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Behavioral inhibition and PTSD symptoms in veterans

Catherine E. Myers^{a,b,*}, Kirsten M. VanMeenen^{a,c}, and Richard J. Servatius^{a,c}

^aDepartment of Veterans Affairs, VA New Jersey Health Care System, East Orange, NJ, USA

^bDepartment of Psychology, Rutgers University-Newark, NJ, USA

^cStress and Motivated Behavior Institute, University of Medicine and Dentistry of New Jersey-New Jersey Medical School, Newark, NJ, USA

Abstract

Behavioral inhibition (BI), a temperamental bias to respond to novel stimuli with avoidance behaviors, is a risk factor for posttraumatic stress disorder (PTSD). It is unclear whether BI accounts for additional variance in PTSD symptom severity beyond that accounted for by general anxiety. Here, 109 veterans (mean age 50.4 years, 9.2% female) provided self-assessment of PTSD symptoms, state and trait anxiety, combat exposure, and current (adult) and retrospective (childhood) BI. Adult BI was correlated with anxiety and PTSD symptom severity, especially cluster C (avoidance) symptoms, but not with combat exposure. A regression model including adult BI, state and trait anxiety, and combat exposure was able to correctly classify over 80% of participants according to presence or absence of severe PTSD symptoms. Because avoidance behaviors are a core component of PTSD, self-assessments of BI may be an important tool in understanding PTSD and potentially assessing vulnerability to the disorder.

Keywords

Posttraumatic stress disorder (PTSD); behavioral inhibition; avoidance; anxiety; veterans

1. Introduction

Although military personnel may have vulnerabilities for anxiety disorders similar to the non-military population, the extreme and constant stressors of deployment, war, and wartime service enhance the likelihood of developing post-traumatic stress disorder (PTSD). However, the development of PTSD is the exception not the rule (Bonanno, 2004). For example, only about 9% of individuals exposed to any form of traumatic event develop PTSD (Breslau et al., 1998). In comparison, one study estimated that less than 15–20% of military personnel returning from combat duty in Afghanistan or Iraq met PTSD criteria 3–4 months later (Hoge et al., 2004), while a recent re-examination of data on Vietnam-era veterans found a lifetime PTSD prevalence of 19% (Dohrenwend et al., 2006). Thus, although PTSD prevalence is generally higher among veterans than among the general population, the large majority do not develop PTSD. The wide range of PTSD symptom

Corresponding author: Catherine E. Myers, NeuroBehavioral Research Laboratory, VA New Jersey Health Care System, 385 Tremont Avenue, Mail Stop 129, East Orange, NJ 07018 USA, Telephone: +973-676-1000 x1810, Fax: +973-395-7111, Catherine.Myers2@va.gov.

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severity among individuals exposed to similarly stressful traumatic events (Pitman et al., 1987; Orr et al., 1993; Shalev et al., 1993; McNally, 2003) indicates that pre-existing vulnerability factors critically modulate an individual's risk to develop PTSD.

One such vulnerability factor is trait anxiety, a relatively stable tendency to perceive stressful situations as dangerous or threatening, and to respond with short-term elevations in current (state) anxiety (Spielberger, 1983). The Spielberger State-Trait Anxiety Inventory (STAI; Spielberger, 1983) is a self-report tool that can be used to assess both state and trait anxiety. The STAI has relatively high test-retest stability as well as correlation with other measures of trait anxiety. Individuals with a diagnosis of PTSD generally have higher Trait Anxiety as measured by the STAI, compared to non-PTSD controls (e.g., Orsillo et al., 1996; Casada and Roache, 2005, 2006), and in one prospective study, high peritraumatic STAI Trait Anxiety among individuals undergoing surgery is associated with higher rates of PTSD symptoms 2–5 years later (Ristvedt and Trinkaus, 2009). In fact, some studies suggest that trait anxiety is a stronger determinant of PTSD symptom severity than the nature of the traumatic event (Lonigan et al., 1994; Phipps, Jurbergs, and Long, 2009). However, the STAI indexes general anxiety and as such is related to risk for a wide range of anxiety disorders, including but not limited to PTSD. It is possible that, by closely examining temperamental variables directly associated with PTSD symptoms, better predictions of risk and vulnerability will be possible.

