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Treatment Length and Symptom Improvement in Prolonged Exposure and Present-Centered Therapy for Posttraumatic Stress Disorder: Comparing Dose–Response and Good-Enough Level Models in Two Manualized Interventions

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Objective: The dose–response model of change in psychotherapy posits that each session of therapy is incrementally beneficial across patients. The contrasting good-enough level model suggests that patients improve at different rates in therapy and discontinue treatment when they are satisfied with their improvement. Support for each theory has been mixed, and many prior studies have relied on samples of patients receiving unstructured treatment approaches. We conducted this study to compare these two theories across two manualized treatments for posttraumatic stress disorder (PTSD). ***Method:*** Two hundred eighty-four female veterans and military service members with PTSD (M_{age} = 44.79; 54.6% White non-Hispanic, 6.7% Black non-Hispanic, 37% other) were randomized to receive 10 sessions of prolonged exposure (PE), a trauma-focused therapy, or present-centered therapy (PCT), a non-trauma-focused therapy. Participants completed the PTSD Checklist (PCL) at even-numbered treatment sessions, and the timing of dropout/treatment completion was monitored. ***Results:*** The point of highest risk for dropout differed between the treatments, with risk in PE corresponding to the beginning of imaginal exposures. In the PE condition, but not in PCT, a higher number of sessions completed increased the likelihood of achieving reliable clinically significant improvement. Across treatments, the rate of change in PTSD symptoms did not differ according to the number of sessions completed ($b = 0.06$, $p = .687$). ***Conclusions:*** Findings support the dose–response model of change in psychotherapy. There were notable differences in dropout across the treatment conditions, including rates, timing, and implications for outcomes. These differences likely reflect differences in content between the protocols.

What is the public health significance of this article?
For women veterans or military service members with posttraumatic stress disorder, there are different patterns of treatment discontinuation between prolonged exposure (PE) or present-centered therapy (PCT). Remaining engaged in PE for more sessions is associated with better treatment outcomes, compared to individuals who dropout of PE early.

Keywords: posttraumatic stress disorder, dose–response, good-enough level, trauma-focused therapy, women

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Access to study data and other study materials is governed by VA policies on data security in research; it is not possible to publicly post the data set. The corresponding author may be contacted by email for further information, including analytic code. This study was not preregistered.

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continued

Treatment length and its relationship to therapeutic outcomes are a matter of significant interest and clinical relevance. Premature therapy termination ("dropout"), typically defined as attending fewer than a specified number of sessions, not completing a defined treatment protocol, or failure to attend a scheduled session without attending future sessions, is common across a range of psychiatric diagnoses. A meta-analysis by Fernandez et al. (2015) of dropout from cognitive behavioral therapy found that, on average, over one quarter of patients dropped out during the course of a treatment episode; the dropout rate among patients with depression or substance abuse was the highest, at 36.4%, while lower rates were found among anxiety disorders (19.6%). Among patients being treated for posttraumatic stress disorder (PTSD), the rate of dropout was 27.2%, although this was based on a comparatively small number of studies. Nevertheless, there has been concern raised about dropout as a clinical problem in PTSD.

In both clinical trials and in routine care, dropout typically occurs early in the course of treatment for PTSD, either prior to the first session or within the first several sessions (Gutner et al., 2016; Holmes et al., 2019; Kehle-Forbes et al., 2016; Niles et al., 2018); this early attrition means that patients have limited time to learn and practice treatment skills. Indeed, completing more sessions of treatment is associated with greater improvement in symptoms and functioning (Szafranski et al., 2017; Tuerk et al., 2013). Yet studies of variable-length treatment for PTSD have found that 13%–37% of participants reached good end-state functioning (GESF) prior to the final protocol session (Galovski et al., 2012; Resick et al., 2021). Szafranski et al. (2017) suggested that patients may make a rational decision to discontinue because they do not need a lengthy course of treatment, and therefore that dropout is not necessarily a negative outcome.

Treatment Length in Trauma-Focused Therapy Versus Non-Trauma-Focused Therapy

Because trauma-focused therapies (TFTs) require patients to directly discuss (and often confront via exposure) their traumatic event(s), there has been some concern that these treatments may promote premature termination to a greater extent compared to non-TFTs. Research has been mixed, with one meta-analysis performed nearly a decade ago finding that, overall, TFTs were not associated with a higher risk of dropout than non-TFTs (Imel et al., 2013) while a more recent meta-analysis that focused specifically on studies in veteran/active-duty populations did find a significantly higher risk of dropout for TFTs (Edwards-Stewart et al., 2021). Special attention has been paid to the case of present-centered therapy (PCT), a non-TFT that was originally developed as an active treatment comparison for a PTSD treatment study (Schnurr et al., 2003). PCT is effective in reducing symptoms compared to waitlist conditions and has consistently higher rates of completion than TFTs (Belsher et al., 2019; Imel et al., 2013). Although the overall level of dropout in PCT is lower than in TFT, it is important to understand if PCT shows a different pattern of dropout timing, or a different relationship between dropout and symptom improvement, compared to TFT.

