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

ABSTRACT

Introduction: Reconsolidation of Traumatic Memories (RTM) is a cognitive intervention for 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 waitlist 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 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 6-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 DSM diagnosis for PTSD: 15 % 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. 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

INTRODUCTION

Among the ~2.5 million service personnel who have served in recent West Asian and Near Eastern theaters [1], between 13% and 17% of those veterans suffer from PTSD [2,3]. Together, these studies suggest that 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 [4], 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 frontline behavioral interventions are employed by the Department of Veterans Affairs for the treatment of PTSD including: Prolonged Exposure (PE), Cognitive Processing Therapy (CPT), and Eye Movement Desensitization and Reprocessing (EMDR). There is considerable evidence for their efficacy. That evidence is generally framed in terms of clinically significant symptom reduction (10-20 points on the PCL-M [6]) and clearance of diagnosis as measured by various PTSD inventories (CAPS, PSS-I, and PCL-M [7,8,9]). 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% [7-9,10]. This has led to calls for the development of new approaches to the treatment of PTSD [7-9,11-14].

The Reconsolidation of Traumatic Memories (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 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 Behavioral Therapies (TFCBTs) 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]. The intervention is not appropriate for the treatment of the dissociative subtype of PTSD [4,5,25,26].

*Studies of RTM efficacy***.**

A pre-pilot study of the intervention was completed in October 2014 by Gray & Bourke [4] with 96% of those treated no longer meeting psychometric scale cutoff criteria for PTSD (see table 1 for analysis). At six-weeks post, after a mean reduction of 33 points, the mean PCL-M score was 28.8. Hedges' g for 6-week follow-up showed a 2.9 SD 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 6 months among volunteers in immediate treatment, untreated waitlist and post-waitlist 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 [15,19,27] and have been observed in humans [17,19,22,28-32]. Previous work has suggested that 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. In contradistinction to earlier investigations, where participants received as many as 5 sessions of RTM, experience has shown that only three

sessions are necessary for most patients. Here, treatments consisted of only 3 sessions but the treatments are 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.

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. 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 theater in which the pre-trauma bookend is displayed in black and white on the screen.
7. The client is instructed in how to find a seat in the theater, 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 which 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 ≤ 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 practiced, 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.

Table note. Table is reproduced from Gray, R., Budden-Potts, D., & Bourke, F. (2016). The Reconsolidation of Traumatic Protocol (RTM) for the treatment of PTSD: A randomized waitlist study of 30 female veterans. Submitted manuscript. It is used with the permission of the authors.

Participants

Male US veterans were recruited from Veterans' groups and Mental Health Service providers in San Diego County, CA. Volunteers were recruited using referrals and word-of-mouth, resulting in a non-random distribution of veterans. Sample demographics are presented in Table 2.

Table 2. Demographic features of the study sample.

Datum		**RTM**	**Control**	**Test Statistic**	**DF**	***p*-value**
Age						
		49.00 ± 19.47	42.66 ± 15.90	$t = 0.97$	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 OEF	2	1			
	War OIF	4	8			
	War-Kuwait	0	1			

	War Viet Nam	6	2			
# of events						
		2.73 ± 0.961	2.46 ± 0.639			
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-squared test with Yates' continuity correction

[b] Pearson's Chi-squared test.

The distribution of participants across ethnic groups, branches of services, and trauma context as well as mean age are reported in table 2. None of these factors had a significant impact upon the results of the study.

Of fifty-five referrals, 13 were ineligible at pre-screening; 30 of the remaining 42 met inclusion criteria. These subjects were randomized to treatment and control conditions. All fifteen 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 thirty subjects who completed treatment 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. All those admitted to the program reported current month flashbacks and nightmares and were highly reactive to stimuli related to the target trauma.

Inclusion and Exclusion Criteria

Inclusion criteria: PCL-M $\geq$ 50, PSS-I $\geq$ 20; 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 $200. Reimbursements were disbursed on a per visit basis.

Exclusion criteria: 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 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, therefor, 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 (NEIRB). All personal identifying and Health Insurance Portability and Accountability Act (HIPAA)–sensitive information was held in strict confidence. The protocol and all aspects of participation were reviewed with participants and signed informed consents were obtained from each. 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 or for emergency treatment. No need for such emergency treatment arose.

Psychometric Scales

The PTSD Checklist Military version (PCL-M) and PTSD Symptom Scale Interview (PSS-I) were used as primary measures of symptoms at various study time points. Both scales are based upon the 17-point DSM IV diagnostic criteria and are regularly used by the military and the VA to assess PTSD symptoms.

