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ORIGINAL ARTICLE

# Identifying Patterns and Predictors of PTSD and Depressive Symptom Change During Cognitive Processing Therapy

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**Abstract** This study sought to identify specific trajectories of posttraumatic stress disorder (PTSD) and depression symptom change (and the relationship thereof) within a variable length course of cognitive processing therapy (CPT). Clinical characteristics, including initial severity of PTSD and depressive symptoms and characterological features consistent with personality disorder diagnoses, were examined as potential predictors of treatment response trajectory. Male and female interpersonal violence survivors ($N = 69$) with PTSD were treated with a modified form of CPT wherein treatment end was dictated by individual course of recovery (4–18 sessions). Latent class growth analysis and Bayesian information criteria revealed three distinct groups based on change patterns (*partial responders*, *consistent responders*, and *initial responders*). Baseline PTSD and depressive symptoms and characterological features were associated with patterns of change. Findings provide evidence for variability in efficiency of response to PTSD treatment and highlight the need for continued assessment of progress to inform the course of therapy.

**Keywords** Posttraumatic stress disorder · Treatment outcome · Cognitive processing therapy · Avoidant personality disorder

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## Introduction

Clinical practice guidelines consistently endorse cognitive-behavioral therapy (CBT) as a first line treatment for posttraumatic stress disorder (PTSD; Forbes et al. 2010; Institute of Medicine 2007; Veterans Health Administration and Department of Defense 2010). The preponderance of the empirical literature supporting CBT for PTSD has focused on assessing the magnitude of symptom reduction *after* a full course of treatment, with comparatively less attention to the patterns and rates of symptom changes that may occur *during* the course of treatment. Examination of such patterns of change has the potential to yield clinically relevant findings, such as rates of response to treatment and identification of clinical correlates of differing trajectories.

Prior studies examining the collective treatment trajectory of PTSD patients have yielded equivocal results. Nishith et al. (2002) looked specifically at patterns of change in PTSD symptom clusters among patients randomized to either cognitive processing therapy (CPT) or Prolonged Exposure (PE). All PTSD symptom clusters

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decreased in a quadratic pattern, such that symptoms remained consistent or increased slightly before getting better, with the exception that avoidance symptoms decreased linearly in the CPT condition. In contrast, a subsequent dismantling study of CPT (Resick et al. 2008) found equivalent support for linear and quadratic models of change on total PTSD symptoms. Macdonald et al. (2011) examined symptom trajectories within CPT and observed an initial rapid decline, which decelerated as treatment progressed. These studies demonstrate that perhaps, unlike depression (which consistently demonstrates a rapid decline followed by less pronounced change; e.g., Howard et al. 1986), there may be considerable variability with respect to PTSD symptom change.

To identify common response patterns over a course of CBT for PTSD, four previous studies have employed statistical modeling methods to distinguish and empirically categorize patients who demonstrate similar response trajectories. Two such studies (Taylor et al. 2001; Stein et al. 2012) reported consistent results, identifying two distinct trajectories, labeled *responders* and *partial/non-responders*. Responders demonstrated steady reduction in PTSD, whereas partial/non-responders showed little evidence of treatment response. Elliott et al. (2005) identified three distinct trajectories: two *responder* groups with different rates of improvement, and one *non-responder* group. In an archival records study of veterans who had received PTSD in a Veteran's Administration hospital outpatient clinic, Schumm et al. (2013) describe a lack of consensus across model fit (two vs. three class model) to best explain PTSD symptom trajectory. The investigators chose the three class model based on the practical applicability and theoretical importance of the model. Similarly to Elliott et al. (2005), the three classes displayed distinct trajectories of symptom change. Results from each of these studies differed with respect to pre-treatment predictors of group assignment. Whereas Stein et al. (2012) observed that responders had lower initial PTSD symptoms, Elliott et al. (2005) found that patients with more severe symptoms of PTSD and depression actually demonstrated the most rapid rate of improvement and largest overall gains. Contrarily, Schumm et al. (2013) reported that the group with the most severe initial PTSD and depressive severity did not fare as well and continued to report moderate PTSD and depression at post-treatment. In contrast, Taylor et al. (2001) found that the two groups were similar with respect to pretreatment PTSD severity, but partial/non-responders had more severe depressive symptoms. Taken together, these studies suggest that initial severity of PTSD and depression is related to rate of recovery, although the exact nature of this relationship remains unclear.

Increasingly, PTSD treatment literature has highlighted the role of depression in symptom change over a course of trauma-focused CBT. Emerging evidence suggests that initial depression may predict PTSD treatment outcome (Chard et al. 2010) as well as efficiency of response (Galovski et al. 2012). Clinical trials have consistently demonstrated that CPT results in concurrent improvements in symptoms of PTSD and depression (Resick et al. 2002, 2008). Although some findings indicate that this interrelationship is accounted for primarily by PTSD symptoms, with PTSD influencing subsequent changes in depression (Aderka et al. 2011), other research suggests that changes in PTSD and depression occur contemporaneously, with no evidence that PTSD symptom changes precede changes in depression (Liverant et al. 2012). Most recently, investigators have demonstrated change in depression preceding remediation of PTSD symptoms over a course of CPT (Schumm et al. 2015). These seemingly contradictory findings warrant further investigations into the relative trajectories of symptom change over the course of therapy.

