to endorse having experienced at least one traumatic event in their lifetime. After completing the assessment battery, participants were fully individually debriefed and given partial credit for their introductory psychology class.

2.3. Measures

2.3.1. Potential covariates

Age and Race were evaluated for possible inclusion as covariates in our analyses. *Race* (coded as Black [$n = 186$, 22%], White [$n = 542$, 64%], and Other [$n = 123$, 14%]) was dummy coded as two variables, Black vs. not Black, and White vs. not White.

2.3.2. Traumatic Life Events Questionnaire (TLEQ) & The Distressing Events Questionnaire (DEQ)

The TLEQ (Kubany, Leisen, Kaplan, Watson, et al., 2000) was used to assess exposure to 22 potentially traumatic events (e.g., physical and sexual assault, combat, motor vehicle accident) consistent with the diagnostic Criterion A (i.e., Criterion A1 [trauma exposure] and A2 [fear, helplessness, or horror]) for PTSD as specified in the DSM-IV-TR (APA, 2000). The last question on the TLEQ asks participants to identify the most distressing event from the list of events they reported personally experiencing. Subsequently, the DEQ was administered to assess the presence of PTSS associated with that most distressing event. The TLEQ has demonstrated good psychometric properties, including convergent validity with other common measures of trauma, test–retest reliability, and has been used in a range of populations (Kubany, Leisen, Kaplan, Watson, et al., 2000).

The DEQ (Kubany, Leisen, Kaplan, & Kelly, 2000) is a 17-item self-report measure which assesses the severity of the 17 symptoms of PTSD (APA, 2000) that the participant has experienced in the 30 days prior to completing the questionnaire. Additionally, the DEQ consists of three subscales representing the three symptom clusters of PTSD (i.e., reexperiencing, avoidance, hyperarousal). The DEQ has excellent internal consistency, good short-term test–retest reliability, and has demonstrated good convergent and discriminant validity (Kubany, Leisen, Kaplan, & Kelly, 2000). Internal consistency within this sample was excellent, $\alpha = .92$.

2.3.3. Acceptance and Action Questionnaire-II (AAQ-II)

The AAQ-II (Bond et al., in press), a measure of EA, is a 10-item self-report measure that assesses one's ability to remain in contact with painful and negative private events (e.g., "I'm afraid of my feelings, My painful memories prevent me from having a fulfilling life"). The AAQ-II has demonstrated adequate psychometric properties, including good convergent, discriminant, and incremental validity and adequate internal consistency (ranging from .76 to .87) across seven samples ($n = 3280$; Bond et al., in press). The AAQ-II was scored such that higher scores were indicative of higher levels of EA. Internal consistency within this sample was good, $\alpha = .84$.

2.3.4. BIS/BAS Scale

The BIS/BAS Scale (Carver & White, 1994) is a 20-item self-report measure designed to assess BIS and BAS sensitivity. Participants rate each item on a 4-point Likert scale based on how much each item pertains to them (1 = very true for me, 4 = very false for me). A total score representing BIS sensitivity was calculated by summing 7 items (e.g., "I worry about making mistakes"; Carver & White, 1994). The BIS/BAS Scale was designed to yield three BAS subscales (i.e., Reward Responsiveness, Fun Seeking, and Drive;

Table 1
Zero-order correlations, means, and standard deviations for study variables.

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1. Age in years	–											
2. Race (% White)	−.03	–										
3. Race (% Black)	.00	−.71**	–									
4. PTSS Total	−.02	−.01	−.01	.92								
5. PTSS reexperiencing	−.04	.02	−.01	.89**	–							
6. PTSS avoidance	−.00	−.01	−.02	.94**	.76**	–						
7. PTSS hyperarousal	−.01	−.03	.01	.87**	.63**	.73**	–					
8. Experiential avoidance	−.06	.01	−.05	.52**	.42**	.48**	.49**	.84				
9. BIS total score	.02	.20**	−.20**	.24**	.19**	.23**	.21**	.44**	.71			
10. BAS-Reward	.02	−.07	.04	−.04	−.02	−.06	−.03	−.01	.19**	.62		
11. BAS-Fun	−.10*	.05	−.12**	.05	.04	.04	.07*	.11*	.06	.41**	.69	
12. BAS-Drive	.02	−.12**	.13**	.04	.04	.02	.04	−.02	−.04	.43**	.47**	.81
Mean	19.48	.64	.22	11.21	3.80	4.09	3.32	28.24	21.68	18.05	12.61	11.31
Standard Deviation	2.41	.48	.41	11.70	4.10	4.97	3.94	9.64	3.49	1.73	2.27	2.63
Minimum	18	0	0	0	0	0	0	10	8	10	4	4
Maximum	52.92	1	1	64	20	24	20	68	28	20	16	16
N	851	843	843	851	851	851	851	851	851	851	851	850

