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Forgetting Trauma: Socially Shared Retrieval-induced Forgetting and Post-traumatic Stress Disorder

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Summary: Memory for related but unpracticed aspects of an event can be impaired by selectively retrieving parts of the same event. This occurs when selective retrieval [within-individual retrieval-induced forgetting (WI-RIF)] is undertaken by individuals and has been extended to social contexts—RIF can be produced in listeners [socially shared retrieval-induced forgetting (SS-RIF)] by a speaker's selective recounting. The effects of post-traumatic stress disorder (PTSD) on WI-RIF and SS-RIF were examined by two experiments. In Experiment 1, combat veterans (with or without PTSD) and non-veteran dyads participated in a RIF paired-associates paradigm adapted for combat-related stimuli. WI-RIF and SS-RIF occurred for combat-related and neutral pairs regardless of group. However, greater WI-RIF and SS-RIF for combat-related words were shown by individuals with PTSD. These findings were replicated by Experiment 2, in which either a combat-related or neutral story was learned by participants, and selective retrieval was embedded in a conversation. That the selective retrieval of trauma-related stimuli leads to enhancement of induced forgetting for individuals with PTSD under certain conditions is suggested by these data. Copyright © 2011 John Wiley & Sons, Ltd.

Researchers have used a range of cognitive tasks to explore the role executive control and inhibition plays in the memory problems observed with post-traumatic stress disorder (PTSD) and other anxiety disorders (see Mathews & MacLeod, 1994; McNally, 2006 for reviews). Findings suggest that individuals with PTSD have difficulty on tasks involving inhibition (for reviews, see McNally, 1998; 2006). For example, McNally and colleagues have shown that individuals with PTSD do not exhibit the standard pattern of forgetting and remembering in the directed forgetting paradigm (McNally, Kaspi, Riemann, & Zeitlin, 1990; McNally, Metzger, Lasko, Clancy, & Pitman, 1998; also Cloitre, 1998; but see DePrince & Freyd, 2001; 2004 as well as the reply by McNally, 2007). In addition, individuals with PTSD demonstrate difficulties inhibiting trauma-related stimuli on the emotional Stroop task (Cassiday, McNally, & Zeitlin, 1992; Foa, Feske, Murdock Kozak, & McCarthy, 1991; McNally et al., 1990).

We explore here another task that may bear on the issue of executive control and inhibition with PTSD, that is, the retrieval-induced forgetting paradigm (RIF; Anderson, Bjork & Bjork, 1994). In this paradigm, the participants first study category–exemplar paired associates with a category label serving as a subsequent retrieval cue. The pairs are constructed so that several pairs have the same category cue. The participants might study the pairs *Fruit–Orange*, *Fruit–Apple*, *Bird–Robin*, and *Bird–Swallow*. A second phase of the experiment involves selective retrieval practice. The participants might be shown the probe *Fruit–Ap___* and be asked to complete it with the studied word. They receive some practice on some exemplars from the categories but none from others. In the final test phase of the experiment, the participants are supplied with the category labels and asked to recall the studied exemplars.

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This experimental design creates three conditions: Rp+ (for Retrieval Practice), in which the participants are tested on pairs they have practiced (*Fruit–Apple*); Rp−, in which the participants are tested on the unpracticed pairs involving the practiced category (*Fruit–Orange*); and Nrp (for No Retrieval Practice), in which the participants are tested on pairs categorically unrelated to Rp pairs and which did not appear in the practice trial. RIF occurs when Nrp > Rp−. RIF is not merely a failure to rehearse information, inasmuch as the rate of forgetting of unpracticed material is not uniform. Rather, its telltale pattern suggests that selective retrieval will induce forgetting of unretrieved but related information.

The RIF paradigm is interesting to those who want to examine executive control and inhibition with PTSD because the induced forgetting produced by the selective practice is often attributed to inhibition (Anderson, 2005; but see Dodd, Castel, & Roberts, 2006; Williams & Zacks, 2001 for alternative accounts). As people try to complete the stem *Fruit–Ap___*, they inhibit competing responses, such as *orange*. Critically, similar competition and subsequent inhibition does not occur for the unrelated, unpracticed items. As the inhibition continues into the final recall phase, the participants will consequently experience more difficulty recalling the related unpracticed items than the unrelated unpracticed items.

The critical role that inhibition plays in RIF suggests that RIF might not be present with PTSD, especially when trauma-related material is involved. Two studies support this conjecture. Amir, Coles, Brigidi, and Foa (2001) found RIF in social phobics for positive and neutral stimuli but not for negative social information. Moreover, after dividing a mixed sample of undergraduates into PTSD, trauma control, and 'non-anxious' groups, Amir, Badour, and Freese (2009) conducted standard RIF experiments by using both trauma-related and neutral word pairs. They observed RIF in the non-anxious controls but not in either of the trauma-exposed groups. Inasmuch as this RIF deficit held both for trauma-related and neutral material, Amir et al. (2009, p. 538)

argued that a 'general deficit in certain aspects of memory' may be involved.

These findings must be approached cautiously, however. First, Amir et al. (2001; 2009) either did not study the participants with PTSD, or when they did study them, the PTSD group comprised a non-clinical population. Second, with respect to the more recent study, the individuals in the PTSD group scored significantly higher on measures of depression and general anxiety, which Amir et al. (2009) acknowledged may have led to the findings, rather than the presence of PTSD *per se*. Third, at least according to Amir et al. (2009), the trauma-related material is not tailored to the specific trauma experienced by the participants in large part because the type of experienced trauma differed across the participants. Rather, the stimulus material according to Amir et al. (2009) involved general 'threat' words, such as 'abandoned', 'anxious', and 'depressed'. As the authors acknowledged, a stronger test of the nature of RIF with PTSD would use trauma-related as opposed to the more general threat-related words. Fourth, other clinical populations associated with executive control problems, such as individuals diagnosed with schizophrenia, have manifested normal RIF (AhnAllen, Nestor, McCarley, & Shenton, 2007; Nestor, Piech, Allen, Niznikiewicz, Shenton, & McCarley, 2005; cf., Soriano, Jiménez, Román, & Bajo, 2009).

For these reasons, we decided to revisit the issue of RIF with PTSD. In the present study, we sought a population of US veterans of the Iraq and Afghan Wars with or without PTSD. To date, no one has studied this population using the RIF paradigm. Not only does this population represent a critical subset of those suffering from PTSD, it also allows us to tailor the trauma-related material to a specific type of trauma rather than to threat more generally.

We also examined whether any deficit we might observe in RIF differed across the extant variants of the RIF paradigm. To date, following Anderson et al. (1994), studies with an anxiety population have employed category–exemplar paired associates and have elicited selective practice with a stem completion task (Amir et al., 2001; 2009). Although any memory difficulty observed in these studies provides support for the inhibition deficit model, it may be possible for individuals with PTSD to show RIF in other experimental contexts. With this possibility in mind, we examined RIF following both the selective practice of paired associates and practice when embedded in a free-flowing conversation. Hirst and his colleagues have found RIF in both these contexts (e.g. Cuc, Koppel, & Hirst, 2007). They have also noted that conversational remembering routinely occurs in everyday life and is usually selective, with participants mentioning some memories while leaving others unmentioned (Marsh, 2007). Moreover, the quick give-and-take of a conversation imposes strict time constraints on the participants and may make it hard for them to undertake a broad search; that is, it may make it difficult for an individual to respond to a retrieval cue or an utterance by a speaker by searching memory for as wide a range of responses as possible. Rather, the speed of conversational interactions may leave the listeners with little time except to respond to a retrieval cue or utterance with the first response that comes to mind; that is, it may confine the listener to undertaking what might be construed as a narrow search. This narrow search may be conducive for RIF (Chan, McDermott, & Roediger, 2006; Hirst & Echterhoff, 2008).

