Evaluation of the reconsolidation of traumatic memories protocol for the treatment of PTSD: a randomized, wait-list-controlled trial

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ABSTRACT

Introduction: The reconsolidation of traumatic memories (RTM) is a cognitive intervention for post-traumatic stress disorder (PTSD) believed to employ reconsolidation blockade with significant potential as a cost-effective and empirically supported treatment. This is the second empirical evaluation of the intervention. **Methods**: This study used a randomized wait-list-controlled design ($n = 30$) to examine the efficacy of three sessions of RTM among male Veterans having high symptom scores on the PTSD Symptom Scale Interview (PSS-I) and the PTSD Checklist – military version (PCL-M) with current-month flashbacks and nightmares. Of the 55 volunteers, 30 met inclusion criteria and participated in the study, 15 each were randomly assigned to treatment and control conditions. After completing a six-week wait period, control subjects also received the intervention. **Results**: Data analyses suggest that RTM was superior to control. There were significant pre-post treatment improvements across measures of PTSD. Gains were maintained at 6 and 12-month follow-ups. At six months post, within group RTM effect sizes (Hedges' g) ranged from 2.79 to 5.33. Further, at six months post, 88% of those treated had lost the DSM diagnosis for PTSD: 15% had lost DSM diagnosis (CPL-M < 50 and DSM criteria not met) and 73% were in complete remission from all symptoms (PCL-M < 30). Therapist competence and adherence to treatment protocols were both strong. Patient satisfaction with the intervention was high. **Discussion**: Study limitations and implications for the assessment and treatment of Veterans with PTSD are discussed.

Key words: post-traumatic stress disorder (PTSD), randomized trials, reconsolidation, waiting list

RÉSUMÉ

Introduction : Le protocole de reconsolidation de souvenirs traumatiques (RST) est une intervention cognitive contre les symptômes de l'état de stress post-traumatique (ÉSPT). Il utilise le blocage de la reconsolidation du souvenir traumatique et contient un potentiel important en tant que traitement à la fois rentable et empiriquement efficace. Cette étude présente la deuxième évaluation scientifique du protocole. **Méthodes** : Cette étude a été menée sous la forme d'un essai aléatoire avec contrôle de la liste d'attente (n = 30) afin d'évaluer l'efficacité de trois séances de RST de vétérans masculins pré-diagnostiqués avec des pointages élevés sur l'échelle d'évaluation ÉSPT (PSS-I) et selon la liste de vérification militaire (PCL-M), indiquant des symptômes importants marqués par des retours en arrière et des cauchemars au cours du mois précédent. Des 55 bénévoles, 30 répondaient aux critères d'inclusion et ont participé à l'étude, 15 ont été choisis aléatoirement pour un traitement dans des conditions contrôlées. Suite aux 6 semaines d'attente, les sujets contrôlés ont aussi reçu l'intervention. **Résultats** : L'analyse des données suggère que le RST donnait des résultats supérieurs au contrôle. Nous avons trouvé une amélioration significative pré et post traitement lors de la réévaluation de l'ÉSPT. Les gains ont été maintenus selon les suivis effectués à 6 et à 12 mois post-traitement. Lors de l'examen de suivi à 6 mois, le coefficient Hedges' g a été calculé entre 2.79 et 5.33. De plus, au suivi de 6 mois, 88% des participants ayant reçu le traitement avaient perdu le diagnostic DSM du ÉSPT : 15% n'avait plus le diagnostic DSM (CPL-M < 50 et le critère DSM n'est pas atteint) et 73% étaient en rémission complète de tous les symptômes (PCL-M < 30). La compétence et l'adhérence des thérapeutes au protocole de traitement étaient élevées. Le niveau de satisfaction des patients était élevé. **Discussion** : La question des limites et des implications de l'étude pour le suivi et le traitement des vétérans avec l'ÉSPT est l'élément central de la discussion.

Mots clés : état de stress post-traumatique (ÉSPT), essai aléatoire, reconsolidation, reconsolidation de souvenirs traumatiques (RST), conditions contrôlées, liste d'attente

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INTRODUCTION

Among the approximately 2.5 million service personnel who have served in recent West Asian and Near Eastern theatres,[1] between 13% and 17% of those Veterans suffer from PTSD.[2,3] These estimates suggest that post-traumatic stress disorder (PTSD) creates an undue burden on active duty warriors, combat Veterans, the medical systems that serve them, and the communities in which they live. The reconsolidation of traumatic memories (RTM) protocol is a brief, non-traumatizing intervention that is supported by a recent pilot study[4] as well as anecdotal and published reports using other versions of the intervention.[5] These studies report high rates of success and little or no recurrence of symptoms. The non-traumatizing nature and brief treatment span of RTM are thought to encourage treatment compliance and retention.

