Cognitive Therapy and Research (2020) 44:611–620
https://doi.org/10.1007/s10608-020-10085-5

ORIGINAL ARTICLE

# Predictors of Treatment Outcome in Group or Individual Cognitive Processing Therapy for Posttraumatic Stress Disorder Among Active Duty Military

**Patricia A. Resick[1] · Stefanie T. LoSavio[1] · Jennifer Schuster Wachen[2,3] · Kirsten H. Dillon[1,9] · Erica E. Nason[4,10] · Katherine A. Dondanville[4] · Stacey Young-McCaughan[4] · Alan L. Peterson[4,5,6] · Jeffrey S. Yarvis[7,11] · Jim Mintz[4,8] · For the STRONG STAR Consortium**

Published online: 27 February 2020


## Abstract

**Background** The purpose of this study was to examine demographic, psychological, military, and deployment variables that might predict posttraumatic stress disorder (PTSD) symptom improvement in a sample of active duty service members who received either group or individual cognitive processing therapy (CPT).

**Methods** Data were analyzed from 165 active duty service members with pre- and posttreatment data participating in a randomized controlled trial comparing group with individual CPT. Pretreatment variables were examined as predictors of change in PTSD severity from baseline to posttreatment, assessed using the PTSD Symptom Scale-Interview Version (PSS-I). Predictors of PSS-I change were first evaluated using Pearson correlations, followed by partial and multiple correlations to clarify which associations remained when effects of other predictors were controlled. Multiple regression analyses were used to test for interactions between pretreatment variables and treatment format.

**Results** Only age was a significant predictor of PTSD symptom change after controlling for other variables and statisitically correcting for testing multiple variables. There was also an interaction between age and treatment format.

**Conclusions** Younger participants had greater symptom improvement, particularly if they received individual treatment. Other pretreatment variables did not predict outcome. CPT appears to be robust across most pretreatment variables, such that comorbid disorders, baseline symptom severity, and suicidal ideation do not interfere with application of CPT. However, individual CPT may be a better option particularly for younger service members.

**Keywords** Posttraumatic stress disorder · Cognitive processing therapy · Randomized controlled trial · Predictors of outcome

✉ Patricia A. Resick
patricia.resick@duke.edu

[1] Department of Psychiatry and Behavioral Sciences, Duke University Medical Center, 1121 West Chapel Hill Street, Durham, NC 27707, USA

[2] Women's Health Sciences Division, National Center for PTSD, VA Boston Healthcare System, Boston, MA, USA

[3] Department of Psychiatry, Boston University School of Medicine, Boston, MA, USA

[4] Department of Psychiatry and Behavioral Sciences, University of Texas Health Science Center at San Antonio, San Antonio, TX, USA

[5] Research and Development Service, South Texas Veterans Health Care System, San Antonio, TX, USA

[6] Department of Psychology, University of Texas at San Antonio, San Antonio, TX, USA

[7] Department of Behavioral Health, Carl R. Darnall Army Medical Center, Fort Hood, TX, USA

[8] Department of Epidemiology and Biostatistics, University of Texas Health Science Center at San Antonio, San Antonio, TX, USA

[9] Present Address: Research and Development, Durham VA Medical Center, Durham, NC, USA

[10] Present Address: School of Social Work, Texas State University, San Marcos, TX, USA

[11] Present Address: 21st Combat Support Hospital at Fort Hood, Killeen, TX, USA

Posttraumatic stress disorder (PTSD) can be a significant problem among active duty military personnel, especially those returning from combat deployments. Evidence-based treatments for PTSD, such as cognitive processing therapy (CPT), have been shown to be effective in an active duty population (Resick et al. 2015, 2017). However, as with any treatment, some individuals show greater benefit than others. There has been surprisingly little research on predictors of PTSD treatment outcome, and research on predictors in active military samples is nonexistent. Determining predictors of treatment outcome may lead to differential recommendations regarding which type of treatment or treatment format may be more appropriate for a particular patient. It may also be useful in refining treatments for those who do not respond well despite completing a course of therapy. The purpose of this secondary data analysis was to examine pretreatment demographic, psychological, military, and deployment variables that predict PTSD improvement in active service members receiving individual or group CPT as part of a larger randomized clinical trial (Resick et al. 2017).

## Demographic Variables

Most research with civilians has focused on demographic predictors of treatment outcome with mostly mixed or equivocal findings. Education has not demonstrated a significant relationship to PTSD treatment outcome (Rizvi et al. 2009; van Minnen et al. 2002). Following prolonged exposure therapy (PE; Foa et al. 2007), older individuals reported higher levels of PTSD symptoms than younger individuals (van Minnen et al. 2002). In a sample of female rape victims, older women in PE and younger women in CPT had the best overall outcomes (Rizvi et al. 2009). In contrast, in a study of variable-length CPT, age was not a significant predictor of number of sessions to achieve good end-state functioning (Galovski et al. 2012). Marital status has not been a predictor in several PE studies (Ehlers et al. 1998; van Minnen et al. 2002) or combined conditions of exposure or cognitive therapy (Tarrier et al. 2000).

Few studies have examined whether race or ethnicity are related to treatment outcome. In one study comparing CPT outcomes of African American and Caucasian women, intent-to-treat analyses revealed no association between race and treatment outcome (Lester et al. 2010). A study on the use of naltrexone and PE to treat comorbid substance use disorder and PTSD found that, while race was related to substance use outcomes, it was not predictive of change in PTSD symptoms (Zandberg et al. 2016).

Previous research has demonstrated that individuals who have experienced multiple traumas endorse more residual PTSD symptoms posttreatment than individuals who have experienced a single traumatic event (van Minnen et al. 2002). Therefore, it is possible that those with greater numbers of potentially traumatic events will have poorer outcomes with a short, 12-session therapy, particularly if treated in a group setting.