Dose–Response Versus Good-Enough Level Models of Dropout

The "dose–response" model of psychotherapy outlines a relationship whereby patients improve in psychotherapy with each additional dose (session), at a negatively accelerating rate (Howard et al., 1986). Under the assumptions of dose–response, therapy length drives patients' improvement and the rate of symptom change is not expected to vary along with the total number of completed sessions. The contrasting "good-enough level" (GEL) model of psychotherapy assumes that patients remain in therapy until they reach some point of (subjectively defined) adequate improvement; patients will therefore attend different numbers of sessions according to their personal rate of improvement (slow improvement = more sessions; Barkham et al., 1996). Under the assumptions of the GEL model, patients' improvement is what determines therapy length, not the reverse, and therefore level of improvement is either not associated with, or negatively associated with, treatment length.

Many studies have directly compared the dose–response and GEL models and the results have largely aligned with the GEL (e.g., Baldwin et al., 2009; Kivlighan et al., 2019; Lee et al., 2021; Niileksela et al., 2021). However, studies that have generally supported the GEL model have indicated that very early dropout may be associated with poorer outcomes. For instance, Baldwin et al. (2009) found that in a sample of participants who completed treatment lengths of 3–29 sessions ($M = 6.46$), the rate of symptom improvement was faster overall for those who ended treatment earlier (consistent with GEL). Yet there was a statistically significant increase in participants' likelihood of achieving reliable clinically significant improvement (RCSI) with increasing numbers of sessions completed (consistent with dose–response) up to eight treatment sessions. Participants who dropped out very early in treatment did not benefit to the same degree as participants who remained for at least eight sessions. Beyond Session 8, the relationship between RCSI and number of sessions was no longer significant. It may be that some minimum dose of treatment is necessary for adequate outcomes, but beyond that minimum threshold, longer treatment lengths are generally associated with poorer outcome as those with more intractable symptoms require longer courses of therapy; this pattern of findings has been labeled "boundaried responsive regulation" (Bone et al., 2021).

Importantly, most of the prior research on dose–response/GEL has involved a naturalistic design where the treatment approach is relatively unstructured (for reviews, see Bone et al., 2021; Robinson et al., 2020). Indeed, many of these studies have not specified the patients' presenting problems and/or the psychotherapies delivered. A smaller number of studies have investigated standardized psychotherapy treatments with more narrowly defined patient samples. Results

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have been mixed, with some studies examining structured cognitive behavioral therapy treatments among more narrowly defined populations finding no relationship between symptom change and treatment length (e.g., Cahill et al., 2003; Zieve et al., 2019), others noting a negative association between treatment length and rate of symptom change (e.g., Lee et al., 2021), and still others indicating a positive association between early termination and symptom worsening or a slower rate of improvement (e.g., Lutz et al., 2014). The issue of the relationship between symptom change and session count is therefore far from settled and may depend upon the specific treatment(s) or diagnoses under consideration.

This study builds upon prior research on dropout from PTSD treatment by replicating and extending a study by Holmes et al. (2019), who conducted perhaps the most relevant and sophisticated examination of dose–response and GEL models among individuals with PTSD. The authors used data from 188 patients with PTSD who were part of an implementation trial of cognitive processing therapy (CPT; Monson et al., 2018; Resick et al., 2016; Stirman et al., 2013), a TFT. Most patients (58.0%) completed all 12 sessions of CPT, and the majority of patients who discontinued (55.7%) did so between Sessions 2 and 5; the single "riskiest" point for dropout was between Sessions 2 and 3. Next, the authors examined what proportion of patients had achieved favorable outcomes with regard to their PTSD symptoms or functioning. A large majority of patients who dropped out did not achieve favorable outcomes, and the proportion of patients who have good outcomes increased with increasing numbers of sessions (in contrast to the GEL model). Finally, the authors tested multilevel growth curve models to examine dose–response versus GEL. GEL would predict a significant interaction between time and number of sessions such that the rate of change was fastest for those who completed fewer sessions, yet results showed the reverse, with the rate of improvement in both PTSD symptoms and overall mental health functioning being greatest for patients who attended more sessions.

The Holmes et al.'s (2019) study thus provides an important and highly relevant point of reference for understanding dropout from TFT. However, there are important differences between CPT and PE (e.g., the former focuses directly on Socratic questioning and cognitive change using worksheets, while the latter is more heavily exposure-based). Furthermore, no study has examined these competing models of dropout within a well-characterized but non-trauma-focused treatment. Therefore, we sought to replicate and extend the prior findings.