Current interventions for PTSD have limited efficacy

Several front-line behavioural interventions are employed by the US Department of Veterans Affairs (VA) for the treatment of PTSD, including prolonged exposure (PE), cognitive processing therapy (CPT), and eye movement desensitization and reprocessing. There is considerable evidence for their efficacy. This evidence is generally framed in terms of clinically significant symptom reduction (10–20 points on the PTSD Checklist – military version (PCL-M)[6]) and the clearance of diagnosis as measured by various PTSD inventories (Clinician Administered PTSD Scale (CAPS), PTSD Symptom Scale Interview (PSS-I), and PCL-M).[7–9] Steenkamp and colleagues have pointed out that minor reductions in multiple symptoms may account for much of the observed change.[8,9] Those changes have often been relatively impermanent. Loss of diagnosis rarely surpasses 35%.[7–10] This has led to calls for the development of new approaches to the treatment of PTSD.[7–9,11–14]

The RTM intervention

RTM provides an alternative to current interventions.[4,5] The procedure begins with a brief, controlled reminder of the target trauma that, in accordance with the reconsolidation paradigm,[15–20] renders the traumatic memory subject to change for a period of between one and six hours (as established in clinical and pre-clinical research).[21,22] The reminder is terminated before it becomes overwhelming and then dissociative experiences of that memory are provided, which are hypothesized to modify the remembered structure of the event. As these changes provide novel information regarding the trauma itself, it is believed that, in accordance with the reconsolidation theory,[5,12,15–20] those changes are incorporated into the trauma memory. These modifications are hypothesized to modify the pathological affective responses that define the hallmark symptoms of PTSD.[23] After treatment, the event becomes available to declarative memory without evoking the strong pathological emotion characteristic of PTSD.[4,5,17,19]

RTM is distinct from other trauma-focused cognitive behavioural therapies in that the brief exposure to the index trauma is not believed to be the operative element in the procedure. Here, exposure serves to initiate a period of labilization during which new information can be added to the structure of the target memory.[5,12,15–20] RTM is a targeted intervention aimed specifically at the intrusive symptoms of PTSD experienced as sudden, uncontrollable autonomic responses to the trauma narrative, its elements, or the triggers for flashbacks and nightmares. This relatively automatic and unconscious response style may be particularly susceptible to modification through "reconsolidative modification."[24]

Studies of RTM efficacy

A pre-pilot study of the intervention was completed in October 2014 by Gray and Bourke[4] with 96% of those treated no longer meeting psychometric scale cut-off criteria for PTSD (for analysis, see Table 1). At six weeks post, after a mean reduction of 33 points, the mean PCL-M score was 28.8. Hedges' g for a six-week follow-up showed a 2.9 standard deviation difference from intake to follow-up (CI 99%, 26.05, 33.71). An informal follow-up, reaching approximately 75% of treatment completers indicated that those gains were maintained at six months post (R. Gray, personal communication, February 1, 2016).

Purpose of the study

The purpose of this study was to examine the effectiveness of RTM using PTSD treatment outcome measures in a population of male combat Veterans. We examined immediate treatment outcomes and treatment effects at six months among volunteers in immediate treatment, untreated wait-list and post-wait-list treated participants. The neural mechanism of reconsolidation is invoked to explain the efficacy, economy, and relative permanence of the intervention and its outcomes. These mechanisms are conserved across species[15,19,25] and have been observed in humans.[17,19,22,26–30] Previous work has suggested that

Table 1. The RTM process outline

1. The client is asked to briefly recount the trauma.
2. Their narrative is terminated as soon as autonomic arousal is observed.
3. The subject is reoriented to the present time and circumstances.
4. Subjective Units of Distress Scale (SUDS) ratings are elicited for the just related narrative.
5. The clinician assists the client in choosing times before and after the event (bookends) as delimiters for the event: one before they knew the event would occur and another when they knew that the specific event was over and that they had survived.
6. The client is guided through the construction (or recall) of an imaginal movie theatre in which the pre-trauma bookend is displayed in black and white on the screen.
7. The client is instructed on how to find a seat in the theatre, remain dissociated from the content, and alter their perception of a black-and-white movie of the index event.
8. A black-and-white movie of the event is played and may be repeated with structural alterations as needed.
9. When the client is comfortable with the black-and-white representation, they are invited to step into a two-second, fully associated, reversed movie of the episode beginning with the post-trauma scene (bookend) and ending with the pre-trauma scene (bookend).
10. When the client signals that the rewind was comfortable, they are asked to relate the narrative or are probed for responses to stimuli that had previously elicited the autonomic response.
11. SUDS ratings are elicited for the just completed trauma narrative.
12. When the client is free from emotions in retelling, or sufficiently comfortable (SUDS $\leq$ 3), they are invited to walk through several alternate, non-traumatizing versions of the previously traumatizing event of their own design.
13. After the new scenarios have been practised, the client is again asked to relate the trauma narrative, and his previous triggers are probed.
14. SUDS ratings are elicited.
15. When the trauma cannot be evoked and the narrative can be told without significant autonomic arousal, the procedure is over.

Note: Table 1 is reproduced from Gray, R, Budden-Potts, D, Bourke, F. The Reconsolidation of Traumatic Protocol (RTM) for the treatment of PTSD: A randomized waitlist study of 30 female Veterans. In press; 2016 (it is used with the permission of the authors).