## Psychological Variables

Prior studies using civilian and veteran samples have examined whether pretreatment psychological factors such as PTSD severity, depression, anxiety, guilt, or suicide risk are associated with PTSD treatment outcomes with mixed findings. van Minnen and colleagues (2002) found that higher pretreatment PTSD severity was associated with worse PE treatment outcomes, but other pretreatment psychological variables (e.g., depression, guilt, and shame) were not. Similarly, Speckens et al. (2006) found that higher pretreatment PTSD severity and anger predicted poorer treatment outcomes for cognitive therapy, but anxiety, depression, self-blame, and dissociation were not associated with outcome. In one study comparing eye movement desensitization and reprocessing therapy to exposure with cognitive restructuring, higher self-reported PTSD severity predicted better treatment outcomes, whereas higher interviewer-rated PTSD severity predicted worse treatment outcomes, regardless of modality (Karatzias et al. 2007). This study also examined whether pretreatment depression and anxiety were associated with treatment response and found no effect (Karatzias et al. 2007).

In contrast to the studies that have found higher PTSD severity to be associated with worse outcomes, Forbes et al. (2003) found that, with veterans, greater PTSD severity at baseline was associated with better treatment outcomes. While some studies have not found an association between depression and treatment outcome (e.g., Speckens et al. 2006; van Minnen et al. 2002), Rizvi et al. (2009) found that higher depression and guilt at pretreatment were associated with better PTSD outcomes for PE and CPT in a civilian sample. Additionally, in a study of variable-length CPT, greater depression at baseline predicted a need for longer treatment (Galovski et al. 2012).

Several studies have found a relationship between higher anger at pretreatment and poorer PTSD treatment response (Foa et al. 1995; Forbes et al. 2005, 2003; Lloyd et al. 2014; Owens et al. 2008; Taylor et al. 2001). However, there have been exceptions where no relationship with anger was found (e.g., Taylor 2003; van Minnen et al. 2002). A few studies have examined the impact of anger on CPT treatment outcomes specifically. Using CPT among male Australian veterans with combat-related PTSD, Lloyd et al. (2014) found that higher baseline scores of anger were predictive of poorer recovery. In a study with U.S. veterans, Owens et al. (2008) found that a combination of higher levels of pretreatment

anger and pretreatment PTSD severity predicted higher posttreatment PTSD severity. However, these findings are not consistent with those from Rizvi et al. (2009), who found that anger did not predict poorer response among a female sample that received CPT.

In a study examining factors associated with outcomes from cognitive-behavioral treatments for PTSD, increased suicide risk was associated with worse treatment outcome (Tarrier et al. 2000). This effect was found above and beyond depression severity, which was not significantly associated with treatment outcome (Tarrier et al. 2000). Together, these findings suggest that anger and suicide risk may be associated with worse PTSD treatment outcome, while findings for PTSD severity, depression, anxiety, and guilt are more equivocal.

Finally, insomnia has been found to be a residual symptom after treatment in several studies (Galovski et al. 2009; Pruiksma et al. 2016). It is possible that insomnia at pretreatment might interfere with active engagement over the course of treatment and predict worse outcome.

Because most PTSD treatment research on demographic and psychological predictors has been conducted with civilian or veteran samples, the extent to which these findings extend to active duty service members is unknown. Additionally, researchers have yet to examine any interactions that might exist between such pretreatment variables and treatment format (i.e., individual versus group treatment).

## Military and Deployment Variables

A number of military- and deployment-related variables might also be related to treatment outcomes in active duty service members. Enlisted service members are more likely to receive a diagnosis of PTSD than officers (Ramchand et al. 2015; Seal et al. 2009). Also, individuals in certain military occupational specilities are more likely to have PTSD, such as those in health care occupations, combat specialists, and service and supply personnel (Ramchand et al. 2015). Higher rates of PTSD are also associated with a higher number of deployments and presumably greater exposure to combat (Ramchand et al. 2015). Another variable of interest might be unit cohesion, which has been associated with lower PTSD severity (Dickstein et al. 2010). While these findings highlight certain populations within the military who may be at greatest risk for PTSD and need for treatment, to date, no research has examined the effects of these variables on outcomes following PTSD treatment.

Finally, variables such as the location of deployment or time since experiencing an index event may be important in predicting treatment outcomes. For example, research among civilians has found that less time since the index event is predictive of needing fewer CPT sessions to achieve good end-state functioning (Galovski et al. 2012). However, because there has been so little treatment outcome research with active duty service members, there is no extant literature on the effect of military variables on treatment that might guide treatment recommendations.

## Current Study

The purpose of this secondary data analysis was to examine demographic, psychological, military, and deployment predictors of treatment outcome in a sample of active duty military receiving either individual or group CPT. In the parent study from which these data were drawn (Resick et al. 2017), it was found that individual therapy was more efficacious than group treatment on PTSD but not depression or suicidal ideation. Therefore, this study also explored interactions between pretreatment variables and treatment format. Due to the inconsistent findings in civilian and veteran samples and the paucity of literature on both predictors of active duty military treatment outcome and comparing outcomes across group versus individual treatment modalities, this study was considered exploratory, with no specific hypotheses. The aim of this study is to determine not only if there are specific predictors of treatment outcome but also whether there are differential predictors across the two formats of therapy that might inform treatment recommendations.

## Methods

### Participants

Data were analyzed from 165 active duty service members participating in a larger randomized controlled trial of CPT who had a posttreatment interview. The primary paper from the clinical trial includes a CONSORT chart and additional detail about the participants (Resick et al. 2017). Those recruited into the trial were active duty military personnel seeking treatment following a deployment to or near Afghanistan or Iraq, with a current diagnoisis of PTSD based on the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision* (*DSM-IV-TR* American Psychiatric Association 2000) as assessed with the PTSD Symptom Scale-Interview Version (PSS-I; Foa et al. 1993). Those who were on psychotropic medication needed to be stable on their dose for at least 6 weeks prior to starting treatment. Exclusion criteria were minimal: current suicide or homicide risk meriting crisis intervention, active psychosis or mania, severe traumatic brain injury, or concurrent PTSD treatment. Service members with comorbidities including substance abuse or mild to moderate postconcussive symptoms were not excluded. The sample did not differ

demographically by treatment format. Participants were 91% male, an average of 34 years old (*SD* 7), with an average of 2.3 deployments (*SD* 1.0) and 11 years in service (*SD* 6.4). See Table 1 for descriptives of demographic, psychological, military, and deployment variable scores at pretreatment.

