Received: 23 November 2021 | Revised: 19 February 2022 | Accepted: 21 February 2022

DOI: 10.1002/jts.22831

RESEARCH ARTICLE

Treating posttraumatic stress disorder at home in a single week using 1-week virtual massed cognitive processing therapy

Philip Held[1] | **Merdijana Kovacevic**[1] | **Kelsey Petrey**[1] | **Enya A. Meade**[1] | **Sarah Pridgen**[1] | **Mauricio Montes**[1] | **Brianna Werner**[1] | **Michelle L. Miller**[2] | **Dale L. Smith**[1,3] | **Debra Kaysen**[4,5] | **Niranjan S. Karnik**[1]

[1]Department of Psychiatry and Behavioral Sciences, Rush University Medical Center, Illinois, USA

[2]Department of Psychiatry, Indiana University School of Medicine, Indianapolis, Indiana, USA

[3]Department of Behavioral Sciences, Olivet Nazarene University, Bourbonnais, Illinois, USA

[4]Department of Psychiatry and Behavioral Sciences, Stanford University School of Medicine, Stanford, California, USA

[5]National Center for PTSD, VA Palo Alto Health Care System, Palo Alto, California, USA

Correspondence
Philip Held; Department of Psychiatry, Rush University Medical Center, 325 S. Paulina St., 2nd Floor; Chicago, IL 60612.
E-mail: Philip_Held@rush.edu

Funding for this research was provided by Philip Held's career development award from the National Institute of Health's National Center for Advancing Translational Sciences (KL2-TR002387). Philip Held also receives grant support from the Wounded Warrior Project and RTI International. Niranjan Karnik is supported, in part, by the National Center for Advancing Translational Science (UL1-TR002389, KL2-TR002387), National Institute on Mental Health (R01-MH117168), National Institute on Alcohol Abuse and Alcoholism (R24-AA026801), National Institute on Drug Abuse (R01-DA041071, UG1-DA049467, R01-DA051464), and Substance Abuse Mental Health Services Administration (H79-SM082299). Debra Kaysen is supported, in part, by the

Abstract

Posttraumatic stress disorder (PTSD) treatments are increasingly delivered in massed formats and have shown comparable results to standard, weekly treatment. To date, massed cognitive processing therapy (CPT), delivered daily, has been delivered primarily in combination with adjunctive services and among veteran populations, but it has not been rigorously evaluated as a standalone intervention. The present study evaluated 1-week massed CPT delivered virtually (i.e., via telehealth) to a community sample of trauma-exposed individuals ($N = 24$). Using a single-arm open-label design, participants received CPT twice per day for 5 days. The results indicated that most participants completed treatment ($n = 23$, 95.8%), and no adverse events were reported. Participants exhibited large reductions in clinician-rated, $d = 2.01$, and self-reported PTSD symptoms, $d = 2.55$, as well as self-reported depressive symptoms, $d = 1.46$. On average, participants reported a 5-point PTSD symptom reduction and 1-point reduction in depressive symptoms for each treatment day. Reductions in PTSD and depressive symptoms were maintained at 3-month follow-up. Overall, 1-week massed CPT delivered virtually was shown to be feasible and to result in rapid symptom reductions that were sustained over time. Virtual massed CPT has the potential to increase

Patient-Centered Outcomes Research Institute (PTSD-2019C1-15636), Department of Defense (W81XWH-17-1-0002), National Institute on Minority Health and Health Disparities (R01-MD011574), National Institute on Alcohol Abuse and Alcoholism (R01-AA027499), National Institute on Mental Health (P50MH115837), and the National Center for PTSD, VA Palo Alto Health Care System. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health, Veterans Administration, Wounded Warrior Project, or any other funding agency.

All other authors declare that they have no competing interests.

access to effective treatments and help trauma survivors restore aspects of their lives in short amounts of time.

Evidence-based posttraumatic stress disorder (PTSD) treatments, such as cognitive processing therapy (CPT; Resick et al., 2017) and prolonged exposure (PE; Foa et al., 2019), are commonly delivered once weekly and have been shown to be effective whether delivered in-person or virtually (Morland et al., 2020). Recent research has shown that CPT delivered virtually via telehealth produces large symptom reductions, suggesting that the virtual delivery format is highly effective (Peterson et al., 2022). Assuming regular attendance, treatment (i.e., nine to 12 sessions) takes approximately three months, with some individuals requiring even more additional time to respond to treatment (Galovski et al., 2012). PTSD treatments increasingly have been delivered via massed format, which involves daily sessions and allows individuals to complete a full course of treatment in a matter of days (Held et al., 2019). Massed evidence-based treatments have been delivered as standalone interventions (Ehlers et al., 2014; Foa et al., 2018; Oprel et al., 2021), or in conjunction with other interventions, as part of intensive PTSD treatment programs (ITPs; Ragsdale et al., 2020). Delivered as standalone interventions, massed PTSD treatments have demonstrated high feasibility and strong efficacy in clinical trials (Ehlers et al., 2014; Foa et al., 2018; Oprel et al., 2021). Three randomized controlled clinical trials comparing massed PE (Foa et al., 2018; Oprel et al., 2021) and cognitive therapy for PTSD (Ehlers et al., 2014) to their standard, weekly counterparts demonstrated large effects on PTSD and high completion rates that were comparable across conditions.

The effectiveness of standalone massed CPT is currently understudied. To date, there are only two reports that detail massed CPT delivered in a single week, as well as one active clinical trial with active duty military (Wachen et al., 2019). In a previous case report, we detailed how individual CPT can be delivered within 1 week by providing two sessions per day for 10 total sessions (Held, Klassen, Small, et al., 2020). Since then, Galovski and colleagues (2021) examined how the effectiveness of massed CPT delivered via 12 sessions within 1 week, with up to three daily sessions, compared to standard, weekly CPT. In their study of 12 survivors of interpersonal violence, massed CPT appeared feasible and produced comparable outcomes as standard CPT at posttreatment and 3-month follow-up. The small sample, with only six individuals receiving massed CPT, was a critical limitation of the study (Galovski et al., 2021). Massed CPT has also been utilized in several ITPs where it was combined with adjunctive services. These CPT-based ITPs have been shown to produce large PTSD symptom reductions that can be maintained in the long term (Bryan et al., 2018; Held et al., in press; Held, Zalta, et al., 2020). Finally, although some CPT-based ITPs have been delivered virtually (i.e., telehealth; Held, Klassen, Coleman, et al., 2020), it is currently undetermined whether standalone massed CPT can be feasibly delivered entirely virtually, which could potentially further increase access (Morland et al., 2020).

