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Changes in PTSD and Depression during Prolonged Exposure and Client-Centered Therapy for PTSD in Adolescents

Carmen P. McLean,

Department of Psychiatry, University of Pennsylvania

Yi-Jen Su,

Graduate Institute of Behavioral Sciences, Chang Gung University

Joseph K. Carpenter, and

Department of Psychiatry, University of Pennsylvania

Edna B. Foa

Department of Psychiatry, University of Pennsylvania

Abstract

Objective—Depressive symptoms are common among individuals with posttraumatic stress disorder (PTSD). Prolonged exposure therapy (PE) for PTSD has been found to alleviate both PTSD and depressive symptoms, but relatively little is known about the pattern of PTSD and depressive symptom change during treatment. This study aimed to investigate the relationship between changes in PTSD and depression during PE for adolescent (PE-A) and client-centered Therapy (CCT). The moderating role of PE-A vs. CCT and the possible differences across symptom clusters of PTSD were also examined.

Method—Participants were 61 female adolescents with sexual assault-related PTSD randomized to PE-A ($n = 31$) or CCT ($n = 30$). Participants completed the Beck Depression Inventory and the Child PTSD Symptom Scale at pre-, mid-, and post-treatment, and before each treatment session.

Results—Multilevel mediation analysis indicated a reciprocal but asymmetrical relationship between changes in PTSD and depression during treatment in the overall sample. Moderated mediation analysis showed that the reciprocal relation was observed only during PE-A. Reductions in PTSD led to reductions in depression to a greater extent (48.7%, 95% CI [30.2, 67.2]) than vice versa (22.0% [10.6, 33.4]). For participants receiving CCT, reduction in PTSD led to reductions in depression (31.6% [11.8, 51.4]) but not vice versa (7.4% [−7.1, 21.9]). The reciprocal relationship between PTSD and depression was also observed across different symptoms clusters of PTSD.

Conclusions—Our findings suggest that changes in PTSD led to changes in depressive symptoms to a greater extent than vice versa across PE-A and CCT.

Keywords

anxiety disorder; mediation; treatment mechanisms; trauma; comorbidity; multilevel analysis

Introduction

Posttraumatic stress disorder (PTSD) and depression are frequently comorbid (Brown, Campbell, Lehman, Grisham, & Mancill, 2001; Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995). Almost half (47.9%) of individuals suffering from PTSD report at least one major depressive episode during their life compared to 11% of those without PTSD (Kessler et al., 1995). In a study of youth with at least sub-clinical PTSD symptoms, 37% had a lifetime diagnosis of a depressive disorder compared to 7% of those without PTSD symptoms (Copeland, Keeler, Angold, & Costello, 2007).

A large body of research indicates that prolonged exposure therapy (PE; Foa, Hembree, & Rothbaum, 2007), a widely used evidence-based treatment for PTSD, alleviates both PTSD and depressive symptoms in adults (Powers, Halpern, Ferenschak, Gillihan, & Foa, 2010). PE for adolescents (PE-A; Foa, Chrestman, & Gilboa-Schechtman, 2009) has also been found effective in alleviating PTSD and depressive symptoms (Foa, McLean, Capaldi, & Rosenfield, 2013; Gilboa-Schechtman et al., 2010).

While the effect of PE on PTSD and depressive symptoms is established, the relationship between changes in these two types of symptoms over the course of treatment is largely unknown. PTSD and depressive symptoms may impact one another during treatment in one of several ways: 1) changes in PTSD symptoms may drive changes in depressive symptoms (but not vice versa); 2) changes in depressive symptoms may drive changes in PTSD symptoms (but not vice versa); 3) changes in depressive and PTSD symptoms reciprocally influence each other; or 4) changes in PTSD and depressive symptoms may be unrelated to one another. Accordingly, depression might be a mediator of therapeutic changes for PE. Examining mediators of therapeutic change in randomized controlled trials (RCTs) can tell us why and how treatment are effective (Kazdin, 2007; Kraemer, Wilson, Fairburn, & Agras, 2002), and comparison of mechanisms across two active treatments may ultimately inform efforts to individualize interventions based on patients' clinical presentation.

To our knowledge, two previous studies have examined the relationship between changes in PTSD and depressive symptoms during PE. The first study found a reciprocal relationship between changes in PTSD and changes in depression during treatment among children and adolescents receiving PE (Aderka, Foa, Applebaum, Shafran, & Gilboa-Schechtman, 2011). Specifically, PTSD symptom reduction accounted for 64% of subsequent reduction in depressive symptoms and reduction in depressive symptoms accounted for 11% of subsequent reduction in PTSD symptoms. The results of a second study with adults demonstrated a similar pattern; reductions in PTSD symptoms accounted for 80% of subsequent reductions in depressive symptoms and reductions in depressive symptoms accounted for 45% of subsequent reductions in PTSD (Aderka, Gillihan, McLean, & Foa, 2013). Notably, in both studies, changes in PTSD symptoms mediated subsequent changes in depressive symptoms to a greater degree than changes in depressive symptoms mediated changes in PTSD.

