HOMEWORK ADHERENCE IN PROLONGED EXPOSURE FOR CHRONIC POSTTRAUMATIC STRESS DISORDER

by

STEPHANIE MARIE KELLER

Submitted in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

Department of Psychological Sciences

CASE WESTERN RESERVE UNIVERSITY

August, 2015
CASE WESTERN RESERVE UNIVERSITY

SCHOOL OF GRADUATE STUDIES

We hereby approve the dissertation of:

Stephanie M. Keller

Candidate for the degree of Doctor of Philosophy*.

Committee Chair

Norah Feeny, Ph. D.

Committee Member:

James Overholser, Ph. D.

Committee Member:

Amy Przeworski, Ph. D.

Committee Member:

Kimberly Emmons, Ph. D.

Date of Defense:

June 20, 2014

*We also certify that written approval has been obtained for any proprietary material contained therein.
# Table of Contents

List of Tables ............................................................................................................. 4
List of Figures ............................................................................................................. 5
Acknowledgements .................................................................................................... 6
Abstract ..................................................................................................................... 7
Introduction ............................................................................................................... 9
Methods ................................................................................................................... 15
  Participant ............................................................................................................. 15
  Measures ............................................................................................................. 17
  Videotaped Coding .............................................................................................. 19
  Overview of Treatment ......................................................................................... 22
  Procedure ........................................................................................................... 23
Results ..................................................................................................................... 24
Discussion ............................................................................................................... 34
Tables and Figures .................................................................................................. 44
References .............................................................................................................. 59
List of Tables

Table 1. Sample Characteristics........................................................................................................44
Table 2. In Vivo Homework Adherence Across Time During PE..............................................45
Table 3. Imaginal Homework Adherence Across Time During PE.............................................46
Table 4. Self-Reported Ratings of Homework Helpfulness Across PE.........................................47
Table 5a. Baseline Linear Model Examining Change in in vivo Adherence Across PE...48
Table 5b. Baseline Linear Model Examining Change in Perceived Helpfulness of in vivo Assignments Across PE..........................................................................................................................49
Table 6a. Baseline Linear Model Examining Change in Imaginal Adherence Across PE..........................52
Table 6b. Baseline Linear Model Examining Change in Perceptions of Imaginal Helpfulness Across PE..................................................................................................................................................53
Table 7a. Time Lagged Regressions of in vivo Homework Adherence and PTSD Symptoms..........................................................................................................................................................55
Table 7b. Time Lagged Regressions of in vivo Helpfulness and PTSD Symptoms...............................56
Table 8a. Time Lagged Regressions of Imaginal Homework Adherence and PTSD Symptoms ........................................................................................................................................................57
Table 8b. Time Lagged Regressions of Helpfulness of Imaginal Homework Adherence and PTSD Symptoms ................................................................................................................................................58
List of Figures

Figure 1. The Impact of Current MDD on Patterns of in vivo Adherence Across PE…..50
Figure 2. The Impact of Current MDD on Patterns of in vivo Helpfulness Across PE…..51
Figure 3. The Impact of MDD on Patterns of Imaginal Helpfulness Across PE.............54
Acknowledgements

Preparation of this manuscript was supported by grants to Drs. Zoellner and Feeny from the National Institute of Mental Health (R01 MH066347, R01 MH066348) and the William T. Dahms, M.D. Clinical Research Unit, funded under the Cleveland Clinical and Translational Science Award (UL1 RR024989).

I would like to thank Norah Feeny, Ph.D. who served as my dissertation chair. Dr. Feeny provided invaluable support and guidance throughout the dissertation process. I would also like to thank Kimberly Emmons, Ph. D., James Overholser, Ph. D., and Amy Przeworski, Ph. D. for serving on my dissertation committee. I greatly appreciate their feedback and support. Finally, I would like to thank all of those involved with the CHANGE coding project including research volunteers at CWRU, collaborators at the University of Delaware, and collaborators at the University of Washington for their helpful collaboration and hard work on the CHANGE coding project.
Homework Adherence in Prolonged Exposure for Chronic Posttraumatic Stress Disorder

Abstract

By

STEPHANIE MARIE KELLER

Overview: Across psychological disorders, homework adherence is related to improved cognitive behavioral therapy outcome (e.g., Beutler et al., 2004; Kazantzis et al., 2010). Patients with PTSD may have difficulty engaging in between-session activities, given that avoidance of trauma-reminders is a core symptom of the disorder (Scott & Stradling, 1997). Despite homework assignments being a primary component of Prolonged Exposure (PE), little is known regarding the role of adherence in treatment outcome.

Method: 84 individuals (76.6% female; 53.6% Caucasian) with a primary diagnosis of PTSD received up to 10 weekly sessions of PE. Self-reported PTSD symptoms (PSS-SR) and ratings of imaginal and in vivo homework completion (Usefulness of Techniques Inventory) were assessed at each session. Patient beliefs were assessed at pre-treatment via self-report (Dysfunctional Attitudes Scale) and in-session via a PE-adapted observer rated coding system (CHANGE; Hayes et al., 2006).

Results: Time-lagged mixed regression models indicated that higher levels of in vivo homework adherence and higher perceptions of helpfulness of in vivo and imaginal homework assignments preceded reductions in PTSD symptoms. Higher levels of imaginal homework adherence did not precede reductions in PTSD symptoms. Hierarchical modeling suggested that patients with co-occurring major depression (MDD) reported lower levels of in vivo homework adherence during PE and rated their in vivo homework as less helpful than those without
MDD. No differences were found in levels or patterns of imaginal homework helpfulness between those with and without MDD. Finally, in-session positive beliefs predicted higher levels of *in vivo* homework adherence during PE. *Conclusion:* Results support homework activities as a critical component of the PE protocol. Clinicians may want to highlight the importance of homework adherence in successful PTSD treatment outcome, with a particular focus for individuals with co-occurring MDD.
Homework Adherence in Prolonged Exposure for Posttraumatic Stress Disorder

Prolonged Exposure (PE) is an efficacious treatment for posttraumatic stress disorder (PTSD) and is well tolerated (Foa, Zoellner, Feeny, Hembree, & Alvarez-Conrad, 2002; Jayawickreme et al., 2014; Powers, Halpern, Ferenschak, Gillihan, & Foa, 2010). While there is a large body of evidence to support the efficacy of PE for PTSD, little is known regarding the treatment mechanisms and processes that lead to symptom reduction. Overall, process research aims to fill the “gaps” in evidence-based practice (Bauer, 2007) by focusing on trajectories of individualized change and unique patient characteristics that contribute to therapeutic change. An important next step in improving PTSD treatment delivery involves examining the process of PE, specifically investigating how PE works and identifying components of the treatment protocol that optimize treatment improvement.

PE consists of four main components including: 1) psychoeducation; 2) breathing retraining; 3) repeatedly re-visiting and re-telling the memory of the trauma (i.e., imaginal exposure); and 4) confronting avoided situations and reminders (i.e., in vivo exposure). In addition, homework is assigned at every session and is thought to be important to outcome. The main homework activities include in vivo exposure assignments, which involve confronting avoided situations in real-life (e.g., increasing social activity, going to public places such as a park or restaurant, watching the news), as well as imaginal exposure assignments, which involve listening to the audio recording of the patient’s re-telling the trauma memory. However, adherence is rarely considered a primary outcome measure and no consistent predictors of treatment adherence have been identified in the treatment of anxiety disorders, including PTSD (Taylor, Abramowitz, &
McKay, 2012). Identifying critical components of PTSD treatments that influence therapeutic change can guide clinicians and alter their treatment approach to better-fit individual patient needs. These considerations highlight the need for a better understanding of the trajectory of homework adherence in PTSD treatment, the impact of homework adherence on treatment outcome, and predictors of homework adherence.

Generally, higher mean levels of homework completion are related to better cognitive behavioral therapy outcome (Beutler et al., 2004; Kazantzis, Dean, & Ronan, 2000; Kazantzis, Whittington, & Datillo, 2010) across a variety of disorders, including anxiety disorders (Abramowitz, Franklin, Zoellner, & DiBernardo, 2002; Simpson et al., 2011). Yet, clinicians commonly report low or moderate levels of patient homework adherence (Kazantzis, Deane, Ronan, & L’Abate, 2005). Only two studies to date have reported on homework adherence in PE (Marks et al., 1998; Resick et al., 2002). Marks and colleagues (1998) reported a mean adherence level across PE and Resick and colleagues (2002) reported total time spent on homework during PE. However, no trials to date have reported on the patterns of homework adherence across time during PE, or any other PTSD treatment. Examining adherence during PE among a generalized trauma sample, Marks and colleagues (1998) assessed homework adherence via therapist ratings. The therapist rated adherence based on the percentage of the homework that was completed of the previous week’s assigned homework tasks. Overall, across PE, patients completed 65% (SD = 29%) of their homework (Marks et al., 1998). Thus, patients completed a moderate amount of homework but also displayed quite a bit of variability in adherence. In the only study to compare mean time spent on homework activities between two evidence based PTSD treatments, individuals who received PE spent more
total time on homework assignments than individuals who received cognitive processing therapy (Resick et al., 2002). Yet, little is known regarding the patterns of adherence over time or the effect of homework adherence on PTSD symptom reduction. Overall, further research is needed to gain a more in-depth understanding of the trajectory of adherence and how these trajectories impact PTSD treatment outcome.

