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Emotional Distress and Positive and Negative Memories from Military Deployment: The Influence of PTSD Symptoms and Time

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Abstract

During military deployment, soldiers are confronted with both negative and positive events. What is remembered and how it affects an individual is influenced by not only the perceived emotion of the event, but also the emotional state of the individual. Here we examined the most negative and most positive deployment memories from a company of 337 soldiers who were deployed together to Afghanistan. We examined how the level of emotional distress of the soldiers and the valence of the memory were related to the emotional intensity, experience of reliving, rehearsal and coherence of the memories, and how the perceived impact of these memories changed over time. We found that soldiers with higher levels of post-traumatic stress disorder (PTSD) symptoms were more affected by both their negative and positive memories, compared with soldiers with lower levels of PTSD symptoms. Emotional intensity of the most negative memory increased over time in the group with highest levels of PTSD symptoms, but dropped in the other groups. The present study adds to the literature on emotion and autobiographical memory and how this relationship interacts with an individual's present level of emotional distress and the passage of time.

Keywords: Post-traumatic Stress Disorder, Autobiographical Memory, Emotion, Military

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Emotional Distress and Positive and Negative Memories from Military Deployment: The Influence of PTSD Symptoms and Time

People encounter both positive and negative events as part of their normal life. Although rarely addressed, this is also true for soldiers during military deployment. In addition to stressful or traumatic events, such as exposure to combat, bombing, and civilian atrocities, soldiers also experience positive events during their deployment, such as moments of pride, manifestations of friendship, and personal growth (Ambrose, 1992; Tedeschi & Calhoun, 1996; Newby et al., 2005; Kang, Aldwin, Choun, & Spiro, 2016; for review see Schok, Kleber, Elands, & Weerts, 2008). Little is known as to how such negative and positive events from deployment are subsequently remembered by the soldiers, and whether this is related to their levels of post-traumatic stress disorder (PTSD) symptoms. Several studies have examined how the perceived valence of an event at the time of encoding can influence aspects of a memory (for reviews see Christianson, 1992; Mather, 2007). Emotion can also interact with memory at recall such that people tend to recall events that are congruent with their current mood (see Blaney, 1986; Matt, Vazquez, & Campbell, 1992 for reviews). However, it is unknown as to whether these findings generalize to soldiers' memories from military deployment, and thus to memories for extreme situations in a population exposed to potential traumas. Here we examine memories for positive and negative events experienced by soldiers during their deployment, how the quality of the memories may change from during deployment to two-four months after deployment, as well as potential interactions with the current level of PTSD symptoms.

Positive versus Negative Memories in relation to PTSD symptoms

In the trauma literature, memory is affected not only by the perceived valence of an event, but also the emotional state of the individual. Frequently it is found that the emotional state at recall can affect the memory for the retrieved event (i.e., Reynolds & Brewin, 1999; Berntsen,

Willert, & Rubin, 2003; McNally, 2003; Rubin, Feldman, & Beckham, 2004; Storbeck & Clore, 2005; Howe & Malone, 2011; see Matt, Vazquez, & Campbell, 1992 for review of mood congruent memory bias). Affective intensity--that is, the typical intensity with which individuals experience their positive and negative emotions (Larson & Diener, 1987) --has been shown to be a stable characteristic that varies from person to person. Individuals high in affective intensity will experience all their emotions, positive and negative, with greater intensity (for review see Larsen & Diener, 1987). In their Study 1, Rubin, Boals, and Berntsen (2008) compared students with high versus low PTSD symptoms severity and their memories for traumatic and non-traumatic autobiographical events. The authors found that participants in the high PTSD symptoms group experienced all types of memories as more emotionally intense and the memories were more rehearsed. This study suggests a tendency for those with higher levels of PTSD symptoms to react with greater emotional intensity to all types of autobiographical memories, not just negative or traumatic autobiographical memories, consistent with the view that similar mechanisms are underlying the processing of traumatic and non-traumatic events (i.e., Rubin, 2006; Rubin, Berntsen, & Bohni, 2008; Rubin, Boals, & Berntsen, 2008). Furthermore, the findings suggest that affect intensity in response to memories may be generally elevated in PTSD (Rubin, Boals, & Berntsen, 2008; also see Litz, Orsillo, Kaloupek, & Weathers, 2000; Tull, Jakupcak, McFadden, & Roemer, 2007; Vujanovic et al., 2013).