An important question is whether this pattern of change in PTSD and depressive symptoms is affected by treatment modality. In the study on adults by Aderka et al. (2013), the relationship between changes in PTSD and depressive symptoms was more reciprocal when PE was combined with cognitive restructuring (CR) than when delivered alone: reductions in posttraumatic symptoms accounted for 60% of reductions in depressive symptoms, and reductions in depressive symptoms accounted for 51% of reductions in posttraumatic symptoms. In a study of cognitive processing therapy (Resick & Schnicke, 1993), no relationship was found between changes in PTSD and subsequent changes in depressive symptoms, or vice versa (Liverant, Suvak, Pineles, & Resick, 2012). Instead, changes in PTSD and depression occurred concurrently. Taken together, these studies suggest that the relationship between changes in depression and PTSD may vary across different treatments.

The first aim of this study was to examine changes in PTSD and depressive symptoms in adolescent girls with PTSD receiving either PE-A or Client-Centered Therapy (CCT), a supportive counseling treatment that has been shown to lead to improvements in PTSD in youth (J. A. Cohen, Deblinger, Mannarino, & Steer, 2004). This is the first study, to our knowledge, to compare patterns of change in PTSD and depressive symptoms between two psychological treatments in adolescents. Based on the findings of Aderka et al. (2011), we hypothesized that changes in PTSD and depression would reciprocally influence each other, with reductions in PTSD having a greater impact on reductions in depression than the vice versa. The current study extends previous research by examining whether the pattern of changes in PTSD and depressive symptoms differs between treatments.

The second aim of this study was to examine the relationship between the PTSD symptom clusters (i.e., re-experiencing, avoidance, and hyperarousal) and depression during treatment. Although longitudinal research has found that the PTSD-depression relationship differs across PTSD symptom clusters (Erickson, Wolfe, King, King, & Sharkansky, 2001), to our knowledge no study has examined these relationships during treatment. Given that reducing avoidance implies increasing approach behaviors, which is itself a well-established treatment strategy for depression (Dimidjian, Barrera, Martell, Muñoz, & Lewinsohn, 2011), we hypothesized that changes in the avoidance symptom cluster of PTSD would account for the greatest proportion of changes in depressive symptoms.

The current study is a reanalysis of the data from an RCT that compared the efficacy of PEA and CCT (Foa et al., 2013). Results of that trial showed that both treatments led to significant improvement in PTSD and associated problems, but PE-A was associated with a greater improvement in PTSD, depression, and functioning than CCT.

Method

Participants

Participants were 61 female adolescents (ages 13–18; $M = 15.3$, $SD = 1.5$) seeking treatment for PTSD at Women Organized Against Rape (WOAR), an urban community mental health clinic in Philadelphia, PA that provides counseling to survivors of rape and childhood sexual abuse. Participants were drawn from those in Foa et al. (2013)'s original randomized intent-to-treat (ITT) sample. The majority of the sample (55.7%) was African American, 27.9%

were Caucasian, and 16.4% were other ethnicities. Children younger than 13 were excluded because there are existing evidence-based treatment protocols for children ages 3–13 (e.g., Deblinger & Heflin, 1996) and PE-A was designed to treat an age cohort for whom no evidence-based protocols previously existed. The upper age criterion was 18, because it commonly considered the beginning of emerging adulthood.

Eligible participants were adolescents with a primary DSM-IV diagnosis of chronic PTSD (93.4%, $n = 57$) or sub-threshold PTSD (6.6%, $n = 4$) related to rape or attempted rape by same-age peers, or sexual abuse by a perpetrator five or more years older that occurred at least 3 months prior to the evaluation for the study. Chronic PTSD was defined as 1 re-experiencing symptom, 3 avoidance symptoms, 2 hyperarousal symptoms, with symptoms lasting longer than 3 months. Sub-threshold PTSD was defined as 1 re-experiencing symptom, 2 avoidance symptoms, 2 hyperarousal symptoms, and a total 14 on the Child PTSD Symptoms Scale-Interview (CPSS-I; Foa, Johnson, Feeny, & Treadwell, 2001). Exclusion criteria were current suicidal ideation with intent, uncontrolled bipolar disorder, schizophrenia, conduct disorder, pervasive developmental disorder, initiation of psychotropic medication within the previous 12 weeks, and current inpatient psychiatric treatment. The majority of the participants (70.5%) had at least one comorbid Axis I disorder. The most common disorders were major depression disorder (MDD; 47.5%), obsessive compulsive disorder (16.4%), generalized anxiety disorder (14.8%), attention deficit hyperactivity disorder (8.2%), and specific phobia (8.2%). This study was approved by the institutional review board at the University of Pennsylvania and the executive board of WOAR.