The work of Hirst and colleagues also suggests another dimension in which to study RIF among individuals with PTSD. According to Hirst and his colleagues (Coman, Manier, & Hirst, 2009; Cuc et al., 2007; Stone et al., 2010; C. Stone et al., in preparation), healthy individuals who listen to others remember will also demonstrate the standard RIF pattern, that is, Nrp > Rp– [we will refer to forgetting in the rememberer as *within-individual retrieval-induced forgetting* (WI-RIF); forgetting in the listener as *socially shared retrieval-induced forgetting* (SS-RIF)]. According to the model of SS-RIF developed by Cuc et al. (2007), whenever a speaker selectively retrieves memories shared with (or similar to) those of listeners, the speaker should be able to induce forgetting in the listener if the listener concurrently retrieves with the speaker. Once concurrent retrieval occurs, then the same cognitive mechanisms involved in RIF for the speaker should come into play for the listener. To date, WI-RIF and SS-RIF have been found in the standard paired-associated paradigm employed by Anderson et al. (1994) as well as in instances in which the practice takes place in free-flowing conversations. It has been documented when the to-be-remembered stimuli are autobiographical memories, stories, scientific material, and highly memorable schema-consistent material (Coman et al., 2009; Cuc et al., 2007; Stone et al., 2010; C. Stone et al., in preparation).

The present study, then, seeks both to revisit and extend the extant research exploring RIF with PTSD, examining for the first time a combat sample performance in a more ecologically valid variant of the RIF paradigm and both WI-RIF and SS-RIF.

EXPERIMENT 1

We began by investigating whether we could observe WI-RIF and SS-RIF in Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) veterans with and without PTSD, as well as non-veterans without PTSD, employing a variant of standard paradigm pioneered by Anderson et al. (1994) and modified by Cuc et al. (2007).

Methods

Participants

One hundred twenty participants were recruited from the New York City area. The 60 OEF/OIF veterans were recruited from the Manhattan Veterans Administration Medical Center and Craigslist. The 60 non-veterans were also recruited thought Craigslist. The participants received $25. We assessed the participants by obtaining demographic information (age, gender, and duration of deployment to Iraq and/or Afghanistan). PTSD symptomatology was assessed with either the Post-traumatic Stress Disorder Checklist-Military Version (PCL-M) or the Post-traumatic Stress Disorder Checklist-Civilian Version (PCL-C; Weathers, Litz, Herman, Huska & Keane, 1993). Symptoms of depression were indexed with the Beck Depression Inventory-Second Edition (BDI-II; Beck, Steer, & Brown, 1996).

Inclusion criteria required that participants be fluent English speakers and 18 years of age or older. All individuals were asked if they participated in OEF/OIF, the length of their deployment, and if they were exposed to combat during their deployment. In order to assess the presence of the Diagnostic Statistical Manual of Mental Disorder (DSM-IV) A1 criteria, each veteran was asked to endorse if during their deployment they had been 'under enemy fire', 'surrounded by the enemy', 'observed someone being hit by the enemy', 'ambushed', 'in a near miss situation', or 'any other experiences in which you were at risk for being severely injured or killed or observed an event(s) that involved the actual or threatened death or serious injury of others.' If any of these items were endorsed, the participants were then asked if their response to the event(s) involved 'intense fear, helplessness, or horror' (PTSD DSM-IV Criteria A2). As for the PCL-M/C, based on recommendations from the previous psychometric research (Blanchard, Jones-Alexander, Buckley, & Forneris, 1996; Bliese et al., 2008), if an individual scored greater than 44, they were assigned to the PTSD group (assuming they met Criteria A1 and A2 and were veterans). If the individual scored less than 44 on the PCL-M/C, they were assigned to the no PTSD group. Any individual reporting a history of traumatic brain injury, history of psychosis (e.g. schizophrenia, delusional disorder, etc.), or seizure disorder were excluded from the study. Further, non-veterans were excluded if they had any previous military training, were exposed to an event that met criteria A1 for PTSD in the DSM-IV, or had ever sought treatment for PTSD. Individuals were tested in pairs consisting of one OEF/OIF veteran and one non-veteran. We counterbalanced which type of participants served as a speaker and which as a listener. In total, 15 veterans with PTSD and 15 without PTSD served as speakers, and 15 of each served as listeners. Consequently, it was also the case that 30 non-veterans served as speakers and 30 served as listeners.

Stimulus Material

The stimulus material consisted of 60 category–exemplar paired associates. The experimental pairs involved four combat-related categories and four neutral categories, with each category containing six exemplars. In addition, there were 12 filler pairs, consisting of a non-experimental neutral category and an associated exemplar.

In developing the trauma pairs, we were sensitive to the character of the trauma that our participants encountered and developed the material by building on previous experiments using word lists to study combat trauma (e.g. Kaspi, McNally & Amir, 1995). We were unaware of words specifically related to OEF/OIF; thus, we conducted pilot work in which we determined four military-relevant categories (*vehicle*, *weapon*, *command*, and *violence*) by extensively searching OEF/OIF blogs. We then asked six OEF/OIF veterans to generate as many words as they could that were most relevant to each category. The six most frequently mentioned words served as the exemplars for the category, with the restriction that none of the exemplars even across categories began with the same first two letters.

Each block contained one exemplar from each category. In the first block, the filler item appeared in the beginning, whereas in the last block, the filler item appeared at the end. No two categories appeared in sequence more than once. Each item in the practice list consisted of the category and a word-stem consisting of the first letters of the exemplar, e.g. *weapon–g___*.

As for the practice list, it was constructed so that only two combat-related categories and two neutral categories appeared in the list. Among those categories, only three of the exemplars were practiced. Categories and exemplars were counterbalanced throughout.

Design and Procedure

The study was carefully designed to be similar to the original paired-associates experiment by Anderson et al. (1994) and Experiment 1 in the original SS-RIF study conducted by Cuc et al. (2007). There were four phases: a learning phase, a practice phase, a distracter task, and a test phase. Demographic information and self-reports were completed either before or after the study and were counterbalanced.

During the learning phase, we asked the two members of a pair to study simultaneously paired associates. Both individuals sat next to each other facing a computer screen. They were instructed that they would be viewing pairs of words and should do their best to remember the words because they would be tested on them later. The word pairs appeared one at a time in the center of the computer screen for 5 seconds, with an interstimulus interval of 1 second.

After a 60-second pause, the practice phase began. One member of the pair was assigned to remember the material (speaker), whereas the other was assigned the role of the listener monitoring for the accuracy of the speaker's recall. Whether a veteran or a control served as speaker was counterbalanced. The speaker and listener both faced the computer screen as in the learning phase. Each pair remained on the screen for 5 seconds, with an interstimulus interval of 1 second. The listener indicated on a scoring sheet whether they thought the speaker's recall for each item was accurate, on a 1–7 scale. The experimenter sat in the corner of the experimental room and recorded the speaker's responses. Each word-stem was practiced three times per trial, in the same order each time.

Next, as a distracter, the participants discussed a movie that they both had seen for 10 minutes. In the final test phase, the participants were separately given booklets to complete a cued recall task. On the top of each page appeared a category cue from the learning phase. The order in which the category cues appeared was random and was counterbalanced across trials, with the restriction that trauma categories or neutral categories never appeared consecutively. The participants were told to write down as many of the original exemplars as possible. They were given as much time as they needed to complete each category but were instructed not to work backwards once they completed a category.