Note: Coefficient alphas (where appropriate) are on the diagonal. Race (% White), 0 = Non-White/1 = White; Race (% Black), 0 = Non-Black/1 = Black; PTSS = posttraumatic stress symptoms; BIS = behavioral inhibition system; BAS = behavioral activation system.
* $p < .05$.
** $p < .001$.

Carver & White, 1994). The BIS/BAS Scales has been shown to have good convergent and discriminant validity and good reliability (Carver & White, 1994). Internal consistency for the BIS/BAS subscales within this sample is as follows: BIS sensitivity ($\alpha = .71$), BAS-Reward Responsiveness ($\alpha = .62$), BAS-Fun Seeking ($\alpha = .69$), and BAS-Drive ($\alpha = .81$).

3. Results

3.1. Preliminary analysis

Prior to conducting analyses to examine the study's primary hypotheses, means, standard deviations, and bivariate correlations were calculated in order to better understand the association between descriptive variables (i.e., age, Race) and variables of interest (i.e., PTSS [DEQ total and symptom cluster scores], BIS subscale score, BAS subscale scores [Reward Responsiveness, Fun Seeking, Drive], and the EA [AAQ-II total score]; see Table 1). As expected, there were positive associations between the DEQ total and symptom cluster scores, AAQ-II total score, and the BIS scale score; and further, all of the BAS subscale scores were positively associated with each other. Interestingly, the BAS-Reward Responsiveness subscale was positively associated with the BIS scale. In addition, the BAS-Fun Seeking subscale was positively associated with one DEQ symptom cluster score (i.e., Hyperarousal) and, as expected, EA.

With regard to possible covariates, age was negatively associated with the BAS-Fun Seeking subscale. Race (% White: 0 = non-White/1 = White) was positively associated with the BIS scale and negatively associated with the BAS-Drive subscale, whereas Race (% Black: 0 = non-Black/1 = Black) was positively associated with the BAS-Drive subscale and negatively associated with the BIS scale and the BAS-Fun Seeking subscale. Accordingly, age, Race (% White), and Race (% Black) were included as covariates in multivariate analyses. Additionally, the frequencies of the most distressing traumatic events reported by participants are provided for descriptive purposes (see Table 2).[1]

Table 2
Frequency of most distressing traumatic events.

Traumatic event	Frequency of endorsement
Sudden unexpected death of loved one	363 (42.7%)
Loved one survived a life threatening illness	81 (9.5%)
Witnessed family violence in childhood	76 (8.9%)
Sexual abuse in childhood	64 (7.5%)
Abortion	36 (4.2%)
Other traumatic event	33 (3.9%)
Motor vehicle accident	31 (3.6%)
Victim of intimate partner violence	24 (2.8%)
Physical abuse in childhood	21 (2.5%)
Stalked	19 (2.2%)
Survived a life threatening illness	17 (2.0%)
Natural disaster	15 (1.8%)
Sexual assault in adulthood (after age 18)	15 (1.8%)
Physically threatened	13 (1.5%)
Witnessed assault	12 (1.4%)
Robbed	11 (1.3%)
Accident unrelated to motor vehicle	8 (.9%)
Miscarriage	8 (.9%)
Combat	3 (.4%)
Assaulted by a stranger	1 (.1%)

Note: N = 851. Participant endorsement of the most distressing potentially traumatic event that they have experienced in their lifetime.