In the present single-arm, open-label pilot trial (NCT04109196), we examined whether virtually delivered (i.e., telehealth) 1-week massed CPT could reduce PTSD and depression symptoms in a sample of community members. Given the rapid and brief nature of massed CPT, we were particularly interested in examining the amount of symptom change that occurred each treatment day (i.e., every two sessions) and whether symptom improvements achieved over the course of the week-long intervention could be maintained for up to 3 months following treatment. Based on prior research examining various other evidence-based PTSD treatments delivered

in massed format (Ehlers et al., 2014; Foa et al., 2018; Galovski et al., 2021; Oprel et al., 2021), we expected that massed CPT would produce large effects on PTSD and depressive symptoms that would be maintained over time. For this trial, 1-week massed CPT was initially supposed to be delivered in person, but the delivery format was switched to virtual due to the COVID-19 pandemic.

METHOD

Participants and procedure

The study sample consisted of 24 participants, 17 of whom self-identified as female (70.8%) and six as male (25.0%). One individual identified as nonbinary (4.2%). Most participants identified as White (70.8%) and non-Hispanic (87.5%) and were employed full-time (45.8%), held a bachelor's degree or higher (66.7%), were single (45.8%), and had experienced sexual trauma (62.5%). The average participant age was 38.4 years (SD = 12.20, range: 20–63 years). Sample demographic characteristics are displayed in Table 1.

The present study was conducted from October 2019 to June 2021. Participants were recruited via online ads, local medical center and community clinician referrals, and from local medical center outpatient psychiatry clinic waitlists. Following a brief phone screen, potential participants provided consent and completed baseline assessments, which included clinician-administered interviews for PTSD and other mental health disorders. Eligible participants completed self-report measures electronically via REDCap. Participants who did not meet the inclusion criteria were offered referrals for appropriate services, as needed. All assessment and therapy sessions were conducted online via a HIPAA-compliant telehealth platform and audio- or video-recorded. Before conducting each session, participants' location was determined for safety reasons. Clinicians checked in regularly with participants about the privacy of their locations. All study procedures were approved by the Rush University Medical Center Institutional Review Board.

Eligibility

Participants were eligible to participate if they were 18 years of age or older; endorsed a *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; American Psychiatric Association [APA], 2013] Criterion A traumatic event; met the *DSM-5* criteria for PTSD or subthreshold PTSD, defined for this study as meeting all but one of the PTSD criteria, on the Clinician-Administered PTSD Scale for *DSM-5* (CAPS-5; Weathers, Blake, et al., 2013); were able to attend two virtual (i.e., video telehealth) sessions per day over the course of 1 week; and resided in the state of Illinois (United States). Exclusion criteria were current suicidal or homicidal intent with an active plan, current or history of psychosis or mania, change in psychotropic medications in the past month, significant cognitive impairment that would prevent treatment engagement, drug or alcohol use within the past 3 months that would require medical observation if discontinued, and serious or unstable medical illness or instability for which hospitalization may be likely. Participants were also excluded if they were currently or had previously completed an evidence-based trauma-focused treatment within the past 3 months or if they were currently involved with legal actions related to their index trauma.

Intervention

During the development of 1-week massed CPT, it was important to prioritize the feasibility of the intervention. CPT was delivered twice per day over the course of 5 business days (i.e., Monday–Friday) for a total of 10 sessions (Held, Klassen, Small, et al., 2020). Following each 50-min CPT session, participants were given at least 30 min and up to 60 min, which was considered ideal, to complete practice assignments (see Supplemental Figure S1 for a sample schedule). Depending on participant availability, the two daily sessions could also be scheduled with increased time between sessions, such as before and after work. If participants needed to reschedule sessions, treatment could stretch into the following week. Following the completion of CPT, participants were given the option to schedule up to three CPT booster sessions prior to their 3-month follow-up assessment.

The 1-week virtual massed CPT intervention followed manualized CPT protocol (Resick et al., 2017), with minor modifications. Participants were assigned to complete at least three worksheets for homework, except after Session 1, which still only focused on the impact statement. At Session 7, clinicians introduced all themes (i.e., safety, power/control, trust, esteem, and intimacy) and helped participants decide which themes were most applicable to their presenting concerns and would be the most pertinent themes on which to focus during the remaining sessions. Participants were assigned to review the modules collectively and identify "stuck points" (i.e., cognitive distortions) related to the themes most relevant to their presenting concerns. Handouts and session contents were not modified and were delivered as intended for the selected themes. Clinicians encouraged participants

TABLE 1 Demographic and clinical characteristics

Variable	*n*	%	*M*	*SD*
Age (years)			38.42	12.20
Index trauma type				
Sexual assault	15	62.5		
Sudden violent death	3	12.5		
Physical assault	3	12.5		
Medical trauma	2	8.3		
Assault with a weapon	1	4.2		
Ethnicity				
Non-Hispanic	21	87.5		
Hispanic	3	12.5		
Race				
White	17	70.8		
Black or African American	4	16.7		
Asian	1	4.2		
Other	1	4.2		
Did not disclose	1	4.2		
Employment status				
Full-time	11	45.8		
Part-time	3	12.5		
Student	2	8.3		
Out of work and looking for work	2	8.3		
Other	2	8.3		
Self-employed	1	4.2		
Out of work and not currently looking for work	1	4.2		
Homemaker	1	4.2		
Retired	1	4.2		
Educational attainment				
Bachelor's degree	10	41.7		
Master's degree	6	25.0		
Some college, no degree	5	20.8		
Trade/technical/vocational trainings	1	4.2		
Associate's degree	1	4.2		
Professional degree	1	4.2		
Marital status				
Single	11	45.8		
Married or in a domestic partnership	10	41.7		
Divorced	1	4.2		
Engaged	1	4.2		
Other	1	4.2		
Self-reported PTSD symptoms (PCL-5)				
Baseline			53.08	12.81
1-week posttreatment			17.55	14.11
3-month follow-up			19.42	15.75
Clinician-assessed PTSD symptoms (CAPS-5)				
Baseline			37.25	10.25
1-week posttreatment			14.77	11.87
3-month follow-up			18.47	16.93

(Continues)