Studies identifying the trajectory of treatment gains in PTSD and depressive symptoms have not considered characterological features, despite the fact that personality disorders (PDs) occur at high rates with PTSD (Friborg et al. 2013), contribute to poorer outcome, and may result in longer courses of psychotherapy (Pietrezak et al. 2011). Residential programs may fare better in terms of overall outcomes with individuals suffering from PTSD and comorbid PDs. Walter et al. (2012) found no differences in PTSD recovery between veterans with and without a comorbid PD who received group and individual CPT as part of their inpatient recovery programs. No study to date has tested the influence of characterological features on patterns of symptom change and recovery during a course of CPT, particularly outside the context of inpatient care.

Finally, the preponderance of research on trajectories of PTSD and depression has examined patterns of symptom change within study samples that received a standardized number of treatment sessions. These designs can only reflect the extent to which the participant responded to therapy within the confines of the number of sessions in the protocol; this, by definition, limits observation of the trajectory of change of those less efficient responders (i.e., those who do not demonstrate a full response within traditional, standardized protocol). A variable-length treatment model provides an ideal opportunity to examine treatment trajectories of patients with diverse response patterns. Galovski et al. (2012) sought to assess the variability of response to treatment by allowing patients' progress in treatment to dictate conclusion of treatment. Results demonstrated that PTSD patients respond to CPT at variable rates of recovery, such that 58 % of patients met stringent end state criteria prior to session 12. A smaller proportion of patients (26 %) had not fully responded to treatment by session 12, but eventually evidenced the same excellent outcomes with the addition of up to 6 CPT sessions.

## Current Study and Aims

The purpose of this study was to extend the findings of Galovski et al.'s (2012) examination of variable length CPT by examining statistically derived groups based on participants' trajectories of change. Our overriding goal was to detect distinct groups of individuals who differed on their overall response to treatment for PTSD and, more importantly, the efficiency of their response. This study further sought to examine specific patterns of change in depression over a course of treatment and assess the degree to which these trajectories map onto changes in PTSD. Finally, we sought to identify predictors of membership in the study groups; specifically, initial severity of PTSD, initial severity of depressive symptoms, and characterological features consistent with personality disorder diagnoses.

## Method

### Participants

Male and female participants were recruited in St. Louis through referral sources including word of mouth, flyers, and advertisements. To be included in the study, participants needed to be at least 18 years old and meet Diagnostic and Statistical Manual, 4th edition (DSM-IV; American Psychological Association 2000) criteria for current PTSD following interpersonal violence, as assessed with the Clinician Administered PTSD Scale (CAPS; Blake et al. 1995). The trauma had to occur at least 3 months prior to study. Participants could not be in an abusive relationship. Participants were included with history of drug and/or alcohol dependence, but needed to be in remission for at least 6 months. Diagnostic exclusion criteria included current mania, psychosis, and severe suicidality. Participants needed to be stable on psychiatric medications throughout treatment.

### Measures

Posttraumatic Stress Diagnostic Scale (PDS; Foa et al. 1997) is a self-report scale used to assess the severity of PTSD symptoms. The 17 symptoms of PTSD are rated on a four-point scale from 0 (not at all/only one time) to 3 (5 or more times a week/almost always). Clinical guidelines include: 0 = no rating, 1–10 = mild, 11–20 = moderate, 21–35 = moderate to severe, and >36 = severe. Foa et al. (1997) reported good sensitivity, specificity, and reliability and study statistics demonstrated high internal consistency ($\alpha = 0.91$).

Beck Depression Inventory-II (BDI-II; Beck et al. 1996) is a 21 item self-report measure designed to assess the presence and severity of depressive symptoms. Symptoms are rated on a four-point scale with the total score obtained by summing the items. Clinical guidelines include; 0–13 = minimal; 14–19 = mild; 20–28 = moderate; 29–63 = severe. The scale has well-established reliability and validity (Beck et al. 1996) and study internal consistency was high ($\alpha = 0.91$).

Schedule for Nonadaptive and Adaptive Personality (SNAP; Clark 1993) is a 375 item, factor-analytically derived, self-report instrument designed to assess personality trait dimensions. The SNAP allows for the assessment of the personality disorder criteria in the DSM-IV. This dichotomous scoring method was utilized to determine the presence of characterological features consistent with DSM-IV personality disorder criteria in our sample. Internal consistency reliabilities for the 15 total scales have median values that range from 0.76 to 0.84. Test–retest reliabilities of the 15 scales are approximately 0.80 across samples.

### Procedure

The original study design is described in Galovski et al. (2012) and included a symptom monitoring control condition from which participants were crossed over to the active treatment condition. The current study examines treatment data and includes participants originally randomized to CPT and the participants who crossed over to CPT upon completion of the comparison condition ($N = 69$). Adherence and competence ratings can be found in that paper, as well as a full description of CPT and the study modifications. In brief, a modified version of CPT was used such that the end of treatment was dictated by the individual's recovery (range = 4–18 sessions). Treatment ended when the participant achieved study end state criteria (a score of $\leq$20 on the PDS and $\leq$18 on the BDI-II). Furthermore, the participant and the therapist needed to agree that treatment goals had been met and an independent blind evaluation by an experienced assessor confirmed the absence of PTSD. The CAPS, PDS, and BDI-II were administered at pre-treatment and the conclusion of treatment. The PDS and BDI-II were also completed at each therapy session. There were no adverse events, and the single-site study was conducted with University of Missouri-St. Louis Institutional Review Board approval.