Another question in the trauma literature is how coherent voluntary memories for traumas are in those who are diagnosed with PTSD versus those who are not. There is no agreed upon definition of personal narrative coherence in the literature (Reese et al., 2011). According to a working definition introduced by Reese et al., (2011) on the basis of a systematic review of the linguistic and cognitive developmental literature of narratives of single events, "a coherent personal narrative is one that makes sense to a naïve listener – not just in terms of understanding when,

where, and what event took place, but also with respect to understanding the meaning of that event to the narrator" (Reese et al., 2011, p. 425). Early theories suggested that trauma memories were incoherent and fragmented, and more so in individuals with PTSD (Brewin, Dalgleish, & Joseph, 1996; Ehlers & Clark, 2000; Brewin, 2001; Brewin & Holmes, 2003; see Brewin, 2014 for review). While this inability to coherently recall an event continues to be a criterion for PTSD diagnosis (American Psychiatric Association, 2013), there is little research to support the hypothesis of incoherent trauma memories in PTSD and in fact most of the research finds the opposite to be true, that is trauma memories are more coherent, or there is no difference in coherence (Byrne, Hyman, & Scott, 2001; Berntsen, Willert, & Rubin, 2003; Rubin, Feldman, & Beckham 2004; O'Kearney & Perrott, 2006; Rubin, Berntsen, Johansen, 2008; Rubin, Boals, & Klein, 2010; Rubin, 2011; Rubin et al., 2016a; see Crespo & Fernández-Lansac, 2016 for review).

Importantly, very few studies have examined the full model needed to assess whether the coherence of trauma memories is reduced relative to other memories in individuals with PTSD compared with other individuals; that is comparing traumatic vs. nontraumatic memories from individuals with PTSD vs. those with No PTSD (Rubin, Boals, & Berntsen, 2008). There is only one known study which shows the expected interaction of PTSD and type of memory when the full model is properly tested. Jelinek et al. (2009) found trauma memories to be less coherent in a PTSD group compared with a healthy control group. Additionally, this decreased coherence was greater for the trauma memories compared with the nontraumatic negative memories. However, the study only found this effect with one of their three coherence measures, the other two measures did not show this interaction. Furthermore, the traumatic memory and nontraumatic negative memory were actually found to be more coherent compared to three non-autobiographical narratives in both the group with PTSD and the healthy control group (Jelinek et al. 2009; see Berntsen & Rubin, 2014 for further discussion). In another full-model study, Rubin (2011) found that traumatic memories

were no more incoherent than non-traumatic memories when participants wrote narratives of their trauma and a comparison memory. Furthermore, there was no interaction with PTSD diagnosis and memory type (Rubin, 2011; see Rubin et al., 2016a for similar findings; see Brewin, 2016, and Rubin et al., 2016b for discussion).

Changes in Emotional Memories over Time

Time is an additional factor adding to the complexity of emotion and memory. Several studies have shown that the emotional intensity of positive events fades more slowly than that of negative events (for reviews see Walker & Skowronski, 2009; Skowronski, Walker, Henderson, & Bond, 2014), known as the fading affect bias. For example, Bohn and Berntsen (2007) examined various qualities of the memories of Germans who found the fall of the Berlin Wall to be either a positive or negative event. They found that positive and negative emotions have differing effects on memory qualities (i.e., emotion, rehearsal, etc.). Those who viewed the event as positive scored higher on measures of reliving and sensory imagery (also see D'Argembeau, Comblain, & Van Der Linden, 2003). Speculatively, a willingness to relive a positive event may lead to an increase in emotional intensity of the memory in comparison with a negative memory, which people may avoid reliving and therefore rate as having less intensity as time passes (Holmes, 1970; Walker, Skowronski, Gibbons, Vogl, & Thompson, 2003).

Few studies have examined the fading affect bias within clinical populations (see Walker & Skowronski, 2009 for review). Walker and colleagues (2003) investigated the role of dysphoria in the fading affect bias. In their Study 1, they had participants recall six emotional events and rate their pleasantness. Participants were separated into a dysphoric or non-dysphoric group based on their scores on the Beck Depression Inventory (BDI: Beck & Steer, 1987). The non-dysphoric group showed a strong fading affect bias, with the intensity associated with their negative memories fading faster than that of their positive memories. In the dysphoric group, the intensity of

negative and positive events faded at the same rate (Walker et al., 2003). Little is known regarding the fading affect bias in relation to PTSD symptoms. However, multiple studies have shown that higher levels of PTSD symptoms are associated with an intensification of the memory for the traumatic event over time (Wyshak, 1994; Roemer, Litz, Orsillo, Ehlich, & Friedman, 1998; King et al., 2000; for review see van Giezen, Arensman, Spinhoven, & Wolters, 2005). For example, in their study of trauma memories from veterans of Operation Desert Storm, Southwick, Morgan, Nicolaou, and Charney (1997) found that over a two-year period, 88% of veterans reported changes in their personal memories for traumatic events. Furthermore, the level of PTSD symptoms two years after the initial assessment of the trauma memories was positively correlated with inconsistencies in the memories. The authors suggest that these findings support the hypothesis that those with higher levels of PTSD symptoms may amplify their trauma memories and consequently may exaggerate the impact of the traumatic event on their present self (Southwick et al., 1997). In another study of soldiers who were deployed to Iraq in 2004, Engelhard, van den Hout, and McNally (2008) replicated an amplification of trauma memories for soldiers with higher levels of PTSD. Memories for traumatic and non-traumatic stressors the soldiers experienced during deployment were measured at five months and 15-months after deployment. The higher the level of PTSD symptoms, the more a soldier increased reporting of traumatic and non-traumatic stressors 15-months after their deployment (Engelhard, van den Hout, & McNally, 2008).