## Measures

Both self-report and interview measures were administered by independent evaluators who were masked to treatment condition. Predictors of PTSD symptom outcome were assessed at baseline. PTSD symptoms were assessed at pretreatment and 2 weeks posttreatment.

### PTSD Symptom Scale-Interview Version (PSS-I; Foa et al. 1993)

The PSS-I is a 17-item clinical interview that evaluates the severity and diagnostic criteria for the *DSM-IV*. Symptoms are rated on a 4-point scale ranging from 0 (*not at all)* to 3 (*very much*). The sum of items represents the severity score, and a diagnosis of PTSD is made if at least one re-experiencing, three avoidance, and two arousal symptoms are present.

### Beck Anxiety Inventory (BAI; Beck et al. 1988)

The BAI is a 21-item questionnaire to assess severity of anxiety symptoms over the past week. It is scored from 0 (*not at all*) to 3 (*severely*). The item scores are totaled.

### Beck Depression Inventory-II (BDI-II; Beck et al. 1996)

The BDI-II is a widely used measure of severity of depression. It has 21 items reflecting different severity of items scaled from 0 (*no disturbance*) to 3 (*maximal disturbance*).

### Beck Scale for Suicidal Ideation (BSSI; Beck and Steer 1991)

The BSSI is a 21 item self-report measure of suicidal ideation, plans, and preparations over the past week. Six of the 21 items screen for suicidality and were summed for this analysis. If a participant endorsed either item 4 (desire to kill self) or 5 (chancing death), they were scored as being at risk for suicide.

### Demographics and Military Service Characteristic Form

Using a form developed by our research group, this measure queried for demographic and military service characteristics including age, race, gender, marital status, education, ethnicity, rank, number of deployments, days since return from deployment, years of service, years since index event, medical board status, military role, and deployment to or

**Table 1** Predictors at baseline

| Variable | Mean (±*SD*) or total (%) |
|---|---|
| Age | 34.2 ± 7.3 |
| Education | |
| High school or less | 43 (26%) |
| Some college | 90 (55%) |
| Associate degree | 18 (11%) |
| College/graduate degree | 14 (8%) |
| Married/cohabiting | 116 (70%) |
| Male | 150 (91%) |
| Ethnicity/race | |
| Black | 42 (25%) |
| Hispanic | 38 (23%) |
| White | 70 (42%) |
| Other | 15 (9%) |
| Life events (#) | 10.1 ± 3.9 |
| Military grade (analyzed as ordinal 2–14) | |
| E-1 to E-3 | 50 (30%) |
| E-4 to E-6 | 46 (28%) |
| E-7 to E-9 | 35 (21%) |
| WO-1 to O-4 | 28 (17%) |
| Theater of combat ever served (not mutually exclusive) | |
| OEF | 51 (31%) |
| OIF | 88 (53%) |
| OND | 100 (61%) |
| Years in service | 11.4 ± 6.4 |
| Years since event | 5.8 ± 5.4 |
| Undergoing medical board process | 38 (23%) |
| Type of duty | |
| Combat arms | 60 (36%) |
| Combat support | 32 (19%) |
| Combat service support | 73 (44%) |
| Number of deployments | 2.3 ± 1.0 |
| Days since returned from deployment | 819.0 ± 696.4 |
| DRRI | |
| DRRI-C combat | 36.3 ± 11.7 |
| DRRI-A aftermath of battle | 34.0 ± 12.5 |
| WRAIR cohesion scale | |
| Horizontal (peer support) | 7.7 ± 2.9 |
| Vertical (command support) | 36.4 ± 10.2 |
| Total support | 44.1 ± 12.4 |
| Baseline symptom severity | |
| PSS-I | 24.3 ± 6.0 |
| BDI-II | 29.0 ± 11.4 |
| BSSI total | 2.0 ± 4.3 |
| BSSI (Screen%) | 6 (4%) |
| ISI | 18.7 ± 4.5 |
| STAXI-2 (state anger) | 26.9 ± 11.9 |
| BAI | 24.4 ± 11.1 |
| TRGI | |
| Hindsight bias | 7.2 ± 7.6 |
| Lack of justification | 8.2 ± 4.8 |

**Table 1** (continued)

| Variable | Mean (±*SD*) or total (%) |
|---|---|
| Wrongdoing | 5.7 ± 5.0 |

Total *N* = 165; ISI *N* = 134; STAXI-2 *N* = 164

*E-1 to E-3* junior enlisted, *E-4 to E-6* junior non-commissioned officer, *E-7 to E-9* senior non-commissioned officer, *WO-1 to O-4* warrant officer and officer, *OEF* operation enduring freedom, *OIF* operation Iraqi freedom, *OND* operation new dawn, *DRRI* deployment risk and resiliancy inventory, *WRAIR* Walter Reed Army Institute of Research Cohesion Scales, *PSS-I* PTSD symptom scale-interview version, *BDI-II* Beck Depression Inventory-II, *BSSI* Beck Scale for Suicidal Ideation, *ISI* Insomnia Severity Index, *STAXI-2* State Trait Anger Expression Inventory-2, *BAI* Beck Anxiety Inventory, *TRGI* Trauma Related Guilt Inventory

near Afghanistan or Iraq in support of Operation Enduring Freedom (OEF), Operation Iraqi Freedom (OIF), and/or Operation New Dawn (OND).