Results

Demographic and self-report questionnaire data are presented in Table 1. Thirty veterans met the criteria for PTSD and 30 veterans did not. Veterans with PTSD had

Table 1. Demographic and clinical summary for veterans and non-veterans

	Veterans with PTSD		Veterans without PTSD		Non-veterans	
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*
Experiment 1						
Age	31.17	5.87	31.23	10.05	28.55	7.89
Months deployed	13.50	3.95	10.63	6.73	—	—
PCL[a]	65.33	8.12	30.47	9.68	27.10	9.34
BDI-II	14.50	10.10	10.93	10.12	12.57	7.98
Experiment 2						
Age	30.87	4.07	31.81	5.63	28.90	5.41
Months deployed	15.00	6.33	9.20	3.28	—	—
PCL[a]	54.73	10.18	25.40	6.67	15.97	6.00
BDI-II	10.67	7.45	8.60	6.14	7.40	6.07

Note: PCL, post-traumatic stress disorder checklist; BDI-II, Beck Depression Inventory-Second Edition.
[a]Veterans completed the PCL-M (military version), non-veterans completed the PCL-C (civilian version).

significantly higher scores on the PCL-M than veterans without PTSD [$t(58) = 15.09$, $p < .0001$, $d = 3.90$] and compared with non-veterans [$t(88) = 19.07$, $p < .0001$, $d = 4.37$] on the PCL-C. Veterans with PTSD were deployed for more months in Iraq and/or Afghanistan than veterans without PTSD [$t(58) = 2.01$, $p < .05$, $d = 1.07$]. Notably, the three groups of participants did not differ significantly on the BDI-II [e.g. veterans with PTSD vs veterans without PTSD, $t(58) = 1.61$, $p = .11$, $d = 0.35$; veterans with PTSD vs non-veterans, $t(88) = 1.12$, $p = .27$, $d = 0.21$].

In what follows, we separately analyzed the data when the participant recalled the material in the practice phase (we refer to this individual as a speaker) and when the participant listened to the other participant recall the material (we refer to this individual as a listener). That is, we first examined WI-RIF and then SS-RIF.

Within-individual Retrieval-induced Forgetting

Here we are concerned with the selective practice of speakers and its effect on the speaker's performance on the final memory test (see Table 2). We conducted a repeated-measures analysis of variance (ANOVA) with two within-subjects factors (Retrieval Type and Word Type) and one between-subjects factor (Group). The results revealed a significant main effect for Retrieval Type [$F(2, 114) = 138.56$, $\eta_p^2 = 0.71$, $p < .001$]. We also found an interaction between Retrieval Type and Group [$F(2, 114) = 3.97$, $\eta_p^2 = 0.12$, $p < .05$] and a three-way interaction for Retrieval Type, Word Type, and Group [$F(2, 114) = 2.65$, $\eta_p^2 = 0.09$, $p < .05$]. No other main effects or interactions were found.

We undertook a series of post hoc analyses in order to unpack these results. We first look at the presence of a practice effect, that is, when Rp+ > Nrp. A practice effect was found for both combat-related word pairs and neutral word pairs for all groups, in all cases ($p < .05$). The size of the practice effect [Rp+ − (Nrp)] did not differ significantly across groups nor across word type.

As for the presence of RIF, that is, Nrp > Rp−, it was found for both combat and neutral material for all three groups. For combat-related word pairs, the following data were obtained: veterans with PTSD, $t(14) = 5.02$, $p < .001$, $d = 1.99$; veterans without PTSD, $t(14) = 4.53$, $p < .05$, $d = 0.80$; non-veterans, $t(29) = 2.55$, $p < .05$, $d = 0.46$. For neutral word pairs, the following data were obtained: veterans with PTSD, $t(14) = 4.53$, $p < .001$, $d = 1.41$; veterans without PTSD, $t(14) = 3.21$, $p < .01$, $d = 0.75$; non-veterans, $t(29) = 6.82$, $p < .01$, $d = 1.03$.

We compared the level of the RIF by calculating absolute impairments, following Anderson et al. (1994; that is, (Nrp)–(Rp−); see Table 3). For veterans with PTSD, the absolute impairment was greater for combat-related word pairs than neutral word pairs [$t(14) = 2.27$, $p < .05$, $d = 0.46$]. The degree of absolute impairment between combat-related and neutral word pairs did not differ for veterans without PTSD and non-veterans. For between-group comparisons, veterans with PTSD demonstrated greater absolute impairment for combat-related word pairs than veterans without PTSD [$t(28) = 2.55$, $p < .05$, $d = 0.68$] and non-veterans [$t(43) = 4.00$, $p < .001$, $d = 1.18$]. Absolute impairments did not differ for neutral word pairs between the three groups.

Table 2. Proportion of Rp+, Rp−, and Nrp items recalled for neutral and combat-related paired associates

			Combat-related word pairs			Neutral word pairs		
			Rp+	Rp−	Nrp	Rp+	Rp−	Nrp
Experiment 1	PTSD+	Speaker	.83 (0.15)	.21 (0.26)	.62 (0.13)	.76 (0.23)	.20 (0.25)	.48 (0.13)
		Listener	.87 (0.11)	.21 (0.22)	.68 (0.14)	.77 (0.17)	.36 (0.28)	.55 (0.21)
	PTSD−	Speaker	.60 (0.28)	.30 (0.26)	.49 (0.21)	.71 (0.23)	.31 (0.29)	.51 (0.24)
		Listener	.71 (0.22)	.43 (0.24)	.55 (0.25)	.70 (0.21)	.39 (0.33)	.57 (0.17)
	Non-veteran	Speaker	.71 (0.15)	.32 (0.21)	.41 (0.19)	.73 (0.21)	.26 (0.26)	.49 (0.18)
		Listener	.71 (0.18)	.32 (0.22)	.52 (0.21)	.72 (0.19)	.35 (0.26)	.53 (0.17)

Note: PTSD+, veterans with PTSD; PTSD−, veterans without PTSD.
Standard deviations appear in parentheses.

Table 3. Experiments 1 and 2: Absolute impairment (Nrp–Rp–) for paired associates and conversations

	Veterans with PTSD		Veterans without PTSD		Non-veterans	
	M	*SD*	*M*	*SD*	*M*	*SD*
Experiment 1: Paired associates						
Combat related						
Speaker	0.41	0.32	0.19	0.33	0.10	0.21
Listener	0.47	0.23	0.12	0.20	0.09	0.24
Neutral						
Speaker	0.28	0.24	0.20	0.24	0.23	0.19
Listener	0.19	0.26	0.18	0.32	0.18	0.15
Experiment 2: Conversations						
Combat-related						
Speaker	0.42	0.27	0.20	0.23	0.16	0.24
Listener	0.37	0.27	0.18	0.14	0.14	0.18
Neutral						
Speaker	0.15	0.27	0.23	0.21	0.26	0.18
Listener	0.16	0.18	0.19	0.22	0.21	0.16

Note: PTSD+, veterans with PTSD; PTSD–, veterans without PTSD.

Socially Shared Retrieval-Induced Forgetting

Table 2 also contains the recall of the listener on Rp+, Rp–, and Nrp items. As with WI-RIF, we first conducted a repeated-measures ANOVA with two within-subjects factors (Retrieval Type and Word Type) and one between-subjects factor (Group). The results revealed a significant main effect for the Retrieval Type [$F(2, 114) = 167.86$, $\eta_p^2 = 0.75$, $p < .001$] and a significant interaction between Retrieval Type and Group [$F(2, 114) = 5.84$, $\eta_p^2 = 0.17$, $p < .001$] as well as the three-way interaction between the Retrieval Type, Word Type, and Group [$F(2, 114) = 3.94$, $\eta_p^2 = 0.12$, $p < .01$].