The Present Study

The present study examined negative and positive memories of experiences during deployment, recorded at two different time points (during and after deployment), from Danish soldiers who were deployed to Afghanistan in 2009. We examined how level of PTSD symptoms influenced memories of positive and negative events from during deployment and how the recall of these emotional memories might change over time. The present study is unique in that it includes

individuals who experienced similar situations (i.e., military deployment), but vary in their current level of PTSD symptoms. Additionally, the time that has passed since the events occurred is similar for all participants, and we include both emotionally positive and negative events.

Based on the literature review, the present study hypothesized that those with higher levels of PTSD symptoms would be more affected by their deployment memories, both negative and positive memories, compared with those with lower levels of PTSD symptoms. This would be shown in higher ratings of emotionality, reliving, and rehearsal associated with the memories. In addition, we hypothesized that those with higher levels of PTSD symptoms would not have less, but possibly even more, coherent memories than those with lower levels of PTSD symptoms. Finally, the high PTSD symptoms group would not show a decrease in intensity of their negative memories, as would be predicted by the fading affect bias, from during deployment to after deployment.

Methods

Participants

The present study consisted of 337 soldiers. Further explanation for participants' inclusion will be described later. Demographic data was provided by 295 soldiers showing a mean age of 25.71 and 81.60% were male. A power analysis using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) for F-test with repeated measures, between factors and 0.95 power level indicated we needed a total sample of 78 participants to detect large effects (f = .40) and 189 participants to detect medium effects (f = .25) with 95% power. Thus our sample size is sufficient to detect large and medium effects.

The sample was drawn from a larger population of 746 Danish soldiers of the Danish Contingent of the International Security Assistance Force 7 (ISAF 7) who participated in a large longitudinal study from which the present study is based. The soldiers were deployed for six months to Afghanistan in 2009 and completed questionnaires addressing PTSD, measures of health,

risk factors, and other relevant measures. These questionnaires were completed on five occasions: before deployment, during deployment (Time 2), 1-3 weeks after return from deployment, 2-4 months after return (Time 4), and 7-8 months after return from deployment (see also Berntsen et al., 2012). In the present study we were only interested in Time 2 and Time 4, which were the time points participants answered questions related to their memories of experiences from deployment.

Materials and Procedure

PCL-IV. Part of the inclusion criteria for the present study was that the soldier completed the PTSD Check List IV (PCL-IV; Blanchard, Jones-Alezander, Buckley, & Forneris, 1996; Weathers, Litz, Huska, & Keane, 1994) measure at post-deployment (Time 4). The PCL-IV is a 17-item standardized checklist for PTSD symptoms where sum scores can range from 17 to 85. In the total population, the internal consistency (cronbach's α) is .85 (Berntsen et al., 2012).

AMQ. In the present study, we examined how soldiers' level of PTSD is associated with characteristics of their most negative and most positive memories from deployment. Autobiographical memories of deployment events were collected twice: during deployment, and 2-4 months after return from deployment (post-deployment, in the following). Each soldier recorded their most negative and most positive memory at each time point[1]. For each memory, the soldiers completed the Autobiographical Memory Questionnaire (AMQ; Rubin, Feldman, & Beckham, 2003). The AMQ measures a broad range of characteristics of autobiographical memories, such as reliving, sensory details, rehearsal, and emotional aspects.

In the present study, negative and positive memories from deployment were examined based on the following AMQ measures: reliving, emotion, and rehearsal. The reliving measure examines the extent to which a person feels as if he/she is re-experiencing the memory when he/she recalls the experience. This scale is a total of seven ratings and includes such questions as, "This memory gave me a feeling of time travel back to the situation itself" and "When I recall the

situation, I can see for myself what happened". For the two time points and both the negative and positive memories, the Cronbach's alphas range = .90-.91. The emotion subscale focuses on the emotional impact the memory has on the person. This scale is a total of three ratings and includes the following questions, "This memory affected my mood", "This memory gave me a physical reaction, when it came to me (such as palpitations, uneasiness, tension, tears, laughter)", and "The feelings I experience when I recall the situation are intense". For the two time points and both the negative and positive memories, the Cronbach's alphas range = .65 - .80. Since the scale had only three items, we also used Pearson's *r* to examine the relationship of the questions to one another for negative (*r* = .30-.62) and positive (*r* = .40-.74) memories. Rehearsal examines the extent to which a person feels he/she thinks about the memory, both voluntarily and involuntarily. This scale is also a total of three ratings and includes the following questions, "Since it happened, I purposely searched back to the incident in mind", "I have talked about the recalled event", and "Since it happened, this recollection has spontaneously come to my mind, without me consciously trying to remember it". For the two time points and both the negative and positive memories, the Cronbach's alphas range = .67 - .80 Again Pearson's *r* was also calculated for the negative (*r* = .32-.58) and positive (*r* = .40-.74) memories. Based on these results, the scales were found to be reliable.