Measures

Schedule of Affective Disorders and Schizophrenia for School-Age Children—Epidemiological Version (K-SADS-E; Kaufman et al., 1996)—The K-SADS-E is a semi-structured clinician-administered interview of DSM-IV Axis I psychiatric disorders that incorporates both child and parent reports. Symptoms are determined on the basis of the frequency, duration, and severity. Good to very good inter-rated reliability and excellent test-retest reliability has been demonstrated (Ambrosini, 2000; Kim et al., 2004). The K-SADS-E was administered at pre- and post-treatment by blind independent evaluators. In the current study, the K-SADS-E was used to assess diagnostic status of major depressive disorder.

Child PTSD Symptom Scale-Self-Report (CPSS-SR; Foa et al., 2001)—The CPSS-SR is a 24-item self-report measure designed to assess PTSD diagnosis and symptoms in children age 8 to 18 years in the last two weeks. The first 17 items correspond directly to DSM-IV criteria for PTSD, including symptom clusters of reexperiencing (Criterion B; 5 items, e.g., “*Having bad dreams or nightmares*”), avoidance/numbing (Criterion C; 7 items, e.g., “*Trying to avoid activities, people, or places that remind you of the traumatic event*”) and hyperarousal (Criterion D; 5 items, e.g., “*Feeling irritable or having fits of anger*”). Items are rated on a 4-point Likert scale (0 to 3; 0 = *not at all*; 3 = *5 or more times a week*), yielding a total score ranging from 0 to 51, as well as severity scores for re-experiencing, avoidance and hyperarousal subscales. An additional seven items assess daily functioning

(e.g., school work, relationship with friend) on a dichotomous scale (0 = absent; 1 = present). The CPSS-SR has excellent internal consistency, excellent one-week test-retest reliability, good convergent validity, and good discriminant validity in females youths with sexual abuse-related PTSD (Gillihan, Aderka, Conklin, Capaldi, & Foa, 2013) as well as in children survivors of an earthquake (Foa et al., 2001). The alpha coefficients in the present study were .80 for total symptoms, .69 for re-experiencing, .71 for avoidance, and .53 for hyperarousal clusters.

Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961)—The BDI is a widely-used 21-item self-report measure of depression, which assesses cognitive (e.g., pessimism, sense of punishment), behavioral (crying, social withdrawal), affective (depressed mood, guilt feelings), and somatic (e.g., loss of appetite, weight loss) components of depression. Items consist of four self-statements valued from 0 (absence of symptoms) to 3 (severe), and individuals are instructed to select the statement in each item that has been true for them during the past week. Total scores range from 0–63, with higher scores indicating more severe symptomatology. The BDI displays good psychometric properties (Beck, Steer, & Carbin, 1988) and has shown good reliability (e.g., Teri, 1982) and validity (e.g., Roberts, Lewinsohn, & Seeley, 1991) in an adolescent sample. The alpha coefficient in the present study was .84.

Procedure

Potential participants called WOAR's 24-hour hotline and completed an initial screening to assess for sexual abuse and length of time since trauma (≥ 3 months; $n = 237$). Adolescents who met study criteria and a non-offending guardian were invited to participate and complete a baseline evaluation to determine study eligibility.

After obtaining informed consent (or assent for adolescents age 17) from participants and their and their primary guardians, baseline evaluations were conducted by blind independent evaluators (IEs) and included the K-SADS-E in order to determine if PTSD was the primary disorder, along with self-report measures including the CPSS-SR and BDI. IEs in this study ($n = 6$) were licensed clinical psychologists who were experienced in working with adolescent trauma survivors. Eligible participants were randomized to receive up to 14 weekly 60–90 minute sessions of either PE-A ($n = 30$) or CCT ($n = 31$). Participants completed the CPSS-SR and BDI at pre-, mid-, and post-treatment evaluations, and before each treatment session. Treatment was provided to study participants at no cost and participants were compensated \$40 for their time at each of the major assessment time points.

Treatment

Treatment was delivered by 4 master's-level counselors at WOAR who received group supervision every other week from 2 doctoral-level psychologists. Counselors were trained to administer both study treatments; they attended a 4-day prolonged exposure training workshop and two 2-day supportive counseling trainings conducted by experts in each respective treatment. New participants were assigned to counselors on a rotating basis and

counselors would implement whichever study treatment the participant had been randomly assigned to.