3.2. Hierarchical multiple regression analysis

A hierarchical multiple regression was conducted in order to test study hypotheses. In the first step of the model, age, Race (% White), and Race (% Black) were entered into the model as predictors of PTSS (i.e., DEQ total score). In the second step, EA (i.e., AAQ total score), the BIS scale score, and each of the BAS subscale scores (i.e., Reward Responsiveness, Fun Seeking, Drive) were entered into the model as predictor variables. In the final step, four interaction terms (i.e., EA × BIS, EA × BAS-Reward Responsiveness, EA × BAS-Fun Seeking, EA × BAS-Drive) were entered into the model as predictor variables.

As seen in Table 3, none of the covariates (i.e., age, Race [% Black], and Race [% White]) were a significant predictor of PTSS, *ns*. In step two of the model, there was a significant main effect of EA, with higher EA scores predicting higher PTSS scores and a

[1] A large proportion of our sample was comprised of participants who reported their most traumatic lifetime event to be the sudden unexpected death of loved one (42.7%). However, when these participants were removed from the sample, and primary analyses procedures were repeated, results were unchanged. That is, statistically significant associations remained significant and nonsignificant findings were unchanged.

Table 3
Hierarchical multiple regression analysis with PTSS as the outcome variable.

Predictor	*B*	*β*	Adjusted R^2
Step 1			−.00
Age	.03	.01	
Race (% Black)	−.42	−.02	
White (% White)	−.49	−.02	
Step 2			.27**
EA	.61	.50**	
BIS	.11	.03	
BAS-Drive	.39	.09*	
BAS-Fun-Seeking	−.05	−.01	
BAS-Reward	−.53	−.08*	
Step 3			.29**
EA × BIS	.05	.16**	
EA × BAS-Drive	−.02	−.05	
EA × BAS-Fun Seeking	.03	.07^	
EA × BAS-Reward	−.03	−.05	

Note: $N = 851$. PTSS = posttraumatic stress symptoms; Race (% White), 0 = Non-White/1 = White; Race (% Black), 0 = Non-Black/1 = Black; EA = experiential avoidance; BIS = behavioral inhibition system sensitivity; BAS = behavioral activation system sensitivity.
^ $p = .051$.
* $p < .05$.
** $p < .001$.

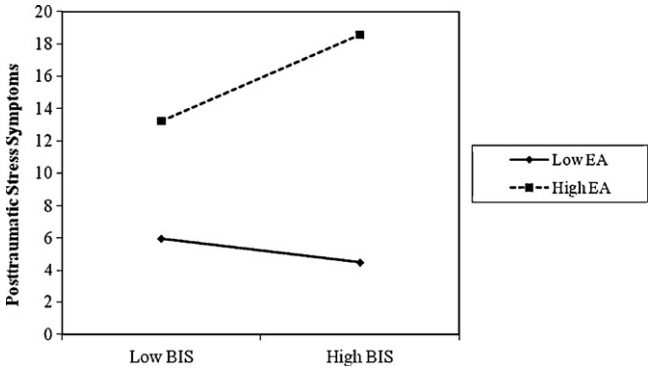

Fig. 1. Interaction effect of BIS sensitivity and EA in predicting PTSS (i.e., DEQ scores). Simple slopes analysis revealed that participants high in EA and high in BIS sensitivity reporter greater PTSS than participants high in EA and low in BIS sensitivity. There was no significant association between BIS sensitivity and PTSS among participants reporting lower EA.

significant main effect of BAS-Drive, with higher BAS-Drive scores predicting higher PTSS scores. Further, there was a significant main effect of BAS-Reward Responsiveness, with lower BAS-Reward Responsiveness scores predicting higher PTSS scores. There was not a significant main effect of the BIS scale or the BAS-Fun Seeking subscale on PTSS, *ns.* In step three of the model, when the four interaction terms were entered as predictor variables, the EA × BIS interaction term was a significant predictor of PTSS, and the EA × BAS-Fun Seeking interaction term was a marginally significant predictor of PTSS.[2]

Two simple slopes analyses were conducted to probe each of the interaction effects (Aiken & West, 1991). Results of the first simple slopes analysis (examining the EA × BIS interaction) revealed a significant positive association between BIS sensitivity and PTSS

[2] Because of the potential overlap between PTSD avoidance symptoms and experiential avoidance as measured by the AAQ-II, we repeated the regression analysis, but replaced total PTSS (i.e., DEQ total score) as the outcome variable with an outcome variable consisting only of DEQ items from the reexperiencing and hyperarousal clusters (items from the avoidance cluster were removed from the total score). Results were almost identical, with only one change in statistically significant associations; BAS-Reward Responsiveness was no longer a significant predictor of PTSS in the second step of the model ($B = -.25$, $\beta = -.06$, $p = .09$).