Objective Coding

In addition to the soldiers' personal ratings on the AMQ, we also had two independent judges code the memories for coherence. The memories in the present study were rated for coherence inspired by the Narrative Coherence Coding Scheme (NaCCs; Reese et al., 2011). The NaCCs has been used to rate the coherence of autobiographical memories across the lifespan and in various populations (see Rubin et al., 2016a, for brief overview). This approach to coding the narratives seems suitable here because the event narrative is examined as a whole, instead of dissecting individual parts (i.e., sentences or phrases). This allows for a general rating of coherence

of the narrative and is not as affected by narrative length as are other more microanalytic coding schemes (Reese et al., 2011). This coding scheme distinguishes between three different levels of coherence; (1) *Context* (i.e., "the orientation of the listener with respect to the time and place of the original events, p. 437), (2) *Chronology* ("the order of actions in the narrative", p. 437) and (3) *Theme* (i.e., "the meaning-making aspect of the narrative", p. 437). Further, as pointed out by Reese et al., (2011), coherence is essentially about making sense to a listener or receiver. Accordingly, to address the three different facets by which we assessed coherence (context and chronology, and theme), raters answered the following three questions: 1. "Do you understand what happened and is it clear?" (*context and chronology*), 2. "Do you get a better idea about who the narrator is and how he/she deals with the world and how they felt in the situation?" (*objective theme*), and 3. "Does the memory trigger emotions in you and/or compassion with the narrator?" (*subjective theme*). Each question was rated on a 5-point Likert scale from 1 = "not at all" to 5 = "very much". The three facets correlated between r = .68 and r = .82, thus we combined the ratings to an average coherence score. A high score indicated a highly coherent memory with a possible range of 1-5. Since coherence was coded on a scale, we used Person's r when comparing the agreement rating between the two judges. There was high agreement on coherence ratings for the negative memories (r = .79) and the positive memories (r = .84).

Results

Data Preparation

Participants were included in the following analyses if they met two criteria. First, the participant had completed the PCL post-deployment. Second, the participant had completed the analyzed AMQ variables both during deployment and post-deployment. For all the analyses, the included participants were classified into one of three groups: low, medium, or high PTSD symptoms. The groups were based on the participants' PCL scores at post-deployment. PCL scores

at post-deployment (N = 337) ranged from 17 to 61. We relied on the guidelines from the U.S. Department of Veteran Affairs (2012) when creating the three PCL groups. Thus, we chose a low cutoff score for the high PCL group in order to have a greater opportunity of detecting those with high levels of PTSD symptoms within a population that typically exhibits low levels of emotional distress. The low PTSD symptoms group included 116 participants who scored 17 on the PCL. Those who scored between 18-28 on the PCL were included in the medium PTSD symptoms group (*n* = 185). The third group, the high PTSD symptoms group, consisted of 36 participants who scored between 29-61 on the PCL at post-deployment (see Table 1 for group characteristics).

Event Descriptions

When completing the AMQ, soldiers were asked to include a brief narrative about the event. However, for ethical reasons soldiers could opt not to do so and therefore we do not have event descriptions for all soldiers. We did have event descriptions for 53.1% of the total memories and of those, 30.2% of the most negative memories were coded as being the same event at both time points and 21.8% of the most positive memories were coded as the same event (interrater agreement = 94.7%). There were three negative events which occurred after the first time point, two involving soldiers losing limbs when stepping on improvised explosive devices (IEDs) and one in which three soldiers were killed, a point we will return to in the discussion. For examples of the most negative and most positive memories, which soldiers reported, see Appendix A.

AMQ and Coherence

Repeated-measures ANOVAs were conducted to compare the following AMQ variables obtained during deployment and post-deployment: reliving, emotionality, and rehearsal. Additionally, coherence ratings were analyzed for both the negative and positive memories. All variables were analyzed separately in four 3 (PTSD group: low vs. medium vs. high) x 2 (time: during deployment vs. post-deployment) x 2 (valence: negative vs. positive) ANOVAs. In all four

ANOVAs, time, during deployment and post-deployment, and valence, negative and positive, were the within-subject variables and group based on PCL scores (described previously), was the between-subject variable.

In order to avoid Type II errors due to a relatively low sample size for the high PTSD symptoms group, additional ANOVAs were conducted examining the most negative and most positive memories separately; 3 (PTSD group: low vs. medium vs. high) x 2 (time: during deployment vs. post-deployment). Since every soldier did not record a positive and a negative memory at both time points, conducting these additional analyses and separating the negative and positive memories, allowed for the inclusion of more soldiers and thus increased our ability to detect smaller effects. However, results from these exploratory two-factor analyses should be viewed as tentative. In these two-factor ANOVAs, time (during deployment versus post-deployment) was the within-subject variable and group based on PCL scores, was the between-subject variable.

Reliving. The measure of reliving varied depending on level of PTSD symptoms. A main effect of PTSD symptoms group was found in the 3 x 2 x 2 ANOVA, which showed a significant group difference, F (2,173) = 21.63, p <.0001, η_p^2 = .20, with the high PTSD symptoms group having the overall highest mean rating (M = 4.06, SE = .24, 95% CI = [3.59 – 4.53]) followed by the medium PTSD symptoms group (M = 3.16, SE = .11, 95% CI = [2.94 – 3.38]) and the lowest mean rating was the low PTSD symptoms group (M = 2.32, SE = .15, 95% CI = [2.03 – 2.61]); all ps < .001. No other significant effects were found in the 3 x 2 x 2 ANOVA.