As defined by the DSM-IV, PTSD symptoms fall into three clusters: re-experiencing (cluster B), avoidance (cluster C), and arousal (cluster D). Although a minimum number of symptoms in each cluster is required for a PTSD diagnosis, avoidance symptoms may be particularly relevant in determining which trauma-exposed individuals are likely to develop PTSD and whether that PTSD is likely to be chronic or remitting. Specifically, whereas re-experiencing and arousal symptoms are relatively common among trauma-exposed individuals, occurring in about 60–80% and 30–60% of cases, respectively, avoidance symptoms are relatively less frequent, observed in only about 10–50% of trauma-exposed individuals (Maes et al., 1998; Breslau et al., 1999). Trauma-exposed individuals who report avoidance symptoms have a particularly high probability of developing PTSD (North et al., 1999). In addition, presence and intensity of avoidance symptoms may be particularly stable over time (Solomon et al., 2009) and may be related to a more chronic, rather than remitting, course of illness in PTSD (Maes et al., 1998).

Given the importance of avoidance to the development of PTSD, the propensity for avoidance behaviors may be a particularly important vulnerability factor contributing to PTSD risk in trauma-exposed individuals. Indeed, one prospective study found that individuals with personality traits related to avoidance and avoidant behaviors, who were then exposed to trauma (terrorist attack), were at heightened risk for development of PTSD (Gil and Caspi, 2006).

Behavioral inhibition (BI) is defined as a temperamental tendency to withdraw from or avoid novel social and non-social situations (Kagan et al., 1987; Morgan, 2006). As such, individuals with high behavioral inhibition should be at heightened risk to respond to stressful situations with avoidance, possibly leading to vulnerability to PTSD and expression of avoidance symptoms. The Adult and Retrospective Measures of Behavioural Inhibition (AMBI/RMBI; Gladstone and Parker, 2005; Gladstone et al., 2005) are a pair of self-report tools to measure current (adult) and childhood (retrospective) BI. A prior study with veterans documented that AMBI and RMBI scores were higher in veterans with severe self-reported PTSD symptoms, indicating an association between behavioral inhibition and PTSD symptom severity (Myers et al., 2011/in press). An unresolved question is whether behavioral inhibition as measured by the AMBI/RMBI and general anxiety as assessed by

STAI are separable vulnerability factors. In other words, is BI a useful predictor of PTSD symptoms, accounting for additional variance beyond that which is already accounted for by general anxiety?

Here, we recruited and tested a group of veterans, both with and without history of exposure to combat, to examine (1) whether self-reported BI correlated with PTSD symptom severity and specifically with avoidance symptoms in veterans, and if so (2) whether BI could account for additional variance in PTSD symptoms, beyond that accounted for by trait anxiety alone. As a secondary goal, because combat exposure is a well-documented risk factor for PTSD, we examined (3) whether either BI or trait anxiety was significantly higher in veterans with combat exposure. If so, that might suggest that high BI and/or Trait Anxiety are acquired in the wake of exposure to traumatic events such as combat; if not, BI and Trait Anxiety would be more likely to be pre-existing traits rather than to develop in the aftermath of exposure to traumatic events.

2. Methods

2.1 Subjects

109 veterans were recruited from the New Jersey Health Care System (NJHCS), East Orange, NJ, with mean age 50.4 years (SD 9.1, range 23–65) and mean education 12.8 years (SD 1.8, range 6–20, including 62 with high school or less, 43 with 1+ years of college, and 4 with postgraduate education). The sample included 10 females (9.2%). Participants identified themselves as African-American ($n=88$), Caucasian ($n=14$), Hispanic ($n=4$), Native American ($n=2$), and Other ($n=1$). Asked about conflicts in which they had served, 32 reported serving during the Vietnam conflict (mean age 58.4 years, SD 5.4), 10 in Gulf War/Operation Desert Storm (GW/ODS; mean age 41.1 years, SD 4.4), 10 in Operation Enduring Freedom/Operation Iraqi Freedom (OEF/OIF; mean age 34.6 years, SD 10.6), and 11 in other conflicts including operations in Bosnia, Granada, and Panama; 46 reported serving in peacetime or no specific conflict. The majority of veterans reporting other/peacetime service reported having served in the era between Vietnam and GW/ODS; mean age for these 57 veterans was 50.3 years (SD 5.0). As would be expected, the group who had served in Vietnam was significantly older than the other groups ($F(3,105)=54.63$, $p<0.001$, Tukey post-hoc test, all $p<0.001$), and the GW/ODS and OEF/OIF groups were significantly younger than the other groups (all $p<0.001$) but did not differ from each other ($p=0.062$).

Veterans were not excluded based upon medical or psychiatric history. When asked to self-report current medications; 48 participants (44%) reported taking psychoactive medications; one participant did not provide information. While some participants were able to specify the name of their medications, others reported the type of medication used (e.g., “anxiety meds” or “anti-depressant”). Thus, further analysis regarding medication usage in this sample was not possible.