RTM can produce reliable reductions in intrusive symptomatology over long time frames.[4,5] In light of this, we hypothesized that RTM participants would show clinically and statistically significant symptom reductions with high-effect sizes using standard measures (PCL-M, PSS-I) and would report total or near total loss of nightmares and flashbacks. We further hypothesized that loss of diagnostic-level symptom scores would persist over at least six months. Departing from earlier investigations, where participants received as many as five sessions of RTM, experience has shown that only three sessions are necessary for most patients. In this study, treatments consisted of only three sessions, but the treatments were otherwise identical.

METHODS

RTM intervention

RTM is a brief cognitive intervention with a minimal, non-traumatizing exposure to the index stimulus at the start of each treatment session. It was administered in three 120-minute sessions. An outline of the procedure is provided in Table 1 (the full protocol is available from the corresponding author).

Participants

Male US Veterans were recruited from Veterans' groups and mental health service providers in San Diego County, California. Volunteers were recruited using referrals and word of mouth, resulting in a non-random distribution of Veterans. The distribution of participants across ethnic groups, branches of services, and trauma context as well as mean age are reported in Table 2.

Chi-square analyses found that none of these factors had a significant impact upon the results of the study. Of the 55 referrals, 13 were ineligible at pre-screening, while 30 of the remaining 42 met inclusion criteria. These subjects were randomized to treatment and control conditions. All 15 individuals in the RTM group completed treatment and follow-up. When later offered the RTM intervention, three decided not to participate further in the study. Of the 30 subjects who entered

Table 2. Demographic features of the study sample

Datum	RTM	Control	Test statistic	*df*	*p* value
age					
	49.0 ± 19.5	42.6 ± 15.9	$t = 0.97$	28	0.33
Ancestry					
Caucasian	10	12	$\chi^2 = 0.17$[a]	1	0.68
Non-Caucasian	5	3			
Branch of service					
Army	3	2	$\chi^2 = 0.79$[b]	3	0.85
Air Force	1	2			
Navy	2	3			
Marines	9	8			
Trauma context					
Other	3	3	$\chi^2 = 4.67$[b]	4	0.32
War (Operation Enduring Freedom)	2	1			
War (Operation Iraqi Freedom)	4	8			
War (Kuwait)	0	1			
War (Vietnam)	6	2			
Number of events					
	2.73 ± 0.9	2.46 ± 0.6			
Therapist					
Therapist A	4	1	$\chi^2 = 0.66$[a]	1	0.42
Therapist B	11	12			

Note: None of the demographic measures were statistically significant.
[a] Pearson's Chi-square test with Yates' continuity correction.
[b] Pearson's Chi-square test.

the study, only eight were not using prescription antidepressants, anxiolytics, or sleep aids at intake. In general, those using no medications performed marginally better than those using prescription drugs or marijuana. It is presupposed that these medications were, or had been, ineffective in relieving the symptoms of PTSD. Further, it is noted that all participants had received a variety of other treatments, and most had been unresponsive to treatment. All those admitted to the program reported current-month flashbacks and nightmares and were highly reactive to stimuli related to the target traumas. Participant flow, in compliance with CONSORT Guidelines, is illustrated in Figure 1.

Inclusion and exclusion criteria

Inclusion criteria (PCL-M $\geq$ 50, PSS-I $\geq$ 20) included at least one nightmare or flashback within the last month; intrusive, instantaneous, phobic-type responses to flashback triggers; and observable autonomic arousal while recounting the index trauma. Participants meeting intake criteria were reimbursed for travel expenses in the amount of US$200. Reimbursements were disbursed on a per visit basis. Exclusion criteria included the possession of a comorbid DSM-IV Axis I or II disorder impairing the participant's ability to complete treatment; PTSD symptoms perceived as part of the participant's identity structure; and clinical judgment that the volunteer was incapable of sustained attention. The RTM protocol requires a significant capacity to focus upon imagined restructurings of the trauma memory; therefore, the inability to focus on the treatment tasks is a major disqualifying element. Excluded participants were referred to their ongoing treatment provider.

Institutional review and consent

The study protocol and informed consent were approved by the New England Independent Review Board. All personal identifying information that was deemed sensitive under the Health Insurance Portability and Accountability Act was held in strict confidence. The protocol and all aspects of participation were reviewed with participants, and signed informed consents were obtained from each individual. If any participant had significant emotional difficulties during the study, an immediate intervention was administered by the licensed clinician on staff. If necessary, the participant was referred to his psychiatrist or primary care physician for emergency treatment. No need for such emergency treatment arose.