Despite the lack of literature addressing the trajectory of homework adherence in PE for PTSD, this is an important area of focus. First, previous researchers have encouraged repeated, session-by-session measurements of process variables, such as homework adherence, in order to adequately assess change (e.g., Laurenceau, Hayes, & Feldman, 2007) and establish temporal predictors of symptom reduction. Second, patients with PTSD may have particular difficulty engaging in between-session exposure activities, given that avoidance of trauma-reminders is a core symptom of the disorder (e.g., Scott & Stradling, 1997). Third, homework considered a critical component of the treatment regimen. PE is designed to enhance the emotional processing of the traumatic event (Foa, Huppert, & Cahill, 2006; Foa & Kozak, 1986) by activating the patient’s fear network, introducing incompatible information, and disconfirming negative beliefs via exposures, to alter the fear network. Specifically, exposure is conducted via two methods: imaginal exposure and *in vivo* exposure (Foa, Hembree, & Dancu, 2002). Homework assignments are designed to complement in-session work, further promoting emotional processing by encouraging patients to listen to the recording of the re-telling of the trauma memory (i.e., imaginal exposure homework) and engage in real-life exposure exercises (i.e., *in vivo* exposure). In fact, *in vivo* exposure is only conducted via homework activities. Fourth, examining homework trajectories can lead to collaborative
discussions between patient and therapist regarding ways to improve adherence. For example, a consistent pattern of poor adherence may provide a signal to a clinician that there are barriers to address (e.g., low motivation, lack of transportation, poor planning). Clinically, identifying a trajectory of poor adherence may allow the clinician to intervene to improve poor adherence, which may in turn, improve outcome. Overall, PE challenges patients to confront and engage in trauma-related situations and memories in a controlled and repeated manner. Homework is designed to complement in-session work and improve treatment outcome. Yet, we know little about the impact of homework adherence on PE outcome.

Given the small body of research examining adherence in psychotherapy and the varied approaches to adherence assessment, it has been difficult for researchers to isolate variables that reliably predict homework adherence, particularly in anxiety disorders (Taylor et al., 2012). Co-occurring major depression (MDD) may impact homework adherence for individuals receiving PE for PTSD. Many patients with PTSD also experience co-occurring depression, with a recent meta-analysis suggesting that over 50% of patients with PTSD also experience depression (Rytwinski, Scur, Youngstrom, & Feeny, 2013). Given that MDD appears to influence PTSD symptom trajectories (e.g., Green et al., 2006; Nixon, Resick, & Nishith, 2004), the presence of this co-occurring disorder may also influence other PTSD treatment processes, such as levels and patterns of homework adherence. For example, depression may make it more difficult for patients to engage effectively or be motivated to complete homework assignments. In addition, patients with co-occurring mood and anxiety disorders may have elevated levels of impaired cognitive focus, energy, and motivation which may hinder their overall
treatment adherence and willingness to accept clinician guidelines (DiMatteo, Lepper, & Croghan, 2000). Generally, it has been suggested that depressive symptoms may “undercut” an individual’s willingness to utilize or try new skills and strategies (Thase & Callan, 2006) and therefore may interfere with their ability to complete assigned homework activities. Examining co-occurring MDD for patients with PTSD may shed light on possible barriers to homework adherence.

Negative cognitions or beliefs are common among individuals with PTSD (e.g., Dunmore, Clark, & Ehlers, 2001; Ehlers & Clark, 2000; Foa & Rauch, 2004; Janoff-Bulman, 1992) and may also impact homework adherence. Individuals with PTSD have more negative beliefs about themselves (i.e., “I am to blame for my trauma”) and the world (i.e., “The world is a dangerous place”) than non-traumatized controls, as well as individuals with a history of trauma exposure but no PTSD (Foa, Ehlers, Clark, Tolin, & Orsillo, 1999). Generally, negative beliefs play an important role in the development, maintenance, and treatment of PTSD (Foa & Rauch, 2004; Moser, Cahill, & Foa, 2010). In fact, recent findings suggest that a reduction in negative self-reported trauma-related cognitions may be a central mechanism of PE (Zalta et al., 2014). To our knowledge, no previous research has examined patient beliefs in relation to homework adherence during PE. Rating the content of treatment sessions, including patient beliefs, using a reliable coding system may provide a more nuanced picture of patient change, producing information that cannot be captured by self-report or interview measures. Further, studies to date have solely focused on negative beliefs (e.g., Zalta et al., 2014) to the neglect of examining positive cognitive changes during PE. Thus, the current study aimed to explore the nature of positive and negative cognitive change within PE sessions using a
modified version of an observer rating system, the Change and Growth Experiences Scale (CHANGE; Hayes et al., 2006). Negative beliefs about the self (e.g., “I am incompetent”) and the world may hinder a patient's ability to complete the homework assignments. For example, negative beliefs about one’s capacity to handle stress may impact their ability to approach distressing trauma reminders during in vivo homework. Similarly, a negative view of the world (e.g., “Something bad will happen if I go to the mall”) may lead a person to be less likely to engage in activities that encourage them to increase their involvement with the community (e.g., ride the bus, go to the mall, go to the grocery store). In fact, some have theorized that poor adherence may result from a patient feeling hopeless, believing that treatment will not be effective, or doubting their ability to complete the assigned task (e.g., Tompkins, 2002). Alternatively, positive self-views (e.g., “I am a strong person and I can handle my stress”) and positive world-views (e.g., “The world is generally a safe place”), may increase an individual’s willingness to attempt their homework exercises. Yet, no literature has explored the role of positive beliefs and their impact on homework adherence in PE. Overall, measuring patient positive and negative beliefs via self-report and in-session content may be able to help uncover and pinpoint factors that influence homework adherence during PE for PTSD.

Although researchers highlighted the importance of examining psychotherapy process questions and understanding “what works for whom” over 40 years ago (Paul, 1967), there has been little research examining individual patient factors that influence psychotherapy trajectory. Specifically, the current study sought to examine patterns of homework adherence among individuals receiving PE for PTSD, patient characteristics (e.g., co-occurring MDD, pre-treatment and in-session beliefs) associated with homework
adherence, and the role of homework adherence in PTSD symptom reduction. First, the study examined the patterns of homework adherence among individuals receiving PE for PTSD. Specifically, patterns of in vivo homework adherence (between sessions 3-10), imaginal exposure homework adherence (between sessions 4-10), and patient perceptions of helpfulness of their homework assignments were tracked during the course of PE for PTSD. It was hypothesized, based on the limited literature (e.g., Marks et al., 1998) that patients would display moderate levels of adherence. Second, we explored potential pre-treatment predictors (i.e., co-occurring MDD, self-reported beliefs) of in vivo and imaginal homework adherence. It was hypothesized that current MDD and higher overall pre-treatment negative beliefs would be associated with lower homework adherence and lower ratings of perceived helpfulness of homework assignments during PE treatment. Third, we examined in-session beliefs, as assessed by observer ratings of in-session content using a reliable coding system (CHANGE; Hayes et al., 2006), as predictors of in vivo and imaginal homework adherence. It was hypothesized that a higher level of negative beliefs would predict a lower level of in vivo and imaginal homework adherence and higher levels of positive beliefs would predict a higher level of adherence. Finally, we explored session-by-session homework adherence (e.g., in vivo and imaginal homework) and helpfulness of homework assignments as predictors of subsequent session PTSD symptom change. It was hypothesized that a high level of homework completion and higher perceptions of homework helpfulness would lead to a reduction in PTSD symptoms at the subsequent session.

Method

Participants
Participants were recruited through a wide range of sources, including clinical referrals and community advertising (e.g., flyers) for a NIMH funded doubly randomized preference trial. Inclusion criteria were broad in an attempt to recruit a clinically representative sample. Participants had to meet Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM–IV; American Psychiatric Association, 1994) criteria for a primary diagnosis of chronic PTSD and be between the ages of 18 and 65. Exclusion criteria were designed to be minimal and informed by appropriate clinical care. Diagnostic co-occurrence was not an exclusion criterion as long as PTSD was determined to be primary. Exclusion criteria included: a) a primary DSM-IV diagnosis other than chronic PTSD; b) a current diagnosis of schizophrenia, other psychotic disorder, unstable bipolar disorder, substance dependence, or depression requiring immediate psychiatric treatment (e.g., suicidal intent or plan); c) severe self injurious behavior or suicide within the past three months; d) no clear trauma memory before the age of three; e) an ongoing relationship with the perpetrator, if the trauma was assault related; f) unwilling or medically non-advisable to stop current cognitive behavioral psychotherapy or antidepressant medication or previous non-response to PE or sertraline; g) medical contraindication for the initiation of sertraline; h) current higher dose use of benzodiazepines (greater than the equivalent of 4 mg of lorazepam, 2 mg alprazolam, 1.5 mg clonazepam, or 20 mg diazepam); and i) pregnant or sexually active female without acceptable birth control. 84 participants with chronic PTSD were randomly assigned to one of two conditions: “choice” or “no choice.” Those in the “choice” condition chose their treatment: either PE therapy for PTSD or PE therapy plus a selective serotonin reuptake inhibitor (sertraline). Those who were randomly assigned to the “no choice”
group were then randomly assigned to either PE or PE plus sertraline. The current study includes all randomized participants to date (N = 84). Participants were, on average, 37.7 years of age (SD = 11.4 years) and primarily female (76.6%). The majority of the sample was Caucasian (53.6%), followed by African American (32.1%), and other ethnic backgrounds (14.3%). Approximately 70% of the sample was not college educated and over half of the sample (55.9%) had an annual household income of less than $20,000. When reporting their primary trauma, 28.6% (n = 24) reported adult sexual assault, 26.1% (n = 22) reported adult non-sexual assault, 17.9% (n = 15) reported childhood sexual assault, 6.0% (n = 5) reported childhood non-sexual assault, 3.5% (n = 3) reported a serious accident (e.g., motor vehicle accident), 2.4% (n = 2) reported combat, and 15.5% (n = 13) reported other traumas (e.g., witnessed a loved one commit suicide or die (n = 10) and serious medical injury and/or complication (n = 3)). See Table 1 for sample characteristics.