### Statistical Methods

In our previous analysis of these data (Galovski et al. 2012), we used hierarchical linear modeling (Raudenbush and Bryk 2002) to examine the impact of CPT on PTSD and depressive symptoms. However, this approach largely assumes that a single trajectory of change can adequately

**Table 1** Demographic differences across empirically derived subgroup

| | PDS group | | |
|---|---|---|---|
| | Initial responders $N = 33$ M (SD) | Consistent responders $N = 31$ M (SD) | Partial responders $N = 5$ M (SD) |
| Age* | $38.67_a$ (11.22) | $40.19_a$ (10.43) | $54.00_b$ (10.32) |
| Years of education | 13.58 (3.02) | 13.03 (2.56) | 12.20 (2.86) |
| | *n* (%) | *n* (%) | *n* (%) |
| White race | 15 (45.5) | 15 (48.4) | 4 (80.0) |
| Hispanic ethnicity | 1 (3.0) | 4 (12.9) | 0 (0.0) |
| Income <$20,000 | 17 (51.5) | 24 (77.4) | 2 (40.0) |
| Marital status, single | 19 (57.6) | 19 (61.3) | 0 (0.0) |
| CSA index event | 15 (45.5) | 11 (35.5) | 3 (60.0) |
| CPA index event | 5 (15.2) | 5 (16.1) | 1 (20.0) |
| ASA index event | 7 (21.2) | 7 (22.6) | 1 (20.0) |
| APA index event | 6 (18.2) | 8 (25.8) | 0 (0.0) |
| Treatment drop-outs* | $6_a$ (18.2) | $13_a$ (41.9) | $0_b$ (0.0) |

*APA* adult physical assault, *ASA* adult sexual assault, *CPA* child physical abuse, *CSA* child sexual abuse, *PDS* Posttraumatic Stress Diagnostic Scale

For those variables on which PDS groups differed significantly, means with differing subscripts within rows are significantly different at the $p < 0.05$ level based on post hoc paired comparisons

* $p < 0.05$

describe all of the individuals undergoing treatment and that all predictors influence individuals in the same way (Jung and Wickrama 2008). In the original analysis, we implicitly hypothesized this assumption as unlikely to be true and created arbitrary groups based on the number of sessions to reach therapeutic targets (i.e., <12 sessions vs. ≥12 sessions). In the current analysis, we formally examined this assumption using a statistical approach.

Latent class growth analysis (Jung and Wickrama 2008; Duncan et al. 2006) examines for the existence of subpopulations of individuals who exhibit similar patterns of change. These subpopulations can each have their own change trajectories, model forms, and even predictors of change. Because each individual could theoretically be unique from all other individuals, and there could be up to *N* subpopulations, the Bayesian information criteria (BIC) was used to conservatively cluster individual trajectories into meaningful groups that minimize the error of prediction while penalizing the model for using more information; in this way the approach selects the smallest number of subpopulations that will best fit the data (i.e., an unbiased number of classes from the total population).

We conducted the analysis using Proc Traj of SAS 9.2 (SAS, Inc, Cary, NC,USA). This algorithm conducts a finite mixture model to select the number of latent classes that reside in the population. The number of classes and the form of their change (e.g., linear, quadratic) were determined using a combination of theory and BIC. Based on our previous experience and the length of time of the observation period, we expected that a curvilinear model (i.e., quadratic) with decelerating reductions in symptoms would be a good fit. The intercepts (coded as Day 0, pretreatment assessment) and change parameters were then plotted across the identified subgroups to examine differences in change. We conducted the models separately for each of our original primary outcomes (PDS and BDI-II) and used frequency counts to compare the group membership across groups. Finally, we examined the frequency of SNAP derived PDs by subpopulation membership. Where appropriate, statistical significance was interpreted using two-tailed tests at $p < 0.05$.

## Results

### Study Sample

In all, 69 participants intended to begin CPT. Fifty participants completed treatment. This sample is described in detail in Galovski et al. (2012) and Table 1 shows the demographic characteristics of each responder group.

### Identifying Trajectories of Individual Change

To examine for the existence of subpopulations of change patterns, we estimated models assuming no subpopulations

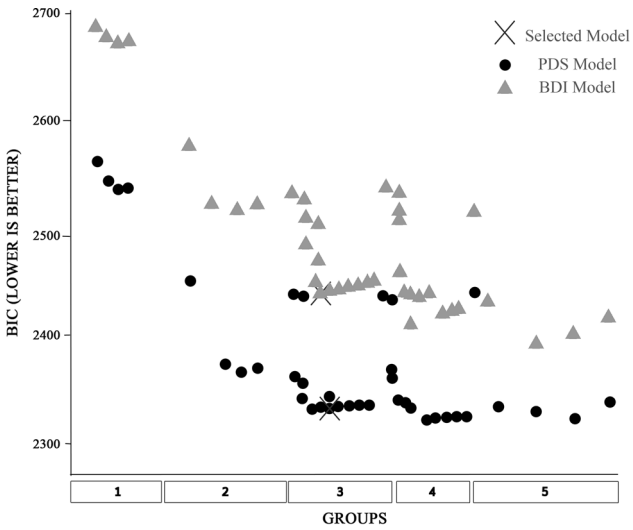


**Fig. 1** Model fit by number of subpopulation. The number of latent groups (*x*-axis) and their forms (e.g., linear, quadratic) are examined using Bayesian Information Criteria (BIC; *y*-axis). Lower BIC scores reflect better fits in the context of simpler models. A three group solution was selected from the considered models for both the PDS (*black circles*) and BDI (*grey triangles*) models