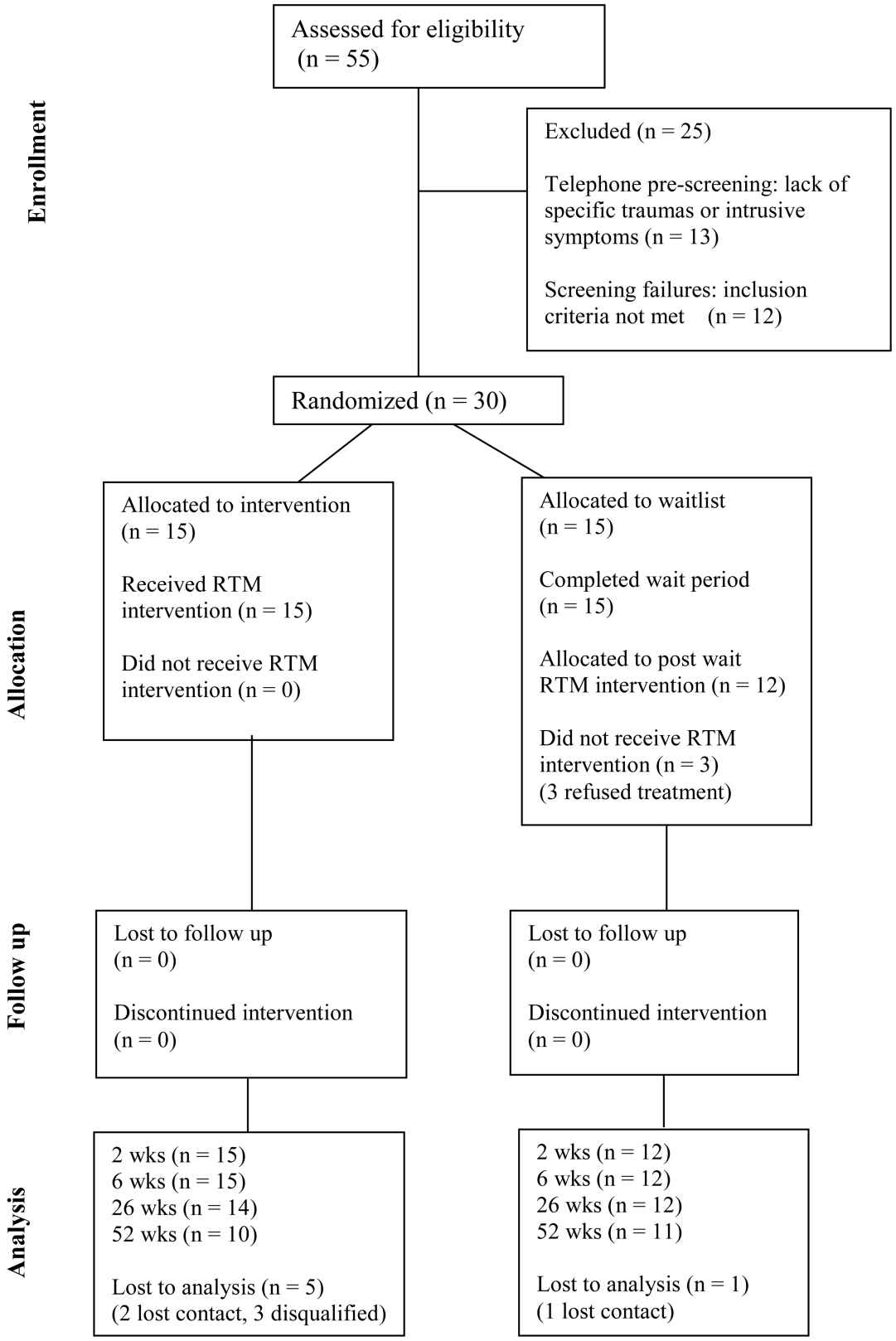

Figure 1. Participant flow chart following Consolidated Standards of Reporting Trials Guidelines.
Note: wks = weeks since completing treatment.

Psychometric scales

The PCL-M and the PSS-I were used as primary measures of symptoms at various study time points (Figure 1). Both scales are based upon the 17-point diagnostic criteria of the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM) and are used regularly by the military and the Department of Veterans Affairs to assess PTSD symptoms. The PSS-I is highly regarded and second only to the CAPS in its accuracy.[31,32] It is sufficiently accurate to be used as a primary diagnostic tool in the assessment of PTSD.[33,34] We have employed it, in lieu of the CAPS, as the primary diagnostic instrument. This was done in light of its ease of use and brief administration time. According to Blanchard and colleagues, PCL-M scores are highly consistent with CAPS scores ($r = 0.93$) and tend to produce consistent scores upon retest.[35] Military standard cut-offs for PTSD were used to infer whether PTSD symptoms remitted below levels that might warrant a clinical diagnosis (PCL-M $\geq$ 50; PSS-I $\geq$ 20).

Study design

A randomized, wait-list-controlled design was used to assess the efficacy of the RTM intervention (see Figure 1). Participants were admitted to the study in cohorts of 10 and then randomly assigned to treatment and control groups. For clarity of reporting, we refer to the study time points on an absolute timeline (weeks 1–16), and we also refer to certain follow-up time points, during which symptoms were evaluated, based on the number of weeks elapsed since the completion of the treatment period. Intake evaluations were performed for all participants on study week 1. The treatment group began treatment on week 2. Participants received three 120-minute treatment sessions separated by a minimum of 24 hours over the course of one to three weeks. During treatment, RTM was administered across a period of one to three weeks due to scheduling problems, the irregular flow of volunteers, and other time constraints. Post-treatment evaluation of RTM subjects was performed two weeks, six weeks, 26 weeks, and one year after treatment. Control participants also had intake assessments during week 1 and were then informed they would wait five weeks before receiving treatment. On study week 6, control participants were re-evaluated using the same symptom scales. Control participants were then offered the same intervention schedule (weeks 6–8), and their symptom scores were measured two weeks and six weeks after treatment. One individual from the original treatment group was not available for long-term follow-up.