**Interview Measures**

Interview measures were completed by independent evaluators who received standardized training on the administration of the PTSD Symptom Scale-Interview Version (PSS-I) and Structured Clinical Interview for the DSM-IV (SCID-IV). Before serving as an independent evaluator, evaluators must meet an 80% reliability criterion for each interview measure. All interviewers were trained mental health professionals ranging from doctoral candidates in Ph.D. programs to Ph.D. level psychologists.

**PTSD Symptom Scale-Interview Version (PSS-I; Foa, Riggs, Dancu, & Rothbaum, 1993).** The PSS-I is an interviewer administered measure consisting of 17-items and produces both a score of PTSD severity and diagnostic status. Items are rated
on a scale based on frequency and severity of symptoms from 0 (not at all) to 3 (5 or more times per week/very much) in the past two weeks. This measure was used to determine PTSD diagnosis for the study. The PSS-I demonstrates good convergent validity and inter-rater reliability, .93-.95 (e.g., Foa & Tolin, 2000).

**Structured Clinical Interview for DSM-IV (SCID-IV; First, Spitzer, Gibbon, & Williams, 1995).** The SCID-IV, a semi-structured interview, was used to determine if other Axis I disorders were primary. This measure was also used to determine if the patient met criteria for co-occurring Major Depressive Disorder (MDD) at pre-treatment. This measure has good inter-rater reliability and validity (Skre, Onstad, Torgersen, & Kringlen, 1991).

**Self-report Measures**

**PTSD severity.** The PTSD Symptom Scale-Self-Report (PSS-SR; Foa, Riggs, Dancu, & Rothbaum, 1993) is a self-report measure consisting of 17-items rating DSM-IV PTSD symptom severity and frequency. Participants rate their symptoms on a scale of 0 (not at all) to 3 (5 times per week/very much). This measure has good reliability and validity (Foa et al., 1993) and is considered to be one of the gold standard measures of PTSD severity. In the present study, patients filled out the PSS-SR at pre-treatment, sessions 1-10, and post-treatment.

**General negative beliefs.** The Dysfunctional Attitude Scale (DAS; Weissman & Beck, 1978) is a 40-item measure of a range of cognitive distortions. The measure demonstrates good reliability and validity (e.g., Beck, Brown, Steer, & Weissman, 1991; Rogers, Park, Essex, & Klein, 2009) in both clinical (e.g., Imber et al., 1990) and non-clinical samples (e.g., Rude & Burnham, 1993). Items on the DAS are rated on a 7-point
Likert scale with higher scores indicating more severe distortions. This measure has demonstrated adequate reliability in clinical samples of depressed adults (e.g., Imber et al., 1990) and adolescents (Rogers et al., 2009). Higher total DAS scores indicate a higher level of distorted beliefs. This measure was administered at pre-treatment.

**Homework adherence.** At each session, beginning at session 3, participants completed the Usefulness of Techniques Inventory (UTI; Foa et al., 1999), assessing *in vivo* and imaginal adherence since the previous session. Participants rated their level of completion during the past week of *in vivo* homework and imaginal exposure homework on a scale from 1 (*not at all*) to 5 (*more than 10 times*). Patients also rated how helpful they perceived the *in vivo* and imaginal exposure assignments to be on a scale from 1 (*not at all helpful*) to 5 (*extremely helpful*). Adherence ratings from each session were utilized in the present study. We also calculated a mean adherence rating and mean helpfulness rating for *in vivo* homework and imaginal homework across PE, by adding up total adherence or helpfulness for each session and then dividing the total adherence or helpfulness by the number of completed sessions.

**Videotaped Coding: The CHANGE**

The CHANGE coding system was developed by Hayes and colleagues (2006) to examine therapeutic processes thought to be important indicators of change in cognitive-behavioral therapies. Researchers at Case Western Reserve University (CWRU) PTSD Research and Treatment Program and the University of Washington (UW) Center for Anxiety and Stress, adapted the original CHANGE system (Hayes et al., 2006) for use in PTSD treatment trials. The current manuscript used the modified CHANGE system, to examine in-depth, individual processes of change throughout PE.
**Coders.** Coders were a team of doctoral-level clinical psychology graduate students, post-doctoral fellows, and bachelor-level research assistants. Coders were trained to reliability criterion (ICC = .80) via weekly meetings and viewing training tapes for approximately 20 hours. Two coders rated each tape. Coders were paired with each other an equal number of times. Weekly meetings were conducted to discuss ratings, discrepancies, and other coding issues.

**Coding Process.** The adapted CHANGE system was utilized to watch and code videotaped PE sessions. The PE session videotapes were rated for patient functioning since the past session\(^1\). For the current manuscript, the homework review portions of session 3 (\(N = 72\)) and session 4 (\(N = 60\)) of PE were coded\(^2\). These sessions were chosen given the interest in understanding homework adherence. In session 2, the first *in-vivo* homework is assigned. Thus, session 3 is the first session in which patients review their *in-vivo* homework with their PE therapist. Similarly, imaginal exposure begins at session 3 and is the first session in which patients are assigned to review their imaginal exposure recording as homework. Thus, session 4 is the first session in which the therapist and patient review imaginal exposure homework. Review of homework occurs at the beginning of each session and lasts for approximately 15-20 minutes.

The following variables were assessed in the present study: **view of the self, sense of**

---

\(^1\) In order to capture change over the course of treatment, patient functioning that occurred *since the past session* was rated. Thus, if a patient stated, “I felt upset three years ago when I lost my job”, this would not be coded as it would not be expected that their level of emotion (e.g., upset) that occurred three years ago would change during treatment.

\(^2\) Of the 84 participants, 12 tapes were missing at session 3 due to participant dropout (\(N = 9\)) and tapes that were unable to be coded due to recording issues (\(N = 3\)). At session 4, 24 tapes were not coded due to participant dropout (\(N = 18\)) and recording issues such as poor audio quality (\(N = 6\)).
hope, and perception of relationships. Each variable is coded for valence (e.g., positive self, negative self, positive hope, negative hope, positive relationships, and negative relationships). Each variable is coded on a 0-3 scale with 0 = not present or very low, 1 = low, 2 = moderate, 3 = high. Variables are not mutually exclusive and can co-occur (e.g., “I feel proud of myself that I called my mom to work on our differences and our relationship has improved a lot”) would be coded under positive self and positive relationships). All categories were rated based on patient subjective perception.

**Self (+/-).** This category captures the patient’s self-concept, sense of worth, desirability, competence and identity. Any statement that captures a patient’s self-judgment over the past week was rated. Some examples of positive self-statements include feeling proud, a sense of accomplishment, and feeling strong (e.g., “I felt stronger this week”, “I didn’t let the fear take over”). Examples of negative self-statements include feeling a sense of worthlessness, weak, damaged, or guilty (e.g., “I am damaged forever as a result of my rape”).

**Hope (+/-).** This variable captures the person’s capacity (or lack of capacity) to see the possibility of change in the future, to recognize recent positive changes, recognition of feeling better, and/or an expression of commitment or determination to make changes. Some examples of positive hope statements include recognizing recent improvements, a feeling of movement in the right direction, and realization of life changes (e.g., “I am beginning to think that I might actually have a successful relationship one day”). Some examples of negative hope statements include feeling stuck or a general lack of commitment to treatment (e.g., “I don’t see the point in coming here anymore”).
Relationships (+/-). This category captures the perceived quality of the person’s interactions with others. This can involve immediate family, romantic partners, friends, coworkers, strangers, religious relationships, or people in general. This category does not include the relationship between the patient and therapist. With regards to homework, relationship quality is often captured in terms of how others reacted to the patient’s homework behaviors/assignments. This category can also occur when other individuals are involved in exposure exercises (e.g., increase intimacy with romantic partner/spouse, spend time with kids, etc.). Some examples of positive relationship statements include feeling satisfied with a social network, feeling loved, connected, and cared for (e.g., “I had a heart-to-heart talk with my husband about wanting to spend more time together. He suggested that we take a vacation together and I felt like he really cared”). Some examples of negative relationship statements include feeling alone, isolated, betrayed, and ignored (e.g., “I went to my mom’s for dinner but she acted like I was invisible. She barely spoke to me and it was hurtful”).

Overview of Treatment

All clinicians had at least a master’s level clinical training. All clinicians received standardized clinical training, through multiple-day initial training workshops and ongoing clinical supervision.

Prolonged exposure (PE; Foa, Hembree, & Dancu, 2002) consists of 10 weekly, 90-120 minute sessions, which include psychoeducation involving common reactions to trauma, breathing retraining, approaching avoided situations outside of therapy (i.e., in vivo exposure) starting in session 2, and approaching the memory of the trauma repeatedly (i.e., imaginal exposure) beginning at session 3. Patients were assigned weekly
between-session homework activities including both imaginal and *in vivo* assignments. Imaginal exposure during each session was audio-recorded and patients were asked to listen to the recording at home on a daily basis. Imaginal homework adherence was measured at sessions 4-10. Participants were also asked to practice *in vivo* exposure exercises which were developed collaboratively between the patient and therapist. *In vivo* exposure exercises involve real-life exposures to feared activities, places, and situations that serve as trauma reminders and may include activities such as engaging in previously avoided social activities (e.g., attending parties with large groups of people, watching a movie with trauma-related content, or increasing intimacy with a partner). *In vivo* homework adherence was measured at sessions 3-10.

Beginning with session 3, the structure of PE sessions involved: homework review from previous session, imaginal exposure, processing of the imaginal exposure, and finally homework assignment at the end of the session.