(i.e., 1 Group) and up to five subpopulations (i.e., 5 Groups). For each number of subpopulations, we examined a series of models ranging from no-change (i.e., intercept only) to third-order change models (i.e., cubic). This resulted in large number of potential estimations because four permutations of models could be estimated for each group in the subpopulation (e.g., $1^4 + 2^4 + 3^4 + 4^4 + 5^4 = 979$ models). To limit the total number of models, we first conducted the model forms that we believed to be most likely (e.g., all linear or all quadratic change) in each subpopulation group. When good fitting models were identified we estimated models that had degrees of freedom near these to identify candidates for the best fit. Figure 1 displays the fit of these models by number of subpopulations. The best fitting models for both the PDS and BDI-II consisted of either 3 or 4 subpopulations with differing patterns of polynomial change parameters (e.g., linear change or quadratic). Due to the modest sample size, we chose the simplest models, which in both outcomes was a 3-subpopulation model. Thus, for each outcome, participants could be classified into one of three subpopulations representing different patterns of change.

The best fitting models for each outcome are presented in Table 2. In terms of changes in PTSD, three different individual patterns were identified: The partial responders ($n = 5$; 7.2 %) exhibited high initial symptoms but reported accelerating change (i.e., a negative quadratic parameter), while the consistent responders ($n = 31$; 44.9 %) exhibited constant decreases in symptoms (i.e., linear change only) and the initial responders ($n = 33$; 47.8 %) exhibited low levels of initial symptoms and decelerating change as treatment progressed (i.e., a positive quadratic parameter). In terms of changes in the BDI-II, the three groups exhibited very similar patterns of change as with symptoms of PTSD. Partial responders ($n = 33$; 47.8 %) again exhibited decelerating reductions in symptoms, whereas consistent responders ($n = 32$; 46.4 %) and initial responders ($n = 4$; 5.8 %) exhibited consistent decreases in symptoms.

## Correlates of Group Membership

Figure 2 displays the trajectories of change for each of the three subpopulations for each outcome (PDS and BDI-II). Initial levels of symptoms were associated with group membership. For both the PDS and BDI-II, higher levels of initial symptoms were strongly associated with patterns of change and levels of one outcome were highly correlated with levels of the other. For example, the slope of change in PDS is highly correlated with the slope of change in BDI-II, $r = 0.65$, $p < 0.001$. Table 3 displays the high concordance between class memberships of the two outcomes, with 46 of 69 (67 %) of participants being in the same responder group in both outcomes. Finally, the presence of characterological features consistent with personality disorder diagnoses appeared to be associated with

**Table 2** Trajectories of three latent classes for the PDS and BDI-II

| | PDS | | | BDI-II | | |
|---|---|---|---|---|---|---|
| | Intercept (95 % CI) | Slope (95 % CI) | Quadratic (95 % CI) | Intercept (95 % CI) | Slope (95 % CI) | Quadratic (95 % CI) |
| Initial responders | 25.28 (23.3, 27.3) | −2.19 (−3.0, −1.4) | 0.06 (0.0, 0.1) | 23.16 (20.9, 25.4) | −2.35 (−3.3, −1.4) | 0.09 (0.0, 0.2) |
| Consistent responders | 34.34 (32.7, 36.0) | −1.48 (−1.7, −1.3) | – | 34.80 (33.1, 36.5) | −1.16 (−1.4, −1.0) | – |
| Partial responders | 42.56 (38.5, 46.6) | 0.47 (−0.6, 1.5) | −0.07 (−0.12, −0.01) | 53.32 (49.4, 57.2) | −1.03 (−1.4, −0.6) | – |

*PDS* Posttraumatic Diagnostic Scale, *BDI-II* Beck Depression Inventory, 2nd edition, *CI* confidence interval

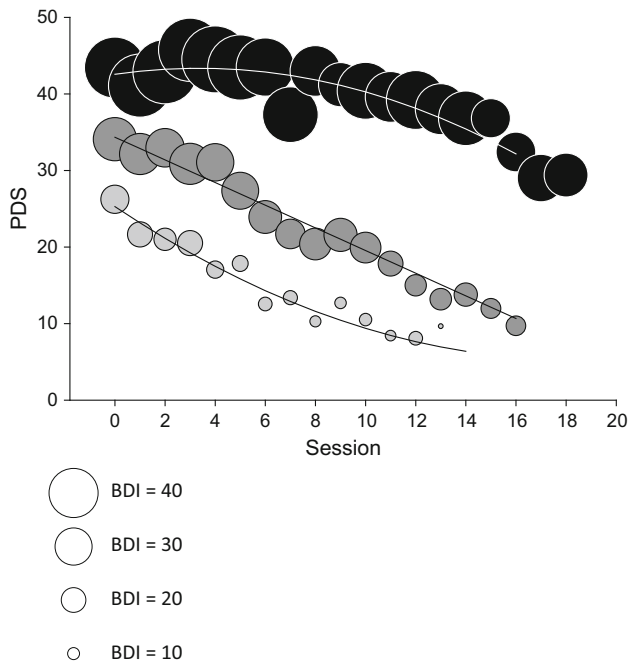


**Fig. 2** Trajectories of change. The trajectory of change on the PDS (*y*-axis) for the three latent groups of individuals (initial responders = *light grey*, consistent responders = *dark grey*, partial responders = *black*) are displayed using a bubble plot. The size of the bubbles corresponds to the average degree of depressive symptoms over time (*x*-axis)

group membership. Consistent responders had numerically higher rates of all considered SNAP-derived personality disorders, but only avoidant personality disorder (APD) was higher to a statistically significant degree in this modest sample (see Table 4). The partial responders demonstrated such an uncommon change pattern that it is difficult to characterize it with any degree of precision.