Three prospective patients dropped out before treatment. Three others were either excluded from further participation due to new traumatizations after completing treatment or dropped out after having no response by six months post. Participants had no active contact with the research team between follow-up visits. All were referred back to their attending service providers (if any) or were allowed to continue with their normal schedules. All treatments and evaluations were performed in a private office suite dedicated to the study in a professional office complex in Vista, California, a suburban municipality in northern San Diego County. All assessments were provided by psychometricians blinded to the study condition from which the subjects were drawn.

Treatment fidelity

All screening and treatment sessions were video recorded on digital media for the assessment of treatment fidelity. Treatment fidelity was assessed periodically by three experts in the RTM protocol.

Data analysis

All analyses were conducted using SPSS, version 17. We examined study group differences in self-reported ancestries and traumatization contexts using Chi-square tests. Symptom scales were examined at each time point and for each treatment group to ensure approximately normal distribution. We examined group differences in pre-treatment symptom scores using one-way analyses of variance (ANOVA). The main analysis comparing the RTM group and wait-listed controls was performed using a repeated-measures ANOVA with type III sum of squares to examine the change in symptom scales for both groups from intake to week 6. Data that violated the assumption of sphericity were corrected for using the Greenhouse-Geisser correction. All data passed Levene's test for homogeneity of variance. Post-hoc tests were conducted with family-wise Bonferroni correction for multiple testing. Effect sizes were calculated as partial eta-squared (η^2_{partial}) for the repeated-measures ANOVA and Hedges' g for within-subject comparisons over time. All data are reported as mean $\pm$ standard deviation.

RESULTS

Using the PSS-I as the primary diagnostic instrument at intake and two-weeks post-treatment of both groups, we

Table 3. Treatment response to RTM intervention as PCL-M score at last measure

	Non-response *n* (%)	PCL-M < 50 *n* (%)	Loss of diagnosis *n* (%)	Full remission *n* (%)	Total effective treatments *n* (%)
Cases	3 (8.66)	0	4 (15)	19 (73)	
Loss of diagnosis			4 (15)	19 (73)	23/26 (88)

Note: non-response = PCL-M > 50 and all DSM criteria still met; PCL-M < 50 = total PCL-M < 50 but DSM criteria still met; Loss of DX = total PCL-M < 50 and DSM criteria no longer met; Full remission = Total PCL-M score < 30 and DSM criteria no longer met.

found that PSS-I intake measures for both groups met standard PSS-I criteria for a diagnosis of PTSD (PSS-I $\geq$ 20). The RTM group intake mean was 37.33 ($\pm$6.51), while the initial and post-wait baseline measures for wait-list subjects were 38.73 ($\pm$6.69) and 38.93 ($\pm$8.09), respectively. At two-weeks post-treatment, PSS-I scores were 9.7 ($\pm$8.05) for the RTM group and 5.9 ($\pm$6.69) for the post-wait-list controls. These scores indicate that, in terms of group means, all treated participants had scored below the diagnostic threshold. Using standard PCL-M values,[33,36] we found that 88% of RTM completers were symptom and diagnosis free at six months post (for an analysis, see Table 3).

The most significant result, for our purposes, is the wait-list comparison between the post-wait baseline and the treatment group's first post-treatment result. These measures were taken at approximately the same time for both groups. If the difference was found to be significant and meaningful, it would show that the passage of time alone could not explain the observed changes. This would support our major claim that the RTM is the main effector of change in this study. We found that the wait-list control's mean score on the PCL-M at the end of the wait period was 67.6 $\pm$ 8.9. When compared with the mean post-treatment score of the RTM group at two weeks post (29.9 $\pm$ 8.9), the difference was significant below the 0.001 level. Hedges g indicated that the intervention accounted for a 3.6 standard deviation decrease in scores ($g = 3.663$, 95% CI [6.013 $-$ 1.314]) when wait-listed controls at week 6 were compared to the RTM Group at two weeks post treatment. This suggests that the RTM intervention produced significant and meaningful change that could not be attributed to the passage of time alone.

Table 4 demonstrates the results from experimental control comparisons. Data include means and standard deviations for intake, the control post-wait intake, and two- and six-week post-treatment evaluations). As hypothesized, a one-way ANOVA showed that differences between intake scores for both groups and the post-wait intake for controls were non-significant; these groups did not differ before treatment. Experimental results at two weeks post were significantly better than intake ($p < 0.001$) as were comparisons between intake and follow-up at all time points ($p = 0.001$). As predicted, all improvements were maintained throughout the follow-up period.