TABLE 1 (Continued)

Variable	*n*	%	*M*	*SD*
Depressive symptoms (PHQ-9)				
Baseline			15.38	4.97
1-week posttreatment			7.73	5.51
3-month follow-up			6.84	5.47

Note: $N = 24$. PTSD = posttraumatic stress disorder; PCL-5 = PTSD Checklist for *DSM-5*; CAPS-5 = Clinician-Administered PTSD Scale; PHQ-9 = nine-item Patient Health Questionnaire.

to initially focus on assimilated stuck points (i.e., those reflecting hindsight bias or inaccurate self or other blame about the traumatic event) before moving to overaccommodated stuck points (i.e., overgeneralized beliefs; Farmer et al., 2017). Participants were encouraged to send their homework via email to the provider at any time before and after their individual sessions. When worksheets were not submitted prior to the next session, clinicians asked participants to send worksheets at the beginning of the session. Worksheets and other treatment materials were jointly viewed and completed using a screen-share feature on the platform. For cases in which homework was not completed, worksheets were completed together in session in line with the standard CPT protocol.

Study assessors

Assessments were conducted by postdoctoral psychology fellows and licensed master's-level clinicians who were trained and masked to the treatment process. All study assessors were normed prior to the beginning of the study. Study assessors needed to achieve interrater reliability greater than .70 to be eligible to administer study assessments. Study assessments were randomly and periodically reviewed, but interrater reliability was not repeatedly assessed.

Study clinicians and fidelity

All study clinicians were postdoctoral psychology fellows or psychologists who received the official 2-day CPT training by a national trainer. For the first two 1-week CPT cases, all study clinicians received daily 30-min supervision and consultation from an experienced supervisor, who has delivered CPT for a number of years and oversees several CPT-based massed PTSD treatment programs. Following the initial two cases, clinicians were provided with weekly supervision but were able to request additional supervision as needed. An informal consultation group was also formed so that clinicians could have an additional outlet to discuss clinical issues that arose. All CPT sessions were audio- and/or video-recorded and randomly and periodically reviewed to ensure that study clinicians were providing the intervention with fidelity.

Measures

Clinician-assessed PTSD symptoms

The CAPS-5 (Weathers, Blake, et al., 2013) is a clinician-administered interview used to assess PTSD symptoms based on *DSM-5* criteria (APA, 2013). The measure has demonstrated good psychometric properties (Bovin et al., 2016; Weathers et al., 2018). Clinicians rate symptoms on a scale from 0 (*absent*) to 4 (*extreme/incapacitating*), with higher scores indicating a higher level of PTSD symptom severity. A symptom was deemed present if its severity was endorsed with a score of 2 (*moderate*) or higher. The CAPS-5 was administered at baseline to assess past-month symptom severity, at 1-week follow-up to assess past-week severity, and at 1- and 3-month follow-ups to examine past-month severity. In the present sample, Cronbach's alpha ranged from .77 to .93.

Self-reported PTSD symptoms

The PCL-5 (Weathers, Litz, et al., 2013) is a 20-item measure self-report measure used to assess *DSM-5* PTSD symptoms. The measure has demonstrated good psychometric properties (Bovin et al., 2016; Wortmann et al., 2016). Participants were instructed to anchor questions to their most distressing (i.e., index) traumatic event. Items were rated on a scale of 0 (*not at all*) to 4 (*extremely*), with higher scores indicating higher PTSD symptom severity. Previous research suggests that a score of 33 or higher indicates probable PTSD (Bovin et al., 2016; Wortmann et al., 2016). At the time of this writing, a 10-point reduction on the PCL-5 was suggested to be indicative of clinically significant PTSD symptom severity changes (National Center for PTSD, 2021). The PCL-5 was administered at baseline to assess past-month symptom severity, 1-week follow-up to assess past-week severity, and at 1- and

3-month follow-ups to assess past-month severity. Past-day PTSD symptoms were assessed before the first session of each treatment day during 1-week massed CPT. In the present sample, Cronbach's alpha ranged from .90 to .95.

Depressive symptoms

The nine-item Patient Health Questionnaire (PHQ-9; Kroenke et al., 2001) was used to assess self-reported symptoms of depression. Participants rated the depressive symptoms they had experienced during the past 2 weeks, scoring answers on a scale of 0 (*not at all*) to 3 (*nearly every day*), with higher scores indicating more severe depressive symptoms. A score of 10 suggests moderate depression (Manea et al., 2012). A 5-point reduction on the PHQ-9 has been suggested to indicate clinically significant changes in depressive symptom severity (Kroenke, 2012). The PHQ-9 was used to assess past-2-week symptom severity at baseline; before the first session of each treatment day; and at 1-week, 1-month, and 3-month follow-ups. In the present sample, Cronbach's alpha ranged from .80 to .88.

Data analysis

We utilized Bayesian longitudinal mixed models to examine change over the course of 1-week massed virtual CPT. The use of mixed-effects models is particularly appropriate for longitudinal analysis due to their ability to account for within-subject clustering and correlations in individual change across measurements. The Bayesian approach also allows for the incorporation of prior knowledge and results as well as for the intuitive and substantive assessment of uncertainty. Additionally, as has been noted with regularity elsewhere, Bayesian methods may be uniquely suited to estimation with small sample sizes (Depaoli & van de Schoot, 2017; Dunson, 2001), such as the present study, although this benefit may be contingent upon careful selection of informative priors (McNeish, 2016). Here, weakly informative priors for time parameters were based on our prior treatment outcomes in both 3-week and 2-week CPT-based ITPs (Held et al., in press), though sensitivity analyses were conducted to examine the robustness of outcomes relative to various prior selections. Models initially examined the effects of time, as well as age and sex, which were given very vague priors (e.g., $N \sim [0, 5]$) for age) due to past massed-treatment results indicating a lack of association with ITP outcomes (Held et al., in press). Small cell sizes obviated the examination of other covariates, such as race and ethnicity, although these variables have not been shown to predict treatment outcomes in prior studies. Simulation-based power analyses based on prior effect sizes for PTSD and depression reduction (Held et al., in press) suggested that over 90% power for detecting changes in these outcomes should be attainable with over 15 participants.