Participants received payment of \$30/hour (maximum of \$60) for their participation in the study. Testing generally occurred between 1000–1200 and 1300–1500; no systematic differences in subject demographics or experimental data were observed as a function of testing time. All participants gave written informed consent before initiation of any experimental procedures; procedures were approved by the NJHCS Institutional Review Board and were conducted in accordance with the Declaration of Helsinki and guidelines established by the Federal Government for the protection of human subjects.

2.2 Procedures

Participants completed a battery of paper and pencil questionnaires that typically required 20–30 min to complete. The package included a demographic questionnaire as well as the

AMBI/RMBI, the STAI, the Combat Exposure Scale (CES; Keane et al., 1989), and the PTSD Checklist-Military version (PCL-M; Blanchard et al., 1996). After completing the questionnaires, participants also performed a 60-minute eyeblink conditioning procedure (data not reported here).

The AMBI is a 16-item self-report inventory that assesses current tendency to respond to new stimuli with inhibition and/or avoidance, and has been shown to be a measure of anxiety proneness (Gladstone and Parker, 2005). Based on previously published norms (Gladstone and Parker, 2005), participants with total AMBI scores from 0–15 are classed as “uninhibited” while those with scores of 16+ are classed as “inhibited.” In addition, AMBI items group into four subscales derived from factor analysis (Gladstone and Parker, 2005): ‘fearful inhibition’ (AMBI-FI), ‘risk avoidance’ (AMBI-RA), ‘non-approach’ (AMBI-NA), and ‘low sociability’ (AMBI-LS). In the current sample, internal consistency was high for total AMBI score (Cronbach’s $\alpha=0.847$) and for AMBI-NA, AMBI-FI, and AMBI-LS subscale scores (all $\alpha>0.750$) but not for AMBI-RA ($\alpha=-0.092$). All AMBI subscale scores were strongly correlated with each other (all $r>0.300$, all $p < 0.001$).

The RMBI is an 18-item self-report inventory used to assess childhood memories of exhibiting inhibition to the unfamiliar. Based on previously published norms (Gladstone and Parker, 2005), participants with total RMBI scores from 0–11 are classed as “uninhibited” while those with scores of 12+ are classed as “inhibited.” As with the AMBI, there are four RMBI subscales derived from factor analysis: ‘fearful inhibition’ (RMBI-FI), ‘risk avoidance’ (RMBI-RA), ‘non-approach’ (RMBI-NA), and ‘shyness and sensitivity’ (RMBI-SS). As originally published, the RMBI allows respondents to endorse a “do not remember” item; such endorsements constitute missing data for the corresponding items on analysis. To avoid this potential for data loss, we used a modified version of the RMBI which eliminated “do not remember” as a response option. In the current sample, internal consistency was high for total RMBI score (Cronbach’s $\alpha=0.831$) and for RMBI-NA, RMBI-FI, and RMBI-SS subscale scores (all $\alpha>0.650$) but not for RMBI-RA ($\alpha=-0.300$). All RMBI subscale scores were significantly correlated with each other (all $r>0.250$, all $p < 0.001$) except for RMBI-RA and RMBI-SS ($r=0.111$, $p=0.251$).

The STAI is a 40-item self-report questionnaire that includes scales measuring State Anxiety (STAI-State) and Trait Anxiety (STAI-Trait). Trait Anxiety is assumed to be a relatively stable personality characteristic, while State Anxiety may change with mood and emotion. In the current sample, internal consistency was high for both STAI-State (Cronbach’s $\alpha=0.949$) and STAI-Trait ($\alpha=0.933$).

The CES is a 7-item self-report questionnaire that assesses exposure to stressful military events. Total CES score was calculated from a sum of weighted scores; as in prior studies (e.g., Ginsberg et al., 2008), veterans with a CES score of 0–7 were classified as non-combat while those with a score of 8+ were classified as having history of exposure to combat.

The PCL-M is a 17-item self-report questionnaire that asks about presence and frequency of PTSD symptoms in response to stressful military experiences; symptoms are rated according to how much they have bothered the participant in the past month. Specific questions correspond to DSM-IV symptom clusters including cluster B (re-experiencing the traumatic event), cluster C (avoidance/numbing), and cluster D (increased arousal). PCL-M scores of 50+ predict PTSD in military samples (Weathers et al., 1993; Blanchard et al., 1996;). Accordingly, we also categorized participants according to presence or absence of current, severe PTSD symptoms (PTSS) based on this cutoff.

2.3 Data analysis

For all questionnaires, missing data values (questions for which no answer was endorsed) were interpolated using the mean value for the remaining items (taking reverse-scored questions into account) or, in the case of AMBI/RMBI and PCL-M, by using the mean values for the remaining items in the same subscale (see also Maguen et al., 2008; Vasterling et al., 2010). In the current sample, nine subjects missed one question apiece (4 on RMBI, 1 on AMBI, 1 on STAI-Trait, 2 on STAI-State, 1 on PCL-M) and one subject missed two on PCL-M. All other subjects completed all items on all questionnaires.