Prolonged Exposure for Adolescents (PE-A; Foa et al., 2009)—PE-A consists of up to 14 weekly 60–90 minute individual sessions. Treatment includes breathing retraining, psychoeducation, in vivo exposure (confronting trauma reminders in daily life), 30–45 minutes of imaginal exposure (revisiting and recounting the traumatic memory followed by discussion of the revisiting experience) followed by ~20 minutes of processing (discussing the experience of revisiting the trauma memory, with a focus on new learning and changed beliefs or perspectives). Treatment concludes with discussion of generalizing skills learned in treatment, relapse prevention, and a “final project”, such as making booklets detailing the trauma and the gains made in treatment.

Client-Centered Therapy (CCT; J. A. Cohen & Mannarino, 1996)—CCT consists of up to 14 weekly 60–90-minute individual sessions, which focus on establishing a trusting, empowering, and validating therapeutic relationship. Counselors provide active listening, reflection, empathy, and encouragement to talk about feelings, and express belief in the participant’s ability to develop positive coping strategies. Counselors address difficulties by encouraging participants to formulate their own strategies rather than prescribing intervention strategies. In sessions 4 and 8, participants are asked how they feel about their trauma. With this exception, participants direct the sessions. Therapists reported that no participants in the CCT condition described their trauma during the sessions.

Treatment Adherence

Counselors’ adherence to the treatment protocols was monitored by trained adherence raters who were otherwise uninvolved in the study. Raters reviewed a randomly selected 20% of video-recorded treatment sessions and assessed adherence to essential components of each treatment and monitored protocol violations.

Data Analysis

Hierarchical linear modeling analyses (HLM; Raudenbush & Bryk, 2002) were performed on the intent-to-treat sample using all the available data from participants. HLM analyses are robust to missing data due to dropout and irregularly spaced measurement occasions. The mixed models module of SPSS 18.0 with restricted maximum likelihood estimation was employed to test the association of change in PTSD and change in depressive symptoms during treatment. The lower level (Level 1) variables were the CPSS-SR and the BDI total scores, which were nested within the participants (Level 2 units). The Level 2 covariate was treatment condition (PE-A vs. CCT). Time was modeled using the number of visits from baseline. A total of 17 time points were available, including pretreatment (Time 1), mid-treatment (Time 9), posttreatment (Time 17), and each of the 14 sessions (Time 2 to 8 & 10 to 16). Based on observed pattern of symptom change during the treatment, a multilevel growth model with a linear time variable was compared to a model with a nonlinear, natural log time variable. We evaluated the model fit based on multiple statistical criteria, i.e., the deviance statistic, the Akaike information criterion (AIC; Akaike, 1987), and the Bayesian

information criterion (BIC). Results indicated a better fit for the non-linear model, therefore a log time variable was used in our analyses.

Multilevel mediation analysis and moderated mediation analysis (Bauer, Preacher, & Gil, 2006; Kenny, Korchmaros, & Bolger, 2003) were used to estimate the lower level mediation model to produce the estimates of the covariance between two mediation paths, a crucial component for estimating random indirect effect. PRODCLIN (MacKinnon, Fritz, Williams, & Lockwood, 2007) was used to test significance and confidence limits of random indirect effects. The proportion mediated (P_M) was calculated as an indicator of effect size (MacKinnon, Fairchild, & Fritz, 2007) to estimate the magnitude of the indirect effect relative to the total effect of the predictor (time) on the outcome variable (Kenny et al., 2003). The total effect is the sum of the direct effect (c'), the indirect effect (ab), and the covariance between a and b (i.e., the covariance between the ordinary-least squares estimates for Paths a and b). The equation of P_M was as follows: $100 \times (ab + \text{covariance of } ab) / (c' + ab + \text{covariance of } ab)$. The 95% confidence intervals for P_M was calculated based on the formula of the approximated standard error for P_M (Tofighi, MacKinnon, & Yoon, 2009).

To establish temporal precedence of change in PTSD and change in depression or vice versa (Kazdin, 2007), mediator variables were “lagged” such that the outcome variable at Time $T+1$ was predicted by the mediator variable at Time T . Next, to examine whether the mediating relationships were moderated by condition, all mediation paths were allowed to vary as a function of treatment condition (Bauer et al., 2006). Effect sizes are reported as ϕ or Cramer’s V for χ^2 test (.10 small, .30 medium, and .50 large) and Cohen’s d for t test (.25 small, .50 medium, and .80 large; Cohen, 1988). The sample size at both levels was sufficient for accurate estimation for MLM analysis (cf. Maas & Hox, 2005).