We further examined each type of memory separately in order to determine if there were further differences among the three PTSD symptoms groups with how they were reliving their most negative and most positive memories. We again found a main effect of group for both the negative and positive memories, F (2,219) = 22.91, p <.0001, η_p^2 = .17 and F (2,182) = 12.13, p <

.0001, η_p^2 = .12, respectively (see Figure 1 a and b for means). Overall, the high PTSD symptoms group recalled their negative and positive memories with more feelings of re-experiencing the memories and therefore were more affected by the memories than the medium and low PTSD symptoms groups, all *p*s < .001. For the most negative memory, there was a main effect of time, *F* (1,219) = 4.78, *p* = .03, η_p^2 = .02. The rating of reliving of the negative memory increased from during deployment (*M* = 2.91, *SE* = .12, 95% CI = [2.68 – 3.14]) to post-deployment (*M* = 3.20, *SE* = .12, 95% CI = [2.97 – 3.43]), with no significant interaction with PTSD symptoms group, although the increase was numerically larger in the high PTSD symptoms group (see Figure 1a). For the positive memory, there was no main effect of time, *p* =.51. Thus, only for the negative memory, did the amount of reliving increase from during to post deployment.

Emotion. The measure of emotional impact, just as with reliving, was also affected differently based on a soldier's level of emotional distress. The 3 x 2 x 2 ANOVA revealed a significant group difference, *F* (2,173) = 25.20, *p* < .0001, η_p^2 = .23, again with the high PTSD symptoms group rating their memories as having the highest emotional impact (*M* = 4.41, *SE* = .25, 95% CI = [3.93 – 4.90]) followed by the medium PTSD symptoms group (*M* = 3.26, *SE* = .11, 95% CI = [3.03 – 3.48]) and the low PTSD symptoms group rated the emotional impact of their memories the lowest (*M* = 2.42, *SE* = .15, 95% CI = [2.12 – 2.72]); all *p*s < .001. There was also a significant main effect of valence, *F* (1,173) = 4.95, *p* =.03, η_p^2 = .03, with the positive memories being rated as having a greater emotional impact (*M* = 3.49, *SE* = .13, 95% CI = [3.23 – 3.74]) compared with the negative memories (*M* = 3.24, *SE* = .11, 95% CI = [3.03 – 3.45]). No other significant effects were found in the 3 x 2 x 2 ANOVA.

The emotional impact of the memory showed a different pattern for emotionally negative and positive memories, when the memories were examined separately in the following exploratory analyses. For the negative memory, there was a main effect of group, *F* (2,219) = 30.82,

p <.0001, η_p^2 = .22, such that as the level of PTSD symptoms increased, the ratings of emotional impact of the memory also increased with the high PTSD symptoms group showing highest ratings, followed by the medium and low groups (Figure 2b). Notably, there was a significant interaction between time and group for the negative memory, F (2,219) = 3.56, p = .03, η_p^2 = .03. This interaction reflected that the high PTSD symptoms group trended towards rating their negative memories as being experienced with more intensity and affecting their mood more at post-deployment, compared with ratings during deployment, p = .07, whereas different patterns were observed in the other two groups. For the medium PTSD symptoms group, the intensity and emotional effect of their negative memory decreased with time, p = .01, and the low PTSD symptoms group remained consistent over time, p = .10, (see Figure 2a for means). For the positive memory, there was only a main effect of group, F (2,182) = 10.50, p < .0001, η_p^2 = .10 (see Figure 2b for means). The high PTSD symptoms group gave the highest ratings of emotional impact, followed by the medium PTSD symptoms group, and the low PTSD symptoms group rated their emotional reaction to their positive memories the lowest of the three groups; all ps < .02.

Rehearsal. When asked how often they recalled, both voluntarily and involuntarily, their negative and positive memories, participants with higher levels of PTSD symptoms rehearsed their memories to a greater extent. The 3 x 2 x 2 ANOVA showed a significant group difference, F (2,166) = 29.32, p < .0001, η_p^2 = .26, with the high PTSD symptoms group having the overall highest mean rating (M = 3.85, SE = .22, 95% CI = [3.41 – 4.28]) followed by the medium PTSD symptoms group (M = 3.12, SE = .10, 95% CI = [2.93 – 3.32]) and then the low PTSD symptoms group (M = 2.10, SE = .14, 95% CI = [1.83 – 2.37]); all ps < .003. There was also a significant main effect of valence, F (1,166) = 4.92, p = .03, η_p^2 = .03, with positive memories being rated as more rehearsed (M = 3.15, SE = .12, 95% CI = [2.92 – 3.38]) compared with negative memories (M = 2.89, SE = .10, 95% CI = [2.70 – 3.09]).