To ensure the viability of priors, prior predictive checks were conducted across 1,000 simulated datasets to ensure the alignment of priors with appropriate values. Hamiltonian Markov chain Monte Carlo (MCMC) was utilized for sampling from the posterior via the No-U-Turn Sampler algorithm (NUTS). We utilized five chains, each with 1,000 burn-in iterations and 5,000 inference iterations. Posterior distributions were summarized via 94% highest density intervals (HDIs), which report the most credible values from the posterior distribution, as well as medians and means. Model checking involved the examination of trace, autocorrelation, and divergence plots assessing the posterior, as well as visual posterior predictive checks of mean, median, variance, and skewness parameters.

We also explored maintenance of gains by comparing 1-week posttreatment symptom severity (i.e., CAPS-5, PCL-5, and PHQ-9) to both 1- and 3-month follow-up time points. We utilized noninferiority tests to assess the probability that 1- and 3-month follow-up severity scores were not inferior to those recorded at 1-week posttreatment. A recently developed Bayes actor approach (van Ravenzwaaij et al., 2019) was utilized here, which allowed for intuitive interpretations of noninferiority by assessing the probability that the follow-up severity measurement can be considered noninferior to the posttreatment measurement relative to the probability that the initial postprogram measurement is superior. This approach was modified to accommodate the repeated-measures structure of the comparisons of interest. We chose conservative noninferiority intervals of 5 points for the PCL-5 and CAPS-5 and 3 points for the PHQ-9.

Bayesian linear mixed models were also explored, including follow-up timepoints. As expected, the linear, PCL-5: $B = -0.37$, HDI [−0.72, −0.01]; PHQ: $B = -0.18$, HDI [−0.34, −0.02], and quadratic slope components, PCL-5: $B = 0.004$, HDI [0.0004, 0.007]; PHQ-9: $B = 0.001$, HDI [0.003, 0.002], were clear given the deceleration of outcome reduction over follow-up time points. These results are not reported here in detail due to consistency with reported results as well as our interest in modeling the degree of massed CPT change and post hoc illustrations of noninferiority of follow-up points compared to outcomes immediately following the treatment. Bayesian linear mixed models and model checks were explored using PYMC3 in Python (Version 3.9.), and noninferiority tests and figures were conducted using R (Version 4.1.1.)

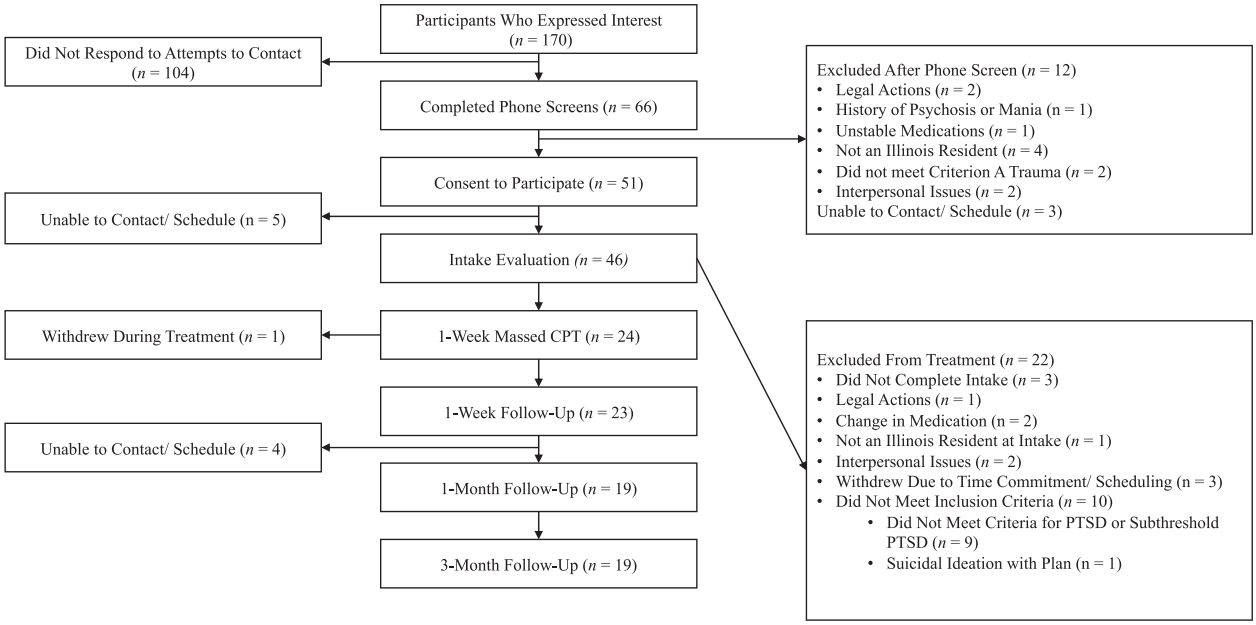

FIGURE 1 CONSORT flow diagram. Note: PTSD = posttraumatic stress disorder

RESULTS

Interest and treatment completion

Between October 2019 and April 2021, a total of 170 individuals expressed interest in participating in this study (see Figure 1 for participant flow). Of the 24 participants who started treatment, 23 (95.8%) completed the intervention, and 21 (91.7%) completed treatment within 5 consecutive days. Two participants were not able to complete treatment within 5 consecutive days due to scheduling conflicts. These two individuals completed treatment at the beginning of the following week (i.e., within 5–7 total treatment days). A total of six (25%) participants utilized booster sessions (Mdn = 2.5 sessions). No adverse events were reported during the study, including the follow-up assessment timepoints.

Clinical outcomes

At baseline, participants experienced moderate-to-severe PTSD symptoms (PCL-5 total score: M = 53.08, SD = 12.81, range: 27–66; CAPS-5 total score: M = 37.25, SD = 10.25, range: 18–59). A total of 20 participants met the full diagnostic criteria for PTSD, and four participants met the criteria for subthreshold PTSD. Deviance information criterion (DIC) supported the superiority of including intercepts and random slopes for time for all mixed models, so the results reported here reflect these parameterizations. Maximum Gelman–Rubin Rc values for all models were below 1.10, indicating effective convergence of MCMC chains (Brooks & Gelman, 1998), and prior and posterior predictive checks and diagnostic evaluations indicated appropriate model and posterior sampling with a lack of divergences. An examination of effective sample size and autocorrelation also indicated a lack of problematic autocorrelation.