The PSS-I is highly regarded and second only to the CAPS in its accuracy [33, 34]. It is sufficiently accurate to be used as a primary diagnostic tool in the assessment of PTSD 33,35, 36(Foa, Riggs, Dancu, & Rothbaum, 1993; VA, 2014; Weathers & Ford, 1996). 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 [37], PCL-M scores are highly consistent with CAPS scores (r=.93) and tend to produce consistent scores upon retest. 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, waitlist-controlled design was used to assess the efficacy of the RTM intervention. Participants were admitted to the study in cohorts of ten 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 through 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 assessment during week 1 and were then informed they would wait 5 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 (study weeks 6 through 8) and their symptom scores measured at 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 assessment of treatment fidelity. Treatment fidelity was assessed periodically by three experts in the RTM protocol.

Data Analysis

All analyses were conducted using SPSS v.17. We examined study group differences in self-reported ancestries and traumatization contexts using chi-squared 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 ANOVAs. The main analysis comparing the RTM group and waitlisted 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 ($\eta^2_{partial}$) for the repeated-measures ANOVA and Hedges' g for within-subject comparisons over time. All data are reported as mean ± standard deviation.

RESULTS

Using the PSS-I as the primary diagnostic instrument at intake and two-weeks post-treatment for both groups, we found that PSS-I intake measures for both groups met standard PSS-I criteria for a diagnosis of PTSD (PSS- I ≥ 20). The RTM group intake mean was 37.33 (± 6.51) while the initial and post wait baseline measures for wait-list subjects were 38.73 (± 6.69) and 38.93 (± 8.09), respectively. At two-weeks post-treatment, PSS-I scores were 9.7 (± 8.05) for the RTM group and 5.9 (± 6.69) for the post waitlist controls. These scores indicate that, in terms of group means, all treated participants had scored below diagnostic threshold.

Using standard PCL-M values [38,35] we found that 88% of RTM completers were symptom and diagnosis free at 6- months post (for analysis see Table 3).

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

	Non-response n (%)	PCL-M <50 n (%)	Loss of Dx n (%)	Full remission n (%).	Total effective treatments n (%)
Cases	3 (8.66%)	0	4 (15%)	19 (73%)	

Loss of Dx		4 (15%)	19 (73%)	23/26 (88%)

Dx=Diagnosis; 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.

The most significant result, for our purposes, is the waitlist comparison between the post wait baseline as compared to the treatment group's first post treatment result. These measures were taken at approximately the same time for both groups. If the difference were 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 waiting list control's mean score on the PCL-M at the end of the wait period was 67.6 ± 8.9, differing in a nonsignificant manner from the initial mean PCL-M score at intake ($p = 0.40$). When compared with the mean post-treatment score of the RTM group at two weeks post (29.9 ± 8.9) the difference was found to be significant below the .001 level. Hedges g (3.663, 95% ci [6.013, -1.314]. indicated that the intervention accounted for a 3.5 standard deviation decrease in scores for intake. This suggests that the RTM intervention produced significant and meaningful change that could not be attributed to the passage of time alone.

Table 4. reports 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 2- 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 to one year post. PCL-M scores remained consistent across all follow up time points (Denise Budden-Potts, personal communication, February 2017). Group means at each follow-up time-point varied less than 5 points: a clinically meaningless difference [6]. A comparison of group scores between the four follow-up points for both RTM and Post waiting list groups (2weeks v. 6 weeks, six weeks v. 26 weeks, and 26 weeks v. 52 weeks) were non-significant at the 0.05 level with one exception. The 6 month to 12-month RTM comparison ($p=0.01$) was affected by the loss of 5 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 4. ANOVA Analysis of Symptom Scale Results Across Time and Condition

Week	Measure	Mean scores ±SD (n)		F	95% CI
		RTM	Control		
Intake	PCL-M	64.9 ± 7.0 (15) *	68.0 ± 9.6 (15)	0.96	65.04 - 70.96

Post wait intake	PCL-M		67.6 ± 8.9 (15)	0.83	
2 weeks post	PCL-M	29.9 ± 11.3 †††	67.6 ± 8.9 (15)	51.2	
	x Group				
	PCL-M		67.6 ± 8.9 (15)	89.1	
	x Time				
	PCL-M		67.6 ± 8.9 (15)	85.1	
	x Interaction				
Week	Measure	Mean scores ±SD (n)		F	95% CI
		PSS-I	Control		
Intake	PSS-I	37.3 ± 6.5 (15) *	38.7 ± 6.7 (15)	0.34	28.94 - 48.46
Post wait intake	PSS-I	37.3 ± 6.5 (15) *	38.9 ± 8.1 (15)	0.36	
2 weeks' post	PSS-I	9.7 ± 8.3 (15) †††	38.9 ± 8.1 (15)	46.1	
	X Group				
	PSS-I		38.9 ± 8.1 (15)	80.7	
	X Time				
	PSS-I		38.9 ± 8.1 (15)	83.1	
	X Interaction				

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 PSS-I scores; SD = Standard Deviation; CI = Confidence Interval.