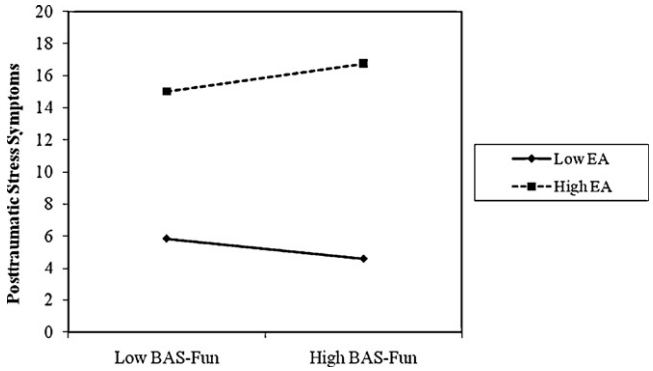

Fig. 2. Interaction effect of BAS-Fun Seeking and EA in the prediction of PTSS (i.e., DEQ scores). Simple slopes were nonsignificant; that is, while the slopes differed in directionality, neither slope was significantly different from 0.

for participants high in EA ($B = .77$, $\beta = .23$, $p < .001$); no association between BIS sensitivity and PTSS was shown for participants low in EA ($B = -.21$, $\beta = -.06$, $p > .05$). Thus, higher BIS sensitivity was associated with higher PTSS for participants high in EA (see Fig. 1). Results of the second simple slopes analysis (examining the EA × BAS-Fun Seeking interaction) revealed that both simple slopes were nonsignificant; there was no association between BAS-Fun Seeking and PTSS for participants high in EA ($B = .39$, $\beta = .08$, $p = .13$), or for participants low in EA ($B = -.27$, $\beta = -.05$, $p = .27$; see Fig. 2).

4. Discussion

The current study is the first to investigate the relationship between BIS and BAS sensitivity, EA, and PTSS. In a female college student sample reporting at least one traumatic event, we examined the unique relationships between the study variables as well as tested EA as a moderator of the relationship between BIS and BAS sensitivity and PTSS. Consistent with our prediction, there was a positive relationship between EA and PTSS. This finding supports previous literature suggesting that EA is associated with PTSS (Marx & Sloan, 2005; Orcutt et al., 2005; Plumb et al., 2004). There was also a positive relationship between each of the three PTSS cluster scores (i.e., reexperiencing, avoidance, hyperarousal) and EA. These results are of importance because they suggest that the association between EA and the PTSS total score is not due to an overlap in items that measure avoidance (i.e., between PTSS avoidance symptoms and EA). Furthermore, although there may be conceptual overlap between EA and PTSS avoidance symptoms, research suggests that EA is a more complex construct than that which is represented by the avoidance and emotional numbing symptoms of the PTSD avoidance cluster (Tull & Roemer, 2003). More specifically, EA is a separate maladaptive class of strategies aimed at reducing unwanted private experiences more broadly (i.e., thoughts, feelings, memories), rather than a strategy which specifically targets unwanted experiences related to a specific traumatic event (Hayes et al., 1996). Therefore, it is not unexpected that these strategies may contribute to the general distress of participants following trauma exposure.

Additionally, we observed positive relationships between BIS sensitivity and PTSS and BIS sensitivity and EA. These findings support previous research suggesting a positive association between BIS sensitivity and anxiety disorder symptoms (Coplan et al., 2006; Fullana et al., 2004a, 2004b; Kashdan, 2002; Kimbrel et al., 2007) and a positive association between BIS sensitivity and emotion regulation difficulties (Tull et al., 2010). Specifically, participants who reported higher levels of BIS sensitivity also reported greater PTSS and higher levels of EA. These findings are the first to sug-

gest a relationship between BIS sensitivity and posttraumatic stress symptomatology. Further, the observed association between BIS sensitivity and EA is consistent with a budding research literature connecting BIS sensitivity to problematic self-regulatory mechanisms, such as emotion regulation difficulties (Tull et al., 2010).