Results

The mean severity of PTSD (CPSS-SR) and depressive symptoms (BDI) at pretreatment were respectively 29.62 ($SD = 7.81$) and 21.30 ($SD = 9.19$) for the total sample; 28.55 ($SD = 8.48$) and 20.61 ($SD = 8.74$) for participants receiving PE-A; and 30.76 ($SD = 7.00$), and 22.03 ($SD = 9.74$) for participants receiving CCT. PE-A and CCT both resulted in significant improvement from pre- to post-treatment in overall PTSD (PE-A: $M = 22.03$, $SD = 10.95$; $t(56) = 10.27$, $p < .001$; CCT: $M = 15.42$, $SD = 11.1$; $t(59) = 7.84$, $p < .001$) and depressive symptoms (PE-A: $M = 14.71$, $SD = 8.99$; $t(56) = 7.31$, $p < .001$; CCT: $M = 11.55$, $SD = 11.18$; $t(59) = 6.69$, $p < .001$). The percentage of pretreatment MDD diagnosis was 51.6% for PE-A and 43.3% for CCT. There were no significant differences on pretreatment PTSD ($t(58) = 1.10$, $p = .277$, $d = 0.28$), depressive severity ($t(58) = 0.60$, $p = .554$, $d = 0.15$), or comorbid MDD diagnosis ($\chi^2(1) = 0.43$, $p = .517$, $\phi = 0.08$) across therapies. Adherence to prescribed components of the treatments was 90.8% for PE-A and 90.5% for CCT. The average number of sessions attended was 11.9 ± 2.9 for PE-A and 11.3 ± 3.7 for CCT, showing no difference between therapies ($t(59) = 0.67$, $p = .508$, $d = 0.17$).

Missing data

Pattern mixture modeling procedures (Hedeker & Gibbons, 1997) were performed to examine the influence of missing data due to dropout. We classified the participants into

three groups depending on their missing data patterns: no missing; sporadic missing, and dropouts. As in the main study (Foa et al., 2013), dropout was defined as receiving fewer than 8 of the possible 14 sessions. By this definition, 13.1% ($n = 8$) met this criterion (3 in PE-A; 5 in CCT). Dummy-coded variables based on the missing-data patterns were constructed as Level 2 model covariates. Their main effects and the interaction effects with Time, Condition, Time $\times$ Condition were nonsignificant, indicating that the missing-data pattern did not influence the model fit.

Multilevel Mediation Analyses: Overall Sample

To elucidate whether changes in PTSD and depressive symptoms would reciprocally influence each other, we first tested the mediation model in which the effect of time on depression is mediated by PTSD symptoms in the overall sample (see Model 1A in Figure 2 and Table 1). PTSD symptoms were lagged to examine whether PTSD symptoms at Time T predict depressive symptoms at Time $T+1$. Results indicated that both lagged PTSD and depressive symptoms significantly decreased over time (Path c and Path a). Lagged PTSD symptoms were significantly associated with depressive symptoms (Path b). The indirect pathway of time on depression via PTSD was significant ($ab = -1.36$; 95% CI $[-1.86, -0.90]$), indicating that changes in PTSD symptoms significantly accounted for subsequent changes in depression. Of the total effect of time on depressive symptoms, 41.7% (95% CI $[27.9, 55.5]$) was mediated by PTSD symptoms.

Next, we examined the “reverse” model in which the effect of time on PTSD is mediated by depression (see Figure 2 and Table 1: Model 1B). Results indicated that both lagged depression and PTSD symptoms significantly decreased over time (Path c and Path a). Lagged depressive symptoms were significantly associated with PTSD symptoms (Path b). The indirect pathway of time on PTSD via depression was significant ($ab = -1.1$; 95% CI $[-1.81, -0.48]$), indicating that changes in depression significantly accounted for subsequent changes in PTSD symptoms. Of the total effect of time on PTSD symptoms, 16.4% $[7.2, 25.6]$ was mediated by depressive symptoms.

In sum, our findings established a reciprocal relation between changes in PTSD and depression during treatment in the overall sample. The 95% CIs of the P_M for the Model 1A and Model 1B did not overlap, showing a significance difference ($p = .01$) in P_M (Cumming, 2009; Cumming & Finch, 2005). This suggests that changes in PTSD led to changes in depression to a greater extent than vice versa.

Moderated Multilevel Mediation: Effect of Treatment Condition (PE-A vs. CCT)

To evaluate the possibility of moderated multilevel mediation (i.e., the association between PTSD and depression over time is moderated by treatment condition [PE-A vs. CCT]), we examined whether individual paths of the mediation model or the magnitude of the indirect effect (ab) vary as a function of condition (Bauer et al., 2006). A dummy-coded treatment variable was included as a Level 2 predictor in the mediation model. The regression coefficients for the treatment variable (i.e., cross-level interaction) produce estimates of the difference in each mediation path between PE-A and CCT, which represents the degree to which treatment moderates the strength of the mediation paths.