Subsequent follow-ups reaching 97% of those treated at six months and 83% at one-year post-treatment found that treatment results remained consistent up to one year post. PCL-M scores remained consistent across all follow-up time points. Group means at each follow-up time point varied less than five points: a clinically meaningless difference.[6] A comparison of group scores between the four follow-up points for both RTM and post-wait-list groups (two weeks vs. six weeks, six weeks vs. 26 weeks, and 26 weeks vs. 52 weeks) were non-significant at the 0.05 level with one exception. The six-month to 12-month RTM comparison ($p = 0.01$) was affected by the loss of five subjects at the one-year follow-up. Three of those subjects had suffered relapse due to retraumatization or treatment failure, and two others could not be reached at the one-year follow-up. A further comparison of all follow-up scores with the initial intake scores found that client responses remained significant below the 0.001 level for all time points up to and including one-year post. This provides some support for our hypothesis that, unlike extinction-based interventions, RTM results would be maintained over time. The same kind and quality of effects were seen in PSS-I measures across groups and times.

Table 5 reports means, standard deviations, *t* values, and effect sizes with Bonferroni-corrected *p* values for within-group differences on both measures. In general, for each group, pre-post comparisons for all time periods were significant at the 0.001 level. Cumulative effect sizes, Hedges' g, combining post-treatment results for all treated subjects were 4.20, 3.63, 3.59, and 6.48 (at

Table 4. ANOVA analysis of symptom scale results across time and condition

		Mean scores ± SD (*n*)			
Week	Measure	RTM	Control	F	95% CI
Intake	PCL-M	64.9 ± 7.0 (15)*	68.0 ± 9.6 (15)	0.96	65.04–70.96
Post-wait-list intake	PCL-M		67.6 ± 8.9 (15)	0.83	
Two weeks post	PCL-M x group	29.9 ± 11.3†	67.6 ± 8.9 (15)	51.2	
	PCL-M x time		67.6 ± 8.9 (15)	89.1	
	PCL-M x interaction		67.6 ± 8.9 (15)	85.1	
		Mean scores ± SD (*n*)			
Week	Measure	PSS-I	Control	F	95% CI
Intake	PSS-I	37.3 ± 6.5 (15)*	38.7 ± 6.7 (15)	0.34	28.94–48.46
Post-wait-list intake	PSS-I	37.3 ± 6.5 (15)*	38.9 ± 8.1 (15)	0.36	
Two weeks post	PSS-I x group	9.7 ± 8.3 (15)†	38.9 ± 8.1 (15)	46.1	
	PSS-I x time		38.9 ± 8.1 (15)	80.7	
	PSS-I x interaction		38.9 ± 8.1 (15)	83.1	

Note: PCL-M = PTSD Checklist, military version; PCLM x Group = a between-group comparison of PCL-M scores; PCL-M x time = comparing intake scores against follow-up scores; PCL-M x interaction = the level to which time point and group affect one another in determining the observed PCL-M results; PSS-I = PTSD Symptom Scale, interview version; PSS-I x group = a between-group comparison of PSS-I scores; PSS-I x time = within group interactions comparing intake scores against follow-up scores; PSS-I x interaction = the level to which time point and group affect one another in determining the observed value of PSS-I scores; SD = standard deviation; CI = confidence interval.
* Non-significant, one-way ANOVA.
† $p < 0.001$, repeated measures ANOVA.

the two-, six-, 26-, and 52-week post-treatment evaluations) for PCL-M and at 2.61 for PSS-I measures at two weeks. These results represent significant effects of treatment and compare well against standard scores from mainline treatments. We note that the 83% response rate and the closely clustered responses at 52 weeks may explain the exaggerated effect size at that point. As RTM is believed to be based on reconsolidation rather than extinction, we expected that RTM would be more stable over time than other treatments such as PE and CPT, which are known to undergo some level of decay.[7–9] In agreement with this, the RTM group showed no significant differences in six-week and six-month post-treatment results ($t = 0.11$, uncorrected $p = 0.91$).

DISCUSSION

Previous research has suggested that RTM would produce clinically significant effects.[4] This was supported by mean symptom score reductions on both the PSS-I and PCL-M at all time points. Monson, Gradus and colleagues defined clinically significant change on the PCL-M as 20 points.[6] These results support reductions >30 points. Hedges' g is a conservative measure of effect size, typically used for small groups. It allows for intergroup comparisons based loosely on the number of standard scores by which varying results have changed. In this study, we report effect sizes ranging from 2.61 to 6.81 supporting very high effectiveness for this intervention (Table 5). These results are encouraging; however, further study with more diverse demographics are needed to see whether this large of an effect will generalize to all PTSD populations.

Importantly, this study is the first to provide quantitative evidence that long-term reductions in PTSD symptoms can be achieved in as few as three treatment sessions using interventions like RTM. Based upon previous reports suggesting that RTM would show long-term resilience,[4,5] symptom scores from this study were examined for deterioration in post-treatment analyses. As expected, RTM group results did not deteriorate in any significant manner between two weeks and one year (Table 5). Generally, most patients (22 out of 27 or 81%) showed a consistent reduction of PTSD symptoms below the clinical cut-point (PCL < 50) that was sustained until the six-month follow-up.