We were also able to examine these relationships in more depth by investigating EA as a moderator of the relationship between BIS sensitivity and PTSS. Consistent with our hypothesis, the relationship between BIS sensitivity and PTSS was dependent upon participants' level of EA. Specifically, for those reporting higher levels of EA, there was a significant difference in PTSS, with the greatest PTSS reported by those highest in BIS sensitivity. For those reporting low levels of EA, there were no difference in PTSS between high and low levels of BIS sensitivity. These findings suggest that an unwillingness to experience unwanted private events in conjunction with increased BIS sensitivity contributes to the severity of PTSS. Theoretically, a highly sensitive BIS is likely to result in stronger anxiety reactions (Corr, 2004; Gray & McNaughton, 2000). Further, it seems reasonable to assume that a traumatic event may activate the BIS as an individual attempts to manage distress associated with trauma exposure. Although an acute stress reaction is typical subsequent to trauma (APA, 2000), if an individual also evaluates this anxiety or stress as overly negative and engages in EA strategies to reduce such experience, the paradoxical increase in anxiety and stress may possibly contribute to the development of PTSS (Marx & Sloan, 2002; Tull & Roemer, 2003; Wenzlaff & Wegner, 2000). Findings from the current study provide preliminary support for this assumption within the context of BIS sensitivity.

Although is difficult to determine clinical significance without convergent diagnostic measures, our findings suggest that participants reporting higher levels of BIS sensitivity and higher levels of EA were also reporting clinically significant symptoms of PTSD. Specifically, Kubany, Leisen, Kaplan, Watson, et al. (2000) have concluded that, among women, a score of 18 or higher on the DEQ was optimal for correctly identifying PTSD status (i.e., PTSD, non-PTSD). The mean PTSS score using the DEQ for those highest in both BIS sensitivity and EA was greater than 18. Therefore, in the present sample, it appears that higher levels of BIS sensitivity and higher levels of EA may be associated with clinical levels of PTSD. Future research will have to examine these relationships with a more complex design (i.e., converging diagnostic measures).

With regard to BAS sensitivity findings, there was a significant positive relationship between BAS-Fun Seeking and EA, which was consistent with our hypothesis. Specifically, higher levels of BAS-Fun Seeking were associated with higher levels of EA. Although it may seem counterintuitive that avoidance would be associated with BAS-Fun Seeking (i.e., the seeking of new rewards or approaching rewards impulsively), there is evidence to suggest that BAS-Fun Seeking is associated with emotion regulation difficulties (Tull et al., 2010). Specifically, available evidence suggests that BAS-Fun Seeking is related to dysfunctional impulsivity (Leone & Russo, 2009) and substance use (Voight et al., 2009). Further, we observed a marginally significant interaction between BAS-Fun Seeking and EA in the prediction of PTSS. However, simple slopes analysis revealed that both simple slopes were nonsignificant; and thus, it is difficult to make any specific interpretation of these findings. However, when our findings are interpreted within the context of previous research, the data suggest an association between BAS-Fun Seeking and maladaptive self-regulatory strategies in relation to negative outcomes. Specifically, seeking rewards or pleasurable experiences which may lead to the reduction of unwanted private experiences or the maladaptive management of emotional experiences could lead to problematic consequences. Future research should investigate the perceived short-term rewards associated with specific avoidance and escape behaviors and their influence on long term outcomes.