Baseline to posttreatment

Overall symptom change between baseline and 1-week posttreatment revealed large effect sizes for the CAPS-5, d = 2.01; PCL-5, d = 2.55; and PHQ-9, d = 1.46. Based on posterior samples in the current models, changes in PCL-5 score over the course of 1-week virtual massed CPT reflected an average decrease in self-reported PTSD symptom severity of over 5 points per day of treatment, B = −5.22, 94% HDI [−6.59, −3.82] (see Supplementary Figure S2); reductions in depression symptoms exceeded 1 point per day, B = −1.09, HDI [−1.68, −0.57] (Supplementary Figure S3). The results did not suggest treatment outcomes differed based on age or sex (Table 2). Model posterior samples indicated that the probabilities of moderate-sized (i.e., d = 0.5) or larger differences in PCL-5 or PHQ-9 scores over time based on sex or a 10-year age difference were below 24% and 3%, respectively. Among the 20 participants who met the criteria for a full PTSD diagnosis at baseline and completed the 1-week follow-up, 15 (75.0%) no longer met the criteria for a PTSD diagnosis at 1-week follow-up.

TABLE 2 Median slopes for posttraumatic stress disorder and depressive symptom severity during 1-week massed cognitive processing therapy

	PCL-5		PHQ-9	
Predictor	**Median slope (*B*)**	**94% HDI**	**Median slope (*B*)**	**94% HDI**
Time	−5.22	[−6.59, −3.82]	−1.09	[−1.68, −0.57]
Age	0.37	[−0.11, 0.84]	−0.03	[−0.14, 0.20]
Sex	−1.31	[−14.02, 11.43]	−0.79	[−5.18, 3.41]

Note: PTSD = posttraumatic stress disorder; PCL-5 = PTSD Checklist for *DSM-5*; PHQ-9 = nine-item Patient Health Questionnaire; HDI = Bayesian highest density interval.

All four of the individuals who had subthreshold PTSD at baseline remained below the subthreshold criteria at 1-week follow-up. Of the 23 study participants, most (n = 20; 87.0%) reported clinically significant changes in PTSD symptom severity from baseline to posttreatment (PCL-5 change: M = 34.55 points, SD = 20.39). Similarly, 13 participants (56.5%) reported clinically significant changes in depressive symptom severity from baseline to posttreatment (PHQ-9 change: M = 7.55 points, SD = 6.93).

Maintenance of gains at 1- and 3-month follow-up

A total of 14 participants (n = 11 with full PTSD at baseline, n = 3 with subthreshold PTSD at baseline) completed the 1-month follow-up assessment. At 1-month follow-up, 10 (71.4%) of the 14 individuals no longer met the criteria for a full or subthreshold PTSD diagnosis. Among the 17 participants (n = 14 with full PTSD at baseline, n = 3 with subthreshold PTSD at baseline) who completed the 3-month follow-up assessment, 13 (76.5%) no longer met the diagnostic criteria for full or subthreshold PTSD at 3-month follow-up. The majority of the 19 participants who completed the 1-month follow-up self-report measures (n = 16, 84.2%) experienced clinically significant changes in self-reported PTSD symptoms from baseline to 1-month (PCL-5 change: M = 39.92 points, SD = 21.08). Nineteen participants also completed the 3-month follow-up self-report measures. Of these individuals, 17 (89.5%) self-reported clinically significance changes in their PTSD symptoms (PCL-5 change: M = 37.71 points, SD = 21.98); similarly, most (n = 14; 73.68%) experienced clinically significant depressive symptom changes from baseline to 1-month follow-up (PHQ-9 change: M = 10.83 points, SD = 6.68) and baseline to 3-month follow-up (PHQ-9 change: M = 7.74 points, SD = 6.25). Noninferiority tests comparing posttreatment clinician- and self-rated PTSD symptom severity and self-rated depression severity indicated that severity levels 1- and 3-month follow-up could generally be considered noninferior to those taken at 1-week posttreatment. The probability that PTSD symptom severity at 1- and 3-month follow-ups would be noninferior to symptom severity at 1-week posttreatment was between 2.9 and over 4,263 times greater than the probability that PTSD severity would worsen at follow-up time points (see Table 3 and Supplementary Figure S4). Particularly high probabilities of noninferiority of depression at follow-up compared to the probability of superior depression response at treatment end reflected the fact that depression improved following the end-of-treatment measurement.

DISCUSSION

The present single-arm open-label trial examined the feasibility and clinical outcomes of 1-week virtual massed CPT. The results suggest that the treatment is safe, feasible, and acceptable. Study results also provide an early indication that 1-week virtual massed CPT may be efficacious. Specifically, participants reported large reductions in PTSD and depressive symptom severity, with average PCL-5 and PHQ-9 decreases of 5 and 1 points, respectively, per treatment day. Thus, participants generally reached meaningful PTSD and depressive symptom changes as early as Day 3 (i.e., after the fourth CPT session). Such improvements are generally observed around the eighth CPT session (Holder et al., 2020), which, in standard, weekly treatment would be 8 weeks after starting treatment, assuming regular attendance. These rapid improvements highlight the benefit of massed treatments, which may be able to restore functioning in as little as a single week. Despite the generally large symptom improvements, participants experienced variability in symptom change both during and after treatment completion. Although research has demonstrated that individuals undergoing standard, weekly evidence-based PTSD treatments (Allan et al., 2017; Dewar et al., 2020; Galovski et al., 2016; Schumm et al., 2013) or CPT or PE provided within ITPs (Brown, Clapp, et al., 2019; Held et al., 2021; Hendriks et al., 2018) exhibit differing treatment trajectories, larger-scale studies are needed to identify which individuals may be most likely to respond to evidence-based treatment delivered in massed formats.

TABLE 3 Effect sizes and noninferiority across outcome measures

		Posttreatment		1-month follow-up		3-month follow-up		Noninferiority relative P[b]	
Outcome	Effect size[1]	*M*	*SD*	*M*	*SD*	*M*	*SD*	Posttreatment to 1-month	Posttreatment to 3-months
PCL-5	2.55	18.78	14.42	17.28	13.85	20.50	15.47	24.88	3.52
PHQ-9	1.46	8.61	5.62	6.00	5.02	7.22	5.36	4,263.05	453.00
CAPS	2.01	16.41	12.57	17.36	16.24	18.47	16.93	5.10	2.90

Note: $n = 1$ 8 participants had both posttreatment and follow-up outcome data. PTSD = posttraumatic stress disorder; CAPS-5 = Clinician Administered PTSD Scale for *DSM-5*; PCL-5 = PTSD Checklist for *DSM-5*; PHQ-9 = nine-item Patient Health Questionnaire.