*Non-significant, One Way ANOVA

††† $p < 0.001$, Repeated Measures ANOVA

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 and 3.59 (at

the 2-, 6-, and 26-week post treatment evaluations) for PCL-M, and at 2.61 for PSSI-Measures at 2 weeks. These results represent significant effects of treatment and compare well against standard scores from mainline treatments.

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

Group	**PCL-M**	**RTM Group**			**Control Group**		
		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 Intake					67.6 ± 8.9 (15)		
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
Group	**PSS-I**	**RTM Group**			**Control Group**		
		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 Intake					38.9 ± 8.1 (15)		
2 weeks post		9.7 ± 8.3 (15) †††	10.33	3.59	25.2 ± 7.6 (15) †††	11.54	4.00

Cumulative Measures across both treatment groups

	PCLM	**Hedges' g**
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
	PSSI	**Hedges' g**
2 weeks post	8.03 ± 7.6 (27) †††	2.61

Table 4. Notes: The PSS-I was only administered at intake, post wait intake, and two-weeks post.

††† Bonferroni-corrected p < 0.001

As RTM is believed to be based on reconsolidation rather than extinction, we predicted that our results would be more stable over time than other treatments such as PE and CPT which are known to undergo decay[7,8,9]. In agreement with this, the RTM group showed no significant differences in 6-week and 6-month post-treatment results ($t = 0.11$, uncorrected $p = 0.91$).

DISCUSSION

We predicted that RTM would produce clinically significant effects. This was supported by mean symptom score reductions on both the PSS-I and PCL-M at all time points. Monson Gradus et al. [6] defined clinically significant change on the PCL-M as 20 points. Our 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. Here we report effect sizes ranging from 2.79 to 5.33 supporting very high effectiveness for this intervention (Table 4.). 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 that indicate the long-term resilience of the effects of RTM [4,5], we predicted that scores would not deteriorate in post treatment analyses. This was supported by the finding that the RTM group results did not differ significantly between 2 weeks and 6 months (Table 3). This suggests that RTM may provide a viable

alternative to some of the current frontline therapies for PTSD which appear to be subject to significant recurrence of symptoms over relatively brief time periods [6,9]. Generally, most patients (twenty-two out of 27 or 81%) showed a consistent reduction of PTSD symptoms below the clinical cut-point (PCL< 50) that was sustained until the 6-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 less than 5 points, an amount determined to be non-significant for the PCL-M [6]. This datum aligns well with the work of Schiller[22] and Soeter and Kindt [38], who have found the attenuation of fear in humans treated in the context of a reconsolidation paradigm to 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, signaled 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. 81% 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

Interestingly, as expected with a variable population, there was variability in treatment response. One subject showed no reduction below threshold, while two others showed initial reductions at two-weeks and rebound by six-weeks; one of these individuals again remitted by 6 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, those whose scores remitted after a relapse at six weeks, it is believed that the psychometrician did not appropriately frame her questions so that the PCL-M only focused upon the treated traumas. As a result, the clients' responses to the PCL-M questions referred to both treated and untreated traumas and may have included their entire pretreatment 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[4,7,8,9,11,12,14], as discussed above. Additionally, 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. Future studies could examine the efficacy of the RTM intervention among active duty soldiers, female participants, and individuals whose PTSD is not related to military combat.

Accessibility and Cost Effectiveness

Clinicians can be trained to effectively administer the protocol in as little as a week. In light of this, RTM offers the possibility of fast deployment at minimal cost. While the behavioral steps are well detailed, the successful administration of the procedure requires training in its administration, especially the observation, calibration, and recording of physiological reactivity.

The nature of the treatment supports patient compliance; its brief nature and short training regimen means that the intervention can help reduce the costs of treatment for active warriors and veterans who suffer from PTSD. These changes can lead to reduced costs to the medical systems, the VA, and faster return to duty for traumatized warriors [5,19].