#### Deployment Risk and Resilance Inventory-2 (DRRI-2): Combat Experiences and Aftermath of Battle Scales (Vogt et al. 2008)

The DRRI-2 is a suite of scales that measure various aspects of deployment experiences. For this analysis, two scales were used: Combat Experiences (23 items) and Aftermath of Battle (e.g., seeing bodies of dead civilians or service members; 16 items). The scales are scored from 1 (*never*) to 5 (*daily or almost daily*). The extent of combat and aftermath events were each summed.

#### Insomnia Severity Index (ISI; Morin 1993)

The ISI is a 7-item self-report scale that assesses the severity of insomnia in the past month. Items are rated on a 0 to 4 scale, with higher numbers corresponding to greater sleep problems.

#### Life Events Checklist Total (LEC; Grey et al. 2004)

This questionnaire includes a list of 16 different potentially traumatic events that are commonly associated with PTSD symptoms. The LEC items are summed to determine the number of different types of traumatic events the participant has experienced (score 0–16).

#### State Trait Anger Expression Inventory-2 (STAXI-2; Spielberger 1999)

The State Anger subscale of the STAXI-2 was used to assess baseline anger. This subscale is a 15-item self-report questionnaire that assesses the intensity of anger experienced "right now." Each item is rated on a scale of 1 (*not at all*) to 5 (*very much so*).

#### Trauma Related Guilt Inventory (TRGI; Kubany et al. 1996)

The Guilt Cognitions scale of the TRGI was used in this study. This 16-item scale is comprised of three subscales: Hindsight Bias, Wrongdoing, and Lack of Justification regarding experience of guilt "right now." Each item is scored from 0 (*not true at all*) to 4 (*extremely true*), and then scores are summed.

#### Walter Reed Army Institute of Research Cohesion Scales (WRAIR; Podsakoff and MacKenzie 1994)

The WRAIR Cohesion Scales assess cohesion and attitudes about support from peers (horizontal cohesion) and leaders (vertical cohesion). The scale consists of 16 self-report items that are rated on a scale of 1 (*strongly disagree/never*) to 5 (*strongly agree/always*) and yields two subscales (horizontal and vertical cohesion) and a total score (total unit cohesion).

### Procedures

This study was approved by the Institutional Research Boards at Brooke Army Medical Center, the University of Texas Health Science Center at San Antonio, Duke University, and VA Boston Healthcare System. As described in greater detail along with other methods in the report of findings of the randomized controlled trial (Resick et al. 2017), participants who met the criteria for inclusion were randomized to either group or individual CPT in cohorts of 16–18 members, with a total of 15 cohorts. Using SAS 9.4, we created randomized block sizes that ranged from 4 to 12. Varying sizes were used to balance groups while making it impossible for the team/PI to predict what the assignment of the next participant would be at any point. A custom web-based application facilitated and masked the randomization process.

Both individual and group treatment was conducted in 12 sessions over a 6 week period. Group sessions were conducted for 90 min with two therapists, and individual sessions were 60 min with one therapist. Participants were dropped from group treatment if they missed four treatment sessions but were asked to continue with assessments for intent-to-treat analyses. In individual therapy, sessions could be rescheduled; however, treatment needed to be completed within 12 weeks or participants were dropped from treatment but asked to continue with assessments.

### Treatment

Also as described in greater detail in the report of findings of the randomized controlled trial (Resick et al. 2017), all participants received CPT (without written accounts). CPT followed the manual developed for military and veterans and incorporated special considerations for working with active-duty military (Resick et al. 2010).

### Data Analysis

The primary outcome variable for this secondary analysis was change in PTSD severity from baseline to the posttreatment assessment using the PSS-I. Pre-post change scores were available for 165 patients who had a posttreatment assessment interview. The analyses used all of these data regardless of engagement in treatment (22% did not complete treatment but did have a post-treatment assessment interview). To assess the impact of missing data, those with and without outcome data were compared on all of the baseline predictor variables, and those results were used in supplementary weighted analyses.

Predictors of PSS-I change were first evaluated using Pearson correlations, followed by partial and multiple correlations to clarify which of these associations remained when effects of the other predictors were controlled. In the case of dichotomous predictors (e.g., male, married), Pearson correlations are point-biserial correlations and are equivalent to *t* tests. Two nominal variables (ethnicity/race, type of duty) were analyzed using multiple regression, which is equivalent to analysis of variance.

Treatment assignment was randomized and thus uncorrelated with any of the predictors apart from chance factors. However, because it was associated with PSS-I change (Resick et al. 2017), we thought that controlling for treatment format in these predictive models might strengthen the associations. That proved not to be the case. Partial correlations controlling for randomized treatment assignment were almost identical to the unadjusted, zero-order correlations, with differences between the partial and unadjusted correlations ranging from − 0.03 to + 0.03, averaging 0.0004 with a median difference of 0.001. For that reason, the partial correlations controlling for treatment assignment are not reported in detail.

We did, however, explore the role of these variables as possible treatment moderators in multiple regression analyses. Each of these models included a predictor, assignment to individual or group format, and their interaction as independent variables. Moderators are variables that predict how much treatments differ. They can identify characteristics of people who do better (or worse) than average in one or another treatment, a distinction that has been drawn between *predictive* variables that apply across treatments and *prognostic* variables that may influence treatment outcomes differently and thus inform treatment choice.

All analyses were done using software in the SAS 9.4 statistical library. We note all results significant at unadjusted $p = 0.05$. However, because of the relatively large number of tests done, we also report adjusted estimates of significance using both the very conservative Bonferroni adjustment and a false discovery rate adjustment at $p = 0.05$ (Benjamini and Hochberg 1995).