Several studies of CPT and/or prolonged exposure (PE), both of which are TFTs, have examined at what session patients with PTSD are unlikely to respond to further treatment (Byllesby et al., 2019; Sripada et al., 2020) or have sought to identify a median effective dose of treatment (e.g., Holder et al., 2020). The questions of when to change the course of treatment or what the minimally adequate dose of treatment, while critically important in a health care environment of finite resources, are fundamentally different from the focus of the present article, which centers on the relationship between dropout and trajectories of change and levels of improvement. For these reasons, we sought to specifically address the issue of dose–response versus GEL in the context of two highly distinct treatments for PTSD.

The Present Study

This study is a secondary analysis of a randomized controlled trial of prolonged exposure (PE; Foa et al., 2019) and PCT among female veterans and active-duty personnel (Schnurr et al., 2007). For a list of other papers using the same dataset, please see the Appendix. Our aims were to (a) compare patterns of treatment dropout in PE and PCT, (b) examine potential differences in outcomes among participants who received different numbers of treatment sessions in each condition, and (c) examine the relationship between within-treatment improvement in PTSD symptoms and number of sessions attended, both generally and as moderated by treatment condition. Based on prior research examining dropout in TFTs (Gutner et al., 2016) and the timing of the introduction of exposure work in PE, we predicted that dropout would be most concentrated in early sessions of PE (prior to Session 5). We did not expect any particular period of higher dropout risk in PCT but expected that the pattern of dropout timing would differ from that of PE, given the lack of exposure work in PCT. We also predicted that across both treatments, those who received fewer treatment sessions would display poorer outcomes compared to those who received more sessions (e.g., Berke et al., 2019; Holmes et al., 2019). Finally, we expected that more rapid improvement in PTSD symptoms in the PE condition would be associated with attending more sessions (as was seen for CPT in Holmes et al., 2019), but we considered the analyses regarding the rate of change and dropout in the PCT condition to be exploratory.

Method

An institutional review board at each recruitment site approved the study protocol. Participants provided written informed consent after they had received a complete description of the study. Detailed information about the study procedure can be found in Schnurr et al.'s (2007) study. We report how we determined our sample size, all data exclusions (if any), all manipulations, and all measures in the study.

Participants

Female veterans ($n = 277$) and active-duty service members ($n = 7$) were recruited from nine Department of Veterans Affairs (VA) Medical Centers, two VA readjustment counseling centers, and one military hospital to participate in a randomized controlled trial designed to compare PE and PCT for the treatment of PTSD. The sample size was determined according to the power analysis described in Schnurr et al.'s (2007) study. Inclusion criteria were current PTSD according to the *Diagnostic and Statistical Manual of Mental Disorders, 4th edition* (*DSM-IV*; American Psychiatric Association, 2000), symptom severity of 45 or higher on the Clinician-Administered PTSD Scale (Weathers et al., 2001), 3 or more months since experiencing trauma, a clear memory of the trauma that caused PTSD, agreement not to receive other psychotherapy for PTSD during the study, and, if on psychoactive medication, a stable regimen or dose for at least 2 months prior to the start of the study treatment. Exclusion criteria were current substance use disorder; current psychotic symptoms; suicidal or homicidal ideation; current psychotic, mania, or bipolar symptoms; cognitive impairment; current involvement in a violent relationship; or self-mutilation within the last 6 months. Sample descriptive statistics are included in Table 1. Participants randomized to PE and PCT did not differ in baseline characteristics (Schnurr et al., 2007).

Table 1
Baseline Participant Characteristics for Those With and Without Endpoint Data

Participant characteristic	Total sample ($N = 284$)		Participants with endpoint data ($n = 257$)		Participants without endpoint data ($n = 17$)	
	M/*n*	*SD*/%	*M*/*n*	*SD*/%	*M*/*n*	*SD*/%
Age (years)	44.79	9.44	45.15	9.33	41.33	9.94
Race/ethnicity						
White, non-Hispanic	155	54.6%	93	32.7%	17	6.0%
Black, non-Hispanic	19	6.7%	140	52.4%	83	31.1%
Hispanic	16	6.0%	18	6.7%	15	62.2%
Other	10	37.0%	1	3.7%	1	3.7%
Married or cohabiting	90	31.7%	78	29.2%	12	44.4%
Working part- or full-time	111	39.1%	98	38.1%	13	48.2%
Posthigh school education	253	89.1%	229	89.1%	24	88.9%
Current mood disorder	181	63.7%	163	63.4%	18	66.7%
Current non-PTSD anxiety disorder	136	47.9%	121	47.1%	15	55.6%
Age at index trauma	21.43	10.08	21.54	10.17	20.37	9.21
Time since index trauma	22.92	13.49	23.16	13.56	20.59	12.80
Baseline PTSD Checklist	57.62	12.59	57.94	12.81	54.59	9.94

Note. $N = 284$. PTSD = posttraumatic stress disorder.