As described above, group membership for each of the responder groups was based separately on PDS scores and then again on BDI-II scores. The majority of participants were classified into the same group (initial, consistent, partial) as per both the change in PTSD and depressive symptoms, suggesting that most often these symptoms improve hand in hand. To assess group differences on important variables, we used membership based on PDS trajectory, given that PTSD was the primary disorder being treated with CPT. Twenty-seven percent of the ITT sample dropped out of the study prematurely. A treatment drop-out (for the purposes of this study) was someone who left treatment prior to session 18 without achieving good end state functioning. Attrition rates differed across study groups ($p < 0.001$). The partial responder group included 0 treatment drop-outs. On the other hand, 68 % of the drop-outs ($n = 13$) fell into the consistent responder group and 37 % fell into the initial responder group ($n = 6$). Drop-outs most typically stopped therapy at session 2 in the initial and consistent responder groups (thus drop-outs' available data points suggested trends most similar to these two groups respectively). When considering those 50 individuals who completed therapy, on average, the initial responders completed 8.44 sessions (range 4–16), the consistent responders completed 12.39 sessions (range 6–18), and all partial responders completed treatment at session 18. Groups did not differ on important demographic variables such as gender, race, or income, nor did they differ on the index trauma (the event perceived by the client to be the worst and chosen as the primary focus of therapy). The sample reported a significant trauma history consisting of multiple traumas across the lifespan (see Galovski et al. 2012 for detail). Group differences did emerge in age, such that partial responders were older than initial and consistent responders (see Table 1).

## Discussion

Overall, these results demonstrate significant improvement in PTSD and depressive symptoms in survivors of interpersonal violence. Galovski et al. (2012) reported that individuals suffering from PTSD could realize significant treatment gains prior to the standard 12 sessions of CPT and that those who had not responded as efficiently to treatment by the CPT protocol's end could go on to realize the same substantial gains if given more therapy. The current study allowed for a closer examination of the overall trajectories of change (not dependent on time in therapy) and the relationship between change in PTSD and depressive symptoms over the course of treatment. By

**Table 3** The association between latent class membership for PDS and BDI-II change models

| PDS group | BDI-II group | | |
|---|---|---|---|
| | Initial responders *n* (%) | Consistent responders *n* (%) | Partial responders *n* (%) |
| Initial responders | 24 (72.7) | 9 (27.3) | 0 (0.0) |
| Consistent responders | 9 (29.0) | 21 (67.7) | 1 (3.2) |
| Partial responders | 0 (0.0) | 2 (40.0) | 3 (60.0) |

$N = 46/69$ (67 %) of participants were in the same relative BDI-II and PDS groups

*PDS* Posttraumatic Diagnostic Scale, *BDI-II* beck depression inventory, 2nd edition

**Table 4** Association between SNAP personality disorder categorizations and latent class membership

| | PDS group | | |
|---|---|---|---|
| | Initial responders $N = 33$ *n* (%) | Consistent responders $N = 31$ *n* (%) | Partial responders $N = 5$ *n* (%) |
| Paranoid | 3 (9.1) | 6 (19.4) | 0 (0.0) |
| Borderline | 5 (25.2) | 8 (25.8) | 0 (0.0) |
| Avoidant | 12 (36.4) | 14 (45.2) | 2 (40.0) |
| Obsessive–compulsive | 5 (15.2) | 5 (16.1) | 0 (0.0) |
| | BDI-II group | | |
| | Initial responders $N = 33$ *n* (%) | Consistent responders $N = 32$ *n* (%) | Partial responders $N = 4$ *n* (%) |
| Paranoid | 3 (9.1) | 5 (15.6) | 1 (25.0) |
| Borderline | 5 (15.2) | 8 (25.0) | 0 (0.0) |
| Avoidant* | 9 $(27.3)_a$ | 18 $(56.3)_b$ | 1 $(25.0)_a$ |
| Obsessive–compulsive | 2 (6.1) | 8 (25.0) | 0 (0.0) |

Missing data were present for up to $n = 16$ (23 %) of each diagnosis. These column percentages are for valid observations by the total number of participants in each group. The categories are not mutually exclusive and could sum to greater than 100 %. For those variables on which groups differed significantly, means with differing subscripts within rows are significantly different at the $p < 0.05$ level based on post hoc paired comparisons. *PDS* Posttraumatic Diagnostic Scale, *BDI-II* Beck Depression Inventory, 2nd edition

* $p < 0.05$

pooling the entire sample and then statistically deriving the groups based on their trajectory of change (versus deciding group membership on number of sessions needed to achieve good end state functioning), we observed three distinct patterns of change [as did Elliott et al. (2005) and Schumm et al. (2013)]. Consistent with previous trials, a portion of our sample realized very little change across therapy. As described in Galovski et al. (2012), this subsample of partial responders was quite small (only 7 % of the total study sample).