## Results

### PTSD Symptom Improvement

The variables included in the analyses are listed in Table 1. Demographic, psychological, military, and deployment variables were assessed at baseline and evaluated as predictors of PTSD symptom improvement. The strongest association was with younger age, $r(163) = 0.314$, $p = 0.00004$. Even with very conservative Bonferroni adjustment for the number of tests, that $p$ value remained significant (adjusted $p = 0.0012$). Seven other predictors had zero-order correlations with the primary outcome that were significant at unadjusted $p = 0.05$. These were TRGI Lack of Justification ($r = 0.16$), DRRI-2 Aftermath of Battle ($r = 0.16$), years of service ($r = 0.18$), days since returned from deployed ($r = 0.17$), rank ($r = 0.19$), WRAIR Vertical Cohesion ($r = 0.17$), and WRAIR Total ($r = 0.17$). However, although the unadjusted $p$ values for these seven variables ranged from $p = 0.013$–$0.041$, none of these associations remained statistically significant when adjusted using either a conservative Bonferroni or more liberal false discovery rate adjustment for multiple testing correction at $p = 0.05$.

Furthermore, none of these seven variables were significantly correlated with improvement at unadjusted $p = 0.05$ when age was partialled. Conversely, younger age remained a significant predictor of PSS-I improvement in a multiple regression model that controlled for all seven of those other variables, $F(1,156) = 10.4$, $p = 0.0015$, even with a Bonferroni adjustment. Thus, only age emerged as a significant predictor in the multivariable analysis.

The following baseline variables were not predictors of treatment improvement as measured by PSS-I change from baseline: race/ethnicity, gender, education, theater of operations (OEF, OIF, OND), number of deployments, type of service duty, combat exposure (DRRI-2 Combat Experiences), years since index event, depression (BDI-II), anxiety (BAI), suicidality (BSS-I), TRGI (total, hindsight bias, wrongdoing), medical board status, number of potentially traumatic life events (LEC), WRAIR Horizontal, STAXI-2 state anger, and sleep problems (ISI).

## Moderators

Age was the only variable among the predictors that had a significant interaction with treatment format in that younger service members did better with individual therapy (Fig. 1). When age was centered at its mean of 33.2 and entered in an OLS regression model as a linear trend main effect (with $df = 1$) and in interaction with treatment format, both the age by treatment format interaction, $F(1,161a) = 5.4$, $p = 0.021$ and the main effect of age, $F(1,161) = 19.28$, $p = < 0.001$, were significant. The main effect of age remained highly significant, $F(1, 160) = 16.24$, $p < 0.001$) and the interaction of age by treatment format, $F(1,160) = 5.95$, $p = 0.016$ was even stronger when baseline PSS-I total was added as a covariate to this model. The interaction is displayed in Fig. 1. However, this interaction of age and treatment format did not remain significant with a false discovery rate adjustment at $p = 0.05$ for multiple tests.

Model-based estimates of mean PSS-I change for participants at age = 20 were $-16.05 \pm 2.13$ ($p < 0.0001$) in individual format vs. $-7.19 \pm 2.07$ ($p = 0.0007$) for group format, which is significantly different, $t(161) = 2.98$, $p = 0.0033$. At age 45, those estimates were changes of only $-0.30 \pm 1.87$ ($p = 0.87$) in individual versus $-2.34 \pm 1.59$ ($p = 0.14$) in group, meaning improvement was nonsignificant in both individual and group CPT for older participants and not significantly different by format, $t(161) = 0.83$, $p = 0.41$.

## Impact of Attrition

Six of the baseline predictor variables were significantly correlated with having posttreatment data: age ($r = 0.17$, $p = 0.006$), rank ($r = 0.17$, $p = 0.006$), tour of duty in Afghanistan (OEF) ($r = -0.24$, $p < 0.001$), combat support ($r = -0.13$, $p = 0.029$) vs. service support ($r = 0.13$, $p = 0.032$) duty, and undergoing a medical board ($r = -0.14$, $p = 0.022$). Inverse probability weighted analyses were done to assess the impact of attrition (Hirano et al. 2003). A simultaneous multiple logistic regression was done to generate predicted probabilities of having posttreatment data, and the reciprocals of those probabilities were used as case weights. This method weights cases who are most similar to cases without outcome data most heavily. In this case, the weighting made little difference. The weighted correlation of age and PSS-I change was $r = 0.312$ ($p < 0.0001$), which differs only in the third decimal place from the unweighted correlation. The significance of the age by treatment format interaction remained in the weighted analysis from $p = 0.021$ to $p = 0.019$.

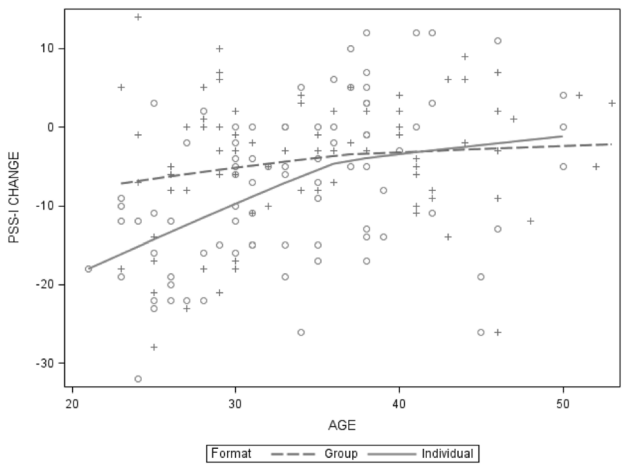


**Fig. 1** Improvement on the PTSD symptom scale-inverview version (PSS-I) by age in individual and group cognitive processing therapy

## Discussion

The current study examined the effects of a number of demographic, psychological, military, and deployment variables at pretreatment on PTSD symptom improvement over the course of individual or group CPT in a sample of active duty service members. Across all of the variables examined, age emerged as the only significant predictor of treatment outcome after controlling for the other variables and for the number of variables examined. Younger participants demonstrated better treatment outcomes than older participants, especially if they received treatment in an individual format. Among those younger than 35, participants in individual treatment improved twice as much as those randomized to group therapy. Among those 35 and over, improvements were smaller in both treatment formats and the difference between formats was not significant. Therefore, younger participants did significantly better in treatment, and this was particularly true for those who received individual treatment compared with group treatment.