In more recent follow-up data, now extending to a full year, we find that treatment effects remain stable for a full year. As noted above, mean PCL-M scores varied by less than five points, an amount determined

Table 5. Within group analyses of PTSD symptom scores as compared to intake

		RTM group			Control group		
Group	PCL-M	mean ± SD (*n*)	*t*	Hedges' g	mean ± SD (*n*)	*t*	Hedges' g
Week							
intake		64.9 ± 7.0 (15)			68.0 ± 9.6 (15)		
Post-wait-list intake					67.6 ± 8.9 (15)		
Post-treatment results							
2 weeks post		29.9 ± 11.3 (15)*	10.47	3.62	25.2 ± 7.6 (12)*	12.49	4.77
6 weeks post		31.4 ± 15.0 (15)*	8.26	2.79	22.8 ± 6.5 (12)*	14.22	5.33
26 weeks post		31.1 ± 16.4 (15)*	8.21	2.61	21.8 ± 4.6 (12)*	14.62	8.83
52 weeks post		20.5 ± 5.01 (10)*	8.55	6.81	20.9 ± 3.9 (11)*	8.87	5.88
		RTM group			Control group		
Group	PSS-I	mean ± SD (*n*)	*t*	Hedges' g	mean ± SD (*n*)	*t*	Hedges' g
Week							
intake		37.3 ± 6.5 (15)			38.7 ± 6.7 (15)		
Post-wait-list intake					38.9 ± 8.1 (15)		
2 weeks post-treatment		9.7 ± 8.3 (15)*	10.33	3.59	25.2 ± 7.6 (15)*	11.54	4.00
Cumulative measures across both treatment groups							
		RTM group					
	PCLM	mean ± SD (*n*)	*t*	Hedges' g			
Intake		66.46 ± 8.27 (30)					
2 weeks post		27.81 ± 9.77 (30)†††		4.20			
6 weeks post		27.59 ± 12.29 (27)†††		3.63			
26 weeks post		26.85 ± 13.08 (26)†††		3.59			
52 weeks post		20.7 ± 4.24 (21)*		6.48			
		RTM group					
	PSSI	mean ± SD (*n*)	*t*	Hedges' g			
2 weeks post treatment		8.03 ± 7.6 (27)*		2.61			

Notes: The PSS-I was only administered at intake, post-wait intake, and two weeks post.
* Bonferroni-corrected $p < 0.001$.

to be non-significant for the PCL-M.[6] This datum aligns well with the work of Schiller[22] and Soeter and Kindt,[36] who have found the attenuation of fear in humans treated in the context of a reconsolidation paradigm will last up to one year. On a human level, we note that the large majority of those treated expressed a great deal of satisfaction with the results. Typically, there was a breakthrough, signalled by an "aha" moment when the trauma memory was described as subjectively more distanced and was spontaneously reappraised as something long past that had meaning within the context of their current life story. Eighty-one percent of clients reported complete cessation of nightmares and flashbacks related to the treated traumas. All could coherently retell the trauma memory without observable autonomic reactivity.

Variability in treatment response

Despite generally positive responses, there was variability in treatment response. One subject showed no reduction below threshold, while two others showed initial reductions at two weeks and a rebound by six weeks; one of these individuals again remitted by six months. One additional individual showed a response through six weeks, but their symptoms measured above threshold at six months. Upon video review, it was found that, for the one non-responsive client, the clinician did not follow the RTM protocol but used other techniques despite instructions to adhere to the written protocol. This result may be regarded as invalid regarding the RTM protocol. For two of the clients whose scores remitted after a relapse at six weeks, it is believed that the psychometrician at the six-week time point did

not appropriately frame her questions. As a result, the clients' responses to the PCL-M questions referred to both treated and untreated traumas and may have included their entire pre-treatment history. When the clinician was asked to review her notes for these cases, she indicated that at all time points both clients were free of nightmares and flashbacks regarding the treated events. For the final case, it is believed that the concurrent suicide of two of his team members either created new traumatic responses or re-installed some of the previously treated traumatic responses. We have nevertheless retained these results in our evaluations.

Despite these results, the RTM protocol may be effective for a relatively high proportion of individuals, compared with other modalities, as discussed above.[4,7–9,11,12,14] In addition, our sample included combat Veterans extending from Vietnam to the more recent conflicts in the Middle East and Afghanistan, suggesting it may be broadly applicable in military populations. It should be noted that our population was characterized by a high mean age (RTM group 45.9 ± 17.2; median $= 44$), reflecting the large numbers of participants from the Vietnam War era. While encouraging in terms of the treatment of long-term chronicity, it nevertheless limits the relevance of the present research in regard to recent war fighters. Future studies could examine the efficacy of the RTM intervention among younger, active duty warriors, female participants, and individuals whose PTSD is not related to military combat.