**Procedure**

Participants provided written informed consent during an initial intake interview with an independent evaluator. Participants also filled out a separate audio and videotape consent form approved by the university-affiliated hospital’s Institutional Review Board stating that they were willing to have their PE sessions videotaped and used by the study staff for research purposes. During the intake interview, both demographic and diagnostic information were obtained. Primary diagnosis of chronic PTSD was determined via the PSS-I and SCID-IV. Following this initial intake, if eligible, participants attended a randomization appointment in which their treatment condition was determined. Participants also completed a battery of pre-treatment self-report measures including
measures assessing negative beliefs (DAS) and severity of PTSD (PSS-SR). Following this visit, patients attended up to 10 weekly sessions of psychotherapy (PE) for their chronic PTSD. Treatment sessions were videotaped and coded for view of self, sense of hope, and perception of relationships. Homework adherence measures were completed at all sessions, beginning at session 3. The present study analyzed the coded videotapes from treatment session 3 and session 4. Following treatment, participants came in for a post-treatment evaluation and filled out measures of their PTSD (PSS-SR) severity.

**Results**

**Pre-treatment PTSD Severity and General Beliefs**

In general, this sample of individuals with chronic PTSD (N = 84) showed moderate to severe levels of PTSD symptoms (PSS-SR: M = 34.77, SD = 7.90, Range 12 - 49) and negative general beliefs (DAS; M = 175.37, SD = 37.61, Range 81 – 255). Further, 62% (N = 52) of the sample met criteria for current MDD based on SCID-IV diagnosis.

**Total Sessions Completed and Handling of Missing Data**

Of 84 patients assessed at pre-treatment, 9 dropped out of active treatment prior to session 3 and are therefore not included in the subsequent analyses. On average, participants (N = 84) completed a mean of 7.27 (SD = 3.40, Range = 0 – 10) sessions. All participants who completed at least 3 sessions (N = 75) were included in analyses examining in vivo adherence. All participants who completed at least 4 sessions (N = 66) were included in analyses examining in vivo adherence. All participants who completed at least 4 sessions (N = 66) were included in analyses examining in vivo adherence.

---

3 One way analyses of variance (ANOVA) were conducted to determine if there were any pre-treatment differences between those who dropped out prior to session 3 (N = 9) and those who did not drop-out prior to session 3 (N = 75). No differences were found on PTSD severity, $F(1, 83) = .00$, $p = .99$ or general negative beliefs (DAS) $F(1, 83) = .26$, $p = .61$. 
were included in analyses examining imaginal adherence. Imputations were not utilized for missing data. Previous researchers have suggested that examining the intent-to-treat sample, as opposed to imputing missing data or using a treatment completer sample, is preferred because it results in an unbiased interpretation of outcome variables (Nich & Carroll, 2002) and is considered to be a more conservative approach. Individuals with MDD (M = 6.89, SD = 3.55) and without MDD (M = 7.9, SD = 3.21) did not differ on mean number of treatment sessions attended $F(1, 83) = 1.87, p = .18, \eta^2 = .02$.

**Mean Levels of *in vivo* and Imaginal Homework Adherence Across PE**

See Tables 2-4 for levels of homework adherence and helpfulness ratings at each PE session. Descriptively, across PE, the majority of patients reported completing their imaginal and *in vivo* assignments a moderate amount, between 2-5 times since the past session (See Tables 2-3). For example, at sessions 3 through 10, between 39.7% and 54.0% of patients reported that they completed their *in vivo* assignments between 2-5 times since the past session. A minority of patients at each session did not complete any *in vivo* homework (Range: 4.0% - 11.3%; Mean Across Sessions = 8.28%) or imaginal homework (Range 4.0% – 15.9%; Mean Across Sessions = 10.48%). Across treatment, patients reported, on average, that their homework assignments were a little helpful to somewhat helpful (See Table 4).

A series of analyses of variance were conducted to examine if there were differences in mean levels of imaginal and *in vivo* homework adherence across PE. Patients reported similar levels of *in vivo* ($M = 3.01, SD = .76$) and imaginal ($M = 2.83, SD = .75$) homework adherence, $F(1, 139) = 1.99, p = .16, \eta^2 = .11$, and perceived the *in vivo* ($M = 3.17, SD = .89$) and imaginal ($M = 2.93, SD = .88$) homework assignments, $F(1, 139) = 2.61, p = .11, \eta^2 = .12$, as similarly helpful. Descriptively, patients
completed a higher mean level of *in vivo* assignments and rated their *in vivo* assignments as more helpful than imaginal assignments, though this difference failed to reach statistical significance.

Pre-treatment PTSD severity (PSS-SR) was not significantly associated with mean level of *in vivo* homework adherence ($r = -.10, p = .76$), perceived helpfulness of *in vivo* assignments ($r = -.11, p = .40$), mean level of imaginal homework completion ($r = -.12, p = .29$), or perceived helpfulness of imaginal homework ($r = .03, p = .82$).

**Data Analytic Strategy for Examining Patterns of *in vivo* and Imaginal Homework Adherence and Perceived Helpfulness of Homework Across PE**

Hierarchical modeling analyses were conducted in HLM 7 (HLM; Raudenbush et al., 2011) to examine the shape of *in vivo* homework adherence and imaginal adherence among individuals receiving PE for PTSD. Hierarchical modeling allows researchers to examine the shape of outcome measures over time and has several advantages over traditional repeated measures techniques, such as repeated measure ANOVAs (Snijders & Bosker, 2012). In particular, multilevel modeling can account for incomplete cases (i.e., missing data). The trajectory of change in multilevel models can take one of three shapes: linear (increasing or decreasing), quadratic, or cubic. Researchers (e.g., Willet et al., 1998) recommend examining at least 3 points to quantify a linear model, 4 points for a quadratic model, and 5 points for a cubic model. Given that the present study will examine 7 data points (sessions 3-10) for *in vivo* exposure and 6 data points for imaginal exposure homework (sessions 4-10), the precision of capturing the pattern of change was optimized.

**Trajectory of *in vivo* homework adherence and perceived helpfulness of *in vivo* assignments.** We first ran a series of models examining the shape of *in vivo*
homework adherence across sessions with no additional parameters. We compared a model including only linear change in *in vivo* adherence across PE (sessions 3-10) to a quadratic model and a cubic model that accounted for the curvature in change. The intercept was significantly different than zero in all models, but only the linear slope effect was significantly different from zero, $\beta = .04, SE = .02, p = .08$, albeit at a trend level. The quadratic, $\beta = .004, SE = .003, p = .19$, and cubic, $\beta = .0003, SE = .0004, p = .35$, slope terms were non-significant. Thus, the baseline model selected for all subsequent analyses was the linear trajectory model (See Table 5a). Also, as indicated in Table 5a, tests of the variance components (random effects), confirmed that there was significant variability around the grand mean of homework scores, suggesting that predictors could be added to the model to determine if patients differed systematically on rates of *in vivo* adherence when adding relevant parameters to the model.

Next, we created a model to examine the pattern of helpfulness of *in vivo* assignments over time. The intercept and linear slope terms were significantly different than zero (Table 5b). The quadratic, $\beta = .007, SE = .002, p = .23$, and cubic, $\beta = .0005, SE = .0001, p = .42$, slope terms were non-significant. Thus, the baseline model selected for all subsequent analyses was the linear trajectory model (See Table 5b). Overall, *in vivo* homework adherence and perceptions of helpfulness of *in vivo* homework assignments increased linearly across time during PE.

**Current co-occurring MDD as a predictor of *in vivo* homework adherence and *in vivo* helpfulness.** We added current MDD diagnostic status ($0 = \text{no MDD}, \ 1 = \text{current MDD}$) into Level 2 of the linear models examining *in vivo* adherence across time and *in vivo* helpfulness across time. We also examined the cross level interaction of
MDD by session (i.e., time) to examine whether or not there were differences in the rate of change in *in vivo* adherence or *in vivo* helpfulness across time between those with and without co-occurring depression.

There was a main effect of current MDD status on *in vivo* adherence, $\beta = -.89$, $SE = .19$, $p = .001$, indicating that those with current MDD had a lower overall level of *in vivo* homework adherence during PE than individuals without current MDD. There was also a significant session by MDD interaction, $\beta = .11$, $SE = .04$, $p = .02$, such that those with current MDD had a significant increase in their level of *in vivo* adherence across time whereas those without current MDD had a relatively consistent level of *in vivo* homework adherence across time (See Figure 1).

We then examined the role of MDD on the pattern of *in vivo* helpfulness during PE. There was a main effect of MDD, $\beta = -.39$, $SE = .23$, $p = .08$, although it was at the trend level, such that those with co-occurring MDD rated their *in vivo* homework as less helpful than those without MDD. However, the session by MDD interaction term was not significant, $\beta = .02$, $SE = .04$, $p = .67$, indicating that the presence of co-occurring MDD at pre-treatment did not impact the rate of change in perceived helpfulness of *in vivo* assignments across time (See Figure 2).

**Patient beliefs as predictors of *in vivo* homework adherence and *in vivo* helpfulness.** We examined pre-treatment negative beliefs (DAS) and observer rated in-session CHANGE coding variables from session 3 (positive and negative view of the self, positive and negative sense of hope, and positive and negative perception of relationships) as predictors of homework adherence (Model 1 dependent variable: *in vivo* adherence; Model 2 dependent variable: *in vivo* helpfulness). All parameters were entered
as covariates into Level 1 of the models. Higher perceptions of positive self, $\beta = .41$, $SE = .20$, $p = .04$, and higher perceptions of positive relationships, $\beta = .49$, $SE = .14$, $p < .001$, predicted higher levels of in vivo homework adherence. Pre-treatment self-reported negative beliefs (DAS), $\beta = .0004$, $SE = .002$, $p = .86$, positive sense of hope, $\beta = .16$, $SE = .15$, $p = .29$, negative view of the self, $\beta = .03$, $SE = .02$, $p = .14$, negative hope, $\beta = .11$, $SE = .08$, $p = .55$, and negative relationship perceptions, $\beta = -.13$, $SE = .10$, $p = .23$ were not significant predictors of levels of in vivo homework adherence.