Pretreatment military and deployment variables such as combat exposure, military grade, time in military, time since the index event, number of deployments, and unit cohesion were not predictive of PTSD improvement after controlling for age. This suggests that CPT is a robust therapy that can be beneficial for a wide range of active duty military personnel and combat experiences. Furthermore, baseline levels of anger, suicide risk, depression, anxiety, and guilt were also not associated with treatment outcome. Therefore, it appears that service members suffering from significant comorbid symptomatology may also benefit from CPT and should not be ruled out of treatment due to comorbidities. This is an important finding because factors such as suicidal ideation and other comorbid symptoms are sometimes used as determinants that someone is not

appropriate for PTSD treatment or that they may need a lot of preperatory work first. In fact, treatment should proceed rather than being delayed.

These findings have important implications for the treatment of active duty service members with PTSD because they suggest that age is a potentially important predictor of treatment response. Because participants under age 35 showed a better treatment response, strongly encouraging service members to seek treatment early may result in improved outcomes. These younger service members did well in both group and individual formats, but they showed particular improvements in individual treatment, whereas older service members benefitted equally from both treatment formats. Therefore, the argument could be made that younger service members should receive individual CPT whenever possible in order to promote optimal treatment outcomes, higher return to duty and greater overall health readiness of the fighting force.

The question arises why younger service members responded to CPT treatment more successfully than older members given that this finding emerged even after controlling for a number of military and deployment variables such as length of time in the military, amount of combat and aftermath of battle, number of deployments, military grade, and time since the worst traumatic event. One variable that was not included in the current analysis, but that we are currently studying, is cognitive flexibility. It is possible that certain inflexible beliefs predate any military experience and have been repeated over time such that older people are more fixed in problematic beliefs. Furthermore, younger service members may have more plasticity and be able to learn new concepts more readily. In the Resick et al. (2002) study comparing CPT with PE, Rizvi et al. (2009) found that younger women did better with CPT while older women had better results with PE. Pehaps in older service members, more repetitions of material and practice would be needed to increase results of CPT, or perhaps if replicated with a comparison of CPT and PE, then patients who are older should be referred to PE.

Overall, only age was both *predictive* (younger age was associated with better PTSD outcomes in both treatments) and *prognostic* (younger patients under 35 did particularly well when randomized to individual treatment rather than group therapy). Older service members did less well in general, and for them, treatment assignment made little difference. Although the prognostic implication of our analyses might have important clinical implications, we emphasize that the age by format interaction was unexpected, and it was only one such finding from many variables examined. It was not significant with adjustment for multiple testing and thus needs replication.

## Limitations

Although the study had a large sample size for a randomized controlled trial, it is important to note that there was a restricted age range, especially in the older age range. Of course, this would be typical in an active duty sample, which was the population of interest, but these results should not be generalized to veteran or civilian samples without replication. Furthermore, there were very few women participants, as is often the case with military samples, so results may differ in a larger female sample. The study was conducted while the *DSM-IV* was still being used. Predictors based on the *DSM-5* will need to be studied to see if the changes in diagnostic criteria have an effect. Finally, due to the nature of conducting a study with active military, there were a number of service members who might have completed treatment if they had not been discharged from the military, moved to other bases, or sent for training or medical treatment. Therefore, these findings might be different in a more stable population.

## Clinical Implications

The results of the current study suggest a number of important clinical and policy recommendations for both military leadership and mental health professionals working with active duty service members. The finding that younger participants demonstrated better treatment outcomes with CPT than older participants suggests that clinicians and the military leadership should encourage and support service members to seek treatment as soon as possible. Importantly, the average age of active duty service members in the Army is 29.2 years old and across all branches of military is 28.5 years old (Department of Defense 2015). This suggests that treating service members for PTSD while they are still in the service is the time period in which they are likely to receive the most benefit from evidence-based treatment for PTSD. Furthermore, by encouraging service members to seek treatment as early as possible, the military may be more likely to retain trained, experienced, and skilled personnel.

This analysis provides important data comparing treatment outcome for group and individual CPT that clinicians can incorporate into their treatment planning and clinical decision-making. Due to practical considerations, such as cost effectiveness and maximizing the number of patients clinics are able to treat (Castillo et al. 2016), group formats have become increasingly common in many clinics. Although our results need replication, the current findings suggest that individual CPT for PTSD may be a better option particularly for younger service members.

**Acknowledgements** We would like to thank Ray Aguilar, Abby Blankenship, Antoinette Brundige, Julie Collins, Paul Fowler, Vanessa Jacoby, Kristi E. Pruiskma and John Roache of the University of Texas Health Science Center at San Antonio and Brett Litz at VA Boston Healthcare System for their help on the project.

**Funding** Funding for this work was made possible by the U.S. Department of Defense through the U.S. Army Medical Research and Materiel Command, Congressionally Directed Medical Research Programs, Psychological Health and Traumatic Brain Injury Research Program awards W81XWH-08-02-116 (Patricia Resick), W81XWH-08-02-109 (Alan Peterson), and W81XWH-08-02-114 (Brett Litz). This work was supported in part by Career Development Award IK2RX002965 (Kirsten Dillon) from the United States Department of Veterans Affairs Rehabilitation R&D Service. The views expressed herein are solely those of the authors and do not reflect an endorsement by or the official policy or position of the U.S. Army, the Department of Defense, the Department of Veterans Affairs, or the U.S. Government.

## Compliance with Ethical Standards

**Conflicts of interest** Patricia A. Resick, Stefanie T. LoSavio, Jennifer Schuster Wachen, Kirsten H. Dillon, Erica E. Nason, Katherine A. Dondanville, Stacey Young-McCaughan, Alan L. Peterson, and Jim Mintz all received funding on the grants listed in this study above. Patricia Resick also receives royalties from Guilford publishing for a CPT manual subsequent to the one used in this study. Jeffrey S. Yarvis has no known conflict of interests associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

**Ethical Approval** All procedures performed in this study involving human participants were in accordance with the ethical standards of Institutional Review Boards at Brooke Army Medical Center, the University of Texas Health Science Center at San Antonio, Duke University, and VA Boston Healthcare System and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

**Informed Consent** Informed consent was obtained from all individual participants included in the study.

## References

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders, text revised* (4th ed.). Washington, DC: Author.