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 [4,12,15,20,22,39,40], 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 [24,39,41,42,24]; 3. RTM uses an abbreviated reminder stimulus that is too short and lacking in intensity to support extinction [5,18,43-47]; 4. The speed of the intervention is incompatible with the creation of extinction memories [4,5,24,45]; 5. The initiation of labilization requires a novel presentation of the fear stimulus rather than a repeated or extended exposure [12,18,27,42,43]. That novelty may include non-reinforcement [15,46,48], changes in duration of re-exposure [43], the presentation of safety information [40], 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 waiting 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 which 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 is also problematic. Future studies would ideally draw from larger and more varied volunteer populations such as those available to VA researchers.

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, Litz et al. [9], Bisson, Roberts and colleagues [7], despite experimental deficits, our results suggest that RTM compares well against the frontline 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. This will be addressed in other studies. As noted, although the study focused on a target population, and thus has limited generalizability to PTSD more generally, its targeting is based upon clinical experience with older variants of the model that suggest that the intervention will not work for the excluded types [5]. We believe that it is not unimportant that the intervention potentially applies to 50-75% of all afflicted by the disorder [25,26]. Further experiments with access to larger pools of veterans will be able to test RTM's generalizability beyond our target group and in the

process further clarify the boundaries of the larger subpopulation which this intervention appears to serve.

A further limitation is the waiting list control. 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 maintenance of treatment gains over at least six months, argue for its value as compared to interventions using similar waiting-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 waiting 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 here illustrated that the RTM protocol can eliminate PTSD diagnoses in upwards of 80% of those treated. Those changes have been maintained by follow-up testing at 6 weeks, six months and one year. Considering these results ~~and one~~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 but will remain inappropriate to the dissociative subtype. We look forward to other studies with larger sample sizes, more diverse populations, and clients less averse to standard treatments

ACKNOWLEDGMENTS

Denise Budden-Potts, PhD. provided most the treatments for this study and worked tirelessly to find recruiting sources. Joseph Potts assisted in recruitment and the collection and organization of data.

Funding: This work was supported by a contribution from the Blue Angels Foundation Fund.

References

1 Bilmes L. The Financial Legacy of Iraq and Afghanistan: …. RWP13-006. Cambridge: *Harvard Kennedy Business School*; 2013.

2 Kok BC, Herrell RK, Thomas JL., Hoge, C.W. Posttraumatic stress disorder associated with combat service in Iraq or Afghanistan: reconciling prevalence differences between studies. *J Nerv Ment Dis*. 2012 200(5), 444-450. doi: 10.1097/NMD.0b013e3182532312

3 Tanielian T, Jaycox L. Eds. *Invisible Wounds of War: Psychological and Cognitive Injuries, Their Consequences, and Services to Assist Recovery*. Santa Monica, CA: RAND Corporation; 2008.

4 Gray R, Bourke F. Remediation of intrusive symptoms of PTSD in fewer than five sessions: A 30- person pre-pilot study of the RTM Protocol. *J Mil Vet Fam Health.* 2015 1(2), 85-92. doi:10.3138/jmvfh.3119

5 Gray R, Liotta R. PTSD: Extinction, Reconsolidation and the Visual-Kinesthetic Dissociation Protocol. T*raumatology*. 2012 June;18(2):3-16.

6 Monson C, Gradus J, Young-Xu Y, et al. Change in posttraumatic stress disorder symptoms: Do clinicians and patients agree? *Psychol Assess*.2008 Jun;20(2):131-8.

7 Bisson JI, Roberts NP, Andrew M, Cooper R, Lewis C. Psychological therapies for chronic post-traumatic stress disorder (PTSD) in adults. *Cochrane Database Syst Rev.* 2013 (12). DOI: 10.1002/14651858.CD003388.pub4

8 Steenkamp MM. Litz BT. Psychotherapy for military-related posttraumatic stress disorder: Review of the evidence. *Clin Psychol Rev*. 2013 Feb;33(1):45-53.