Measures

PTSD Checklist

The PTSD Checklist (PCL; Weathers et al., 1993) was used to assess self-reported PTSD symptom severity. Participants rated how much they have been bothered by each of the 17 *DSM-IV* PTSD symptoms in the past week on a scale from 1 = *not at all* to 5 = *extremely*. PTSD symptom severity was calculated as the sum of all 17 items (score range from 17 to 85), using mean substitution for missing items. The PCL was completed before enrolling in the study and before the start of even-numbered treatment sessions (Sessions 2, 4, 6, 8, and 10). RCSI was defined as a 10-point decrease in the PCL (Monson et al., 2008). GESF was defined as having both a 10-point decrease on the PCL and a score below 40 on the PCL (10 points below the clinical cut-off proposed by Weathers et al., 1993).

Missing Data

Because the PCL was completed at the beginning of even-numbered sessions, no within-treatment PCL scores are available for participants completing fewer than two sessions. Seventeen participants were randomized to a treatment condition but did not receive any treatment. Of the six treatment nonstarters assigned to PE, one moved, two reported health problems, one had a scheduling conflict, and two withdrew without response. Of the 11 treatment nonstarters assigned to PCT, one deployed, one reported health problems, two had scheduling conflicts, and seven withdrew with no response. An additional seven participants (five in PE and two in PCT) only attended the first session of treatment. Three participants who were missing PCL scores from their final session were also excluded from the outcome analyses. There were no significant differences between those included and excluded from the outcome analyses on any of the characteristics summarized in Table 1.

Procedure

Participants were randomly assigned to receive 10 weekly 90-min sessions of either PE or PCT. Treatment manuals specified the content and structure of each session. For both treatments, Sessions 1 and 2 included introductory information about the treatment rationale and psychoeducation about PTSD. The theoretical rationale for PE emphasizes the importance of exposure to the trauma memory/cues as a means of modifying memory structures and achieving symptom change. In the PE condition, imaginal exposure occurred in Sessions 3 through 10. Between-session "homework" assignments of in vivo exposure were also included. As noted above, PCT was developed as a non-TFT comparison condition and therefore does not involve any direct exposure (imaginal or in vivo) to the trauma. In the PCT condition, Sessions 3 through 9 focused on identifying and discussing current daily difficulties, and in Session 10 participants reviewed treatment accomplishments and made future plans; throughout treatment they also completed a journal as homework.

Treatment was delivered by master's- or doctoral-level female therapists with experience in treating PTSD. Two therapists per condition per site were randomized to treatment condition. All sessions were videotaped and reviewed by supervisors. Ratings of competence and adherence did not differ between treatment conditions (Schnurr et al., 2007).

Statistical Analyses

Analyses were performed using SAS 9.4 (SAS Institute, 2013). Survival curves and hazard rates were generated using the LIFETEST procedure. The log-rank test was used to test whether the survival curves for PE and PCT differed. To examine the relationship between endpoint outcome and number of sessions completed and treatment condition, we used the LOGISTIC procedure to generate logistic regressions predicting each endpoint outcome (RCSI, GESF, and both RCSI and GESF) from the number of sessions completed, treatment condition, and the product of treatment condition and number of sessions completed, controlling for baseline PTSD symptom severity. Treatment condition was effect-coded (PE = 0.5, PCT = −0.5), and baseline symptom severity and number of sessions completed were mean centered to improve the interpretability of the intercept and lower order coefficients in the model.

Defining Time

Given our interest in assessing the dose–response relationship between symptom change and the amount of treatment received, we used session number as the time metric, rather than days in treatment. This approach is similar to the one taken by other investigations of the dose–response model (e.g., Baldwin et al., 2009; Nielsen et al., 2016). Because the PCL was administered at the beginning of each even-numbered session, session number was coded so that session = 1 would correspond to the PCL administered at the beginning of Session Number 2 (after completing one session of treatment).

Based on previous dose–response analyses suggesting nonlinear patterns of symptom change during treatment (e.g., Nielsen et al., 2016), we compared linear, quadratic, cubic, and log-linear effects of time on symptom change. We used SAS PROC MIXED with maximum likelihood estimation to compare the fit of linear, quadratic, cubic, and log-linear time parameters in longitudinal models with a random intercept and slope, using centered baseline symptom severity as a covariate. Model fit was compared using the Akaike information criterion (AICc) and Bayesian information criterion (BIC). We then compared the fit of the longitudinal model to models including the number of sessions completed ("main effects" model), and the number of sessions completed plus the interaction between session and the total number of sessions completed (stratified model). Finally, we examined whether treatment condition moderated the effects of session and/or number of sessions completed in each of the models described above. In all of these models, treatment condition was effect-coded (PE = 0.5, PCT = −0.5), and baseline symptom severity and number of sessions completed were mean centered. The session was not mean centered in the longitudinal analyses, given the meaningfulness of session = 0 as before the start of treatment.

Access to study data and other study materials is governed by VA policies on data security in research; it is not possible to publicly post the data set. The corresponding author may be contacted by email for further information, including analytic code. This study was not preregistered.