Beck, A. T., Epstein, N., Brown, G., & Steer, R. A. (1988). An inventory for measuring clinical anxiety: Psychometric properties. *Journal of Consulting and Clinical Psychology, 56*, 893–897. https://doi.org/10.1037/0022-006X.56.6.893.

Beck, A. T., & Steer, R. A. (1991). *Manual for the Beck Scale for suicide ideation*. San Antonio, TX: The Psychological Corporation.

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Manual for the BDI-II*. San Antonio, TX: The Psychological Corporation.

Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society B, 57*, 289–300. https://doi.org/10.1111/j.2517-6161.1995.tb02031.x.

Castillo, D. T., Chee, C. L., Nason, E., Keller, J., C'de Baca, J., Qualls, C., …, Keane, T. M. (2016). Group-delivered cognitive/exposure therapy for PTSD in women veterans: A randomized controlled trial. *Psychological Trauma: Theory, Research, Practice, and Policy*, *8*, 404–412. https://doi.org/10.1037/tra0000111.

Department of Defense (2015). *2015 Demographics: Profile of the military community.* Washington, DC: Department of Defense, Office of the Deputy Assistant Secretary of Defense for Military Community and Family Policy. Retrieved from https://download.militaryonesource.mil/12038/MOS/Reports/2015-Demographics-Report.pdf.

Dickstein, B. D., McLean, C. P., Mintz, J., Conoscenti, L. M., Steenkamp, M. M., Benson, T. A., …, Litz, B. T. (2010). Unit cohesion and PTSD symptom severity in Air Force medical personnel. *Military Medicine, 175,* 482–486. https://doi.org/10.7205/milmed-d-09-00178.

Ehlers, A., Clark, D. M., Dunmore, E., Jaycox, L., Meadows, E., & Foa, E. B. (1998). Predicting response to exposure treatment in PTSD: The role of mental defeat and alienation. *Journal of Traumatic Stress, 11*, 457–471. https://doi.org/10.1023/A:1024448511504.

Foa, E. B., Hembree, E. A., & Rothbaum, B. O. (2007). *Prolonged exposure therapy for PTSD: Emotional processing of traumatic experiences: Therapist guide*. New York: Oxford University Press.

Foa, E. B., Riggs, D. S., Dancu, C. V., & Rothbaum, B. O. (1993). Reliability and validity of a brief instrument for assessing posttraumatic stress disorder. *Journal of Traumatic Stress, 6*, 459–473. https://doi.org/10.1002/jts.2490060405.

Foa, E. B., Riggs, D. S., Massie, E. D., & Yarczower, M. (1995). The impact of fear activation and anger on the efficacy of exposure treatment for posttraumatic stress disorder. *Behavior Therapy, 26*, 487–499. https://doi.org/10.1016/S0005-7894(05)80096-6.

Forbes, D., Bennett, N., Biddle, D., Crompton, D., McHugh, T., Elliott, P., et al. (2005). Clinical presentations and treatment outcomes of peacekeeper veterans with PTSD: Preliminary findings. *American Journal of Psychiatry, 162*, 2188–2190. https://doi.org/10.1176/appi.ajp.162.11.2188.

Forbes, D., Creamer, M., Hawthorne, G., Allen, N., & McHugh, T. (2003). Comorbidity as a predictor of symptom change after treatment in combat-related posttraumatic stress disorder. *Journal of Nervous and Mental Disease, 191*, 93–99. https://doi.org/10.1097/01.NMD.0000051903.60517.98.

Galovski, T. E., Blain, L. M., Mott, J. M., Elwood, L., & Houle, T. (2012). Manualized therapy for PTSD: Flexing the structure of cognitive processing therapy. *Journal of Consulting and Clinical Psychology, 80*, 968–981. https://doi.org/10.1037/a0030600.

Galovski, T. E., Monson, C., Bruce, S. E., & Resick, P. A. (2009). Does cognitive-behavioral therapy for PTSD improve perceived health and sleep impairment? *Journal of Traumatic Stress, 22*, 197–204. https://doi.org/10.1002/jts.20418.

Gray, M. J., Litz, B. T., Hsu, J. L., & Lombardo, T. W. (2004). Psychometric properties of the life events checklist. *Assessment, 11*, 330–341. https://doi.org/10.1177/1073191104269954.

Hirano, K., Imbens, G. W., & Ridder, G. (2003). Efficient estimation of average treatment effects using the estimated propensity score. *Econometrica, 71*(4), 1161–1189. https://doi.org/10.1111/1468-0262.00442.

Karatzias, A., Power, K., McGoldrick, T., Brown, K., Buchanan, R., Sharp, D., et al. (2007). Predicting treatment outcome on three measures for post-traumatic stress disorder. *European Archives of Psychiatry and Clinical Neuroscience, 257*(1), 40–46. https://doi.org/10.1007/s00406-006-0682-2.

Kubany, E. S., Haynes, S. N., Abueg, F. R., Manke, F. P., Brennan, J. M., & Stahura, C. (1996). Development and validation of the Trauma-Related Guilt Inventory (TRGI). *Psychological Assessment, 8*, 428–444. https://doi.org/10.1037/1040-3590.8.4.428.

Lester, K., Artz, C., Resick, P. A., & Young-Xu, Y. (2010). Impact of race on early treatment termination and outcomes in posttraumatic

stress disorder treatment. *Journal of Consulting and Clinical Psychology, 78*, 480–489. https://doi.org/10.1037/a0019551.

Lloyd, D., Nixon, R. D. V., Varker, T., Elliott, P., Perry, D., Bryant, R. A., …, Forbes, D. (2014). Comorbidity in the prediction of cognitive processing therapy treatment outcomes for combat-related posttraumatic stress disorder. *Journal of Anxiety Disorders, 28,* 237–240. https://doi.org/10.1016/j.janxdis.2013.12.002.