9 Steenkamp MM, Litz BT, Hoge CW, Marmar CR. Psychotherapy for Military-Related PTSD: A Review of Randomized Clinical Trials. *JAMA. 2015;*314(5), 489-500. doi: 10.1001/jama.2015.8370

10 Halvorsen JØ, Stenmark H, Neuner F, Nordahl HM. (2014). Does dissociation moderate treatment outcomes of narrative exposure therapy for PTSD? A secondary analysis from a randomized controlled clinical trial. *Behav Res Therapy. 2014 57*, 21-28. doi: http://dx.doi.org/10.1016/j.brat.2014.03.010

11 Barrera TL, Mott JM, Hofstein RF, Teng EJ. A meta-analytic review of exposure in group cognitive behavioral therapy for posttraumatic stress disorder. *Clin Psychol Rev.* 2013, 33(1):24-32. doi: http://dx.doi.org/10.1016/j.cpr.2012.09.005

12 Fernández R, Bavassi L, Forcato C, Pedreira M. The dynamic nature of the reconsolidation process and its boundary conditions: Evidence based on human tests. *Neurobiol Learn Mem. 2016 (130)*, 202-212. doi: http://dx.doi.org/10.1016/j.nlm.2016.03.001

13 Goetter EM, Bui E, Ojserkis RA, et al. A systematic review of dropout from psychotherapy for posttraumatic stress disorder among Iraq and Afghanistan combat veterans. *J Trauma Stress. 2015 28*(5), 401-409. doi: 10.1002/jts.22038

14 Goodson J, Helstrom A, Halpern JM, et al. The treatment of posttraumatic stress disorder in U.S. combat veterans: A meta-analytic review. *Psychol. Rep. 2011 109*(2), 573-599. doi: 10.2466/02.09.15.16.PR0.109.5.573-599.

15 Agren T. Human reconsolidation: A reactivation and update. *Brain Res Bull*. 2014 Jun; 105:70-82.

16 Forcato C, Burgos VL, Argibay PF, et al. Reconsolidation of declarative memory in humans. *Learn. & Mem.* 2007 14(4), 295-303.

17 Kindt M, Soeter M, Vervliet B. Beyond extinction: erasing human fear responses and preventing the return of fear. *Nature Neuroscience*. 2009 12(3), 256-258. doi: 10.1038/nn.2271

18 Lee JL. Reconsolidation: maintaining memory relevance. *Trends Neurosci*. 2009 July; 32(8):413-420.

19 Schiller D, Phelps E. Does reconsolidation occur in humans? *Front Behav Neurosci*. 2011 May; 5(24):1-24.

20 Schiller D, Kanen JW, LeDoux JE, et al. (2013). Extinction during reconsolidation of threat memory diminishes prefrontal cortex involvement. *PNAS*. 2013 doi: 10.1073/pnas.1320322110

21 Nader K, Schafe GE, Le Doux JE. Fear memories require protein synthesis in the amygdala for reconsolidation after retrieval. *Nature*. 2000 Aug 17;406(6797):722-6.

22 Schiller D, Monfils MH, Raio CM, et al. Does reconsolidation occur in humans? *Nature*. 2010 Jan 7;463(7277):49-53. doi: 10.1038/nature08637. Epub 2009 Dec 9.

23 Foa EB, Meadows E. Psychosocial treatments for posttraumatic stress disorder: A critical review. *Annu Rev Psychol*. 1997 48, 449-480.

24 Kredlow M, Unger L, Otto M. Harnessing reconsolidation to weaken fear and appetitive memories: A meta-analysis of post-retrieval extinction effects. *Psychol. Bul. 2016 142*(3), 314-336. doi: 10.1037/bul0000034

25 Lanius RA, Vermetten E, Loewenstein RJ, et al. Emotion modulation in PTSD: Clinical and neurobiological evidence for a dissociative subtype. *Am J Psychiatry. 2010 167*(6), 640-647. doi: 10.1176/appi.ajp.2009.09081168

26 Wolf EJ. The Dissociative Subtype of PTSD: Rationale, Evidence, and Future Directions. *PTSD Research Quarterly. 2013;24*(4), p. 1.

27 Pedreira ME, Perez-Cuesta LM, Maldonado H. Mismatch Between What Is Expected and What Actually Occurs Triggers Memory Reconsolidation or Extinction. *Learn Mem.* 2004 Sep-Oct;11(5):579-85.

28 Meir Drexler, S., et al., Effects of postretrieval-extinction learning on return of contextually controlled cued fear. *Behav Neurosci*, 2014;128(4): p. 474-81.

29 Forcato C, Rodríguez MLC, Pedreira ME. Repeated Labilization-Reconsolidation Processes Strengthen Declarative Memory in Humans. *PLoS ONE*. 2011;6(8), e23305.

30 Forcato C, Fernandez RS, Pedreira ME. Strengthening a consolidated memory: the key role of the reconsolidation process. *J Physiol*, Paris. 2014 Sep-Dec;108(4-6):323-33. PubMed PMID: 25218188. Epub 2014/09/15. eng.