Bivariate linear correlation (Pearson's r) was used to investigate associations between questionnaire scores; independent-samples t -tests and chi-square tests, with Yates continuity correction as appropriate for 2x2 tables, were used to examine group differences in continuous and categorical variables. Stepwise linear regression and logistic regression were used to investigate ability of demographic variables and questionnaire scores to predict PCL-M scores and PTSS classification. The threshold for significance, alpha, was set as 0.05 (two-tailed), with Bonferroni correction used to adjust alpha to protect against inflated risk of family-wise error under multiple significance tests.

3. Results

Turning first to demographic variables, based on CES, 85 of the 109 veterans were classified as non-combat; of the remaining 24 veterans, 7 reported "Light-Moderate," 11 "Moderate," 3 "Moderate-Heavy," and 3 "Heavy" exposure to combat. Mean CES for the combat group was 20.75 (SD 7.7) compared to 1.3 (SD 2.4) in the non-combat group. All female participants were non-combat; however the gender imbalance between combat and non-combat groups failed to reach significance (Yates-corrected $\chi^2=1.86$, $df=1$, $p=0.173$), presumably due to the low inclusion of females overall.

CES scores and PCL-M scores were highly correlated in this sample ($r=0.395$, $p<0.001$). Mean PCL-M total scores were significantly higher in combat than non-combat veterans (Table 1), as were the number of items endorsed as "Moderate" or greater in each PTSD symptom cluster (independent-samples t -tests, Bonferroni-corrected alpha=0.013, all $t>10.0$, all $p<0.001$). Using the 50+ cutoff for PTSS, 47 veterans had PTSS; rate of PTSS was higher among combat veterans ($n=18$ of 24) than non-combat veterans ($n=29$ of 85; Yates-corrected $\chi^2=11.14$, $df=1$, $p=0.001$).

Turning next to behavioral inhibition scores, on the AMBI, mean total score was 18.3 (SD 6.8), with subscale means AMBI-NA=3.5 (SD 1.8), AMBI-FI=8.0 (SD 3.7), AMBI-RA 3.5 (SD 1.2), and AMBI-LS=3.6 (SD 1.7); on the RMBI, mean total score was 13.3 (SD 6.7), with subscale means RMBI-NA=4.5 (SD 2.7), RMBI-FI=2.9 (SD 2.5), RMBI-RA=2.8 (SD 1.4), and RMBI-SS=3.0 (SD 2.1). Within individual participants, AMBI and RMBI total scores were highly correlated ($r=0.425$, $p<0.001$). There was no effect of gender on AMBI or RMBI total scores or subscale scores (independent-samples t -tests, Bonferroni-corrected alpha=0.005, all $p>0.010$). 59 of 109 veterans were classed as "inhibited" based on RMBI (45.9%), and 67 of 109 veterans were classed as "inhibited" based on AMBI (61.5%).

Total PCL-M scores were highly correlated with AMBI ($r=0.553$, $p<0.001$) but not RMBI total scores ($r=0.223$, $p=0.020$). Using the cutoffs described above to class veterans as inhibited vs. inhibited, PCL-M scores as well as all PTSD symptom cluster scores were significantly higher in veterans classed as inhibited based on AMBI but not in veterans classed as inhibited based on RMBI (Table 2; independent-samples t -tests, Bonferroni-corrected alpha=0.006, all $p<0.001$).

Considering the anxiety scores, mean STAI-State score in this sample was 40.9 (SD 14.1); mean STAI-Trait was 47.9 (SD 12.2); within individual participants, STAI-State and -Trait scores were highly correlated ($r=0.836$, $p<0.001$). There were no gender differences in either measure (all $t<1.0$, all $p>0.300$). Both STAI-State and -Trait scores were significantly correlated with PCL-M total scores (all $r>0.650$, all $p<0.001$). Using a median split on STAI scores, 52 veterans were classified with “low” State Anxiety (STAI-State score <40) and 57 with “high” State Anxiety; 55 veterans had “low” Trait Anxiety (STAI-Trait score <49) and 54 had “high” Trait Anxiety. PCL-M scores as well as all PTSD symptom cluster scores were significantly higher in veterans classed with high State or Trait Anxiety than in veterans with low Anxiety scores (Table 3; independent-samples t -tests, Bonferroni-corrected $\alpha=0.005$).