As shown in Table 1, the indirect paths (c , a , b , c') of the mediation model (i.e., PTSD mediates the relationship between the time and depression) and its indirect effect were significant in both PE-A (Model 2A) and CCT (Model 3A). Although none of the individual paths (Figure 2; Path a , b , and c') significantly differed across conditions, PE-A had a significantly greater indirect effect than CCT ($ab = -1.85$ vs. -0.94 , $p < .05$), suggesting that changes in PTSD accounted for greater amount of changes in depression in PE-A than in CCT. The P_M was 48.7% (95% CI [30.2, 67.2]) for PE-A and 31.6% [11.8, 51.4] for CCT.

In the reverse mediation model (i.e., depression mediates the relationship between time and PTSD; PE-A: Model 2 B; CCT: Model 3B), all the individual paths were significant except Path b (i.e., the association between lagged depression and PTSD) in CCT. Path b was also significantly greater in PE-A than in CCT, $B_{diff} = 0.28$, $t(40.3) = 2.17$, $p = .036$. A significant indirect effect was found only in PE ($ab = -1.66$, 95% CI $[-2.71, -0.77]$), suggesting that changes in depression significantly accounted for subsequent changes in PTSD only in PE but not in CCT. The P_M was 22.0% [10.6, 33.4] for PE-A and 7.4% $[-7.1, 21.9]$ for CCT.

In sum, our findings established a reciprocal relation between changes in PTSD and depression for PE but not for CCT condition. For participants receiving PE, the proportion overlap of the 95% CIs of P_M for the Model 2 A and Model 2 B was less than .50 (i.e., 0.21), showing a significance difference ($p < .05$) in P_M (Cumming, 2009; Cumming & Finch, 2005). This suggests that changes in PTSD led to changes in depression to a greater extent than vice versa in PE.

Multilevel Mediation Analyses: PTSD Symptom Clusters

Finally, to examine the relationship of specific symptom clusters of PTSD (i.e., re-experiencing, avoidance, and arousal) and depression during treatment (see Table 2), we tested the mediation model in which the effect of time on depression is mediated by PTSD symptom clusters. Results indicated that all symptom clusters significantly decreased during treatment (Path a , $ps < .001$), and each cluster was significantly associated with subsequent depression (Path b , $ps < .001$). The indirect effect was significant for each cluster (all $ps < .05$), indicating that changes in each symptom cluster significantly accounted for subsequent change in depression. The P_M was 34.0% (95%CI [20.7, 47.3]) for avoidance, 22.5% [11.8, 33.2] for re-experiencing, and 25.6% [14.6, 36.6] for arousal symptoms. The proportion overlap of the 95% CIs of P_M for each pair of symptom clusters was all greater than .50 (ranging from 1.04 to 1.71), showing no significance difference in P_M across symptom clusters.

In the reverse model, we tested the mediation model in which the effect of time on PTSD symptom clusters is mediated by depression. The indirect pathway was significant for each cluster (all $ps < .05$), indicating that changes in depression significantly accounted for subsequent changes in all symptom clusters. The P_M ranged from 14.1% to 19.4%. The proportion overlap of the 95% CIs of P_M for each pair of symptom clusters was all greater than .50 (ranging from 1.48 to 1.78), showing no significance difference in P_M across symptom clusters.

Given the strong overlap between depression and avoidance symptoms, we further divided avoidance symptoms into active avoidance (Criteria C1–C2) and numbing (Criteria C3–C7) clusters to examine their associations with depression (see Table 2). The indirect effects were still significant for both symptom clusters when testing the mediation model in which the effect of time on depression is mediated by PTSD symptom clusters. However, in examining the reverse model, the indirect effect was only significant for the numbing cluster.

In sum, a reciprocal relation was observed between changes in each PTSD symptom cluster and depression during treatment. The amount of mediation, whatever the model, was equivalent for all symptom clusters.

Discussion

To our knowledge, this is the first study to compare patterns of changes in PTSD symptoms and depressive symptoms between two psychotherapies for PTSD in adolescents (i.e., PE-A vs. CCT). When examining the overall sample, multilevel mediation analysis indicated a reciprocal but asymmetrical relationship between changes in PTSD and depression during treatment. When further examining the role of treatment condition, moderated mediation analysis showed that the reciprocal relation was found only during PE-A. Specifically, reductions in PTSD symptoms led to reductions in depression to a greater extent (48.7%, 95% CI [30.2, 67.2]) than vice versa (22.0% [10.6, 33.4]), a finding that is consistent with Aderka et al.'s (2013) findings on PE with children and adolescents, and with adults (2011).