Higher perceptions of positive hope, $\beta = .38$, $SE = .16$, $p = .02$, and higher perceptions of positive relationships, $\beta = .34$, $SE = .13$, $p = .008$, predicted higher perceptions of in vivo helpfulness. Pre-treatment self-reported negative beliefs (DAS), $\beta = .0008$, $SE = .002$, $p = .73$, positive view of the self, $\beta = .26$, $SE = .18$, $p = .06$, negative view of the self, $\beta = .13$, $SE = .02$, $p = .14$, negative hope, $\beta = -.10$, $SE = .14$, $p = .47$, and negative relationships, $\beta = -.01$, $SE = .11$, $p = .92$, were not significant predictors of levels of in vivo helpfulness.

Overall, in-session positive beliefs, assessed via in-session observational coding, appear to impact level of in vivo homework adherence and perceptions of in vivo helpfulness. However, pre-treatment and in-session negative beliefs do not appear to significantly predict levels or helpfulness of in vivo homework during PE.

**Trajectory of imaginal homework adherence and perceived helpfulness of imaginal homework.** We ran a series of models examining the shape of imaginal homework adherence across PE sessions with no additional parameters. We compared a model including only linear change in imaginal adherence across PE (sessions 3-10) to a quadratic model and a cubic model that accounted for the curvature in change. The
intercept was significantly different than zero in all models. The linear, $\beta = .005$, $SE = .02$, $p = .84$, quadratic, $\beta = -.00005$, $SE = .003$, $p = .99$, and cubic, $\beta = .00008$, $SE = .0005$, $p = .99$, slope terms were not significant, indicating that level of imaginal exposure homework did not increase or decrease across PE. See Table 6a for non-significant baseline linear model.

Next, we examined the pattern of perceived helpfulness of imaginal homework over time. The intercept terms were significant in all models. The linear slope term was significant, $\beta = .05$, $SE = .02$, $p = .05$. The quadratic, $\beta = .006$, $SE = .003$, $p = .12$, and cubic, $\beta = .0008$, $SE = .0006$, $p = .21$, slope terms were not significant. The linear trajectory model was the baseline model selected for all subsequent analyses (See Table 6b). Overall, imaginal homework adherence remained stable and perceived helpfulness of imaginal assignments increased across treatment.

**Current co-occurring MDD as a predictor of imaginal homework helpfulness.** We added MDD diagnostic status (0 = no MDD, 1 = current MDD) into Level 2 of the linear model examining helpfulness of imaginal exposure homework over time. There was not a significant main effect of MDD on imaginal homework helpfulness, $\beta = .12$, $SE = .24$, $p = .64$, indicating that those with and without MDD rated their imaginal homework as similarly helpful. We also examined the cross level interaction of MDD by session (i.e., time) to examine whether or not there were differences in the rate of change in imaginal helpfulness ratings across time between those with and without co-occurring depression. The interaction term was not significant, $\beta = -.01$, $SE = .04$, $p = .83$, indicating that perceptions of helpfulness of imaginal
exposure homework increased at a similar rate for those with and without current MDD (See Figure 3).

**Patient beliefs as predictors of imaginal homework helpfulness.** We examined pre-treatment negative beliefs (DAS) and observer rated in-session CHANGE coding variables from session 4 (positive and negative view of the self, positive and negative sense of hope, and positive and negative perception of relationships) as predictors of imaginal homework helpfulness. All parameters were entered as covariates into Level 1 of the models. None of the beliefs variables, including pre-treatment negative beliefs (DAS), $\beta = .0009$, $SE = .002$, $p = .72$, positive view of self, $\beta = .02$, $SE = .20$, $p = .94$, negative self, $\beta = .10$, $SE = .14$, $p = .50$, positive hope, $\beta = .24$, $SE = .17$, $p = .15$, negative hope, $\beta = .08$, $SE = .18$, $p = .63$, positive relationship perceptions, $\beta = .20$, $SE = .17$, $p = .24$, and negative relationship perceptions, $\beta = .02$, $SE = .14$, $p = .87$, emerged as significant predictors of helpfulness of imaginal homework during PE.

**Session-By-Session Changes: Homework Adherence as a Predictor of PTSD Symptom Reduction**

The final goal of the proposed study aimed to shed light on the relationship between homework adherence (e.g., *in vivo* and imaginal) and PTSD symptom reduction. The main goal of the analyses was to examine whether changes in homework adherence predicted changes in subsequent PTSD symptoms. However, the possibility existed that bi-directional causality could also occur (e.g., reductions in PTSD symptoms could predict an increase in homework adherence).

---

4 Given that there was not a significant amount of change in imaginal homework adherence across time, we did not run subsequent models examining the impact of patient beliefs as predictors of patterns of change in imaginal exposure adherence.
We utilized time-lagged regression models to test the relationship between homework adherence and PTSD symptom change. This statistical model allows for an examination of potential causal relationship between two variables, examining the strength of the relationship between a predictor at Time 1, and a dependent variable at Time 2, while controlling for the autocorrelation with that predictor at Time 1. Our dataset included PSS-SR scores from sessions 1-10, in vivo homework adherence and helpfulness from sessions 3-10, and imaginal homework adherence and helpfulness from sessions 4-10. All models were tested in PROC Mixed with restricted maximum likelihood in SAS 9.2 (SAS Institute, Cary NC).

**Session-by-session changes in in vivo homework and PTSD symptom change.**

We conducted two sets of analyses with PTSD severity (at session k+1) as the dependent variable and in vivo homework (completed between session k and k+1) variables as the predictors: (1) in vivo adherence predicting next-session PSS-SR and (2) Perceived helpfulness of in vivo assignments predicting next-session PSS-SR. We then conducted two sets of analyses with in vivo homework variables (completed between sessions k and k+1) as the dependent variable and PTSD symptoms at the prior session (session k) as the predictor: (3) PSS-SR severity predicting in vivo adherence, and (4) PSS-SR predicting next-session perceptions of helpfulness of in vivo assignments.

For the models with in vivo adherence (Table 7a) and perceived helpfulness of in vivo assignments (Table 7b) as the dependent variables, the cross-lagged effect of PSS-SR on in vivo homework adherence and in vivo helpfulness was negligible to small and not significant, suggesting that PTSD symptoms were not driving or impacting
subsequent changes in \textit{in vivo} homework adherence ($d = .24$) or perceived helpfulness of \textit{in vivo} assignments ($d = .06$).

For the models with PTSD symptoms as the dependent variable, the effects of \textit{in vivo} adherence (Table 7a) in predicting subsequent PSS-SR score ($d = .37$) and helpfulness (Table 7b) of \textit{in vivo} assignments ($d = .46$) in predicting subsequent PSS-SR score were moderate and statistically significant, suggesting that higher levels of \textit{in vivo} homework adherence and higher levels of perceived helpfulness of \textit{in vivo} homework preceded reductions in PTSD symptoms.

These findings indicate that higher levels of \textit{in vivo} homework adherence and higher perceptions of helpfulness of \textit{in vivo} assignments impacted reductions in PTSD symptoms at the next session.

\textbf{Session-by-session changes in imaginal homework and PTSD symptom change.} We first conducted two sets of analyses with PTSD (at session k+1) as the dependent variable and imaginal homework (completed between session k and k+1) variables as the predictors: (1) Imaginal adherence predicting next-session PSS-SR and (2) Perceived helpfulness of imaginal assignments predicting next-session PSS-SR. We then conducted two sets of analyses with imaginal homework variables (completed between sessions k and k+1) as the dependent variable and PTSD symptoms at the prior session (session k) as the predictor: (3) PSS-SR predicting imaginal adherence, and (4) PSS-SR predicting next-session perceptions of helpfulness of imaginal assignments.

For the models with imaginal adherence (Table 8a) and perceived helpfulness of imaginal assignments (Table 8b) as the dependent variables, the cross-lagged effects of PSS-SR were small to negligible and non-significant, suggesting that PTSD symptoms at
the prior session were not impacting subsequent changes in imaginal adherence ($d = .22$) or perceived helpfulness of imaginal assignments ($d = .13$).

For the models with PTSD symptoms as the dependent variable, the effect of imaginal adherence (Table 8a) in predicting subsequent reductions in PTSD symptoms ($d = .27$) was small and non-significant, indicating that levels of imaginal homework adherence were not significantly impacting reductions in PTSD symptoms. However, the effect of perceptions of helpfulness of imaginal homework assignments ($d = .39$) on reductions in PTSD symptoms was moderate and significant (Table 8b).

These results indicate that perceptions of helpfulness of imaginal homework, but not the level of imaginal homework adherence, preceded reductions in PTSD symptoms during PE.

**Discussion**

Homework assignments, a primary component of PE (Foa et al., 2002), are designed to complement in-session work, provide patients with opportunities to practice the skills they learn in therapy, and enhance treatment outcome. However, homework adherence is rarely considered a primary outcome measure and few studies have examined homework adherence during PE (Marks et al., 1998; Resick et al., 2002) or any other PTSD treatment. This is the first study to track session-by-session levels of homework completion during PE and shed light on the role of both homework adherence as well as patient perception of homework helpfulness in PTSD symptom reduction. Higher levels of *in vivo* homework adherence, higher perceptions of helpfulness of *in vivo* homework, and higher perceptions of imaginal homework helpfulness preceded reductions in PTSD symptoms during PE. However, PTSD symptom reductions did not
precede improvements in homework adherence or perceived helpfulness. Additionally, current co-occurring MDD impacted \textit{in vivo} homework adherence and perceptions of \textit{in vivo} helpfulness during PE. Interestingly, imaginal homework adherence did not impact PTSD symptom reduction and co-occurring MDD did not significantly impact levels or patterns of imaginal homework helpfulness during PE. Clinically, these findings highlight the importance of not only homework completion during PE, but also patient perception of homework usefulness.