Post hoc analyses revealed that a practice effect was present for all groups and for both combat-related and neutral material, with $p < .05$ in all cases. The size of the practice effect did not differ significantly across groups and material. With respect to RIF, for both combat and neutral pairs, as with WI-RIF, we found that Nrp was significantly greater than Rp–, for all three groups. For combat-related word pairs, the following data were obtained: veterans with PTSD, $t(14) = 7.92$, $p < .001$, $d = 2.06$; veterans without PTSD, $t(14) = 2.36$, $p < .05$, $d = 0.49$; non-veterans, $t(29) = 2.11$, $p < .05$, $d = 0.50$. For neutral word pairs, the following data were obtained: veterans with PTSD, $t(14) = 2.76$, $p < .01$, $d = 0.77$; veterans without PTSD, $t(14) = 2.19$, $p < .05$, $d = 0.88$; non-veterans, $t(29) = 6.31$, $p < .001$, $d = 0.82$.

We again calculated the absolute impairments (see Table 3). As with WI-RIF, veterans with PTSD exhibited greater impairment for combat-related than neutral pairs [$t(14) = 2.72$, $p < .05$, $d = 1.10$]. We did not find a similar significant difference for the other two groups. Also consistent with WI-RIF, veterans with PTSD produced more impairment for combat-related word pairs than veterans without PTSD [$t(28) = 4.38$, $p < .001$, $d = 1.58$] and non-veterans [$t(43) = 5.05$, $p < .001$. $d = 1.57$].

We then considered whether output interference may have contributed to our findings in the participants with PTSD. According to the output interference hypothesis, RIF impairment arises because the recalled Rp+ items interfere with the recall of Rp– items (Anderson & Spellman, 1995). We examined for this possibility by following the procedure suggested by Macrae and Roseveare (2002; see also Barnier, Hung, & Conway, 2004). We began by calculating the average position of Rp items on the final cued recall test. Each Rp item was ranked from 1 (first) to 6 (last) depending on the order in which the item was recalled. We then subtracted the mean Rp+ and Rp– scores and sorted the participants into an early Rp+ group ($n = 15$) and an early Rp– group ($n = 15$). We again conducted an ANOVA with two within-subject factors (Retrieval Type and Story Type) with the early Rp+/– serving as the between-group factor. We did not observe any significant main effects or interaction effects for recall order position. Irrespective of recall order, the veterans with PTSD recalled more Nrp items than Rp– in the combat [early Rp+: $t(14) = 9.18$, $p < .001$, $d = 2.91$; early Rp–: $t(14) = 4.56$, $p < .001$, $d = 1.77$] and neutral [early Rp+: $t(14) = 4.73$, $p < .001$, $d = 1.41$; early Rp–: $t(14) = 2.63$, $p < .05$, $d = 0.76$] conditions. Moreover, both early Rp+ and early Rp– groups showed greater impairment for combat than neutral words [early Rp+: $t(14) = 2.33$, $p < .05$, $d = 1.02$; early Rp–: $t(14) = 2.66$, $p < .05$, $d = 0.64$]. Our findings do not appear to be the result of output interference.

Discussion

The most surprising results of Experiment 1 are that we not only observed the RIF in veterans with PTSD but we also found for these individuals that it was more robust for combat-related material than for neutral material. These results differ from those obtained by Amir et al. (2001, 2009). Moreover, they seem inconsistent with the findings of others using tasks such as directed forgetting and the emotional Stroop tasks, at least to the extent that one can reasonably assume that the three tasks involved similar processes of inhibition (see Anderson & Levy, 2007; Conway & Fthenaki, 2003; Román, Soriano, Gómez-Ariza, & Bajo, 2009). As far as the SS-RIF is concerned, it was clearly present for all participants whether combat-related or neutral material was involved. However, consistent with the WI-RIF findings, only the veterans with PTSD group demonstrated greater induced forgetting for combat-related compared with neutral words.

Additionally, the veterans with PTSD demonstrated greater forgetting for combat-related words than the veterans without PTSD or the non-veteran groups.

We wanted to replicate our results but in a different experimental context. Consequently, we followed the procedure devised by Cuc et al. (2007) and examined selective practice embedded in a free-flowing conversation.

EXPERIMENT 2

Method

Participants

Sixty participants were recruited from the New York City area. Thirty OEF/OIF veterans were recruited through fliers at the Manhattan Campus of the VA Harbor Healthcare System and electronic announcements placed on craigslist (www.craigslist.com), and 30 non-veterans were recruited thought craigslist. All participants received $25.

We paired veterans with or without PTSD with a non-veteran control. Prescreen interviews, exclusion criteria, and self-report measures were identical to the previous experiment. As in the previous experiment, a score of >44 on the PCL-M/C was used to determine the presence of PTSD.

Materials

We constructed two stories: one neutral, one combat-related. The neutral story was adopted from Cuc et al. (2007) and consisted of eight episodes, with six events per episode. Consistent with Cuc et al., we included eight additional episodes, with six events in each episode, in order to increase the likelihood that the participants would not recall all the episodes. The filler episodes were interspersed among the experimental episodes. The 16 episodes as a whole formed a coherent story.

As for the combat-related story, in order to ensure that the veterans would view it as 'combat-related,' we first reviewed a collection of autobiographical narratives of soldiers returning from Iraq (Tripp, 2007) and selected from these narrative episodes and events the ones we viewed as combat-related. We assembled these episodes and events into stories by using the same episode and event structure we used for the neutral stores. That is, there were eight 'experimental' episodes, with six events per episode, and eight filler episodes, also with six events per episode. We then modified the stories based on feedback received from five OEF/OIF veterans who did not participate in the study on the relevance of the stories to their combat experiences. As a final assessment of the combat-relatedness of the stories, each participant in the main study rated the relevance of these stories on a Likert-type scale of 1 (not at all) to 7 (very relevant) to their personal combat experiences (in the case of the non-veterans, what they imagined it might be like) at the end of Experiment 1. Veterans with and without PTSD found the combat-related episodes more relevant than non-veterans [$t(43) = 9.63$, $p < .0001$, $d = 3.23$, $t(43) = 7.14$, $p < .0001$, $d = 2.13$, respectively], but the levels of relevance did not differ among veterans with and without PTSD [$t(28) = 0.45$, $p = .67$, $d = 0.16$].

Both stories were presented on a computer screen, one episode at a time. Each episode was identified with a title presented on the top of the computer screen (e.g. *Got ready for school*). At the same time, the six events were listed immediately below the title (e.g. *Tom woke up late*, *He took a shower*). For the combat-related stories, the titles of the episodes were: *Out with Policeman*, *Tom Enters the Market*, *Exits Iraqi Home*, *Patrolling the Roadside*, *Night Operation*, *Heading Home in a Humvee*, *Convoy Attack*, *Arrest a High Official*. The content and titles of the filler categories were military related but did not pertain to combat (e.g. *Received a Letter*, *Needed a New Pair of Boots*).

Design and Procedure

After signing the consent form, a pair of participants were introduced to each other and then asked to complete the demographic and self-report assessments. The order of the assessments was counterbalanced. After these preliminaries, the participants were instructed that they would be reading a story. Which story (neutral or combat-related) was initially read was counterbalanced across trials. The title of each episode appeared on the screen for 3 seconds. Then the title and the related events were presented on the screen together for 20 seconds. At the end of the presentation of each episode, instructions appeared at the bottom of the screen that asked the participant to type into a box the title of the episode. They were given 3 seconds to do so.