Identification of RTM with the reconsolidation mechanism

A final factor that may account for the enhanced efficacy and robust changes related to the RTM approach lies in its proposed mechanism of action. This has been discussed previously.[4,5] The identification of reconsolidation blockade as the probable mechanism underlying the RTM intervention[5] is based upon five observations: (1) the syntax of RTM[4,5] matches the syntax of reconsolidation[5,15–20]; (2) the results of the intervention tend to be long lasting or permanent[4,12,15,20,22,37,38] and, at this point, are not known to be characterized by clinical relapse as reflected in extinction memories (spontaneous recovery, contextual renewal, reinstatement, and rapid reacquisition;[24,37,39,40] (3) RTM uses an abbreviated reminder stimulus that is too short and lacking in intensity to support extinction;[5,18,41–45] (4) the speed of the intervention is incompatible with the creation of extinction memories;[4,5,24,43] and (5) the initiation of labilization requires a novel presentation of the fear stimulus rather than a repeated or extended exposure.[12,18,25,40,41] That novelty may include non-reinforcement,[15,44,46] changes in duration of re-exposure,[41] the presentation of safety information,[38] or simply retelling the trauma narrative in a clinical setting.[15] RTM introduces multiple levels of novelty.[5]

Limitations of the study

The current study is limited by several factors. These include the nature of the sample, the size of the sample, and the diversity of the sample. It is further limited by its focus on male-only Veterans and its targeting of a specific subpopulation of PTSD afflicted Veterans. Finally, we must consider that this was a wait-list control study without an active comparison treatment. The sampling technique was largely a combination of referrals and word-of-mouth recruitment, resulting in a non-random distribution of Veterans that may limit the external validity of the results. The fact that many of the referrals came through recommendations of others who had had good results from the study was also problematic. Future studies would ideally draw from larger and more varied volunteer populations such as those available to VA researchers.

With respect to the size of the sample, were it not for the size of the effects measured and their stability over time, the small sample would make further generalization difficult. Nevertheless, in this test of the protocol, there are effect sizes that suggest that these results compare well against the results of other treatments. Recalling the analyses of Steenkamp and colleagues[9] and Bisson and colleagues,[7] our results suggest that, despite experimental deficits, RTM compares well against the front-line treatments offered by the VA. This will only be born out with further experimental review.

While the sample is fairly diverse, it is notable for its lack of female participants. In light of the growing combat presence of female warriors, this is a significant omission. This will be addressed in other studies. As noted, the study focused on a target population that may account for only between 50% and 75% of the military PTSD universe and, thus, has limited generalizability.[47,48] Its targeting, however, is based upon clinical experience with older variants of the model that suggest that the intervention will not work for the excluded types.[5] Earlier we noted that the sample was significantly skewed toward an older patient population. To assess its value for current warriors and recent Veterans, a group of younger or more diverse ages must be sampled. Further studies with access to larger pools of Veterans will

be able to test RTM's generalizability beyond our target group. Further studies should also be designed to further clarify the boundaries of the larger subpopulation that this intervention appears to serve.

The wait-list control presents a further imitation of the study. Such comparisons indicate, basically, that our results are better than nothing. Nevertheless, observed effect sizes (greater than two standard measures), symptom reductions (>30 points), loss of diagnosis (for more than 80% of those treated), and the maintenance of treatment gains over at least one year demonstrate the value of this intervention compared to other interventions that have also been investigated using similar wait-list controls for more main-line treatments.[7–9,23,49] We acknowledge that an active comparison condition would provide more generalizable results and a more valid comparison for RTM. We note, however, that the agencies who have helped by referring clients have a great deal of difficulty finding volunteers for placebo, possibly less effective or more noxious comparison, conditions. It is with these limitations in mind that we chose the wait-list design. We invite other researchers to create the required comparison trials. Insofar as the current association between RTM and the blockade of reconsolidation of the trauma memory is currently inferred based upon the elements described above. There are some obvious, but logical, means of testing the purported relationship. We invite other researchers to test the identification.

CONCLUSIONS

We have illustrated in this study that the RTM protocol has the potential to eliminate PTSD diagnoses in upwards of 80% of those treated, with changes being maintained by follow-up testing at six weeks, six months, and one year. Considering these results and one other study discussed above, we suggest that the RTM protocol may be a viable treatment modality for PTSD-related symptoms in a military population challenged by high levels of intrusive symptoms. Due in part to its roots in the treatment of phobic reactions and a 30-year history of clinical use,[5] it is hypothesized that the RTM intervention will work especially well for individuals with significant levels of intrusive symptoms. Nevertheless, the current study has significant limitations that must be addressed to substantiate any such claims. We look forward to other studies with larger sample sizes, more diverse populations, clients that are less averse to standard treatments, and other refinements to further test these observations.

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COMPETING INTERESTS

None declared.

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Daniel Tylee, Richard Gray, and Frank Bourke helped select the research questions and data set, analyzed the results, and drafted the manuscript. Richard Gray conducted the literature search. Daniel Tylee analyzed the results and edited and revised the manuscript. All authors edited and revised the manuscript; all approved the final version submitted for publication.

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