Overall, the majority of patients completed a moderate amount of homework during PE. However, at any given session, about 8-10% of patients reported that they did not complete any homework activities since the past session. These rates are comparable to those found in a previous study examining adherence among patients receiving cognitive behavioral therapy for MDD which found that 10% of patients did not complete any assigned homework tasks (Bryant, Simons, & Thase, 1999). There have been few empirical examinations of ways to improve adherence. Specific therapist factors, such as concrete goal setting and collaborative discussions regarding homework assignment, have been found to improve homework adherence (Detweiler-Bedell & Whisman, 2005) among patients receiving cognitive therapy for MDD. Similarly, Bryant and colleagues (1999) found that one of the strongest predictors of patient adherence during cognitive therapy for MDD was the amount of time that the therapist spent reviewing previously assigned homework tasks. In the current study, higher levels of \textit{in vivo} homework adherence, in particular, were associated with lower PTSD symptoms at the subsequent session. Thus, clinicians may want to consider spending time planning homework assignments, examining potential barriers to homework completion (e.g., avoidance,
practical concerns), and troubleshooting/problem solving when homework is not completed. Current findings suggest that clinicians should focus not only on level of homework completion during PE, but also on improving patient perceptions of homework helpfulness. Both objective (i.e., level of homework completion) and subjective (i.e., patient perception of helpfulness of homework) facets of homework activities impacted PTSD symptom reduction. For patients who perceive their imaginal and in vivo homework assignments as unhelpful, clinicians may want to work with the patient to determine why they perceived the homework was unhelpful. Examining the underlying reasons may help the clinician to either alter the homework assignments to better match the patient’s needs or work with the patient on altering their underlying beliefs about the homework activities. For example, a patient may view a homework assignment as unhelpful because it did not reduce their anxiety, did not fit into their schedule, etc. Overall, patients may perceive the homework as unhelpful for a variety of reasons and collaborative discussions between the therapist and patient may help to determine the underlying reasons for poor adherence, improve both adherence and patient views of homework helpfulness, and potentially reduce PTSD symptoms.

Overall, in vivo adherence, but not imaginal exposure adherence, increased across treatment. Similarly, higher levels of in vivo adherence, but not imaginal exposure adherence, predicted PTSD symptom reduction. Clinically, patients may not have attributed the reduction in their PTSD symptoms to their imaginal homework completion, and therefore may not have increased their level of adherence to promote further symptom reduction. However, future research may want to examine patient attribution of change, particularly in terms of homework assignments (e.g., “Which homework
assignments do you think have been most helpful in reducing your PTSD symptoms?”), in order to empirically examine this hypothesis.

Patients with co-occurring MDD reported lower levels of in vivo homework completion and rated their in vivo homework as less helpful than individuals without current MDD. Some have theorized that depressive symptoms, such as hopelessness, sadness, and low motivation “conspire” to reduce the impact of clinical recommendations (Thase & Callan, 2006). Thus, MDD symptoms may reduce patient willingness to act on therapist suggestions, including completing homework assignments. However, higher levels of pre-treatment willingness to try new strategies to cope with depressive symptoms have not been found to be associated with overall level of homework adherence during cognitive behavioral therapy for depression (Burns & Nolen-Hoeksema, 1991; Burns & Spangler, 2000). Alternative conceptualizations (e.g., Bryant, Simons, & Thase, 1999) suggest beliefs commonly associated with depression, such as the tendency to evaluate the outcome of tasks/events negatively (e.g., “I guess I can try the homework but I’m sure it won’t help someone like me anyway”), may also negatively impact homework adherence. Current findings provide support for this theory, given that, on average, individuals with PTSD and co-occurring MDD perceived their in vivo assignments as less helpful than those without MDD. Encouragingly however, in vivo adherence and perceptions of in vivo helpfulness increased during the course of treatment among those with co-occurring MDD. Finally, neurobiological theories may also partially account for the current findings regarding the impact of co-occurring MDD on in vivo homework adherence. Gray (1971; 1982) theorized that two interconnected neurobiological systems regulate motivational behaviors: the behavioral inhibition (BIS)
and behavioral activation (BAS) system. Generally, the BAS system is motivated by reward, facilitates goal-related behavior, and is associated with approach related behaviors (Gray, 1982). The BIS system (Gray, 1982) is motivated by punishment and facilitates withdrawal related behaviors (e.g., avoidance). In an epidemiological study, Johnson and colleagues (2003) found that higher levels of BIS activation were associated with a lifetime diagnosis of depression as well as current depression, even after controlling for co-occurring anxiety. Thus, a diagnosis of MDD was associated with higher levels of punishment-related motivation and a general pattern of withdrawal when approached with novel situations. This pattern of activation could impact homework adherence, suggesting those with PTSD and co-occurring MDD may be more likely to avoid novel situations (i.e., *in vivo* homework assignments) than individuals with PTSD alone. Clinically, therapists may want to discuss depressive symptoms as a possible barrier to homework completion with their patients who present with PTSD and co-occurring MDD. Collaborative troubleshooting while assigning homework (e.g., what will you do if it’s time to complete your *in vivo* assignment and you are feeling sad or unmotivated?) may be helpful in improving adherence for those with current MDD.

Positive patient beliefs were also found to impact *in vivo* homework adherence. Cognitive models of both PTSD (e.g., Ehlers & Clark, 2000; Janoff-Bulman, 1992) and depression (e.g., Abramson, Metalsky, & Alloy, 1989; Beck, 1967) focus solely on the role of negative beliefs in producing and maintaining symptoms. Additionally, previous reports have found that negative cognitions negatively impact PTSD treatment outcome (e.g., Foa & Rauch, 2004; Zalta et al., 2014). However, the results of the current study suggest that positive self and world-views may also be particularly impactful during the
PTSD treatment process. Recently, theoretical and empirical work has begun to move toward understanding positive shifts during PTSD treatment, such as an increase in resiliency (e.g., Davidson et al., 2005; Davidson et al., 2012). Resilience can be defined as an individual’s ability, following a traumatic experience, to maintain healthy and stable levels of psychological and physical functioning, as well as experience and express positive emotions and beliefs (Bonanno, 2004). Examining individuals receiving either medication alone or medication in combination with cognitive behavioral treatment for PTSD, resilience was found to increase over the course of treatment (Davidson et al., 2005). The largest changes in resilience related to increases in self-confidence, social support, and control over one’s circumstances (Davidson et al., 2005). However, no research to date has focused on positive changes (e.g., resilience, positive beliefs) during PE in relation to homework adherence. Theoretical models of homework adherence have suggested that the most “direct influence on compliance is the patient’s cognitions” and includes “hopeful thoughts” and “beliefs about self-efficacy and one’s ability to problem solve” (Bryant, Simons, & Thase, 1999). This is the first study to provide empirical support for this theoretical model, which emphasized patient beliefs, including positive beliefs, as an important factor contributing to adherence during psychotherapy. Pre-treatment self reported negative general beliefs (e.g., “If I fail partly, it is as bad as being a complete failure”) and in-session negative beliefs (e.g., negative hope, negative self view, negative perceptions of relationships) were not associated with levels of homework adherence or helpfulness across PE. In contrast, positive beliefs expressed in treatment sessions were related to both homework completion and helpfulness. Higher positive self view (e.g., “I feel proud that I was able to get out of the house this week”) was associated
with higher levels of *in vivo* adherence and a stronger sense of positive hope (e.g., “I noticed a big improvement this week”) was associated with higher perceptions of *in vivo* helpfulness.

A stronger perception of positive relationships (e.g., “My husband was really supportive when I told him I wanted to start going on more dates”) was associated with higher levels of both *in vivo* adherence and *in vivo* helpfulness. These findings expand on recent literature suggesting that perceptions of positive social support in particular, may be influential during PTSD treatment. For example, we have previously found that higher levels of self-reported positive trauma-related support (e.g., having someone tell you that you are not to blame for the trauma) were associated with a stronger early therapeutic alliance during PE or medication (sertraline) treatment for PTSD (Keller, Zoellner, & Feeny, 2010). However, levels of self-reported negative trauma-related support were not significantly associated with early alliance (Keller et al., 2010). Clinically, a focus on bolstering patient’s positive beliefs, as opposed to solely focusing on reducing negative views, may be helpful in improving levels of homework adherence during PE.