[a]Represents effect size of baseline to posttreatment changes using Gibbon and colleagues' (1993) paired variant of Cohen's *d*. [b]Using a Bayes factor approach, estimates represent how much more likely the probability of noninferiority of follow-up severity is compared to the probability that the first posttreatment measure of severity was superior.

Symptom improvements achieved over the course of 1-week virtual massed CPT were maintained up to 3 months following treatment. For self-reported depressive symptoms, participants continued to report improvements following treatment. These results are consistent with prior research of standalone massed evidence-based treatments for PTSD (Ehlers et al., 2014; Foa et al., 2018; Oprel et al., 2021) and align with recent findings on massed CPT reported by Galovski and colleagues (2021). More information is needed to ascertain the role of CPT booster sessions, the optimal timing of booster sessions, and for whom these sessions are needed to ensure that gains made during massed treatments can be maintained.

Our findings extend existing research on massed PTSD treatments delivered in-person (Ehlers et al., 2014; Foa et al., 2018; Oprel et al., 2021) by suggesting that the virtual delivery format does not negatively impact outcomes or maintenance of massed treatment gains. Although this may not be surprising in light of the robust literature on standard, weekly PTSD treatments delivered via telehealth (Morland et al., 2020), it is nonetheless noteworthy, as the virtual delivery of massed treatment can remove barriers and further increase access to these treatments for some individuals. In this trial, several participants were able to continue working full-time and/or taking care of their children during the week of treatment by scheduling their two sessions before and after their work hours.

A key limitation was the single-arm design, which, in combination with the small sample size and homogenous nature of the sample (i.e., largely female, White, highly educated and employed, and primarily sexual assaults), substantially limits the generalizability of the study results and necessitates further examinations to understand how 1-week virtual massed CPT compares to standard, weekly CPT. The PHQ-9 was used as a daily measure in the present study, but participants were asked to rate depressive symptoms they experienced over the past 2 weeks. Generally, additional research is needed to validate the daily use of measures that are traditionally used to assess symptoms on a weekly or monthly basis. Another limitation was the limited follow-up period. Adding follow-up assessments beyond the 3-month time point would be helpful to discern long-term outcomes. Relatedly, the open-label design may have influenced participants' self-selection to be part of this research. The virtual nature, despite increasing access for some, may have been prohibitive, especially individuals from lower socioeconomic backgrounds. Finally, the study was conducted during the COVID-19 pandemic, which may have impacted who sought to participate in this research and their outcomes.

The encouraging results presented here lay a strong foundation for larger-scale, controlled research to investigate which individuals may be optimal candidates for massed CPT and to examine potential mechanisms through which this condensed delivery format may positively impact outcomes. Additional work is also needed to examine the implementation potential of 1-week massed CPT in various treatment settings.

OPEN PRACTICES STATEMENT

The preregistration for this study can be accessed at https://clinicaltrials.gov/ct2/show/NCT04109196. Neither the data nor the materials have been made available on a permanent third-party archive; requests for the data or materials should be sent via email to the lead author at Philip_Held@rush.edu.

ORCID

Philip Held https://orcid.org/0000-0003-3974-1802
Merdijana Kovacevic https://orcid.org/0000-0001-8906-7698
Kelsey Petrey https://orcid.org/0000-0002-1422-5898
Enya A. Meade https://orcid.org/0000-0002-3721-3398
Sarah Pridgen https://orcid.org/0000-0002-2640-8050
Mauricio Montes https://orcid.org/0000-0002-3497-1986
Brianna Werner https://orcid.org/0000-0003-1857-3256

Michelle L. Miller https://orcid.org/0000-0001-6150-0242
Dale L. Smith https://orcid.org/0000-0003-0854-9973
Debra Kaysen https://orcid.org/0000-0001-7961-2787
Niranjan S. Karnik https://orcid.org/0000-0001-7650-3008

REFERENCES

Allan, N. P., Gros, D. F., Myers, U. S., Korte, K. J., & Acierno, R. (2017). Predictors and outcomes of growth mixture modeled trajectories across an exposure-based PTSD intervention with veterans. *Journal of Clinical Psychology*, *73*(9), 1048–1063. https://doi.org/10.1002/jclp.22408

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). Author.

Bovin, M. J., Marx, B. P., Weathers, F. W., Gallagher, M. W., Rodriguez, P., Schnurr, P. P., & Keane, T. M. (2016). Psychometric properties of the PTSD Checklist for the *Diagnostic and Statistical Manual Of Mental Disorders*–Fifth Edition (PCL-5) in veterans. *Psychological Assessment*, *28*(11), 1379–1391. https://doi.org/10.1037/pas0000254

Brooks, S. P., & Gelman, A. (1998). General methods for monitoring convergence of iterative simulations. *Journal of Computational and Graphical Statistics*, *7*(4), 434–455. https://doi.org/10.1080/10618600.1998.10474787

Brown, L. A., Belli, G. M., Asnaani, A., & Foa, E. B. (2019). A review of the role of negative cognitions about oneself, others, and the world in the treatment of PTSD. *Cognitive Therapy and Research*, *43*(1), 143–173. https://doi.org/10.1007/s10608-018-9938-1

Brown, L. A., Clapp, J. D., Kemp, J. J., Yarvis, J. S., Dondanville, K. A., Litz, B. T., Mintz, J., Roache, J. D., Young-McCaughan, S., Peterson, A. L., & Foa, E. B., for the STRONG STAR Consortium. (2019). The pattern of symptom change during prolonged exposure therapy and present-centered therapy for PTSD in active duty military personnel. *Psychological Medicine*, *49*(12), 1980–1989. https://doi.org/10.1017/S0033291718002714

Bryan, C. J., Leifker, F. R., Rozek, D. C., Bryan, A. O., Reynolds, M. L., Oakey, D. N., & Roberge, E. (2018). Examining the effectiveness of an intensive, 2-week treatment program for military personnel and veterans with PTSD: Results of a pilot, open-label, prospective cohort trial. *Journal of Clinical Psychology*, *74*(12), 2070–2081. https://doi.org/10.1002/jclp.22651

Depaoli, S., & van de Schoot, R. (2017). Improving transparency and replication in Bayesian statistics: The WAMBS-Checklist. *Psychological Methods*, *22*(2), 240–261. https://doi.org/10.1037/met0000065