When the memories were analyzed separately, the main effect of group was also found for the negative, F (2,208) = 31.70, $p < .0001$, $\eta_p^2 = .23$, as well as the positive memories, F (2,181) = 12.63, $p < .0001$, $\eta_p^2 = .12$, (see Figure 3 a and b for means). There was no effect of time for either type of memory, $p = .25$ (negative) and $p = .26$ (positive) and no interaction.

Coherence. A significant group effect was again found in the 3 x 2 x 2 ANOVA, F (2,96) = 3.31, $p = .04$, $\eta_p^2 = .07$, reflecting memories of the high PTSD symptoms group being rated as significantly more coherent ($M = 3.30$, $SE = .23$, 95% CI = [2.85 – 3.74]) compared with the low PTSD symptoms group ($M = 2.55$, $SE = .18$, 95% CI = [2.19 – 2.91]), $p = .01$. The medium PTSD symptoms group had no difference in coherence rating ($M = 2.89$, $SE = .10$, 95% CI = [2.69 – 3.09]) compared to the high, $p = .10$ and low, $p = .11$, PTSD symptoms groups. There was also a main effect of time, F (1,96) = 11.92, $p = .001$, $\eta_p^2 = .11$, with memories being rated as more coherent during deployment ($M = 3.11$, $SE = .12$, 95% CI = [2.88 – 3.35]) compared with post-deployment ($M = 2.71$, $SE = .12$, 95% CI = [2.48 – 2.95]).

The follow-up ANOVAs analyzing negative and positive memories separately, also showed a main effect of group for both the negative F (2,147) = 6.25, $p = .002$, $\eta_p^2 = .08$, and the positive memories, F (2,111) = 3.11, $p = .05$, $\eta_p^2 = .05$ (see Figure 4 a and b for means). For the negative memories, the high PTSD symptoms group had higher coherence ratings compared with the low PTSD symptoms group, $p = .001$, but did not differ from the medium PTSD symptoms group, $p = .10$. The medium PTSD symptoms group was significantly more coherent compared with the low PTSD symptoms group, $p = .01$. For the positive memories, the high PTSD symptoms group was more coherent compared to both the medium, $p = .04$, and the low, $p = .02$, PTSD symptoms groups. The medium and low PTSD symptoms groups did not significantly differ in coherence, $p = .33$. There was also a significant main effect of time for both the negative, F (1,147) = 8.01, $p = .01$, $\eta_p^2 = .05$, and the positive memories, F (1,111) = 5.00, $p = .03$, $\eta_p^2 = .04$. From

during deployment to post-deployment, coherence of both the negative and positive memories decreased.

Summary. Overall, the AMQ and coherence measures behaved similarly for both the negative and positive memories. All measures were affected by level of PTSD symptoms, with the high PTSD symptoms group giving higher ratings, showing more impact of the memories, for both negative and positive memories compared to the medium and low PTSD symptoms groups. As a whole, AMQ ratings of reliving, emotional impact, and rehearsal increased as PTSD symptoms increased. Similarly, coherence scores increased with increasing level of PTSD symptoms. This pattern of results was found for both the negative and positive memories. Time, comparing during deployment ratings to post-deployment ratings, showed few effects; overall, ratings held constant over time. One exception was coherence scores, which showed a decrease from during deployment to post-deployment.

When negative and positive memories were analyzed separately in the exploratory follow-up analyses, which were conducted to allow smaller effects to be detected, reliving ratings were affected by time, but only for the negative memories, which showed an increase in ratings from during deployment to post-deployment. Time interacted with PTSD symptoms group for the emotional intensity of negative memories. More specifically, those with high PTSD symptoms showed an increase from during deployment to post-deployment in the emotional intensity of their negative memory while those with medium or low PTSD symptoms showed a decrease, or no significant change, in emotional intensity.

Discussion

The present study, of a company of soldiers deployed together to Afghanistan in 2009, examined the most negative and most positive memories from their time of deployment. The memories were recorded at two different time points, during deployment and 2-4 months post-

deployment. The soldiers gave their subjective ratings of reliving, emotion, and rehearsal for each memory and we also included the objective rating of coherence. The present study examined the relation between the level of emotional distress and qualities of differently valenced memories and how the qualities of these emotional memories changed over time. The present study is unique in that we used a group of individuals who shared a similar, extended event (military deployment) at the same time, and we measured both positive and negative memories from that time-period.

A group difference was consistently found in all analyses conducted. The high PTSD symptoms group scored higher on all variables measured compared to the medium and low PTSD symptoms groups. This finding is consistent with the notion that higher levels of emotional distress can affect how someone remembers an event (i.e., Schwarz, Kowalski, & McNally,1993; Mechanic, Resick, & Griffin,1998; Berntsen, Willert, & Rubin, 2003; McNally, 2003; Engelhard, van den Hout, & McNally, 2008). The present study is also consistent with the theory of elevated affective intensity, particularly negative affective intensity, in those with high levels of PTSD symptoms (Tull, Jakupcak, McFadden, & Roemer, 2007; Rubin, Boals, & Berntsen, 2008) as the high PTSD symptoms group remembered both their negative and positive deployment memories with equally elevated scores on all measures. In their study on adults who experienced traumatic events, Vujanovic and colleagues (2013), found that negative affective intensity was positively associated with all PTSD outcome measures. However, in the present study, we found the high PTSD symptoms group to also score higher on all measures for their positive memories. This suggests that not only negative, but also positive affective intensity is elevated in those with higher levels of emotional distress, consistent with previous work (Rubin, Boals, & Berntsen, 2008; Rubin, Feldman & Beckham, 2011).