After the participants finished studying the story, they returned to the common space in which they were first introduced. They were then asked to individually complete a series of algebra problems for 15 minutes. Following the distracter task, the individuals were instructed that they were to recall jointly everything that they could remember about the story that they had previously studied. They were told that it did not matter what order they recalled the story in, but it was important that they work together on this project. The experimenter sat passively in the room, listening to them. After both participants said that they could not recall anything else, the session ended. Each collaborative recall was tape recorded, of which the participants were aware. In order to ensure that the coder would be able to identify which speaker was who, the participants were asked to begin the recall by saying their randomized ID number.

Subsequent to the conversation phase, the participants were given another set of algebra equations to complete individually for 15 minutes. Following the distracter task, the participants were again ushered into separate rooms and asked to complete a cued recall task. The cued recall test consisted of test booklets with one episode title appearing on the top of each page. The participants were instructed to write down as much as they could accurately recall about the episodes. They were instructed to complete the booklet in order and not to work backwards. The order of titles was randomized across the participants.

After completing the recall task, the participants were then given another 15-minute algebra distracter task to complete. The experimenter then informed the participants, who remained in their separate rooms, that they now would study another story. If they had initially studied the combat-related story, they now studied the neutral story, and vice

versa. As in the previous part of the experiment, the participants then completed a distracter task, jointly recounted the story, then undertook another distracter task and finally answered the cued recall test. The experiment ended by asking the participants to rate the combat-relatedness of the two stories.

Coding

Each recorded conversation was transcribed. Coding was based on the scheme used by Cuc et al., (2007). Two coders identified whether a response matched an event from the original stimulus material. Each event mentioned during the conversation was then categorized as being a speaker or a listener. Then, for each possible event, coders identified if the event was mentioned, heard, or neither mentioned nor heard. Events mentioned were labeled Rp+, events that were in the same episode but not mentioned were Rp−, and events that were in episodes that were not mentioned were Nrp. The analysis furnished four variables: Practice (Rp+, Rp−, or Nrp), Role (speaker or listener), Story Type (combat and neutral), and Subject Type (veteran with PTSD, veteran without PTSD, and non-veteran). There were no disagreements between the two coders.

Results

In what follows, we first present demographic results and then examine separately the performance of the participants when they were speakers (WI-RIF) and their performance when they were listeners (SS-RIF). In both instances, we will focus on the proportion of items recollected in the final cued recall test.

Demographic Measures

Table 1 presents the demographic and self-report data for the individuals that participated in Experiment 2. Fifteen veterans met the criteria for PTSD and 15 veterans did not. Veterans with PTSD had significantly higher scores on the PCL-M than veterans without PTSD [$t(28) = 9.33$, $p < .001$, $d = 3.41$] and compared with non-veterans on the PCL-C [$t(43) = 16.10$, $p < .001$, $d = 4.64$]. Individuals with PTSD were also deployed to OEF/OIF for more months than those without PTSD [$t(28) = 3.15$, $p < .01$, $d = 0.52$]. As in Experiment 1, scores on the BDI-II did not differ significantly.

Within-individual Retrieval-induced Forgetting

Confining our analyses to the final recall of the participants when they served as a speaker in the conversation, we conducted a repeated-measures ANOVA with two within-subject factors (Retrieval Type and Story Type) as well as one between-subject factor (Group). See Table 4. The results revealed significant main effects for Retrieval Type [$F(2, 114) = 197.93$, $\eta_p^2 = 0.78$, $p < .001$. We also found an interaction for Story Type and Group, $F(2, 114) = 4.76$, $\eta_p^2 = 0.14$, $p < .01$] and a three-way interaction for Retrieval Type, Story Type, and Group [$F(2, 114) = 2.70$, $\eta_p^2 = 0.09$, $p < .05$].

We undertook a series of post hoc analyses in order to unpack these results. We focused initially on the presence of a practice effect, that is, Rp+ > Nrp. A series of *t*-tests revealed that a practice effect was present for all groups and for both combat-related and neutral material, with $p < .001$ in all cases. As for the presence of RIF, that is, Nrp > Rp−, again, we found WI-RIF for all three groups and for both combat and neutral material. For combat-related stories, the following data were obtained: veterans with PTSD, $t(14) = 6.02$, $p < .001$, $d = 1.92$; veterans without PTSD, $t(14) = 3.25$, $p < .01$, $d = 0.77$; non-veterans, $t(29) = 3.64$, $p < .01$, $d = 0.68$. For neutral stories, the following data were obtained: veterans with PTSD, $t(14) = 2.30$, $p < .05$, $d = 0.66$; veterans without PTSD, $t(14) = 4.16$, $p < .01$, $d = 0.94$; non-veterans, $t(29) = 8.12$, $p < .001$, $d = 1.19$.

We also compared absolute impairment scores (Nrp–Rp−) (see Table 3). The results are similar to those of Experiment 1. Veterans with PTSD demonstrated more absolute impairment for combat-related stories than for neutral stories [$t(13) = 2.40$, $p < .05$, $d = 1.07$]. However, absolute impairment scores did not differ between combat-related stories and neutral stories among veterans without PTSD or controls. As for between-group comparisons, veterans with PTSD demonstrated greater absolute impairment for combat-related stories than veterans without PTSD [$t(28) = 2.45$, $p < .05$, $d = 0.96$] and controls [$t(43) = 3.41$, $p < .001$, $d = 1.07$]. No other differences were found. That is, rates of impairment for neutral stories did not differ among the three groups, nor did rates of impairment for combat-related stories differ between veterans without PTSD and controls.

Socially Shared Retrieval-induced Forgetting

We next examined the final recall for material when individuals were listeners in the conversation. We again conducted repeated-measures ANOVA with two within-subject factors (Retrieval Type and Story Type) as well as one between-subject factor (Group) (again, see Table 4). The results revealed significant main effects for Retrieval Type [$F(2, 114) = 129.73$, $\eta_p^2 = 0.70$, $p < .001$] and for Story Type [$F(2, 114) = 10.31$, $\eta_p^2 = 0.15$, $p < .01$]. We also found a three-way interaction for Retrieval Type, Story Type, and Group [$F(2, 114) = 3.03$, $\eta_p^2 = 0.09$, $p < .05$].

As with WI-RIF, we conducted a series of post hoc analyses. A series of *t*-tests revealed practice effects, again present for all groups and for both combat-related and neutral material, with $p < .0001$ in all cases. As for within-group comparisons of RIF and consistent with Experiment 1, Nrp was significantly greater than RP− across all three groups and for combat and neutral material. For combat stories, the following data were obtained: veterans with PTSD, $t(14) = 5.27$, $p < .001$, $d = 1.54$; veterans without PTSD, $t(14) = 5.00$, $p < .001$, $d = 0.86$; non-veterans, $t(96) = 4.11$, $p < .001$, $d = 0.65$. For neutral stories, the following data were obtained: veterans with PTSD, $t(14) = 3.60$, $p < .01$, $d = 0.56$; veterans without PTSD, $t(14) = 3.28$, $p < .01$, $d = 0.93$; non-veterans, $t(29) = 8.12$, $p < .001$, $d = 0.96$.