The vast majority of the sample fell into one of the two "responder" groups. First, we observed that a distinct pattern of change representing an efficient and initially rapid response to treatment emerged, suggesting that for some portion (in this case about half) of our PTSD positive population, we can expect a fairly smooth, efficient course of recovery with notable symptom improvement occurring in the initial part of therapy. On the other hand, we also certainly observed that about half of our sample experienced a much more consistent decrease in symptoms across their time spent in therapy. Clinically, given the apparent variability of rates of change across patients, these data speak to the importance of monitoring symptoms, such as PTSD and depression, repeatedly throughout the course of therapy. By monitoring symptom change throughout the protocol, the therapist and patient together can not only determine the current symptom status, but also the trajectory of change. The trajectory of change can inform treatment. If change mimics our initial responders, stay the course. If symptoms are trending downward but recovery is not yet realized, there is a likelihood that additional therapy will result in important gains and that recovery can be achieved. Contrarily, if no change is evident as sessions progress, further examination of the therapeutic process is warranted. Are we working on the true index event? Have we missed important assimilated stuck points, or, are the current stuck points serving some important function for the client (as per the CPT protocol)? A number of potential culprits can negatively influence progress in therapy. Monitoring progress is necessary to identify these impediments to recovery.

Equally noteworthy, these data demonstrated important relationships between PTSD and depression symptomatology and recovery. First, a remarkable correlation between baseline symptom severity (both PTSD and depression) and the rate of change emerged. Essentially, the most severe levels of both PTSD and depression [seen in the partial responder group, similar to Taylor et al. (2001)] resulted in the least amount of overall change, despite the longest course of therapy of any of the participants. Initial levels of PTSD and depression differed between the initial and consistent responders as well. More severe levels of both sets of symptoms were related to slower, steadier rates of change across therapy (similar to Stein et al. 2012). However, they did not necessarily relate to overall outcome as both responder groups realized significant improvements in both domains. This finding stands in contrast to previous findings that the group demonstrating more severe PTSD and depression ended treatment with continued moderate levels

of both disorders (Schumm et al. 2013). Of note, the Schumm study consisted of an archival review of patient charts and did not include patients who continued CPT beyond 12 sessions. By not including these patients, it is possible that the most severe participants (the ones who required more than 12 sessions of PTSD therapy) were not included in the study. It is also possible that had CPT continued for some additional number of sessions that this non-responder class might have evidenced improvements similar to the current study.

With respect to correlates of group membership, the presence of characterological features also appeared to be related to response trajectories. Although consistent with previous literature (Friborg, et al. 2013; Pietrezak et al. 2011), the results of these exploratory analyses should be interpreted with caution given the low base rates of individuals suffering from comorbid elevated characterological features that are consistent with DSM-IV personality disorders. Further, it is important to keep in mind that the instrument used to detect these characterological features (SNAP) is not diagnostic in nature. The specific elevations that emerged most consistently were features descriptive of paranoid PD, borderline PD, avoidant PD, and obsessive–compulsive PD. The role of characterological features in the partial responder group's recovery is difficult to interpret due to the small sample size. Of clinical note, individuals in the partial responder group displayed elevated criteria consistent with several pervasive disorders such as histrionic PD, dysthymia, and generalized anxiety disorder. These patterns of symptoms did not occur in this study sample with enough frequency to formally evaluate their influence on recovery, but may be excellent choices as predictors of poorer outcome in future study. The consistent responders had a higher rate of elevated characterological personality features overall. However, only those indicative of avoidant PD differed significantly between initial and consistent responders. Thus, not surprisingly, the presence of avoidant PD may influence the course of recovery from PTSD. Most PTSD therapies rely on breaking through avoidance inherent in the disorder. An added diagnosis of avoidant PD would understandably complicate that process. That being said, although a relatively longer, less efficient course of therapy (one without the initial, notable gains observed in the initial responder group) was related to higher levels of avoidant personality traits, the overall outcomes between initial and consistent responders were similar. This suggests that the presence of avoidant PD characteristics does not portend worse outcomes, perhaps just a bit more arduous course of therapy.

The relationship between trajectories of change of PTSD and depressive symptoms is noteworthy. The majority of the participants (67 %) were in the same study group. These data suggest that, for two thirds of the sample, change in PTSD and depression occurred hand in hand. One third of the sample was not similarly categorized into study groups on PTSD and depressive symptoms, suggesting that for a significant minority of PTSD patients, recovery from PTSD and depression does not occur simultaneously. The patterns of symptom change that emerged in this study may explain, in part, the contradictory findings across previous studies (Resick et al. 2002, 2008; Aderka et al. 2011; Liverant et al. 2012; Schumm et al. 2015). Perhaps identification of the temporal pattern of symptom change for PTSD and depressive symptoms across populations is less important than the recognition of the variability of those patterns within populations. Identifying the specific relationship of PTSD and depression for a given individual may provide valuable information in tailoring individualized treatment strategies. The sample size in this third of our study was too small to further assess the relationship between PTSD and depression. However, larger studies may certainly yield important clinical information about how recovery from one set of symptoms may hasten, or possibly impede, recovery from the other.