Dewar, M., Paradis, A., & Fortin, C. A. (2020). Identifying trajectories and predictors of response to psychotherapy for post-traumatic stress disorder in adults: A systematic review of the literature. *Canadian Journal of Psychiatry. Revue Canadienne de Psychiatrie*, *65*(2), 71–86. https://doi.org/10.1177/0706743719875602

Dunson, D. B. (2001). Commentary: Practical advantages of Bayesian analysis of epidemiologic data. *American Journal of Epidemiology*, *153*(12), 1222–1226. https://doi.org/10.1093/aje/153.12.1222

Ehlers, A., Hackmann, A., Grey, N., Wild, J., Liness, S., Albert, I., Deale, A., Stott, R., & Clark, D. M. (2014). A randomized controlled trial of 7-day intensive and standard weekly cognitive therapy for PTSD and emotion-focused supportive therapy. *The American Journal of Psychiatry*, *171*(3), 294–304. https://doi.org/10.1176/appi.ajp.2013.13040552

Farmer, C. C., Mitchell, K. S., Parker-Guilbert, K., & Galovski, T. E. (2017). Fidelity to the cognitive processing therapy protocol: Evaluation of critical elements. *Behavior Therapy*, *48*(2), 195–206. https://doi.org/10.1016/j.beth.2016.02.009

Foa, E. B., Hembree, E. A., Rothbaum, B. O., & Rauch, S. A. M. (2019). *Prolonged exposure therapy for PTSD: Emotional processing of traumatic experiences: therapist guide* (2nd ed.). Oxford University Press.

Foa, E. B., McLean, C. P., Zang, Y., Rosenfield, D., Yadin, E., Yarvis, J. S., Mintz, J., Young-McCaughan, S., Borah, E. V., Dondanville, K. A., Fina, B. A., Hall-Clark, B. N., Lichner, T., Litz, B. T., Roache, J., Wright, E. C., & Peterson, A. L., for the STRONG STAR Consortium. (2018). Effect of prolonged exposure therapy delivered over 2 weeks vs 8 weeks vs present-centered therapy on PTSD Symptom severity in military personnel: A randomized clinical trial. *JAMA*, *319*(4), 354–364. https://doi.org/10.1001/jama.2017.21242

Galovski, T. E., Blain, L. M., Mott, J. M., Elwood, L., & Houle, T. (2012). Manualized therapy for PTSD: Flexing the structure of cognitive processing therapy. *Journal of Consulting and Clinical Psychology*, *80*(6), 968–981. https://doi.org/10.1037/a0030600

Galovski, T. E., Harik, J. M., Blain, L. M., Farmer, C., Turner, D., & Houle, T. (2016). Identifying patterns and predictors of PTSD and depressive symptom change during cognitive processing therapy. *Cognitive Therapy and Research*, *40*(5), 617–626. https://doi.org/10.1007/s10608-016-9770-4

Galovski, T. E., Werner, K. B., Weaver, T. L., Morris, K. L., Dondanville, K. A., Nanney, J., Wamser-Nanney, R., McGlinchey, G., Fortier, C. B., & Iverson, K. M. (2021). Massed cognitive processing therapy for posttraumatic stress disorder in women survivors of intimate partner violence. *Psychological Trauma: Theory, Research, Practice, and Policy*. Advance online publication. https://doi.org/10.1037/tra0001100

Gibbons, R. D., Hedeker, D. R., & Davis, J. M. (1993). Estimation of effect size from a series of experiments involving paired comparisons. *Journal of Educational Statistics*, *18*(3), 271–279. https://doi.org/10.3102/10769986018003271

Held, P., Bagley, J. M., Klassen, B. J., & Pollack, M. H. (2019). Intensively delivered cognitive-behavioral therapies: An overview of a promising treatment delivery format for PTSD and other mental health disorders. *Psychiatric Annals*, *49*(8), 339–342. https://doi.org/10.3928/00485713-20190711-01

Held, P., Klassen, B. J., Coleman, J. A., Thompson, K., Rydberg, T. S., & Van Horn, R. (2020). delivering intensive PTSD treatment virtually: The development of a 2-week intensive cognitive processing therapy–based program in response to COVID-19. *Cognitive and Behavioral Practice*, *28*(4), 543–554. https://doi.org/10.1016/j.cbpra.2020.09.002

Held, P., Klassen, B. J., Small, C. F., Brennan, M. B., Van Horn, R., Karnik, N. S., Pollack, M. H., & Zalta, A. K. (2020). A case report of cognitive processing therapy delivered over a single week. *Cognitive and Behavioral Practice*, *27*(2), 126–135. https://doi.org/10.1016/j.cbpra.2019.07.006

Held, P., Smith, D. L., Bagley, J. M., Kovacevic, M., Steigerwald, V. L., Van Horn, R., & Karnik, N. S. (2021). Treatment response trajectories in a three-week CPT-Based intensive treatment for veterans with PTSD. *Journal of Psychiatric Research*, *141*, 226–232. https://doi.org/10.1016/j.jpsychires.2021.07.004

Held, P., Smith, D. L., Pridgen, S., Coleman, J. A., & Klassen, B. J. (in press). More is not always better: 2 weeks of intensive cognitive processing therapy-based treatment are non-inferior to 3 weeks. *Psychological Trauma: Theory, Research, Practice, and Policy*.

Held, P., Zalta, A. K., Smith, D. L., Bagley, Jenna M., Steigerwald Victoria L., Boley Randy A., Miller Michelle L., Brennan, Michael B., Van Horn, R., & Pollack, Mark H. (2020). Maintenance of treatment gains up to 12-months following a 3-week cognitive processing therapy-based intensive PTSD treatment program for veterans. *European Journal of Psychotraumatology*, *11*(1), 1789324. https://doi.org/10.1080/20008198.2020.1789324

Hendriks, L., de Kleine, R. A., Broekman, T. G., Hendriks, G.-J., & van Minnen, A. (2018). Intensive prolonged exposure therapy for chronic PTSD patients following multiple trauma and multiple treatment attempts. *European Journal of Psychotraumatology*, *9*(1), 1425574. https://doi.org/10.1080/20008198.2018.1425574