Both AMBI and RMBI scores were significantly correlated with both STAI-State and -Trait scores (r , Bonferroni-corrected $\alpha=0.013$, all $r>0.300$, all $p<0.001$).

There was no difference in scores of combat vs. non-combat veterans on STAI-State, STAI-Trait, AMBI/RMBI total scores, or AMBI/RMBI subscores (independent-samples t -tests, Bonferroni-corrected $\alpha=0.005$, all $p>0.050$ except STAI-Trait, $p=0.008$). Thus, although combat history was associated with high PCL-M scores, the association of high AMBI and STAI scores with high PCL-M scores was independent of exposure to combat in this sample. Further, when the analysis was restricted to the subgroup of veterans with exposure to combat ($n=24$), there was still a significant correlation between AMBI and PCL-M ($r=0.62$, $p=0.001$) but not between RMBI and PCL-M ($r=-0.06$, $p>0.500$), and significantly higher PCL-M and PTSD cluster scores in veterans classed as inhibited on AMBI (all $t>2.9$, all $p<0.01$) but not in veterans classed as inhibited on RMBI (all $t<1.0$, all $p>0.300$). In other words, although combat veterans formed a small proportion of the current sample, there was no evidence that the relationship of AMBI and RMBI to PTSD symptoms was qualitatively different in this subgroup.

Further, dividing participants into groups based on era of military service (Vietnam era, GW/ODS, OEF/OIF, or other/peacetime), there were no significant differences among groups on AMBI, RMBI, STAI-State, STAI-Trait, or PCL-M scores (ANOVA, all $F<3.00$, all $p>0.100$), and no significant differences in rates of PTSS status as a function of service era ($\chi^2=7.39$, $df=3$, $p=0.060$). Although era of military service is a gross measure, and although the more recent service eras were underrepresented in the current sample, nevertheless there is no evidence in the current sample that questionnaire scores were modified as a result of time since military service.

Stepwise linear regression on PCL-M scores, with predictor variables of age, education, gender (coded as 1=female, 0=male), RMBI, AMBI, STAI-State, STAI-Trait, and CES scores produced a best-fit model including four variables: STAI-Trait ($\beta=0.371$), CES ($\beta=0.264$), STAI-State ($\beta=0.253$), and AMBI ($\beta=0.170$). This model was able to account for significant variance in PCL-M scores ($R^2=0.646$, $F(4,104)=47.47$, $p<0.001$). Inclusion of the remaining variables did not account for significant additional variance (all p -to-include >0.050). The addition of AMBI to the model resulted in a significant change in prediction ($t=2.35$, $p=.021$), compared with the model including STAI-Trait and CES alone ($R^2=0.627$). Entering AMBI/RMBI subscale scores in the regression analysis resulted in a similar model with factors of STAI-State and -Trait, CES, and AMBI FI (STAI-Trait $\beta=0.329$, CES $\beta=0.268$, STAI-State $\beta=0.242$, and AMBI FI $\beta=0.228$; $R^2=0.656$, $F(4,104)=49.63$, $p<0.001$). The addition of AMBI FI to the model resulted in a significant change in prediction ($t=3.02$, $p=.003$), compared with the model including STAI-Trait and CES alone ($R^2=0.607$).

Stepwise linear regression on PTSD cluster B symptoms, using the same variables, produced a three-variable model including STAI-Trait ($\beta=0.253$), CES ($\beta=0.332$), and STAI-State ($\beta=0.314$); overall $R^2=0.467$; $F(3,105)=30.69$, $p<0.001$). Repeating the regression on PTSD cluster C symptoms produced a three-variable model including STAI-Trait ($\beta=0.455$), CES ($\beta=0.241$), and AMBI ($\beta=0.278$); overall $R^2=0.557$; $F(3,105)=44.09$, $p<0.001$). Repeating the regression on PTSD cluster D symptoms produced a two-variable model including STAI-Trait ($\beta=0.638$) and CES ($\beta=0.148$); overall $R^2=0.469$; $F(2,106)=46.81$, $p<0.001$). In summary, while STAI-Trait and CES scores were predictive of scores for all three symptom clusters, AMBI accounted for additional variance in predicting cluster C symptoms.

To investigate the ability of these variables to predict PTSS classification, stepwise logistic regression on PTSS status (coded as 1=presence or 0=absence of severe, current PTSD symptoms), was conducted using AMBI/RMBI subscale scores as well as age, education, gender, STAI and CES scores, resulting in a four-variable model including AMBI FI ($B=0.106$) as well as STAI-State ($B=0.069$), STAI-Trait ($B=0.062$) and CES ($B=0.147$, constant -9.041). This model correctly classified 82.6% of cases, including 54 of 62 non-PTSS cases (87.1% selectivity) and 36 of 47 PTSS cases (76.6% sensitivity). Results were similar, but prediction slightly less accurate, when AMBI/RMBI total scores were used in place of subscale scores (80.7% correct classification).