*In vivo* homework adherence as well as perceptions of *in vivo* and imaginal homework helpfulness preceded improvements in PTSD symptoms. However, PTSD severity did not influence patients’ level of homework adherence or perceptions of homework helpfulness. These findings are consistent with the depression literature (Burns & Spangler, 2000). Specifically, homework adherence was found to reduce depressive symptoms among patients receiving cognitive behavioral therapy for MDD, but depressive symptom reduction did not impact homework adherence (Burns & Spangler, 2000). Contrary to our hypothesis, levels of imaginal homework adherence did
not predict subsequent reductions in PTSD symptoms. Theoretical models conceptualizing exposure therapy as a learning experience (e.g., Lang, Craske, & Bjork, 1999) may partially account for our findings, which suggest that \textit{in vivo} exposure may have a particularly salient role in PTSD symptom reduction. Lang and colleagues (1999) suggest that increasing variation in the “to be learned task” can improve treatment outcome. During PE, \textit{in vivo} exposure may be helpful because this type of exposure pairs trauma-related cues (i.e., situations that the patient is avoiding) with non-fearful responses (i.e., low anxiety when nothing dangerous happens) in a variety of contexts. Thus, patients can learn that they will be safe in multiple contexts, situations, and places. Without variation in the exposure, the patient will likely only learn to retrieve a non-fearful response in relation to a single situation in a specific setting (Lang et al., 1999). During PE, \textit{in vivo} assignments are designed to vary, such that the patient approaches multiple previously avoided situations/people/places over the course of therapy (e.g., going to the mall, going on a date with a partner, watching the news, etc.). However, imaginal exposure homework is generally consistent across treatment, and involves listening to the recording of the trauma memory between each session. Though generally consistent, there is some variation in imaginal exposure. For example, once patients begin to show a reduction in distress during imaginal exposure (usually around session 6 or 7), the exposure focuses on “hot spots”, or the most distressing portion of the memory. Thus, there are likely additional factors that may account for the current findings. For example, \textit{in vivo} assignments specifically, may serve a dual purpose, functioning both as an exposure exercise and a behavioral activation task for patients with PTSD. Behavioral activation, an evidence-based treatment for depression (Cuijpers, van Stratten, &
Warmerdam, 2006), focuses on increasing patient engagement in pleasant activities and positive interactions with their environment. Some have suggested that behavioral activation be also be useful for patients with PTSD, particularly those who present with co-occurring depression, high levels of avoidance, and social isolation (e.g., Cukor, Spitalnick, Difede, Rizzo, & Rothbaum, 2009). Recent findings suggest that a modified behavioral activation treatment protocol may be effective in the treatment of PTSD among veterans (Jakupcak, Wagner, Paulson, Varra, & McFall, 2010) and individuals with PTSD related to a physical injury (Wagner, Zatzick, Ghesquiere, & Jurkovich, 2007). Generally, *in vivo* assignments may not only reduce fear and distress in situations that serve as trauma-reminders, but might also increase an individual’s overall level of social interaction. Additionally, *in vivo* exposure, as opposed to imaginal exposure, may have a stronger relationship with treatment outcome given the degree of variation in the assigned tasks and level of social interaction the tasks entail.

Our results should be interpreted with several limitations in mind. First, although we examined patient factors (i.e., co-occurring MDD, pre-treatment beliefs, and in-session beliefs) as predictors of homework adherence, future research should consider examining additional potential predictors of homework adherence including therapist and task factors. For example, future research may examine additional pre-treatment and in-session patient factors (e.g., history of child abuse, avoidance of session material) or therapist factors (e.g., time spent on homework assignment and review) that may be associated with homework adherence during PE. Second, while this study is an important first step in examining adherence during PE, further research is needed to determine levels of optimal homework completion during PE. Third, homework adherence was
assessed via self-report and we did not assess therapist ratings of adherence. Future studies may consider reporting patient and therapist measures of adherence, examining patient and therapist concordance rates in adherence levels, and examining the differential impact of patient vs. therapist adherence ratings on treatment outcome. Finally, we did not assess the quality of homework, that is, the degree to which the homework was done correctly. However, previous researchers have suggested that quality assessments are often difficult (Bryant, Simons, & Thase, 1999) because this requires the therapist and patient to establish explicit and clear descriptions of what “correct” means regarding homework completion.

This study was an important first step in unpacking the impact of in vivo and imaginal homework adherence and perceptions of homework helpfulness on PTSD symptom reduction during PE. These findings suggest that higher levels of homework adherence during PE predict subsequent reductions in PTSD symptoms. Given that about 8-10% of patients did not complete any homework at a given session, clinicians may want to consider highlighting homework assignments as an important component of the treatment, early on, in order to possibly improve adherence levels during PE. Importantly, patients’ positive in-session beliefs were related to improved adherence and perceived helpfulness of homework assignments. These findings are encouraging, and suggest that clinicians should focus on strengthening patients’ positive views, as opposed to solely reducing negative self and world-views. Overall, this study supports that homework is an important part of PE, allows patients to practice their newly learned skills, and improves treatment outcome.
Table 1

Sample Characteristics

<table>
<thead>
<tr>
<th>Demographic Variable</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary Trauma</strong></td>
<td></td>
</tr>
<tr>
<td>Adult Sexual Assault</td>
<td>28.6</td>
</tr>
<tr>
<td>Childhood Sexual Assault</td>
<td>17.9</td>
</tr>
<tr>
<td>Adult nonsexual assault</td>
<td>26.1</td>
</tr>
<tr>
<td>Accident (motor vehicle)</td>
<td>3.5</td>
</tr>
<tr>
<td>Childhood nonsexual assault</td>
<td>6.0</td>
</tr>
<tr>
<td>Other (e.g., death/violence to a loved one)</td>
<td>15.5</td>
</tr>
<tr>
<td>Combat/war</td>
<td>2.4</td>
</tr>
<tr>
<td><strong>Education level</strong></td>
<td></td>
</tr>
<tr>
<td>Not college educated</td>
<td>70</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td></td>
</tr>
<tr>
<td>&lt;$20,000 per year</td>
<td>55.9</td>
</tr>
<tr>
<td>≥$20,000 per year</td>
<td>44.1</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>53.6</td>
</tr>
<tr>
<td>African American</td>
<td>32.1</td>
</tr>
<tr>
<td>Other</td>
<td>14.3</td>
</tr>
</tbody>
</table>
Table 2

*In Vivo Homework Adherence Across Time During PE*

<table>
<thead>
<tr>
<th>Did Not Practice</th>
<th>Practiced Less Than 2 Times</th>
<th>Practiced 2-5 Times</th>
<th>Practiced 6-10 Times</th>
<th>Practiced More than 10 Times</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session 3 (N = 71)</td>
<td>11.3%</td>
<td>15.5%</td>
<td>54.9%</td>
<td>14.1%</td>
</tr>
<tr>
<td>Session 4 (N = 63)</td>
<td>11.1%</td>
<td>20.6%</td>
<td>39.7%</td>
<td>12.7%</td>
</tr>
<tr>
<td>Session 5 (N = 56)</td>
<td>17.9%</td>
<td>5.4%</td>
<td>44.6%</td>
<td>21.4%</td>
</tr>
<tr>
<td>Session 6 (N = 55)</td>
<td>5.5%</td>
<td>9.1%</td>
<td>49.1%</td>
<td>27.3%</td>
</tr>
<tr>
<td>Session 7 (N = 53)</td>
<td>7.5%</td>
<td>9.4%</td>
<td>47.2%</td>
<td>20.8%</td>
</tr>
<tr>
<td>Session 8 (N = 49)</td>
<td>4.1%</td>
<td>10.2%</td>
<td>51.0%</td>
<td>22.4%</td>
</tr>
<tr>
<td>Session 9 (N = 42)</td>
<td>4.8%</td>
<td>9.5%</td>
<td>52.4%</td>
<td>16.7%</td>
</tr>
<tr>
<td>Session 10 (N = 50)</td>
<td>4.0%</td>
<td>20.0%</td>
<td>46.0%</td>
<td>18.0%</td>
</tr>
</tbody>
</table>
Table 3

*Imaginal Homework Adherence Across Time During PE*

<table>
<thead>
<tr>
<th>Session</th>
<th>Did Not Practice</th>
<th>Practiced</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All Times</td>
<td>Less Than 2 Times</td>
<td>2-5 Times</td>
<td>6-10 Times</td>
<td>More than 10 Times</td>
</tr>
<tr>
<td>Session 4</td>
<td>(N = 63)</td>
<td>15.9%</td>
<td>19.0%</td>
<td>46.0%</td>
<td>9.5%</td>
</tr>
<tr>
<td>Session 5</td>
<td>(N = 55)</td>
<td>14.5%</td>
<td>12.7%</td>
<td>58.2%</td>
<td>5.5%</td>
</tr>
<tr>
<td>Session 6</td>
<td>(N = 55)</td>
<td>7.3%</td>
<td>5.5%</td>
<td>61.8%</td>
<td>16.4%</td>
</tr>
<tr>
<td>Session 7</td>
<td>(N = 53)</td>
<td>11.3%</td>
<td>11.3%</td>
<td>56.6%</td>
<td>17.0%</td>
</tr>
<tr>
<td>Session 8</td>
<td>(N = 49)</td>
<td>6.1%</td>
<td>14.3%</td>
<td>67.3%</td>
<td>6.1%</td>
</tr>
<tr>
<td>Session 9</td>
<td>(N = 42)</td>
<td>14.3%</td>
<td>14.3%</td>
<td>57.1%</td>
<td>9.5%</td>
</tr>
<tr>
<td>Session 10</td>
<td>(N = 50)</td>
<td>4.0%</td>
<td>24.0%</td>
<td>46.0%</td>
<td>20.0%</td>
</tr>
</tbody>
</table>
Table 4

*Self-Reported Ratings of Homework Helpfulness Across PE*

<table>
<thead>
<tr>
<th></th>
<th>Helpfulness of <em>in vivo</em> Exposure</th>
<th>Helpfulness of Imaginal Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Session 3</td>
<td>2.84 (1.19)</td>
<td>--</td>
</tr>
<tr>
<td>Session 4</td>
<td>3.16 (1.17)</td>
<td>2.80 (1.10)</td>
</tr>
<tr>
<td>Session 5</td>
<td>3.13 (1.28)</td>
<td>2.67 (1.23)</td>
</tr>
<tr>
<td>Session 6</td>
<td>3.33 (1.04)</td>
<td>3.18 (1.17)</td>
</tr>
<tr>
<td>Session 7</td>
<td>3.60 (.95)</td>
<td>3.13 (1.14)</td>
</tr>
<tr>
<td>Session 8</td>
<td>3.57 (.98)</td>
<td>3.14 (1.04)</td>
</tr>
<tr>
<td>Session 9</td>
<td>3.55 (.80)</td>
<td>2.98 (1.02)</td>
</tr>
<tr>
<td>Session 10</td>
<td>3.47 (1.10)</td>
<td>3.14 (1.13)</td>
</tr>
</tbody>
</table>