In contrast, a reciprocal relation was not observed in CCT. Reductions in PTSD symptoms drove subsequent reductions in depression (31.6% [11.8, 51.4]) but depression did not drive changes in PTSD (7.4% [−7.1, 21.9]). Furthermore, we found that PE-A had a significantly greater indirect effect than CCT ($p < .05$), as also reflected in the difference in amount of mediation (48.7% vs. 31.6%). Thus, the relationship between PTSD and depression during treatment varied as a function of treatment conditions, with a stronger reciprocal relationship between changes in PTSD and depression in PE-A than in CCT. One possible reason for this finding may be that PE-A encourages patients to approach previously avoided situations during and between sessions, a procedure that also involves behavioral activation, an efficacious treatment for depression (Dimidjian et al., 2011). In contrast, CCT does not encourage exposure.

This explanation is consistent with the findings of the different PTSD symptom clusters, in which reductions in each of the three symptom clusters (re-experiencing, avoidance, and hyperarousal) significantly accounted for subsequent reductions in depression. Although the amount of mediation seems to be greater for avoidance cluster than for other clusters, no significant differences were noted between each pair of symptom clusters. In addition, we found that the relationship between changes in avoidance symptoms and changes in depression does not seem to be due to the overlap between emotional numbing (e.g. restricted emotions, loss of interest) and depression, as changes in both active avoidance symptoms (e.g. avoiding trauma reminders) and numbing symptoms significantly mediated changes in depression.

As shown in our results, because the degree of improvement of PTSD and depression was significantly greater during PE-A than CCT, this might, in part, influence our ability to fully examine the patterns of change in PTSD and depression across treatments. Smaller changes in both symptoms might raise the possibility of range restriction (or variance) problem. However the standard deviations of the improvement scores were alike for the CPSS-SR (PE-A: 10.95; CCT: 11.1) and BDI (PE-A: 8.99; CCT: 11.18) across treatments, suggesting that differential pathways across treatments were not due to the effect of range restrictions. More importantly, our mediation approach examined *mediation of change* instead of *mediation of treatment*, which means that the main focus was on the factors that accounted for within-subject change over time instead of the factors that accounted for between-treatment differences. Accordingly, the superior response of PE-A over CCT may have a limited impact on the present findings.

In the two prior studies examining changes in PTSD and depression during PE, reductions in depression accounted for 45% of reductions in PTSD symptoms in adults (Aderka et al., 2013), but only 11% in youths and adolescents (Aderka et al., 2011). In the present study, depressive symptoms partially mediated subsequent changes in PTSD among adolescents receiving PE-A, with depression accounting for 22% of changes in PTSD symptoms. Taken together, these findings seem to suggest that changes in depression may play a greater role in affecting changes in PTSD among adults than children or adolescents. Developmental differences, shorter time since trauma, or differences in trauma type may account for this inconsistency.

An important clinical implication of these findings is that even in the context of comorbid depression, treatments for PTSD should focus on the reduction of PTSD symptoms because reductions in PTSD will lead to reductions in depression more so than vice versa. Future research should examine whether certain components of PE (e.g., in vivo exposures) are associated with a more reciprocal relationship between PTSD and depression. Understanding which treatment components yield the greatest impact on both PTSD and depression help increase treatment efficacy with PTSD and comorbid symptoms.

Several limitations of the current study warrant note. First, the sample size was small, particularly when examining differences between treatments. It is important to replicate these findings in a larger sample to arrive at a stronger conclusion about the differential relationship between changes in PTSD and depression across treatments. Second, the sample was comprised of female adolescents with sexual assault-related PTSD, and therefore the results may not generalize to adults, males, or other trauma-types. On the other hand, the strength of this study is the ethnically diverse clinical sample; participants in the current study were representative of the urban population from which they were drawn. Last, we divided the C-PSS avoidance symptom cluster into “active avoidance” and “numbing” clusters to test their associations with depressive symptoms during treatment. This analysis rests on the hypothesized four-factor “numbing” model of PTSD supported by a number of confirmatory factor analytic studies (e.g., Baschnagel, O’Connor, Colder, & Hawk, 2005; Scher, McCreary, Asmundson, & Resick, 2008) with the adult version of the CPSS (i.e., Posttraumatic Diagnostic Scale; Foa, Cashman, Jaycox, & Perry, 1997). However, the 4-

factor numbing model has not been validated with the C-PSS. Therefore, the results of the analysis on “active avoidance” and “numbing” clusters should be carefully interpreted.

These limitations notwithstanding, our study replicates and extends previous research by demonstrating that: 1) PTSD and depression reciprocally influence one another during treatment, with PTSD driving change in depression more so than vice versa; 2) the relationship between PTSD and depressive symptoms varies across treatment type, with depressive symptoms partially driving change in PTSD in PE-A but not CCT; and 3) all three symptom clusters of PTSD show reciprocal relationships between changes in PTSD and changes in depression, with avoidance accounting for the greatest subsequent effect of changes in PTSD on changes in depression.

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Figure 1.
CONSORT Diagram of Participant Flow Through Study Procedures

Figure 2.
Schematic of Multi-Level Mediation Model

Table 1

Mediation Analyses On the Relations Between PTSD and Depression.