Finally, the results of this study point to the importance of addressing attrition rates in PTSD therapies. Surprisingly, all of our treatment drop-outs fell into one of the responder groups. This suggests that during relatively brief sojourns in therapy, their PDS and BDI-II scores were trending downward on trajectories similar to those who ended up showing substantial treatment gains. It is unknown whether those individuals who dropped out early would have continued this course had they remained in therapy. Most respondents reported that they dropped out of therapy due to logistic issues such as housing, childcare, employment, transportation, etc. (see Galovski et al. 2012). Finding ways to help individuals suffering from PTSD prioritize and manage treatment while considering these and other barriers is essential (Stecker et al. 2013).

While the results of this study are thought-provoking, they are, nonetheless, not free from limitations. The sample size is smaller than is recommended for latent class analysis, particularly for the partial responder group. Relatedly, our model selection was conservative, partially due to sample size. The analysis could have been influenced by overextraction due to distributional skew (Bauer and Curran 2003). Furthermore, due to the variable length treatment paradigm, it is impossible to disentangle treatment 'dose' (i.e., the number of sessions) from treatment response (i.e., slope). In this analysis, smaller slopes are indicative of receiving more treatment sessions. While the variability in slopes is meaningful, this variability cannot be evaluated independent of treatment duration. Finally, we chose to force the nature of change to be polynomial given our review of the previous literature in similar projects. While we remain convinced that this was a wise choice, other models may have resulted

in different patterns of inter-individual change. Finally, replication of these results is needed, with larger samples and additional types of trauma.

Although this study offered an extension of previous work in its focus on male and female interpersonal assault survivors and represented both Black and White participants, a direct comparison between combat-exposed and interpersonal trauma survivors may help to explain the continued differences in rates of recovery. A priori hypothesis testing utilizing a design which allows patient progress to determine treatment end coupled with demonstrated fidelity to protocols (to ensure that recovery rates or lack thereof are not due to adherence and competence issues) may illuminate the source of effect size differences in outcomes across patient populations. Such a study may identify mechanisms of action that more closely map onto the needs of specific patient populations and edge the needle in the direction of recovery.

In summary, this study expands significantly on our earlier work (Galovski et al. 2012) by essentially allowing the data to speak for themselves. Results show distinct trajectories of change among trauma survivors, suggesting that the rate of change in trauma therapy is variable across patients. Importantly, initial levels of PTSD and depressive severity were related to treatment trajectory. Overall, the presence of SNAP-derived personality disorders was less important to response trajectory, with the exception of avoidant PD which appeared to be linked to a more consistent rate of change versus initial, substantial improvements. The clinical relevance of these findings cannot be overstated. In Galovski et al. (2012), we reported considerable variability in the length of time required to achieve clinical success in CPT. This study adds to that work by also identifying important differences in rates of change during that therapy suggesting that cases demonstrating consistent, but less initial improvement have a high likelihood of achieving the same overall outcomes as clinical cases with relatively more initial change with diminished returns at the back end of therapy.

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**Compliance with Ethical Standards**

**Conflict of Interest** Galovski received grant support for this project from National Institute of Mental Health/NIH. She has also received research grants from SAMHSA that are not related to this project. Harik, Blain and Chappuis declare that they have no conflicts of interest. Turner holds a research grant from Merek, Inc. (Migraine MK-0974 Proposal #36554) which examines adherence to migraine medication. Houle holds a research grant from Merek, Inc. (Migraine MK-0974 Proposal #36554) which examines adherence to migraine medication. Houle is also a statistical consultant for DePOMED—designs an FDA application for an abortive migraine drug for children.

**Ethical Approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee 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** All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation. Informed consent was obtained from all individual subjects participating in the study.

**Animal Rights** No animal studies were carried out by the authors for this article.

## References

Aderka, I. M., Foa, E. B., Applebaum, E., Shafran, N., & Gilboa-Schechtman, E. (2011). Direction of influence between posttraumatic and depressive symptoms during prolonged exposure therapy among children and adolescents. *Journal of Consulting and Clinical Psychology, 79*, 421. doi:10.1037/a0023318.

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

Bauer, D. J., & Curran, P. J. (2003). Distributional assumptions of growth mixture models: Implications for overextraction of latent trajectory classes. *Psychological Methods, 8*, 338–363. doi:10.1037/1082-989X.8.3.338.

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Manual for the beck depression inventory* (2nd ed.). San Antonio, TX: The Psychological Corporation.

Blake, D. D., Weathers, F. W., Nagy, L. M., Kaloupek, D. G., Gusman, F. D., Charney, D. S., et al. (1995). The development of a clinician-administered PTSD scale. *Journal of Traumatic Stress, 8*, 75–90. doi:10.1007/bf02105408.

Chard, K. M., Schumm, J. A., Owens, G. P., & Cottingham, S. M. (2010). A comparison of OEF and OIF veterans and Vietnam veterans receiving cognitive processing therapy. *Journal of Traumatic Stress, 23*, 25–32. doi:10.1002/jts.20500.

Clark, L. A. (1993). *Schedule for nonadaptive and adaptive personality: Manual for administration, scoring, and interpretation*. Minneapolis, MN: Univ. of Minnesota Press.

Duncan, T. E., Duncan, S. C., Strycker, L. A., Li, F., & Alpert, A. (2006). *An introduction to latent variable growth curve modeling: Concepts, issues, and applications* (2nd ed.). Mahwah, NJ: Lawrence Erlbaum.