Results

Temporal Patterns of Treatment Completion and Dropout

Table 2 shows the number of sessions attended by participants in each treatment condition. Most participants in both treatments completed all 10 sessions, although completion of all sessions was lower in PE (61.7%, $n = 87$) than PCT (79.0%, $n = 113$), $\chi^2(1, n = 284) = 10.22$, $p = .0014$. Several previous studies have used eight sessions of psychotherapy as a threshold for an adequate dose (e.g., Shiner et al., 2020), and most patients who respond to evidence-based protocols for PTSD make most of their gains by Session 8 (Galovski et al., 2012; Tuerk et al., 2011). Using this definition, 93 participants (66.0%) in PE and 119 participants (83.2%) in PCT received an adequate dose of treatment, $\chi^2(1, n = 284) = 11.18$, $p = .0008$. On average, participants in PE completed fewer sessions ($M = 7.62$, $SD = 3.43$) than those in PCT ($M = 8.59$, $SD = 3.13$), $t(282) = 2.47$, $p = .014$.

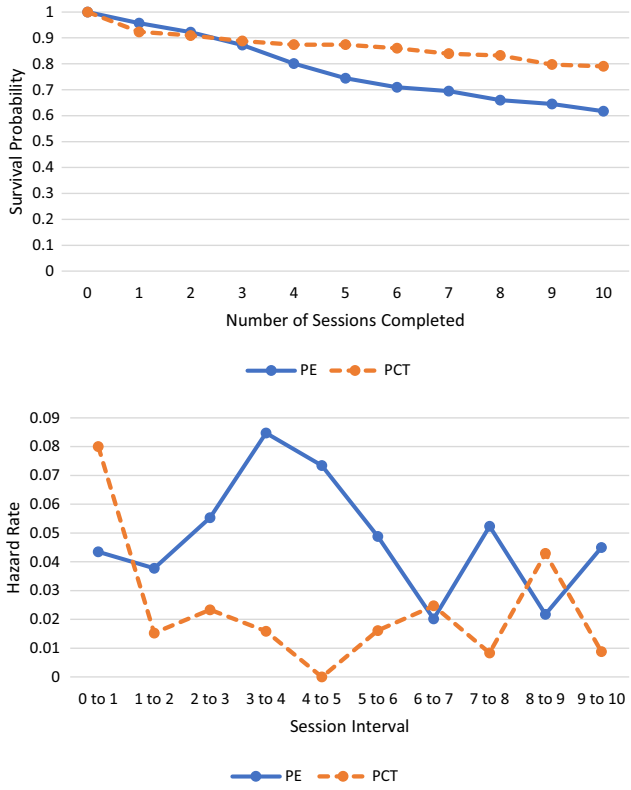
Figure 1 contains the survival curves and hazard functions by treatment condition. For PE, the likelihood of dropout was highest between the third and fourth sessions ($n = 10$, conditional probability of failure = 0.0813), followed by between the fourth and fifth sessions ($n = 8$, conditional probability of failure = 0.0708). For PCT, the highest likelihood of dropout occurred between randomization and the first treatment session ($n = 11$, conditional probability of failure = 0.0769), followed by between sessions eight and nine ($n = 5$, conditional probability of failure = 0.0420). The log-rank test

Table 2
Total Number of Sessions Completed by Treatment Condition

	PE		PCT	
Session number	*n*	%	*n*	%
0	6	4.3	11	7.7
1	5	3.6	2	1.4
2	7	5.0	3	2.1
3	10	7.1	2	1.4
4	8	5.7	0	0.0
5	5	3.6	2	1.4
6	2	1.4	3	2.1
7	5	3.6	1	0.7
8	2	1.4	5	3.5
9	4	2.8	1	0.7
10	87	61.7	113	79.0

Note. $N = 284$. PE = prolonged exposure; PCT = present-centered therapy.

Figure 1
Survival Probability and Hazard Rate for Prolonged Exposure (PE) and Present-Centered Therapy (PCT)



Note. See the online article for the color version of this figure.

suggests that the survival curves for PE and PCT differ, $\chi^2(1, n = 284) = 9.57$, $p = .002$.

Favorable Outcomes by Treatment Length

Table 3 shows the proportion of participants who attained RCSI (i.e., a reduction of 10 or more points on the PCL) or GESF (both RCSI and a total PCL less than 40) for each treatment condition by treatment length. Very few participants who completed only 2–4 sessions of PE achieved good outcomes, but a majority of those completing eight or more sessions did so. For PCT, fewer than half of participants achieved favorable outcomes regardless of treatment length. Among those participants who completed most or all treatment sessions (8–10), 55.4% in the PE condition achieved GESF, whereas only 25.4% met this threshold in PCT.