In addition, the high PTSD symptoms group was coded as having more coherent negative and positive memories compared with the low PTSD symptoms group. This is notable as it

follows the more recent findings demonstrating that those with PTSD or high levels of emotional distress have more coherent memories (i.e., Rubin, Feldman, & Beckham, 2004; Rubin et al., 2016). The decrease in coherence over time was unexpected, though a possible explanation is simple forgetting (Rubin, 1982), and future research should expand on this finding.

When examined separately, the negative and positive memories behaved similarly across variables, time, and group, but with a few notable exceptions. First, time affected only the negative memory in the rating of reliving, such that as time passed, the ratings of reliving increased, irrelevant of PTSD symptoms severity level. No similar effect was observed for the positive memory

A second notable finding is that for the rating of emotional intensity of the most negative memory only, time interacted with PTSD symptoms group. This interaction was mainly driven by the high PTSD symptoms group rating their negative memories as more emotionally intense after deployment, compared with during deployment. In contrast, the medium and low PTSD symptoms groups displayed a decrease in their ratings of emotionality of their most negative memories after deployment. The high PTSD symptoms group's tendency to experience their most negative memory with more emotional intensity after deployment may help to explain their elevated emotional distress. This finding may suggest the amplification of the most negative memory, which previous studies have found to occur as time passes and PTSD symptoms increase (for review see van Giezen et al., 2005). That is, the soldiers with higher levels of emotional distress may have a tendency to "over remember" or amplify their negative memories. The fading affect bias would predict that as time passes, this intensity for their negative memory should fade, not increase. While the other two groups, the medium and the low PTSD symptoms groups, were demonstrating this lessening of intensity for their negative memories, the high PTSD symptoms group was being more affected by their negative memories as time passed. Previously, the fading affects bias has been

shown to be disrupted in dysphoric individuals (Walker et al., 2003), but as the fading affect bias has not been directly studied in populations with different levels of PTSD symptoms (see Skowronski et al., 2014 for review), the present study is the first, to our knowledge, to demonstrate this increase of emotional intensity as time passes in those with high levels of PTSD symptoms.

However, this interpretation should be considered with caution. First, the finding was a result of exploratory follow-up analyses. Second, although we asked for the most negative and most positive memories from their time of deployment, we cannot be certain that soldiers chose the same memories during deployment and after deployment (i.e., that the same event was written about as their most negative memory both during and after deployment). In other words, the increase in intensity for the negative memories in the high PTSD symptoms group may reflect that these soldiers chose to report more severe memories post deployment. However, this does not appear to be the case as there were three highly negative events, which occurred during deployment, but after the first measurement point, two which involved soldiers losing limbs after stepping on IEDs and one in which three Danish soldiers were killed after their truck ran over an IED. Of the most negative memories listed after deployment for all three groups, 35.2% were about these three instances. Yet only five soldiers in the high PTSD symptoms group (13.89%) wrote about one of these instances whereas they were reported by 15 soldiers in the low PTSD symptoms group (12.93%) and 43 soldiers in the medium PTSD symptoms group (23.24%). Thus, an alternative explanation is that the high PTSD symptoms group may have higher affective intensity compared to the medium and low PTSD symptoms groups. In particular, as previous literature has shown (i.e, Tull, Jakupcak, McFadden, & Roemer, 2007; Rubin, Boals, & Berntsen, 2008; Vujanovic et al., 2013), negative affective intensity is positively associated with PTSD symptoms, thus the increase in emotional intensity and reliving for the high PTSD symptoms group may be associated with their general characteristic of experiencing their emotions with greater intensity.

While the same memories were not always reported at both time points, the events did occur within the same time frame, during deployment, as those were the instructions for retrieval and consistent with the content descriptions. Also, as should be expected in a study with multiple time points, as time passes, there is the opportunity for more events to occur, as is exemplified in the three negative instances that occurred after the first time point. Previous research with military populations has also found it difficult to be sure the same memory is being recorded at different time points. For example, in their study of Gulf War veterans, Southwick and colleagues (1997) found that 70% of the veterans reported an event at the second measured time point, which they did not mention at the first time point and this was associated with PTSD severity. Therefore, even when soldiers were asked to think about their combat experience in general, it was still difficult to determine if the same memory of the experience was being used as PTSD severity affected how soldiers remembered their combat experience (Southwick et al., 1997). Additional research should attempt to control for the use of the same event or be sure to get event descriptions in order to see if our results would replicate.