Holder, N., Shiner, B., Li, Y., Madden, E., Neylan, T. C., Seal, K. H., Lujan, C., Patterson, O. V., DuVall, S. L., & Maguen, S. (2020). Cognitive processing therapy for veterans with posttraumatic stress disorder: What is the median effective dose? *Journal of Affective Disorders*, *273*, 425–433. https://doi.org/10.1016/j.jad.2020.04.030

Kroenke, K. (2012). Enhancing the clinical utility of depression screening. *Canadian Medical Association Journal*, *184*(3), 281–282. https://doi.org/10.1503/cmaj.112004

Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine*, *16*(9), 606–613. https://doi.org/10.1046/j.1525-1497.2001.016009606.x

Manea, L., Gilbody, S., & McMillan, D. (2012). Optimal cut-off score for diagnosing depression with the Patient Health Questionnaire (PHQ-9): A meta-analysis. *Canadian Medical Association Journal*, *184*(3), E191–E196. https://doi.org/10.1503/cmaj.110829

McNeish, D. (2016). On using Bayesian methods to address small sample problems. *Structural Equation Modeling: A Multidisciplinary Journal*, *23*(5), 750–773. https://doi.org/10.1080/10705511.2016.1186549

Morland, L. A., Wells, S. Y., Glassman, L. H., Greene, C. J., Hoffman, J. E., & Rosen, C. S. (2020). Advances in PTSD treatment delivery: Review of findings and clinical considerations for the use of telehealth interventions for PTSD. *Current Treatment Options in Psychiatry*, *7*(3), 221–241. https://doi.org/10.1007/s40501-020-00215-x

National Center for PTSD. (2021). *PTSD Checklist for DSM-5 (PCL-5)*. https://www.ptsd.va.gov/professional/assessment/adult-sr/ptsd-checklist.asp

Oprel, D. A. C., Hoeboer, C. M., Schoorl, M., Kleine, R. A. de, Cloitre, M., Wigard, I. G., Minnen, A. van, & Does, W. van der. (2021). Effect of prolonged exposure, intensified prolonged exposure and STAIR + prolonged exposure in patients with PTSD related to childhood abuse: A randomized controlled trial. *European Journal of Psychotraumatology*, *12*(1), 1851511. https://doi.org/10.1080/20008198.2020.1851511

Peterson, A. L., Mintz, J., Moring, J. C., Straud, C. L., Young-McCaughan, S., McGeary, C. A., McGeary, D. D., Litz, B. T., Velligan, D. I., Macdonald, A., Mata-Galan, E., Holliday, S. L., Dillon, K. H., Roache, J. D., Bira, L. M., Nabity, P. S., Medellin, E. M., Hale, W. J., & Resick, P. A. (2022). In-office, in-home, and telehealth cognitive processing therapy for posttraumatic stress disorder in veterans: A randomized clinical trial. *BMC Psychiatry*, *22*(1), 41. https://doi.org/10.1186/s12888-022-03699-4

Ragsdale, K. A., Watkins, L. E., Sherrill, A. M., Zwiebach, L., & Rothbaum, B. O. (2020). Advances in PTSD treatment delivery: Evidence base and future directions for intensive outpatient programs. *Current Treatment Options in Psychiatry*, *7*(3), 291–300. https://doi.org/10.1007/s40501-020-00219-7

Resick, P. A., Monson, C. M., & Chard, K. M. (2017). *Cognitive processing therapy for PTSD: A comprehensive manual*. Guilford Publications.

Schumm, J. A., Walter, K. H., & Chard, K. M. (2013). Latent class differences explain variability in PTSD symptom changes during cognitive processing therapy for veterans. *Psychological Trauma: Theory, Research, Practice, and Policy*, *5*(6), 536–544. https://doi.org/10.1037/a0030359

van Ravenzwaaij, D., Monden, R., Tendeiro, J. N., & Ioannidis, J. P. A. (2019). Bayes factors for superiority, non-inferiority, and equivalence designs. *BMC Medical Research Methodology*, *19*(1), 71. https://doi.org/10.1186/s12874-019-0699-7

Wachen, J. S., Galovski, T. E., Dondanville, K. A., & Resick, P. A. (2019, November 14–16). Massed cognitive processing therapy in active duty military: Design of a randomized clinical trial [Poster presentation]. 35th Annual Meeting of the International Society for Traumatic Stress Studies, Boston, MA, United States.

Weathers, F. W., Blake, D. D., Schnurr, P. P., Kaloupek, D. G., Marx, B. P., & Keane, T. M. (2013). *The Clinician-Administered PTSD Scale for DSM-5 (CAPS-5)*. https://www.ptsd.va.gov/professional/assessment/adult-int/caps.asp

Weathers, F. W., Bovin, M. J., Lee, D. J., Sloan, D. M., Schnurr, P. P., Kaloupek, D. G., Keane, T. M., & Marx, B. P. (2018). The Clinician-Administered PTSD Scale for *DSM–5* (CAPS-5): Development and initial psychometric evaluation in military veterans. *Psychological Assessment*, *30*(3), 383–395. https://doi.org/10.1037/pas0000486

Weathers, F. W., Litz, B. T., Keane, T. M., Palmieri, P. A., Marx, B. P., & Schnurr, P. P. (2013). *The PTSD Checklist for DSM-5 (PCL-5)*. https://www.ptsd.va.gov/professional/assessment/adult-sr/ptsd-checklist.asp

Wortmann, J. H., Jordan, A. H., Weathers, F. W., Resick, P. A., Dondanville, K. A., Hall-Clark, B., Foa, E. B., Young-McCaughan, S., Yarvis, J. S., Hembree, E. A., Mintz, J., Peterson, A. L., & Litz, B. T. (2016). Psychometric analysis of the PTSD Checklist–5 (PCL-5) among treatment-seeking military service members. *Psychological Assessment*, *28*(11), 1392–1403. https://doi.org/10.1037/pas0000260

Zalta, A. K. (2015). Psychological mechanisms of effective cognitive–behavioral treatments for PTSD. *Current Psychiatry Reports*, *17*(4), 560. https://doi.org/10.1007/s11920-015-0560-6

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

How to cite this article: Held, P., Kovacevic, M., Petrey, K., Meade, E. A., Pridgen, S., Montes, M., Werner, B., Miller, M. L., Smith, D. L., Kaysen, D., & Karnik, N. S. (2022). Treating posttraumatic stress disorder at home in a single week using 1-week virtual massed cognitive processing therapy. *Journal of Traumatic Stress*, 1–11. https://doi.org/10.1002/jts.22831