Table 4 shows the logistic regressions predicting endpoint outcomes (RCSI, GESF) from number of sessions completed, treatment condition, and the product of treatment condition and number of sessions completed, controlling for baseline PTSD symptom severity. For both outcomes, (higher) number of sessions completed and (PE) treatment condition were associated with a higher log-odds of good outcome. Treatment condition moderated the effect of number of sessions completed for RCSI, $b = 0.39$ ($SE = .14$), $Z = 2.76$, $p = .006$. Controlling for baseline symptom severity, the conditional effect of number of sessions completed was significant for PE, $OR = 1.563$ [95% CI = 1.32, 1.85], $p < .001$, but not for PCT, $OR = 1.063$ [95% CI = 0.86, 1.32], $p = .58$.

Analyses Collapsing Across Treatment Condition

The linear model of change was the best-fitting model (AICc = 8125.2; BIC = 8150.0). The fit of the quadratic model was similar (AICc = 8126.7; BIC = 8155.0), but given that the quadratic term was not significant, $b = .02$, $SE = 0.03$, $t(853) = 0.71$, $p = .47$, we selected the more parsimonious linear model. Table 5 contains the solution for fixed effects for the aggregate model, main effects model, and stratified model. Controlling for baseline symptom severity, symptoms decreased at a rate of −1.64 points per session. The rate of change in symptoms did not differ by the number of sessions completed, $b = 0.06$, $SE = 0.15$, $t(853) = 0.40$, $p = .687$.

Table 3
Symptom Change and End-State Functioning by Treatment Condition

Condition and session count	RCSI		GESF	
	n	%	*n*	%
PE				
2–4 sessions	3	12.5	0	0.0
5–7 sessions	5	41.7	1	8.3
8–10 sessions	70	76.1	51	55.4
PCT				
2–4 sessions	2	40.0	0	0.0
5–7 sessions	1	16.7	0	0.0
8–10 sessions	57	48.3	30	25.4

Note. $N = 257$. RCSI = reliable clinically significant improvement (10-point reduction in symptom severity); GESF = good end-state functioning (10-point reduction in symptom severity and total score below 40 on Posttraumatic Stress Disorder Checklist); PE = prolonged exposure; PCT = present-centered therapy.

Examination of Treatment Condition Differences

Although there was no treatment condition by session interaction in posttreatment outcomes (Schnurr et al., 2007), visual inspection suggested that there might be differences between the two treatments in the pattern of change during treatment. We examined model fit when we added treatment condition by session interaction(s) to the linear, quadratic, cubic, and log-linear models. The linear (AICc = 8094.6; BIC = 8126.4) and quadratic (AICc = 8094.5; BIC = 8133.3) had the best fit indices. Both the linear and quadratic models had a significant treatment by session interaction. For the linear model, there was a significant interaction between treatment condition and session, $b = -1.35$, $SE = 0.22$, $t(853) = -6.09$, $p < .001$. The conditional slopes of session for both treatment conditions were significant (both ps $< .001$), the conditional effect of session for PE, $b = -2.40$, $SE = .17$, $t(853) = -14.28$, was steeper than for PCT, $b = -1.04$, $SE = 0.15$, $t(853) = -7.03$. At average baseline symptom severity, estimated PTSD symptom severity was significantly lower in PE than in PCT starting at Session 4. In the quadratic model, there was a significant interaction between treatment condition and the quadratic term, $b = 0.12$, $SE = 0.06$, $t(851) = 1.97$, $p = .0495$. Examining the conditional effects of the quadratic term by treatment condition showed that the quadratic effect was marginally significant for PCT, $b = 0.07$, $SE = 0.04$, $t(851) = 1.76$, $p = .079$, and the quadratic effect for PE was nonsignificant, $b = -0.05$, $SE = 0.04$, $t(851) = -1.06$, $p = .29$. The sign of the coefficient for the quadratic term for PCT suggests the rate of symptom severity improvement decreased over sessions.

Given the significant quadratic by treatment type effect, we chose to retain the quadratic term in subsequent models. Table 6 contains the results of the aggregate, main effects, and stratified models including interactions between treatment conditions and each of the effects in the model. Model fit for the stratified model was not significantly higher than the main effects model, likelihood ratio test $\chi^2(2) = 2.2$, $p = .33$, or the aggregate model, likelihood ratio test $\chi^2(6) = 3.9$, $p = .69$.

Discussion

PCT and PE resulted in different patterns of dropout among participants, with distinct points of highest risk for dropout. The treatments were also associated with different rates of completion and adequate dose, which conforms to what has been shown previously with regard to PCT being a more "tolerable" treatment compared to TFTs (e.g., Belsher et al., 2019; Imel et al., 2013). Across both conditions, participants' rate of symptom change did not differ according to their total number of sessions completed. Among participants randomized to PE, a higher number of sessions completed was associated with increased likelihood of achieving RCSI, but this was not the case for participants randomized to PCT. Among participants randomized to PCT, there was some evidence that a higher number of sessions was associated with decreasing benefit, whereas participants randomized to PE continued to see a steady rate of improvement throughout the treatment period.