Morin, C. M. (1993). *Insomnia: Psychological assessment and management*. New York: Guilford Press.

Owens, G. P., Chard, K. M., & Cox, T. A. (2008). The relationship between maladaptive cognitions, anger expression, and posttraumatic stress disorder among veterans in residential treatment. *Journal of Aggression, Maltreatment, & Trauma, 17*, 439–452. https://doi.org/10.1080/10926770802473908.

Podsakoff, P. M., & MacKenzie, S. B. (1994). An examination of the psychometric properties and nomological validity of some revised and reduced substitutes for leadership scales. *Journal of Applied Psychology, 79*, 702–713. https://doi.org/10.1037//0021-9010.79.5.702.

Pruiksma, K. E., Taylor, D. J., Wachen, J. S., Mintz, J., Young-McCaughan, S., Peterson, A. L., …, Resick, P. A., on behalf of the STRONG STAR Consortium. (2016). Residual sleep disturbances following PTSD treatment in active duty military personnel. *Psychological Trauma: Theory, Research, Practice, and Policy , 8,* 697–701. https://doi.org/10.1037/tra0000150.

Ramchand, R., Rudavsky, R., Grant, S., Tanielian, T., & Jaycox, L. (2015). Prevalence of, risk factors for, and consequences of posttraumatic stress disorder and other mental health problems in military populations deployed to Iraq and Afghanistan. *Current Psychiatry Reports, 17*, 37. https://doi.org/10.1007/s11920-015-0575-z.

Resick, P. A., Monson, C. M., & Chard, K. M. (2010). *Cognitive processing therapy veteran/military version: Therapist's manual*. Washington, DC: Department of Veterans' Affairs.

Resick, P. A., Nishith, P., Weaver, T. L., Astin, M. C., & Feuer, C. A. (2002). A comparison of cognitive-processing therapy with prolonged exposure and a waiting condition for the treatment of chronic posttraumatic stress disorder in female rape victims. *Journal of Consulting and Clinical Psychology, 70*, 867–879. https://doi.org/10.1037//0022-006x.70.4.867.

Resick, P. A., Wachen, J. S., Dondanville, K. A., Pruiksma, K. E., Yarvis, J. S., Peterson, A. L., et al. (2017). Effect of group vs individual cognitive processing therapy in active-duty military seeking treatment for posttraumatic stress disorder: A randomized clinical trial. *JAMA Psychiatry, 74*, 28–36. https://doi.org/10.1001/jamapsychiatry.2016.2729.

Resick, P. A., Wachen, J. S., Mintz, J., Young-McCaughan, S., Roache, J. D., Borah, A. M., …, Peterson, A. L., on behalf of the STRONG STAR Consortium. (2015). A randomized clinical trial of group cognitive processing therapy compared with group present-centered therapy for PTSD among active duty military personnel. *Journal of Consulting and Clinical Psychology, 83,* 1058–1068. https://doi.org/10.1037/ccp0000016.

Rizvi, S. L., Vogt, D. S., & Resick, P. A. (2009). Cognitive and affective predictors of treatment outcome in cognitive processing therapy and prolonged exposure for posttraumatic stress disorder. *Behaviour Research and Therapy, 47*, 737–743. https://doi.org/10.1016/j.brat.2009.06.003.

Seal, K. H., Metzler, T. J., Gima, K. S., Bertenthal, D., Maguen, S., & Marmar, C. R. (2009). Trends and risk factors for mental health diagnoses among Iraq and Afghanistan veterans using Department of Veterans Affairs health care, 2002–2008. *American Journal of Public Health, 99*, 1651–1658. https://doi.org/10.2105/AJPH.2008.150284.

Speckens, A. E. M., Ehlers, A., Hackmann, A., & Clark, D. M. (2006). Changes in intrusive memories associated with imaginal reliving in posttraumatic stress disorder. *Anxiety Disorders, 20*, 328–341. https://doi.org/10.1016/j.janxdis.2005.02.004.

Spielberger, C. D. (1999). *STAXI-2: State-trait anger expression inventory-2*. Lutz, FL: Psychological Assessment Resources Inc.

Tarrier, N., Sommerfield, C., Pilgrim, H., & Faragher, B. (2000). Factors associated with outcome of cognitive-behavioural treatment of chronic post-traumatic stress disorder. *Behaviour Research and Therapy, 38*, 191–202. https://doi.org/10.1016/S0005-7967(99)00030-3.

Taylor, S. (2003). Outcome predictors for three PTSD treatments: Exposure therapy, EMDR, and relaxation training. *Journal of Cognitive Psychotherapy, 17*, 149–162.

Taylor, S., Fedoroff, I. C., Koch, W. J., Thordarson, D. S., Fecteau, G., & Nicki, R. M. (2001). Posttraumatic stress disorder arising after road traffic collisions: Patterns of response to cognitive–behavior therapy. *Journal of Consulting and Clinical Psychology, 69*(3), 541–551. https://doi.org/10.1037//0022-006x.69.3.541.

van Minnen, A., Arntz, A., & Keijsers, G. P. J. (2002). Prolonged exposure in patients with chronic PTSD: Predictors of treatment outcome and dropout. *Behaviour Research and Therapy, 40*, 439–457. https://doi.org/10.1016/S0005-7967(01)00024-9.

Vogt, D., Proctor, S. P., King, D. W., King, L. A., & Vasterling, J. J. (2008). Validation of scales from the Deployment Risk and Resilience Inventory (DRRI) in a sample of Iraq War veterans. *Assessment, 15*, 391–403. https://doi.org/10.1177/1073191108316030.

Zandberg, L. J., Rosenfield, D., McLean, C. P., Powers, M. B., Asnaani, A., & Foa, E. B. (2016). Concurrent treatment of posttraumatic stress disorder and alcohol dependence: Predictors and moderators of outcome. *Journal of Consulting and Clinical Psychology, 84*, 43–56. https://doi.org/10.1037/ccp0000052.