Elliott, P., Biddle, D., Hawthorne, G., Forbes, D., & Creamer, M. (2005). Patterns of treatment response in chronic posttraumatic stress disorder: An application of latent growth mixture modeling. *Journal of Traumatic Stress, 18*, 303–311. doi:10.1002/jts.20041.

Foa, E. B., Cashman, L., Jaycox, L., & Perry, K. (1997). The validation of a self-report measure of posttraumatic stress disorder: The Posttraumatic Diagnostic Scale. *Psychological Assessment, 9*, 445–451. doi:10.1037/1040-3590.9.4.445.

Forbes, D., Creamer, M., Bisson, J. I., Cohen, J. A., Crow, B. E., Foa, E. B., et al. (2010). A guide to guidelines for the treatment of PTSD and related conditions. *Journal of Traumatic Stress, 23*, 537–552. doi:10.1002/jts.20565.

Friborg, O., Martinussen, M., Kaiser, S., Overgard, K. T., & Rosenvinge, J. H. (2013). Comorbidity of personality disorders and anxiety disorders: A meta-analysis of 30 years of research. *Journal of Affective Disorders, 145*, 143–155. doi:10.1016/j.jad.2012.07.004.

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. doi:10.1037/a0030600.

Howard, K. I., Kopta, S. M., Krause, M. S., & Orlinsky, D. E. (1986). The dose–effect relationship in psychotherapy. *American Psychologist, 41*, 159–164. doi:10.1037/0003-066X.41.2.159.

Institute of Medicine. (2007). *Treatment of PTSD: An assessment of the evidence*. Washington, DC: National Academies Press.

Jung, T., & Wickrama, A. S. (2008). An introduction to latent class growth analysis and growth mixture modeling. *Social and Personality Psychology Compass, 2*, 302–317. doi:10.1111/j.1751-9004.2007.00054.x.

Liverant, G. I., Suvak, M. K., Pineles, S. L., & Resick, P. A. (2012). Changes in posttraumatic stress disorder and depressive symptoms during cognitive processing therapy: Evidence for concurrent change. *Journal of Consulting and Clinical Psychology, 80*, 957–967. doi:10.1037/a0030485.

Macdonald, A., Monson, C. M., Doron-Lamarca, S., Resick, P. A., & Palfai, T. P. (2011). Identifying patterns of symptom change during a randomized controlled trial of cognitive processing therapy for military-related posttraumatic stress disorder. *Journal of Traumatic Stress, 24*, 268–276. doi:10.1002/jts.20642.

Nishith, P., Resick, P. A., & Griffin, M. G. (2002). Pattern of change in prolonged exposure and cognitive-processing therapy for female rape victims with posttraumatic stress disorder. *Journal of Consulting and Clinical Psychology, 70*, 880–886. doi:10.1037/0022-006X.70.4.880.

Pietrezak, R. H., Goldstein, R. B., Southwick, S. M., & Grant, B. F. (2011). Personality disorders associated with full and partial posttraumatic stress disorder in the U.S. population: Results from Wave 2 of the National Epidemiologic Survey on Alcohol related Conditions. *Journal of Psychiatric Research, 24*, 678–686.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods* (2nd ed.). Newbury Park, CA: Sage.

Resick, P. A., Galovski, T. E., Uhlmansiek, M., Scher, C. D., Clum, G., & Young-Xu, Y. (2008). A randomized clinical trial to dismantle components of cognitive processing therapy for posttraumatic stress disorder in female victims of interpersonal violence. *Journal of Consulting and Clinical Psychology, 76*, 243–258. doi:10.1037/0022-006X.76.2.243.

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. doi:10.1037/0022-006X.70.4.867.

Schumm, J. A., Dickstein, B. D., Walter, K. H., Owens, G. P., & Chard, K. M. (2015). Changes in posttraumatic stress disorder symptoms during cognitive processing therapy. *Journal of Consulting and Clinical Psychology, 83*, 1161–1166. doi:10.1037/ccp0000040.

Schumm, J. A., Walter, K. H., & Chard, K. M. (2013). Latent class differences Explain variability in PTSD symptom changes during cognitive processing therapy for veterans. *Psychology of Trauma: Theory, Research, Practice, & Policy, 5*, 536–544.

Stecker, T., Shiner, B., Watts, B. V., Jones, M., & Conner, K. R. (2013). Treatment-seeking barriers for veterans of the Iraq and Afghanistan conflicts who screen positive for PTSD. *Psychiatric Services, 64*(3), 280–283. doi:10.1176/appi.ps.001372012.

Stein, N. R., Dickstein, B. D., Schuster, J., Litz, B. T., & Resick, P. A. (2012). Trajectories of response to treatment for posttraumatic stress disorder. *Behavior Therapy, 43*, 790–800. doi:10.1016/j.beth.2012.04.003.

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*, 541–551. doi:10.1037//0022-006X.69.3.541.

Veterans Health Administration and Department of Defense. (2010). *VA/DoD clinical practice guideline for the management of posttraumatic stress*. Washington, DC: Veterans Health Administration, Department of Defense.

Walter, K., Bolte, T., Owens, G., & Chard, K. (2012). The impact of personality disorders on treatment outcome for veterans in a postrauamtic stress disorder residential treatment program. *Cognitive therapy & Research, 36*, 576.