We again calculated absolute impairments (see Table 3). When we contrasted impairment within groups, the veterans with PTSD demonstrated more absolute impairment for combat-related stories than neutral stories [$t(13) = 2.45$, $p < .05$, $d = 1.26$]. However, absolute impairment scores did not differ between combat-related stories and neutral stories among veterans without PTSD or non-veterans. As for

Table 4. Proportion of Rp+, Rp–, and Nrp items recalled for neutral and combat-related stories

			Combat-related story			Neutral story		
			Rp+	Rp–	Nrp	Rp+	Rp–	Nrp
Experiment 2	PTSD+	Speaker	.80 (0.21)	.08 (0.12)	.50 (0.29)	.78 (0.25)	.26 (0.25)	.41 (0.21)
		Listener	.78 (0.28)	.08 (0.19)	.45 (0.28)	.72 (0.28)	.26 (0.31)	.41 (0.23)
	PTSD–	Speaker	.72 (0.25)	.16 (0.21)	.35 (0.28)	.64 (0.34)	.14 (0.23)	.36 (0.24)
		Listener	.52 (0.29)	.13 (0.14)	.32 (0.28)	.62 (0.29)	.15 (0.21)	.34 (0.20)
	Non-veteran	Speaker	.75 (0.23)	.16 (0.20)	.31 (0.24)	.83 (0.18)	.25 (0.25)	.50 (0.16)
		Listener	.68 (0.31)	.13 (0.20)	.27 (0.23)	.79 (0.29)	.26 (0.26)	.47 (0.17)

Note: PTSD+, veterans with PTSD; PTSD–, veterans without PTSD.
Standard deviations appear in parentheses.

between-group comparisons, veterans with PTSD demonstrated greater absolute impairment for combat-related stories than veterans without PTSD [$t(28) = 2.34$, $p < .05$, $d = 1.28$] and non-veterans [$t(43) = 3.43$, $p < .001$, $d = 1.28$]. No other differences were found. These results are similar to those of Experiment 1.

As in Experiment 1, we again investigated whether the findings for PTSD participants may be due to output interference effects. Because of the way in which the data was coded, we conducted separate ANOVAs for speakers and listeners. We again conducted an ANOVA with two within-subject factors (Retrieval Type and Story Type) with early Rp+/– serving as the between-group factor. Following the same procedure outlined in Experiment 1, PTSD participants were sorted into an early Rp+ group ($n = 8$) and an early Rp– group ($n = 7$). We did not observe any significant main effects or interactions effects for recall order position for the speakers or listeners, suggesting that the within and group differences for WI-RIF and SS-RIF in the PTSD participants remained the same whether the participants were in the early Rp+ or the early Rp– group.

Finally, it should be noted that the contribution of the participants to a conversation did not differ across groups. For instance, the number of items recalled in a conversation did not differ significantly across group or material. For the combat-related story, 19.20 items were recalled by veterans with PTSD, 17.28 by veterans without PTSD, and 18.24 by non-veterans. For neutral story, 18.72 items were recalled by veterans with PTSD, 17.80 by veterans without PTSD, and 18.96 by non-veterans. Moreover, the number of instances of Rp– and Nrp emerging from a recounting was large enough to make analysis reasonable: an average of 13.68 Rp– items and 17.49 items for Nrp. These figures were similar across groups and material.

GENERAL DISCUSSION

When employing neutral material, both experiments in this study found both WI-RIF and SS-RIF at equivalent levels of impairments for veterans with PTSD, veterans without PTSD, and non-veterans. Differences, however, emerged when combat-related materials were employed. In both Experiments 1 and 2, the RIF for combat-related material was present with PTSD, a finding that differs from the failure of Amir et al. (2009) to find the RIF. How do we account for this difference? Inasmuch as only Experiment 1 in our study employed a procedure similar to the one utilized by Amir et al., Experiment 1 will serve as our point of comparison with Amir et al. (2009).

One explanation is that the search processes undertaken by the participants in the two experiments may have differed, with the Amir et al. (2009) studies providing the time for a broad search and with our study constricting this time. The nature of the search matters because, as we noted in the introduction, a 'broad' search may reduce the RIF, whereas a 'narrow' search may facilitate it. Chan et al. (2006) suggest that the longer the retrieval time, the greater the chance that the participants will demonstrate retrieval-induced facilitation. Amir et al. (2009) did not specify how long they allotted for retrieval during the practice phase. On the other hand, we gave our participants only a limited time to retrieve the cued item, 5 seconds, which based on our past experience with the RIF paradigm should be conducive for the RIF. Chan et al. (2006) only began to show clear evidence of facilitation when response times were 15 seconds or more.

Another reason for possibly different search processes is that the stimulus material of Amir et al. (2009) and Experiment 1 in this study differed. As already noted, the combat-related stimuli were general in Amir et al. (2009), more about threat than about specific trauma. Such stimulus construction was necessary inasmuch as the trauma that the participants experienced was varied, from sexual abuse to military involvement. Moreover, Amir et al. (2009) included both positive and negative exemplars of each threat-related category, for example, exemplars of the category *alone* were, among others, *depressed* and *privacy*. In contrast, Experiment 1 here employed categories and words directly related to the participants' trauma, none of which were associated with positive emotion.

These differences in stimulus material may have led to different avoidance strategies, which, in turn, led to the different search strategies. Cognitive models propose that avoidance is a common coping strategy for individuals with PTSD (e.g. Conway & Pleydell-Pearce, 2000; Ehlers & Clark, 2000). The specific nature of our trauma-related material may have increased the probability that the PTSD participants avoided thinking about the related stimulus material, that is, they may have avoided a broad search. In contrast, the general nature of the material of Amir et al. (2009) and their use of positive and negative words may have reduced the likelihood that the PTSD participants in their experiment avoided a broad search. If, as noted, they

occasionally undertook a broad search but in another instance limited their search, this mixed strategy would have contributed to the negative results they reported. It is important to emphasize that we are not claiming that our veterans with PTSD cannot process the trauma-related material if task demands required them to. They clearly did not avoid encoding the material—we found a clear practice effect—nor did they avoid retrieving the trauma-related word if requested by the experimenter, as was the case with the stem completions in the practice phase of the experiment. Our claim is that they avoided the processing of trauma-related material unless something about the task demanded or promoted retrieval.

The differences between our results and those of Amir et al. (2009) may also have arisen not because of differences in the elicited search processes but because there were differences in both the severity and the source of trauma in the two studies. Amir et al. (2009) used college students who experienced a wide range of trauma that, on the surface, appear to vary widely in severity (24% of their PTSD participants identified their trauma as an 'accident'). All of our participants in the two trauma groups identified incidents during their military service that would clearly qualify as DSM-IV traumatic stressor. It may be that the individuals with PTSD are more likely to avoid a broad search if their PTSD is severe or combat-specific.

Of course, we cannot be certain that any of these differences account for the inconsistencies between our study and Amir et al. (2009); however, they are striking enough to make any strong comparison between the two studies difficult. Other studies that have shown a deficit with executive functioning and inhibition with PTSD have used tasks that involve voluntary inhibition, such as directed forgetting (Conway & Fthenaki, 2003). However, the RIF may involve automatic inhibition (Conway & Fthenaki, 2003). Although Román et al. (2009) have shown that the RIF requires attentional resources, it may still be the case that the inhibition putatively underlying RIF is automatic, at least in the sense of not voluntarily initiated.

Given our strong results and the consistency of the results across two different RIF tasks, it would appear that those with PTSD can inhibit competing responses when retrieving. The ecologically valid nature of our second experiment makes our results even more pertinent to the everyday experience of individuals with PTSD. However, what about the more robust RIF we documented with PTSD? For us, this difference does not suggest that the veterans with PTSD exerted more effort when they inhibited competing responses. Rather, as we argued in discussing the Amir et al. (2009) results, the difference in impairment between those with PTSD and those without PTSD might be more straightforwardly understood in terms of the possibility of an occasional broad search in the non-PTSD populations. The specific trauma-related character of the stimulus material and the specific nature of the trauma of the PTSD population in this study may have led the veterans with PTSD to avoid broad searches, but the non-PTSD populations were not under similar constraints. As a result, a broad search may have sometimes contaminated their results, producing the lower level of impairment that we observed.