Model	Model description		c	a	b	c'	Cor ab	Proportion mediated (%)[95% CI]
	Condition	Mediator → Outcome						
Mediation analysis: Combined across conditions								
1A	Combined	PTSD → Depression	-3.36***	-7.61***	0.18***	-1.96***	-0.04	41.7 [27.9, 55.5]
1B	Combined	Depression → PTSD	-6.35***	-4.51***	0.25**	-5.70***	-0.01	16.4 [7.2, 25.6]
Moderated mediation analysis: Treatment Conditions								
2A	PE	PTSD → Depression	-4.01***	-8.43***	0.22***	-1.95***	0.00	48.7 [30.2, 67.2]
2B	PE	Depression → PTSD	-7.92***	-4.68***	0.35*** ^a	-6.18***	-0.08	22.0 [10.6, 33.4]
3A	CCT	PTSD → Depression	-2.97***	-6.78***	0.14***	-2.03***	-0.00	31.6 [11.8, 51.4]
3B	CCT	Depression → PTSD	-5.68***	-4.44***	0.07 ^b	-5.27***	-0.08	7.4 [-7.1, 21.9]

Note. Bold type for *ab* (indirect effect) column indicates $p < .05$. *c*, *a*, *b*, *c'* represent the paths of the mediation model as depicted in Figure 2; Cor *ab*, correlation between paths *a* and *b*; *ab*, indirect effect; 95% CI, 95 percent confidence interval. Superscripts ^a and ^b denote statistically significant difference ($p < .05$) difference across treatment conditions. PTSD = posttraumatic stress symptoms as assessed by the Child PTSD Symptom Scale; Dep = depressive symptoms as assessed by the Beck Depression Inventory; PE = prolonged exposure therapy; CCT = client centered therapy.

**
 $p < .01$.

 $p < .001$.

Table 2

Mediation Analyses on PTSD Symptom Clusters.

Model description		<i>c</i>	<i>a</i>	Change in M	<i>b</i>	<i>c'</i>	Change in Y controlling for M	Correlation of <i>a</i> & <i>b</i>	Indirect effect [95% CI]	Proportion mediated (%) [95% CI]
Mediator	Outcome	Change in Y	Change in Y	Time	M→Y controlling for Time					
Cluster: Reexperiencing										
Reexperiencing	Depression	-3.39 ***	-2.29 ***		0.38 ***	-2.62 ***		0.01	-0.77 [-1.15, -0.43]	22.5 [11.8, 33.2]
Depression	Reexperiencing	-1.96 ***	-4.52 ***		0.08 **	-1.64 ***		0.05	-0.37 [-0.60, -0.16]	16.3 [5.6, 27.0]
Cluster: Avoidance										
Avoidance	Depression	-3.40 ***	-3.18 ***		0.31 ***	-2.25 ***		-0.17	-0.99 [-1.50, -0.53]	34.0 [20.7, 47.3]
Depression	Avoidance	-2.83 ***	-4.52 ***		0.09 **	-2.43 ***		-0.00	-0.40 [-0.70, -0.12]	14.1 [4.6, 23.6]
Cluster: Arousal										
Arousal	Depression	-3.40 ***	-2.21 ***		0.39 ***	-2.53 ***		0.00	-0.87 [-1.24, -0.53]	25.6 [14.6, 36.6]
Depression	Arousal	-2.02 ***	-4.52 ***		0.07 **	-1.62 ***		-0.09	-0.30 [-0.53, -0.09]	19.4 [8.5, 30.3]
Cluster: Active avoidance & Numbing										
Act. Avoidance	Depression	-3.43 ***	-1.27 ***		0.48 **	-2.69 ***		-0.13	-0.62 [-1.02, -0.25]	21.8 [10.7, 32.9]
Depression	Act. Avoidance	-1.17 ***	-4.53 ***		0.02	-1.06 ***		-0.02	-0.09 [-0.23, 0.04]	9.4 [-1.1, 19.9]
Numbing	Depression	-3.40 ***	-1.91 ***		0.44 ***	-2.43 ***		-0.13	-0.84 [-1.29, -0.45]	28.5 [17.3, 39.7]
Depression	Numbing	-1.65 ***	-4.53 ***		0.07 **	-1.36 ***		0.03	-0.32 [-0.51, -0.15]	17.6 [7.1, 28.1]

Note. Bold type for *ab* (indirect effect) column indicates $p < .05$. *c*, *a*, *b*, *c'* represent the paths of the mediation model as depicted in Figure 2; Cor *ab*, correlation between paths *a* and *b*; *ab*, indirect effect; 95% CI = 95 percent confidence interval; Ac. Avoidance = active avoidance.

** $p < .01$.

*** $p < .001$.