Our results indicate the presence of important differences in dropout and its implications for improvement between these two manualized treatments for PTSD. The distinct findings between the

Table 4
Logistic Regressions Predicting Symptom Change and End-State Functioning From Number of Treatment Sessions Completed and Treatment Condition, Controlling for Baseline Symptom Severity

Model	*B*	*SE*	*OR*	*Z*	*p*
RCSI					
Constant	0.27	0.14	1.31	1.86	.062
Baseline symptom severity	0.03	0.01	1.03	2.72	.007
Number of sessions completed	0.25	0.07	1.29	3.64	<.001
Treatment condition	0.86	0.29	2.37	2.99	.003
Number of Sessions × Treatment Condition	0.39	0.14	1.47	2.76	.006
GESF					
Constant	−1.23	0.30	0.29	−4.25	<.001
Baseline symptom severity	−0.04	0.01	0.96	−2.91	.004
Number of sessions completed	0.72	0.24	2.06	3.06	.002
Treatment condition	1.21	0.58	3.36	2.10	.036
Number of Sessions × Treatment Condition	0.19	0.47	1.22	0.41	.679

Note. $N = 257$. Baseline symptom severity and number of sessions completed are mean centered. RCSI = reliable clinically significant improvement; GESF = good end-state functioning; *B* = unstandardized coefficient; *SE* = standard error; *OR* = odds ratio.

two treatment conditions likely reflect differences in the treatment content across the protocols. For example, the point of highest risk for dropout in PE corresponds to the time when imaginal exposure is introduced in that protocol; participants randomized to PCT were instead most likely to drop out prior to initiating treatment (perhaps because they were dissatisfied with their randomization) or toward the latter part of treatment. Similarly, the content in PE builds over time, with participants (ideally) achieving increased tolerance of their emotional responses and increased insight into their traumatic experience and reactions as they continue to complete imaginal and in vivo exposures. The PCT content, while structured, may not result in this same sense of growth. Our finding that continued persistence in PE results in higher likelihood of favorable outcomes and incremental improvement may reflect these protocol differences. Importantly, in our sample, treatment condition did not moderate the (lack of) effect of number of sessions completed on rate of change, and this lack of effect is consistent with dose–response. Collectively our findings, particularly for the PE condition, most closely align with the assumptions of the dose–response model.

Our results are broadly consistent with Holmes et al. (2019); those authors also found that the likelihood of dropout from TFT (CPT, rather than PE) was highest at the point when participants were first asked to engage directly with the trauma memory. That study also showed that increasing numbers of CPT sessions were associated with increasing likelihood of a positive treatment outcome. However, we did not replicate the finding that participants whose symptoms improved more rapidly attended more sessions of treatment. This may be due to differences between the CPT and PE protocols (e.g., new content is introduced in every session of the CPT protocol, whereas the structure and content of PE are relatively unchanged after Session 3), differences between the maximum number of sessions permitted in each study (12 for Holmes et al., 10 for the present study), or due to sample demographics (e.g., Holmes et al.'s sample was approximately half veterans/active-duty military and half civilians and 48% male, compared to the present study's female veteran sample).

Importantly, while our approach focuses on the specific relationship between treatment length and symptom change, there are factors beyond symptom improvement that also influence treatment retention. For example, substantial prior research has implicated demographic variables, comorbid disorders, logistical barriers, and other characteristics in relation to dropout, although the results are highly heterogeneous across studies (see Stoycos et al., 2023). A comprehensive review of this work is beyond the scope of the present article, but we emphasize that ultimately many factors may contribute to a patient's choice to end treatment. It should be noted that massed treatment approaches (in which sessions are delivered intensively) appear to have lower rates of dropout compared to standard weekly sessions (e.g., Ragsdale et al., 2020), even when the protocol content is the same as what is delivered in standard settings. It may be that factors such as time and external obligations have a greater impact on

Table 5
Multilevel Growth Curve Models Solution for Fixed Effects Collapsed Across Treatment Condition

	Aggregate model			"Main effects" model			Stratified model		
Variable	*B*	*SE*	*p*	*B*	*SE*	*p*	*B*	*SE*	*p*
Intercept	59.97	0.62	<.001	59.76	0.63	<.001	59.79	0.64	<.001
Baseline symptom severity	0.64	0.04	<.001	0.64	0.04	<.001	0.64	0.04	<.001
Session	−1.64	0.12	<.001	−1.64	0.12	<.001	−1.66	0.13	<.001
Number of sessions completed				−0.34	0.25	.18	−0.42	0.32	.19
Number of Sessions Completed × Session							0.06	0.15	.69
−2 log likelihood	8111.1			8109.3			8109.1		

Note. $N = 257$. Baseline symptom severity and number of sessions completed are mean centered. *B* = unstandardized coefficient; *SE* = standard error.