Based on previous findings suggesting a relationship between BAS-Reward Responsiveness and emotion regulation difficulties (Tull et al., 2010), we predicted that there would be a negative relationship between BAS-Reward Responsiveness and EA. This hypothesis was not supported in the present study. However, our hypothesis was exploratory, as there has been no direct investigation of the relationship between BIS and BAS sensitivity and EA. Our findings would suggest that EA is unrelated to the positive experiences associated with a reward or in anticipation of a reward as measured by the BAS-Reward Responsiveness subscale. Interestingly, we found that there was a negative relationship between BAS-Reward Responsiveness and PTSS. That is, participants reporting higher levels of PTSS also reported lower levels of BAS-Reward Responsiveness. This finding suggests that PTSS are associated with decreased positive responses in relation to rewards and reward expectation. These findings are consistent with recent literature suggesting that PTSD is characterized by a diminished capacity to experience positive emotional states (Kashdan, Elhai, & Frueh, 2006), which may be inherent to the emotional numbing symptoms of the PTSD avoidance cluster (Litz & Gray, 2002; Orsillo, Theodore-Oklota, Luterek, & Plumb, 2007; Tull & Roemer, 2003). Therefore, the reduced experience of positive affect by those with PTSS may be reflected in this BAS dimension.

Finally, we observed an unexpected positive relationship between BAS-Drive and PTSS, with participants who reported greater PTSS also reporting higher levels of BAS-Drive. Given the conceptual definition of BAS-Drive (i.e., persistence toward reward attainment; Corr, 2004) and previous research suggesting positive outcomes associated with this BAS dimension (Smillie & Jackson, 2006) we would not have expected a positive relationship between PTSS and BAS-Drive. However, recent research has suggested BAS-Drive as the best predictor of functional outcomes (Leone & Russo, 2009) because BAS-Drive comprises a type of functional impulsivity which allows individuals to act quickly when personal goal pursuit is at stake (e.g., see Dickman, 1990). Leone and Russo (2009) have proposed that the BAS-Drive dimension is even more complex. In addition to persistence and functional impulsivity, Leone and Russo (2009) suggest that BAS-Drive comprises an ability to weigh conflicting options and respond flexibly to goal pursuit by delaying or inhibiting dysfunctional impulses. Therefore, higher levels of BAS-Drive may foster the ability to persist in reward attainment within the context of strong motivational conflict (i.e., PTSS). In fact, higher levels of BAS-Drive may be needed for functional outcomes such engaging in goal attainment, in conjunction with increased PTSS severity, which may be an explanation for the assumed minimal level of functional impairment in our sample (i.e., college attendees).

4.1. Limitations

The present study is not without limitations. The cross-sectional study design restricts our understanding of the causal relationships of the variables. Future research should investigate the temporal direction of these variables. Specifically, longitudinal designs would be able to determine the impact of pre-trauma BIS sensitivity on the use of self-regulatory processes and the subsequent development of psychopathology. These designs would also allow us to understand the developmental trajectory as opposed to the cross-sectional impact that these variables have on one another. Our sample also limits the generalizability of the findings. Specifically, an entirely female sample reduces our ability to extend the findings to males or to determine or discuss sex differences in the findings. We cannot assume that findings within a male sample would emulate the findings of the current study. Further, considering that our sample is a college-student sample, there is a concern regarding extending these findings to other samples not of simi-

lar age and level of functioning. Lastly, it is difficult to know how our findings truly represent the various subsystems described in RST. Without adequate measures of the BIS and FFFS subsystems, we are limited in our understanding of these two subsystems and the relation of these subsystems to self-regulatory processes and psychopathology.

4.2. Conclusions

The current study is the first to examine the interaction of neurobiological subsystems (i.e., BIS and BAS) and self-regulatory mechanisms (i.e., EA) in relation to trauma-related psychopathology (i.e., PTSS). Most importantly, the current study identifies EA as moderator of the relationship between BIS sensitivity and PTSS, a finding which may have clinical significance. Lastly, the current study highlights the complexity of the BIS and BAS in relation to psychopathology. Not only are there unique contributions of the systems in relation to posttraumatic stress symptomatology, but also there may be interplay between the systems (i.e., BIS and BAS-Drive). Future studies should investigate the interaction of the systems within the context of psychopathology, and identify how the sensitivity of the systems manifest into specific behaviors and self-regulatory processes (either adaptive or maladaptive strategies). These directions may provide important information regarding the influence of these interactions on individual's perceptions and evaluations of maladaptive behaviors and symptoms, which may inform our conceptualization and treatment of psychopathology.

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