4. Discussion

This study examined relationships between current BI, anxiety, history of combat exposure, and severity of self-assessed PTSD symptoms in veterans. While BI and anxiety scores were correlated, regression analyses indicated that BI could account for additional variance in PTSD symptom severity beyond that accounted for by anxiety alone. When PTSD symptom clusters were considered, BI was specifically related to cluster C (avoidance) symptoms. These results support the premise that the AMBI assesses an individual's tendency to respond to novel situations with avoidance, which would potentially manifest in trauma-exposed individuals as increased probability to experience cluster C symptoms. Given that cluster C symptoms are the core feature of PTSD, as well as the least-frequently observed among trauma survivors (Maes et al., 1998; Breslau et al., 1999), this suggests that behavioral inhibition, as indexed by the AMBI, may be particularly useful in understanding PTSD symptoms.

4.1. Association of AMBI and PTSS

In the current sample, PCL-M scores were associated with high AMBI, but not RMBI, scores. This is similar to the relation between PCL-M and AMBI observed in our prior study (Myers et al., 2011/in press). There are several reasons why the AMBI might be more strongly associated with PCL-M scores than RMBI. First, and most simply, both AMBI and PCL-M assess contemporaneous behaviors, attitudes, and symptoms, whereas the RMBI assess retrospective (childhood) behaviors. The original AMBI/RMBI validation paper (Gladstone & Parker, 2005) noted that, although BI is considered to be a relatively stable personality trait, some individuals do change over time, and some individuals who are classed as "inhibited" based on RMBI are "uninhibited" based on AMBI, and vice versa, which could weaken an association with current PTSD symptoms. The RMBI is also presumably more vulnerable to selective remembering, and it may be that individuals with high vs. low childhood BI are differently biased to forget or to recall and endorse RMBI items. Since the AMBI and PCL-M questionnaires were administered within a 2-hour window in the current study, it is also possible that responses to one questionnaire affect an individual's subsequent responses to the other questionnaire, although it is less clear why this would affect the relationship between AMBI and PCL-M more than the relationship between RMBI and PCL-M. Any or all of these factors may contribute to the conclusion,

also endorsed in the original AMBI/RMBI validation paper (Gladstone and Parker, 2005), that AMBI is better correlated than RMBI with measures such as anxiety proneness and clinical symptoms.

In the current study, we also modified the RMBI to eliminate “do not remember” responses, and this manipulation may affect the reliability of the measure. Gladstone and Parker (2005) did not report the rates of endorsement of “do not remember” items in the validation sample, nor did they describe how such responses should be scored (e.g. are such responses scored as zeros, potentially artificially deflating RMBI scores of participants who endorsed high numbers of “do not remember” items, or are the remaining answers pro-rated to normalize scores across participants). However, in our prior study which used subjects drawn from the same veteran population as the current study, and in which we did allow “do not remember” responses on RMBI, mean RMBI scores pro-rated to compensate for such responses were similar to those obtained in the current sample (Myers et al., 2011/in press: mean RMBI 12.7 (*SD* 6.6), current study: mean RMBI 13.3 (*SD* 6.7)). Therefore, we think it unlikely that this manipulation reduced RMBI reliability.

The current study also documented a relation between AMBI/RMBI and both state and trait anxiety, indexed by STAI, which were themselves also associated with higher PCL-M scores in this sample. This latter finding is consistent with prior studies showing higher trait anxiety in individuals with clinically-diagnosed PTSD relative to non-PTSD controls (e.g., Orsillo et al., 1996; Casada and Roache, 2005, 2006). However, the central finding of this study was that PTSD symptoms could be better predicted by a model including both anxiety and behavioral inhibition than by anxiety alone, suggesting that each construct accounts uniquely for some variance in individual PTSS scores.