What about the SS-RIF results? The present study is the first to explore SS-RIF in individuals with PTSD. Once again, SS-RIF was more robust for those with PTSD when combat-related material was involved. In Experiment 2, this increased level of impairment for SS-RIF might merely reflect the increased level of impairment that we observed for WI-RIF. Whatever the explanation, we still need to explore why the veterans with PTSD would concurrently remember with the speaker. We have argued that they can block a broad search when they act as a speaker. Why can they not block concurrent retrieval when they served as a listener?

The answer may be found once again in the task demands of the two experiments in this study. In Experiment 1, the participants are required to rate the accuracy of the speaker's response, which presumably require concurrent retrieval. In Experiment 2, the participants are asked to jointly recount the story. If the veterans with PTSD were to participate in the conversation—which they clearly did—then they would have to ensure that what they said was relevant to what was previously recounted by others. This effort would presumably involve concurrently retrieving the story along with the speaker, if only covertly. The enhanced interference found in the emotional Stroop task (Kaspi et al., 1995) for individuals with PTSD suggests that those with PTSD may be especially inclined to concurrently retrieve along with the speaker, but one does not have to make this claim to account for the results. Our veterans with PTSD responded to the task demands when they encoded the trauma-related material and when they retrieved the trauma-related words to complete the stem in Experiment 1. They presumably would also respond to the task demands they faced as a listener.

Overall, then, the results of the present experiments suggest that the inhibition associated with the selective retrieval of information is intact. Anderson (2005) has argued that the RIF facilitates the subsequent remembering of the practiced material in that it reduces subsequent response competition. For the veterans with PTSD, our results suggest that when they tell their stories of their trauma, they will find with repeated telling that the unmentioned items become less accessible and the mentioned items become more accessible. Moreover, as they listen to others repeat their story, the same sculpting will occur. Critically, Coman et al. (2009) suggest that the speaker does not have to tell the same story to elicit SS-RIF in the listener, only a similar story. As a result, the presence of RIF with PTSD suggests that, even for veterans with PTSD, listening to other's combat-related stories will both enhance aspects of their memories about their own war experiences and induce forgetting for other personally held memories about the war.

Although caution must be taken in generalizing these laboratory based findings to clinical phenomena, these data suggest that WI-RIF and SS-RIF may be relevant to a number of clinical observations. PTSD is characterized, in part, by the selective retrieval of intrusive and distressing autobiographical memories (APA, 1994). Cognitive theories (Ehlers & Clark, 2000) and investigations into the characteristics of intrusive autobiographical memories (Ehlers, Hackmann, & Michael, 2004; Hackmann, Ehlers, Speckens,

& Clark, 2004) suggest that re-experiencing symptoms following trauma tend to focus on the same or similar events. Therefore, the RIF may be a particularly effective paradigm for modeling and testing the cognitive consequences that occur naturally in PTSD. Interestingly, along with the repeated retrieval of intrusive memories, PTSD is also associated with abnormal forgetting. Studies consistently show that individuals with PTSD have difficulty generating detailed episodic memories (for a review see Moore & Zoellner, 2007). These 'overgeneralized' memories have been shown to co-occur with intrusive memories in a sample of trauma-exposed individuals (Wessel, Merckelbach, & Dekkers, 2002), providing some indirect support that RIF may be associated with these processes. Although claims have been made that RIF may be an underlying mechanism in overgeneralized memory (Wessel & Hauer, 2006), it has yet to be tested. Taken together, enhanced RIF observed for combat-related material among individuals with PTSD in these experiments may therefore help to better understand the puzzling and seemingly contradictory relation between the abnormal forgetting and the simultaneous abnormal remembering observed with PTSD.

These findings may also have therapeutic implications. Enhanced SS-RIF could heighten clinicians' sensitivity to the consequences of social interactions in shaping the course of therapy for their patients with PTSD, as other studies of social aspects of memory have, such as the work of Loftus and colleagues (see Loftus, 2003) on memory intrusion. In addition, these data may shed light on the benefits of Cognitive Behavioral Therapy for PTSD. In Cognitive Behavioral Therapy for PTSD, reconstructing and elaborating on the traumatic memory is a central treatment goal (Ehlers, & Clark, 2000; Foa & Rothbaum, 1998; Resick & Schnicke, 1993). Cognitive theories suggest that elaborating on these memories allows patients to update their trauma memories with more adaptive and corrective information (Ehlers et al., 2004). From the RIF perspective, these therapeutic strategies may be effective in part because they increase the accessibility of memories and information that is critical in helping patients to contextualize and re-appraise these memories in ways that promote recovery. SS-RIF may also represent a previously unexamined social pathway by which individuals recover from traumatic events. Differences in social interactions are likely to either promote or reduce RIF based on recollection style (high vs low elaborator) of the interaction. According to this model, individuals that are highly elaborative may reduce RIF in the trauma-exposed individual if their recounting aids in the contextualization of the traumatic memories. On the other hand, low elaborating individuals may attempt to discuss a traumatic event but, perhaps as a result of the intense emotional material, may avoid further discussion. As a result, these social dynamics may facilitate the conditions necessary for SS-RIF, inhibiting corrective trauma-related details, which may further maintain PTSD symptoms. Although social support is a strong predictor of recovery from traumatic events (e.g. Brewin, Andrews, & Valentine, 2000; Ozer, Best, Lipsey, & Weiss, 2003), social dynamics vary, and future studies may further examine the cognitive and clinical consequences when individuals remember together.

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REFERENCES

AhnAllen, C. G., Nestor, P. G., McCarley, R. W., & Shenton, M. E. (2007). The role of retrieval inhibition in the associative memory impairment of schizophrenia. *Psychiatry Research*, *150*, 43–50.

APA. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: American Psychiatric Association.

Amir, N., Badour, C. L., & Freese, B. (2009). The effect of retrieval on recall of information in individuals with posttraumatic stress disorder. *Journal of Anxiety Disorders*, *23*, 535–540.

Amir, N., Coles, M. E., Brigidi, B., & Foa, E. B. (2001). The effect of practice on recall of emotional information in individuals with generalized social phobia. *Journal of Abnormal Psychology*, *110*, 76–82.

Anderson, M. C. (2005). The role of inhibitory control in forgetting unwanted memories: A consideration of three methods. In C. MacLeod & B. Uttl (Eds.), *Dynamic cognitive processes* (pp. 159–190). Tokyo: Springer-Verlag.

Anderson, M. C., Bjork, R. A., & Bjork, E. L. (1994). Remembering can cause forgetting: Retrieval dynamics in long-term memory. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, *20*, 1063–1087.

Anderson, M. C., & Levy, B. J. (2007). Theoretical issues in inhibition: Insights from research on human memory. In: D. Gorfein & C. MacLeod (Eds.), *Inhibition in cognition* (pp. 81–102). Washington, DC: American Psychological Association.

Anderson, M. C., & Spellman, B. A. (1995). On the status of inhibitory mechanisms in cognition: Memory retrieval as a model case. *Psychological Review*, *102*, 68–100.

Barnier, A., Hung, L., & Conway, M. (2004). Retrieval-induced forgetting of emotional and unemotional autobiographical memories. *Cognition and Emotion*, *18*, 457–477.

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Manual for the Beck depression inventory* (2nd ed.). San Antonio, TX: The Psychological Corporation.

Blanchard, E. B., Jones-Alexander, J., Buckley, T. C., & Forneris, C. A. (1996). Psychometric properties of the PTSD checklist (PCL). *Behavior Research and Therapy*, *34*, 669–673.