*Note:* 1 - Not at All Helpful; 2 = A Little Helpful; 3 – Somewhat Helpful; 4 – Very Helpful; 5 – Extremely Helpful
Table 5a

**Baseline Linear Model Examining Change in in vivo Adherence Across PE**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Unstandardized Coefficient</th>
<th>SE</th>
<th>Variance Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>2.95***</td>
<td>.11</td>
<td>.53***</td>
</tr>
<tr>
<td>Linear Δ in <em>in vivo</em> adherence</td>
<td>.04</td>
<td>.02</td>
<td>.01***</td>
</tr>
</tbody>
</table>

*Significance values for between-person change are not calculated by the HLM 7 program.*

* p < .05
**p < .01
***p < .001

a Significance values for between-person change are not calculated by the HLM 7 program.
Table 5b

*Baseline Linear Model Examining Change in Perceived Helpfulness of in vivo Assignments Across PE*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Unstandardized Coefficient</th>
<th>SE</th>
<th>Variance Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>2.99**</td>
<td>.12</td>
<td>.60**</td>
</tr>
<tr>
<td>Linear Δ in <em>in vivo</em> Helpfulness</td>
<td>.09**</td>
<td>.02</td>
<td>.01*</td>
</tr>
<tr>
<td>Between-person Δ, r</td>
<td></td>
<td></td>
<td>.78a</td>
</tr>
</tbody>
</table>

*a Significance values for between-person change are not calculated by the HLM 7 program.*

* p < .05
**p < .01
***p < .001
Figure 1

The Impact of Current MDD on Patterns of in vivo Adherence Across PE

Note: Session Range is between 0 – 7 due to the data structure requirements of the HLM program. For example, in vivo homework data from actual Session 3 was set to Session 0 in order to more directly interpret the intercept term.
Figure 2

*The Impact of Current MDD on Patterns of in vivo Helpfulness Across PE*

Note: Session Range is between 0 – 7 due to the data structure requirements of the HLM program. For example, *in vivo* homework data from actual Session 3 was set to Session 0 in order to more directly interpret the intercept term.
### Table 6a

**Baseline Linear Model Examining Change in Imaginal Adherence Across PE**

<table>
<thead>
<tr>
<th>Variable (N = 66)</th>
<th>Unstandardized Coefficient</th>
<th>SE</th>
<th>Variance Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>2.78***</td>
<td>.11</td>
<td>.52***</td>
</tr>
<tr>
<td>Linear Δ in Imaginal Adherence</td>
<td>.004</td>
<td>.02</td>
<td>.004</td>
</tr>
<tr>
<td>Between-person Δ, r</td>
<td></td>
<td></td>
<td>.60*</td>
</tr>
</tbody>
</table>

*Significance values for between-person change are not calculated by the HLM 7 program.

* p < .05
**p < .01
***p < .001
Table 6b

**Baseline Linear Model Examining Change in Perceptions of Imaginal Helpfulness Across PE**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Unstandardized Coefficient</th>
<th>SE</th>
<th>Variance Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>2.86***</td>
<td>.11</td>
<td>.53***</td>
</tr>
<tr>
<td>Linear Δ in Imaginal Helpfulness</td>
<td>.05*</td>
<td>.002</td>
<td>.02</td>
</tr>
<tr>
<td>Between-person Δ, r</td>
<td></td>
<td></td>
<td>.80^</td>
</tr>
</tbody>
</table>

^ Significance values for between-person change are not calculated by the HLM 7 program.
* p < .05
**p < .01
***p < .001
Figure 3

_The Impact of MDD on Patterns of Imaginal Helpfulness Across PE_

*Note:* Session Range is between 0 – 6 due to the data structure requirements of the HLM program. For example, imaginal homework data from actual Session 4 was set to Session 0 in order to more directly interpret the intercept term.
Table 7a

*Time Lagged Regressions of in vivo Homework Adherence and PTSD Symptoms*

<table>
<thead>
<tr>
<th>Test and variable (N = 75)</th>
<th>B</th>
<th>SE</th>
<th>t</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicting <em>in vivo</em> Adherence from time-lagged PSS-SR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>2.86</td>
<td>.15</td>
<td>18.69</td>
<td>&lt; .001</td>
<td>3.06</td>
</tr>
<tr>
<td>Lagged PSS-SR</td>
<td>.008</td>
<td>.005</td>
<td>1.46</td>
<td>.15</td>
<td>.24</td>
</tr>
<tr>
<td>Predicting PSS-SR from <em>in vivo</em> Adherence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>2.31</td>
<td>.92</td>
<td>2.51</td>
<td>.01</td>
<td>.41</td>
</tr>
<tr>
<td>PSS-SR autocorrelation</td>
<td>.89</td>
<td>.02</td>
<td>40.26</td>
<td>&lt; .0001</td>
<td>6.60</td>
</tr>
<tr>
<td><em>In Vivo</em> Adherence</td>
<td>-.55</td>
<td>.24</td>
<td>-2.27</td>
<td>.02</td>
<td>.37</td>
</tr>
</tbody>
</table>

*Note.* PSS-SR = PTSD Symptom Scale – Self Report; \( d = \text{Cohen’s } d \), where \( d = t*\sqrt{2/n} \)
Table 7b

*Time Lagged Regressions of in vivo Helpfulness and PTSD Symptoms*

<table>
<thead>
<tr>
<th>Test and variable (N = 75)</th>
<th>$\beta$</th>
<th>SE</th>
<th>$t$</th>
<th>$p$</th>
<th>$d$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicting <em>in vivo</em> helpfulness (DV) from time-lagged PSS-SR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>3.30</td>
<td>.16</td>
<td>20.84</td>
<td>&lt;.0001</td>
<td>3.39</td>
</tr>
<tr>
<td>Lagged PSS-SR</td>
<td>-.002</td>
<td>.006</td>
<td>-.36</td>
<td>.72</td>
<td>.06</td>
</tr>
<tr>
<td>Predicting PSS-SR (DV) from <em>in vivo</em> helpfulness</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>3.14</td>
<td>1.01</td>
<td>3.10</td>
<td>.003</td>
<td>.50</td>
</tr>
<tr>
<td>PSS-SR autocorrelation</td>
<td>.87</td>
<td>.02</td>
<td>38.91</td>
<td>&lt;.0001</td>
<td>6.34</td>
</tr>
<tr>
<td><em>in vivo</em> Helpfulness</td>
<td>-.68</td>
<td>.24</td>
<td>-2.80</td>
<td>.005</td>
<td>.46</td>
</tr>
</tbody>
</table>

*Note.* PSS-SR = PTSD Symptom Scale – Self Report; $d$ = Cohen’s $d$, where $d = t\sqrt{2/n}$.
### Table 8a

**Time Lagged Regressions of Imaginal Homework Adherence and PTSD Symptoms**

<table>
<thead>
<tr>
<th>Test and variable (N = 66)</th>
<th>β</th>
<th>SE</th>
<th>t</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicting Imaginal Adherence from time-lagged PSS-SR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>2.73</td>
<td>.14</td>
<td>18.90</td>
<td>&lt;.001</td>
<td>3.27</td>
</tr>
<tr>
<td>Lagged PSS-SR</td>
<td>.007</td>
<td>.006</td>
<td>1.30</td>
<td>.19</td>
<td>.22</td>
</tr>
<tr>
<td>Predicting PSS-SR from Imaginal Adherence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>1.65</td>
<td>.99</td>
<td>1.66</td>
<td>.10</td>
<td>.28</td>
</tr>
<tr>
<td>PSS-SR autocorrelation</td>
<td>.90</td>
<td>.02</td>
<td>39.10</td>
<td>&lt; .0001</td>
<td>6.76</td>
</tr>
<tr>
<td>Imaginal Adherence</td>
<td>-.44</td>
<td>.29</td>
<td>-1.55</td>
<td>.12</td>
<td>.27</td>
</tr>
</tbody>
</table>

*Note. PSS-SR = PTSD Symptom Scale – Self Report; d = Cohen’s d, where d = t*√(2/n)*
Table 8b

*Time Lagged Regressions of Helpfulness of Imaginal Homework Adherence and PTSD Symptoms*

<table>
<thead>
<tr>
<th>Test and variable (N = 66)</th>
<th>β</th>
<th>SE</th>
<th>t</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicting Helpfulness of Imaginal Adherence from time-lagged PSS-SR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>2.87</td>
<td>.17</td>
<td>17.29</td>
<td>&lt;.001</td>
<td>2.99</td>
</tr>
<tr>
<td>Lagged PSS-SR</td>
<td>.005</td>
<td>.007</td>
<td>.75</td>
<td>.46</td>
<td>.13</td>
</tr>
<tr>
<td>Predicting PSS-SR from Helpfulness of Imaginal Adherence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>2.05</td>
<td>.95</td>
<td>2.15</td>
<td>.03</td>
<td>.37</td>
</tr>
<tr>
<td>PSS-SR autocorrelation</td>
<td>.90</td>
<td>.02</td>
<td>38.47</td>
<td>&lt;.0001</td>
<td>6.66</td>
</tr>
<tr>
<td>Imaginal Helpfulness</td>
<td>-.57</td>
<td>.25</td>
<td>-2.25</td>
<td>.03</td>
<td>.39</td>
</tr>
</tbody>
</table>

*Note. PSS-SR = PTSD Symptom Scale – Self Report; d = Cohen’s d, where d = t*√(2/n)*
References


Davidson, J. R. T., Stein, D. J., Rothbaum, B. O., Pedersen, R., Szumski, A., & Baldwin,


combination for reducing posttraumatic stress disorder in female assault victims.


*Psychological Assessment, 11*, 303-314. doi: 10.1040-3590/99/S3.00