4.2. Combat exposure and PTSS in the current sample

Consistent with prior studies, combat and non-combat veterans showed high correlation between degree of combat exposure (CES score) and degree of self-reported PTSD symptoms (PCL-M scores). In the current sample, more combat than non-combat veterans reached the criterion for PTSS; nevertheless about a third of non-combat veterans scored high enough on PCL-M to be classified as PTSS. These data demonstrate that even veterans with little or no history of exposure to combat may report high rates of PTSD symptoms, possibly related to non-combat but service-related stressors including deployment and/or reintegration into civilian life, as well as to life experiences unrelated to an individual's military service. It is of course possible that the current sample of veterans has a higher rate of PTSD symptoms than the general veteran population. In fact, while PTSS classification is not the same as a clinical diagnosis of PTSD, the observed rates of PTSS are considerably higher than rates of PTSD diagnosis observed the general population (estimated lifetime prevalence <10%; Kessler et al., 1995), or in active military personnel prior to their first deployment (approximately 9–12%; Kline et al., 2010; Vasterling et al., 2010). However, a recent study of over 1,500 Marines who deployed in support of conflicts in Iraq and Afghanistan found that deployment-related stressors were even more strongly associated with self-reported PTSD symptoms than was combat exposure (Booth-Kewley et al., 2010). Clearly, further studies of PTSD vulnerability should examine the impact of a broad range of stressors related to military service, rather than focusing exclusively on the stress of combat exposure as a sole or major determinant of risk.

In the current study, although AMBI and STAI scores were related to each other, and to PCL-M, neither behavioral inhibition nor anxiety was significantly higher in combat than in non-combat veterans. Because combat exposure was the only form of potential trauma explicitly examined in the current study, the present data cannot rule out the possibility that other types of trauma contributed to high AMBI and/or STAI scores in the current data.

Further studies should include examination of these other potential stressors, including both those related to military service, as well as those that may have occurred in civilian life before or after an individual's period of service. Nevertheless, the fact that neither AMBI/RMBI nor STAI scores were higher in combat than non-combat veterans in this sample suggests that high behavioral inhibition and anxiety are not acquired as a result of exposure to stressors such as combat.

Similarly, the current study found no significant relationship between AMBI/RMBI scores, STAI anxiety scores, PCL-M scores, or PTSS rates among veterans as a result of era of military service. This lack of relationship must be qualified by the overrepresentation of Vietnam-era veterans in the current sample (32 out of 109 participants). However, the relatively stable rates of PTSS in the current sample across a range of time since military service suggest first, that time since exposure to combat does not strongly modify the relationship between BI, anxiety, and PTSD symptoms, and second, that similar rates of PTSD symptoms are reported by veterans across a range of eras and conflicts. This would be generally consistent with epidemiological studies suggesting broadly similar prevalence of current PTSD among veterans of the Vietnam era (15.2% for males and 8.1% for females; Kulka et al., 1990), Gulf War (10–12%, Kang et al., 2003), and recent OEF/OIF deployments (13.8%, Tanielian and Jaycox, 2008).

4.3. Limitations and future directions

An important variable contributing to individual differences in the current study may have been history of psychiatric disorder and/or current use of psychotropic medications. Given the characteristics of the veteran population, excluding such individuals would have resulted in an extremely unrepresentative sample. Additionally, not all veterans with psychiatric symptoms receive a clinical diagnosis, in part because of unwillingness or inability to seek treatment. Further, given the known association of BI with vulnerability to anxiety disorders (including PTSD), excluding individuals with diagnosed psychiatric disorders would presumably have resulted in disproportionate exclusion of individuals with high BI, relative to those with low BI, which in turn would distort both group size and study results. However, including such individuals may of course have introduced other potential confounds. Further studies could attempt to examine this issue, perhaps by considering a larger sample size in which presence or absence of specific psychiatric disorders could be treated as additional covariates for analysis.

Prior studies have also found higher rates of PTSD in individuals with female gender (e.g., Tolin and Foa, 2006; Ranasinghe and Levy, 2007; DiGrande et al., 2008) and lower level of educational attainment (DiGrande et al., 2008; Iversen et al., 2008; Zohar et al., 2009; Booth-Kewley et al., 2010), suggesting that these demographic variables are also pre-existing risk factors for PTSD. In the current sample, neither gender nor education was significantly related to PCL-M scores nor as predictive of PTSD classification. This may be due to the low inclusion in the current study of females (<10%) and of individuals with high educational attainment (only $n=4$ participants with post-college education). Future work should examine these issues more closely. The current sample did not replicate Gladstone and Parker's (2005) finding of higher RA in females, which again may be due to low inclusion of females in the current sample; however, internal consistency of the RA subscales was generally poor in the current sample. Interestingly, both AMBI RA and RMBI RA were the least internally-consistent subscales in the Gladstone and Parker sample, with alpha of 0.52 for AMBI RA and 0.40 for RMBI RA, compared to alphas of 0.80 or greater for all other AMBI/RMBI subscales. On the other hand, AMBI FI was a significant predictor of PCL-M scores. This may be because the questions used to generate FI scores (e.g., "Do you tend to withdraw and retreat from those around you? Do you tend to observe strangers from a distance first, before being able to mix in?") are more closely related to the

avoidance symptoms of PTSD; it may also simply reflect the fact that AMBI FI scores, which are based on 7 questions (score range 0–14), have the potential for greater variance across subjects than the other AMBI subscale scores, which are based on only 3 questions apiece (score range 0–6).