Bliese, P. D., Wright, K. M., Adler, A. B., Cabrera, O., Castro, C. A., & Hoge, C. W. (2008). Validating the posttraumatic stress disorder screen and the posttraumatic stress disorder checklist with soldiers returning from combat. *Journal of Consulting and Clinical Psychology*, *76*, 272–281.

Brewin, C. R., Andrews, B., & Valentine, J. D. (2000). Meta-analysis of risk factors for posttraumatic stress disorder in trauma-exposed adults. *Journal of Consulting and Clinical Psychology*, *68*, 748–766.

Cassiday, K. L., McNally, R. J., & Zeitlin, S. B. (1992). Cognitive processing of trauma cues in posttraumatic stress disorder. *Cognitive Therapy and Research*, *16*, 283–296.

Chan, J. C. K., McDermott, K. B., & Roediger, H. L. (2006). Retrieval-induced facilitation: Initially nontested material can benefit from prior testing of related material. *Journal of Experimental Psychology: General*, *135*, 553–571.

Cloitre, M. (1998). Intentional forgetting and the clinical disorders. In J. M. Golding & C. L. MacLeod (Eds.), *Intentional forgetting: Interdisciplinary approaches* (pp. 395–412). Mahwah, NJ: Erlbaum.

Coman, A., Manier, D., & Hirst, W. (2009). Forgetting the unforgettable: Socially-shared retrieval-induced forgetting for September 11th. *Psychological Science*, *20*, 627–633.

Conway, M. A., & Fthenaki, A. (2003). Disruption of inhibitory control of memory following lesions to the frontal and temporal lobes. *Cortex*, *39*, 667–686.

Conway, M. A., & Pleydell-Pearce, C. W. (2000). The construction of autobiographical memories in the self-memory system. *Psychological Review*, *107*, 261–288.

Cuc, A., Koppel, J., & Hirst, W. (2007). Silence is not golden: Socially-shared retrieval-induced forgetting. *Psychological Science*, *18*, 727–733.

DePrince, A. P., & Freyd, J. J. (2001). Memory and dissociative tendencies: The roles of attentional context and word meaning in a directed forgetting task. *Journal of Trauma & Dissociation*, *2*, 67–82.

DePrince, D. P., & Freyd, J. J. (2004). Forgetting trauma stimuli. *Psychological Science*, *15*, 488–492.

Dodd, M. D., Castel, A. C., & Roberts, K. E. (2006). A strategy disruption component to retrieval-induced forgetting. *Memory and Cognition*, *34*, 102–111.

Ehlers, A., & Clark, D. M. (2000). A cognitive model of posttraumatic stress disorder. *Behaviour Research and Therapy*, *38*, 319–345.

Ehlers, A., Hackmann, A., & Michael, T. (2004). Intrusive re-experiencing in post-traumatic stress disorder: Phenomenology, theory, and therapy. *Memory*, *12*, 403–415.

Foa, E. B., Feske, U., Murdock, T. B., Kozak, M. J., McCarthy, P. R. (1991). Processing of threat-related information in rape victims. *Journal of Abnormal Psychology*, *100*, 156–162.

Foa, E. B., & Rothbaum, B. O. (1998). *Treating the trauma of rape: Cognitive behavioral therapy for PTSD*. New York: Guilford Press.

Hackmann, A., Ehlers, A., Speckens, A., & Clark, D. M. (2004). Characteristics and content of intrusive memories in PTSD and their changes with treatment. *Journal of Traumatic Stress*, *17*, 231–240.

Hirst, W., & Echterhoff, G. (2008). Creating shared memories in conversation: Towards a psychology of collective memory. *Social Research*, *75*, 183–216.

Kaspi, S. P., McNally, R. J., & Amir, N. (1995). Cognitive processing of emotional information in posttraumatic stress disorder. *Cognitive Therapy and Research*, *19*, 433–444.

Loftus, E. F. (2003). Our changeable memories: Legal and practical implications. *Nature Reviews. Neuroscience*, *4*, 231–234.

Macrae, C. N., & Roseveare, T. A. (2002). I was always on my mind: The self and temporary forgetting. *Psychonomic Bulletin and Review*, *9*, 611–614.

Marsh, E. (2007). Retelling is not the same as recalling: Implications for memory. *Current Directions in Psychological Science*, *16*, 16–20.

Mathews, A., & MacLeod, C. (1994). Cognitive approaches to emotion and emotional disorders. *Annual Review of Psychology*, *45*, 25–50.

McNally, R. J. (1998). Experimental approaches to cognitive abnormality in posttraumatic stress disorder. *Clinical Psychology Review*, *18*, 971–982.

McNally, R. J. (2006). Cognitive abnormalities in post-traumatic stress disorder. *Trends in Cognitive Sciences*, *10*, 271–277.

McNally, R. J. (2007). Betrayal trauma theory: A critical appraisal. *Memory*, *15*, 280–294.

McNally, R. J., Kaspi, S. P., Riemann, B. C., & Zeitlin, S. B. (1990). Selective processing of threat cues in posttraumatic stress disorder. *Journal of Abnormal Psychology*, *99*, 398–402.

McNally, R. J., Metzger, L. J., Lasko, N. B., Clancy, S. A., & Pitman, R. K. (1998). Directed forgetting of trauma cues in adult survivors of childhood sexual abuse with and without posttraumatic stress disorder. *Journal of Abnormal Psychology*, *107*, 596–601.

Moore, S. A., & Zoellner, L. A. (2007). Overgeneral autobiographical memory and traumatic events: An evaluative review. *Psychological Bulletin*, *133*, 419–437.

Nestor, P. G., Piech, R., Allen, C., Niznikiewicz, M., Shenton, M., & McCarley, R. W. (2005). *Schizophrenia Research*, *75*, 199–209.

Ozer, E. J., Best, S. R., Lipsey, T. L., & Weiss, D. S. (2003). Predictors of posttraumatic stress disorder and symptoms in adults: A meta-analyses. *Psychological Bulletin*, *129*, 52–73.

Resick, P. A., & Schnicke, M. K. (1993). *Cognitive processing therapy for sexual assault victims: A treatment manual*. Newbury Park CA: Sage Publications.

Román, P., Soriano, M. F., Gómez-Ariza, C., & Bajo, M. T. (2009). Retrieval-induced forgetting and executive control. *Psychological Science*, *20*, 1053–1058.

Soriano, M. F., Jiménez, J. F., Román, P., & Bajo, M. T. (2009). Inhibitory processes in memory are impaired in schizophrenia: Evidence from retrieval-induced forgetting. *British Journal of Psychology*, *100*, 61–64.

Stone, C., Barnier, A. J., Sutton, J., & Hirst, W. (2010). Building social consensus about the past: Memorability, integration, and socially shared retrieval-induced forgetting. *Memory*, *18*, 170–184.

Tripp, E. F. (2007). *Surviving Iraq: Soldiers' stories*. Northampton: Interlink Publishing Group.

Weathers, F. W., Litz, B. T., Herman, D. S., Huska, J. A., & Keane, T. (1993). *The PTSD checklist: Reliability, validity, and diagnostic utility.* Paper presented at the Annual Meeting of the International Society for Traumatic Stress Studies.

Wessel, I. & Hauer, B. (2006). Retrieval-induced forgetting of autobiographical memory details. *Cognition and Emotion*, *20*, 430–447.

Wessel, I., Merckelbach, H., & Dekkers, T. (2002). Autobiographical memory specificity, intrusive memory, and general memory skills in Dutch-Indonesian survivors of the World War II era. *Journal of Traumatic Stress*, *15*, 227–234.

Williams, C. C., & Zacks, R. T. (2001). Is retrieval-induced forgetting an inhibitory process? *American Journal of Psychology*, *114*, 329–354.