Table 6
Multilevel Growth Curve Models Solution for Fixed Effects Including Treatment Condition Interactions

Variable	Aggregate model			"Main effects" model			Stratified model		
	B	*SE*	*p*	*B*	*SE*	*p*	*B*	*SE*	*p*
Intercept	60.32	0.78	<.001	59.99	0.81	<.001	60.02	0.84	<.001
Baseline symptom severity	0.64	0.04	<.001	0.64	0.04	<.001	0.64	0.04	<.001
Session	−1.85	0.32	<.001	−1.79	0.32	<.001	−1.82	0.38	<.001
Session^2	0.01	0.03	.68	0.01	0.03	.80	0.01	0.05	.85
Treatment	−0.22	1.57	.89	−0.72	1.63	.66	−0.40	1.67	.81
Treatment × Session	−0.17	0.64	.80	−0.11	0.65	.86	−0.42	0.75	.58
Treatment × Session^2	−0.12	0.06	.05	−0.13	0.06	.04	−0.06	0.09	.48
Number of sessions completed				−0.39	0.29	.18	−0.45	0.55	.42
Number of Sessions Completed × Treatment				0.01	0.59	.98	−0.08	1.11	.95
Number of Sessions Completed × Session							0.04	0.48	.94
Number of Sessions Completed × Session^2							−0.002	0.08	.98
Number of Sessions Completed × Session × Treatment							0.29	0.96	.76
Number of Sessions Completed × Session^2 × Treatment							−0.11	0.16	.48
−2 log likelihood	8,072.2			8,070.0			8,068.3		

Note. $N = 257$. Baseline symptom severity and number of sessions completed are mean centered. B = unstandardized coefficient; SE = standard error.

retention when treatment is delivered over the course of months versus weeks. However, it remains to be seen how symptom change, as conceptualized within the dose–response and GEL frameworks, may be related to dropout from these massed programs.

This study exclusively recruited women veterans, and as such, our results cannot be assumed to generalize to other groups of individuals with PTSD. Furthermore, both treatments delivered in the study were constrained with respect to the maximum total number of sessions that could be delivered. This may have prevented us from identifying patterns associated with longer courses of treatment (e.g., that after a certain point in treatment individuals may become much less likely to respond, even in the case of PE where additional sessions appeared to be beneficial in our sample, because those cases are simply too severe, intractable, or better addressed with a different form of intervention). As PE is one of the major PTSD treatments delivered within the Veterans Affairs Healthcare System, it may be possible for future studies to use system-wide data to examine the relationship between PE treatment length and rate of symptom change in a setting where there is no externally defined limit on sessions. Nevertheless, the PE protocol itself recommends an upper limit of sessions, making the use of an upper bound in this trial ecologically valid. Conclusions based upon this study will likely generalize to manualized treatments for PTSD generally, while our findings may have less relevance for unstructured treatments. Finally, in this study, participants only completed the PCL at even-numbered sessions, which may have obscured session-by-session improvement patterns.

Understanding the relationship between treatment length and symptom change is extremely clinically relevant. The timing of dropout varied substantially between the two conditions; clinicians delivering either of these treatments should be mindful of these risky periods and increase their use of motivational strategies during these times. For patients receiving PE in particular, our results suggest that retention in treatment is important for them to maximize symptom improvement. Clinicians who routinely deliver TFTs should be trained to identify risk factors and early warning signs for dropout and emphasize the likelihood of incremental improvement over the course of treatment to encourage patients to remain in treatment long enough to get a sufficient dose. Developing effective strategies to intervene and prevent dropout remains a high priority in order to maximize patients' benefit from treatment.

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Appendix

Published Manuscripts Using Data From the Same Sample

Citation	Variable
Current article	PTSD symptoms and number of sessions completed
MS 1	PTSD symptoms
MS 2	PTSD symptoms, trauma history, demographics, psychological diagnoses, depression, state anxiety, functioning, quality of life, treatment credibility, and medication use
MS 3	PTSD symptoms and psychological diagnoses
MS 4	PTSD symptoms, psychological diagnoses, social and occupational impairment, functional impairment, and quality of life
MS 5	PTSD symptoms and dissociation
MS 6	PTSD symptoms
MS 7	PTSD symptoms and demographics
MS 8	PTSD symptoms, psychiatric diagnoses, occupational impairment, and occupational satisfaction
MS 9	PTSD symptoms, psychiatric diagnoses, personality diagnoses, and traumatic exposure
MS 10	PTSD symptoms, depression symptoms, employment status, occupational impairment, and occupational satisfaction
MS 11	PTSD symptoms, dysfunctional sexual behavior, sexual concerns, demographics, and trauma exposure
MS 12	PTSD symptoms and quality of life
MS 13	PTSD symptoms, medication use, depression, general mental and health functioning, trauma exposure, past experience with psychotherapy, and PTSD disability pension status

Note. MS = manuscript; PTSD = posttraumatic stress disorder.

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