Future work should clearly investigate the relationship of AMBI/RMBI scores to PTSD symptoms in samples with larger inclusions of females, as well as consider potential differences in individuals with PTSD due to combat exposure versus other (military and non-military) sources of trauma. In addition, to the degree that high AMBI/RMBI scores are correlated both with behaviorally-inhibited temperament as well as with current PTSD symptoms, future work should investigate the degree to which high AMBI scores may represent a marker of pre-existing vulnerability to PTSD in individuals not yet exposed to trauma. In particular, AMBI/RMBI scores could be considered together with biological markers of PTSD risk, such as circulating levels of stress hormones such as cortisol, resting heart rate, and/or startle responding, to determine whether such a combination of measures may provide more sensitive and selective predictors of PTSD symptom severity, and of risk for PTSD, than any marker alone.

In summary, a sample of combat and non-combat veterans showed high correlation between self-reported PTSD symptoms and personality measures including trait anxiety and current (adult) behavioral inhibition. Although the latter two variables were highly correlated, they each contributed uniquely to predicting PTSD symptom severity, with behavioral inhibition showing a particular relationship to cluster C (avoidance) symptoms. The lack of association between combat exposure and the personality measures suggests that high trait anxiety and behavioral inhibition are not acquired as a result of exposure to potentially traumatic events, such as combat. This, together with the relative stability of behavioral inhibition as a personality trait, suggests that behavioral inhibition may be a pre-existing factor that contributes to an individual's overall risk for PTSD when exposed to potentially traumatic events. As such, further longitudinal studies examining self-assessed behavioral inhibition in individuals subsequently exposed to trauma, including but not limited to combat, would be insightful.

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Table 1

PTSD symptoms in combat and non-combat veterans.

	Combat (n=24)	Non-combat (n=85)
Total PCL-M score	58.8 (17.4) *	41.0 (17.3)
Cluster B symptoms	3.8 (2.0) *	1.7 (2.1)
Cluster C symptoms	5.3 (2.3) *	2.7 (2.5)
Cluster D symptoms	3.9 (1.7) *	2.7 (2.0)

Mean (SD) Post-traumatic Stress Disorder Checklist-Military version (PCL-M) total scores, and number of symptoms from each PTSD symptom cluster endorsed as "Moderate" or higher, in combat and non-combat veterans.

* combat > non-combat, independent-samples *t*-test, all $t > 10.0$, all $p < 0.001$.

Table 2

PTSD symptoms in veterans with “uninhibited” vs. “inhibited” temperament

	“Uninhibited” (based on RMBI; <i>n</i> =50)	“Inhibited” (based on RMBI; <i>n</i> =59)	“Uninhibited” (based on AMBI; <i>n</i> =42)	“Inhibited” (based on AMBI; <i>n</i> =67)
PCL-M	40.6 (19.0)	48.6 (17.8)	33.3 (12.8)	52.2 (18.2) *
Cluster B	1.9 (2.2)	2.4 (2.2)	1.1 (1.7)	2.8 (2.2) *
Cluster C	2.6 (2.6)	3.8 (2.6)	1.5 (1.8)	4.4 (2.5) *
Cluster D	2.6 (2.1)	3.6 (1.9)	2.0 (1.7)	3.6 (1.7) *

PCL-M total scores, and PTSD symptom cluster scores, in veterans classed as uninhibited vs. inhibited based on RMBI (score 12+) or AMBI (score 16+).

* Inhibited > Uninhibited, independent-samples *t*-test, all $t > 4.00$, all $p < 0.001$.

Table 3

PTSD symptoms in veterans with low vs. high anxiety

	Low State Anxiety (<i>n</i> =55)	High State Anxiety (<i>n</i> =54)	Low Trait Anxiety (<i>n</i> =55)	High Trait Anxiety (<i>n</i> =54)
PCL-M	34.9 (15.3)	55.2 (16.3) *	33.3 (14.2)	56.9 (14.9) *
Cluster B	1.2 (2.0)	3.1 (2.0) *	1.0 (1.7)	3.3 (2.1) *
Cluster C	2.0 (2.2)	4.6 (2.5) *	1.6 (2.0)	5.0 (2.1) *
Cluster D	2.0 (1.9)	4.0 (1.5) *	1.8 (1.9)	4.2 (1.2) *

PCL-M total scores, and PTSD cluster symptom scores, in veterans classed with “high” or “low” State or Trait Anxiety based on median split of STAI scores.

* high anxiety > low anxiety, independent-samples *t*-test, all $t > 4.00$, all $p < 0.001$.