31 Kindt M, van Emmerik A. New avenues for treating emotional memory disorders: towards a reconsolidation intervention for posttraumatic stress disorder. *Ther Adv Psychopharmacol.* 2016; May 1, 2016. DOI: 10.1177/2045125316644541

32 Soeter M, Kindt M. An Abrupt Transformation of Phobic Behavior After a Post-Retrieval Amnesic Agent. *Biol Psychiatry.2016;78*(12), 880-886. doi: 10.1016/j.biopsych.2015.04.006

33 Foa EB, Riggs D, Dancu C, Rothbaum B. Reliability and validity of a brief instrument for assessing post-traumatic stress disorder. *J Trauma Stress*. 1993;6, 459-473.

34 Foa EB, Tolin DF. Comparison of the PTSD Symptom Scale-Interview Version and the Clinician-Administered PTSD Scale. *J Trauma Stress. 2000;*13: 181-191.

35 VA National Center for PTSD. Using the PTSD Checklist for DSM-IV (PCL) [Internet]. 2014 Jan. Washington, DC: US. Department of Veterans Affairs. http://www.ptsd.va.gov/professional/pages/assessments/assessment-pdf/PCL-handout.pdf Published January. 2014. Updated March 2016. Accessed July 4, 2016.

36 Weathers F, Ford J. Psychometric properties of the PTSD checklist (PCL-C, PCL-S, PCL-M, PCLPR). In: Stamm B.H, ed. *Measurement of stress, trauma, and adaptation*. Lutherville, MD: Sidran Press; 1996.

37 Blanchard EB, Jones-Alexander J, Buckley TC, Forneris CA. Psychometric properties of the PTSD Checklist (PCL). *Behav Res Ther*. 1996;34, 669–673.

38 Soeter, M, Kindt M. "An Abrupt Transformation of Phobic Behavior After a Post-Retrieval Amnesic Agent." Biol Psychiatry. 2015; 78(12): 880-886.

39 Björkstrand J, Agren T, Frick A, et al. Disruption of Memory Reconsolidation Erases a Fear Memory Trace in the Human Amygdala: An 18-Month Follow-Up. *PLoS ONE. 2015;10*(7), e0129393. doi: 10.1371/journal.pone.0129393

40 Clem R, Schiller D. New Learning and Unlearning: Strangers or Accomplices in Threat Memory Attenuation? *Trends Neurosci. 2016;39*(5), 340-351. doi: http://dx.doi.org/10.1016/j.tins.2016.03.003

41 Bouton ME. Context and behavioral processes in extinction. *Learn Mem.* 2004 Sept;11(5):485-941

42 Kindt M, Soeter M. Reconsolidation in a human fear conditioning study: A test of extinction as updating mechanism. *Biol Psychol*. 2013 Jan;92(1):43-50.

43 Almeida-Correa S, Amaral OB. Memory labilization in reconsolidation and extinction--evidence for a common plasticity system? *J Physiol. Paris*. 2014 Sep-Dec;108(4-6):292-306. PubMed PMID: 25173958. Epub 2014/09/01. eng.

44 Merlo E, Milton A, Goozée Z, et al. Reconsolidation and Extinction Are Dissociable and Mutually Exclusive Processes: Behavioral and Molecular Evidence. J *Neurosci. 2014;34*(7), 2422-2431. doi: 10.1523/jneurosci.4001-13.2014

45 Nader K. Memory traces unbound. *Trends Neurosci. 2003; 26:65*–72.

46 Perez-Cuesta L, Maldonado H. Memory reconsolidation and extinction in the crab: mutual exclusion or coexistence? *Learn Mem. 2009;16*(11), 714-721. doi: 10.1101/lm.1544609

47 Suzuki A, Josselyn SA, Frankland PW, et al. Memory reconsolidation and extinction have distinct temporal and biochemical signatures. *J Neurosci*. 2004;24(20), 4787-4795. doi: 10.1523/jneurosci.5491-03.2004

48 Schwabe L, Nader K, Pruessner JC. Reconsolidation of human memory: brain mechanisms and clinical relevance. *Biol Psychiatry. 2014;76*(4), 274-280. doi: 10.1016/j.biopsych.2014.03.008

49 Devilly GJ, McFarlane AC. When wait lists are not feasible, nothing is a thing that does not need to be done. *J Consult Clin Psychol*. 2009 Dec;77(6):1159-68.