Limitations

One potential criticism of the present study is the variance in the number of participants included in the analyses, particularly in the high PTSD symptoms group which had a lower number of participants compared to the other two groups. However, this follows what is often found in military populations. It is estimated that between 4.7% - 19.9% soldiers recently returning from deployment of the most recent wars (Operation Iraqi Freedom and Operation Enduring Freedom) are diagnosed with PTSD (Magruder & Yeager, 2009). In the present study, a total of 36 soldiers were included in the high PTSD symptom group, 10.7% of our sample, which falls in the typical range of military personnel being diagnosed with PTSD soon after returning from deployment.

A second limitation of the present study is the cutoff scores we used on the PCL to create the three PTSD symptoms groups. The low PTSD symptoms group was those who scored 17 on the PCL (the lowest possible score). However, where to separate the medium from the high PTSD symptoms group was difficult to determine as there are no standard cutoff scores in the literature. Using guidelines from the U.S. Department of Veteran Affairs (2012), we chose to have a lower cutoff point for the high PTSD symptoms group in order to have the highest opportunity of detecting cases in a population where PTSD diagnosis is low (soldiers recently returning from deployment; Magruder & Yeager, 2009). Future research should examine if our results would replicate in a veteran sample using standardized cutoff scores. However, as the guidelines also state, more research is first needed to determine these standard cutoff scores in various populations (U.S. Department of Veteran Affairs, 2012).

A third limitation is the definition of coherence used in the present study. Our coherence findings should be replicated with additional studies as they had smaller effect sizes compared to the AMQ measures. A possible explanation is that we only had short narratives on which to base our coherence ratings. This was one reason for using the NaCCs as our basis for operationalizing coherence as this method is less affected by narrative length than other methods (Reese et al., 2011). However, ratings may have differed if event narratives were elicited in a different manner, such as asking soldiers to focus on the highly emotional aspects of the event (Brewin, 2016; see also Rubin et al., 2016b). This is not a limitation unique to the present study. The use of different definitions of coherence and different methods of retrieving narratives has led to inconsistent findings in the trauma literature (Reese et al., 2011).

Recently, Rubin et al. (2016a) compared the coherence of trauma memories, most important, and positive memories of adults with and without PTSD. Coherence was rated on 28 different measures, which included three ratings by the participants, seven objective ratings, and 18

computer-scored ratings. Differences in coherence were found among the three types of memories, but notably, these differences did not interact with PTSD diagnosis. Overall, trauma memories were as coherent as important and positive memories and coherence did not differ between those diagnosed with PTSD and those not diagnosed nor were any interactions observed (Rubin et al., 2016a). Brewin (2016) notes that the findings from Rubin et al. (2016a) may be due to the methods used to rate coherence. That is, some researchers rate coherence on a more microanalytic scale, dissecting a narrative sentence by sentence or determining the highly emotional aspects of the narrative ("hot spots"), while others measure general coherence of the entire narrative. In their defense, Rubin et al. (2016b) note that some of the measures used in Rubin et al. (2016a) actually fit Brewin's (2016) definitions for measuring smaller aspects of the narratives (e.g., "hot spots") and still Rubin et al. (2016b) found no support for less coherence in trauma memories. In short, there is disagreement in the literature as to how memory coherence is best defined and measured. With only three different codings of coherence used in the present study, all of which addressed the global level, it is unclear to which extent the present findings may generalize to studies using different analytic approaches, such as approaches involving more fine-grained analyses of coherence and more extended types of narratives.

In spite of these limitations, the fact remains that the high PTSD symptoms group was more affected by both their negative and positive memories, compared to the medium and low PTSD symptoms groups, as their ratings were consistently higher at both time points, for all measures, and for both types of memories.

Conclusion

Through the examination of the most negative and most positive memories from the time of deployment, the present study was able to demonstrate that soldiers returning from deployment with high levels of PTSD symptoms were more affected, negatively and positively, by

their memories from during deployment. Our results showed a steady increase of ratings of the memories' reliving experience, emotional intensity, and rehearsal as emotional distress levels increased. The present study demonstrates the importance of memory and how it interacts with an individual to either reduce, maintain, or exacerbate his/her level of emotional distress.

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Footnote

[1]While we asked for soldiers to note their most negative and most positive memories at each time point, soldiers were given the option to choose a milder event if thinking of the most extreme event caused too much distress.

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Tables and Figures

Table 1

PTSD Symptom Group Characteristics

	PTSD Symptom Grouping		
	Low (*n* = 116)	Medium (*n* = 185)	High (*n* = 36)
Variable	*M (SD)*	*M (SD)*	*M (SD)*
Gender	81.00% male	83.80% male	72.20% male
Age	26.69 (8.70)	25.18 (5.79)	25.43 (6.11)
Years in Military	6.54 (8.99)	4.97 (5.71)	5.74 (6.00)
*PCL	17.00 (0.00)	21.25 (3.03)	38.39 (9.14)
*BDI	.90 (2.11)	4.83 (4.42)	17.31 (10.27)

Note. Years in Military are years in military up to the deployment in 2009. * = significant group difference among all three groups. PCL: F (2, 334) = 457.34, $p < .0001$, $\eta^2 = .73$. BDI: F (2, 329) = 156.00, $p < .0001$, $\eta^2 = .49$.

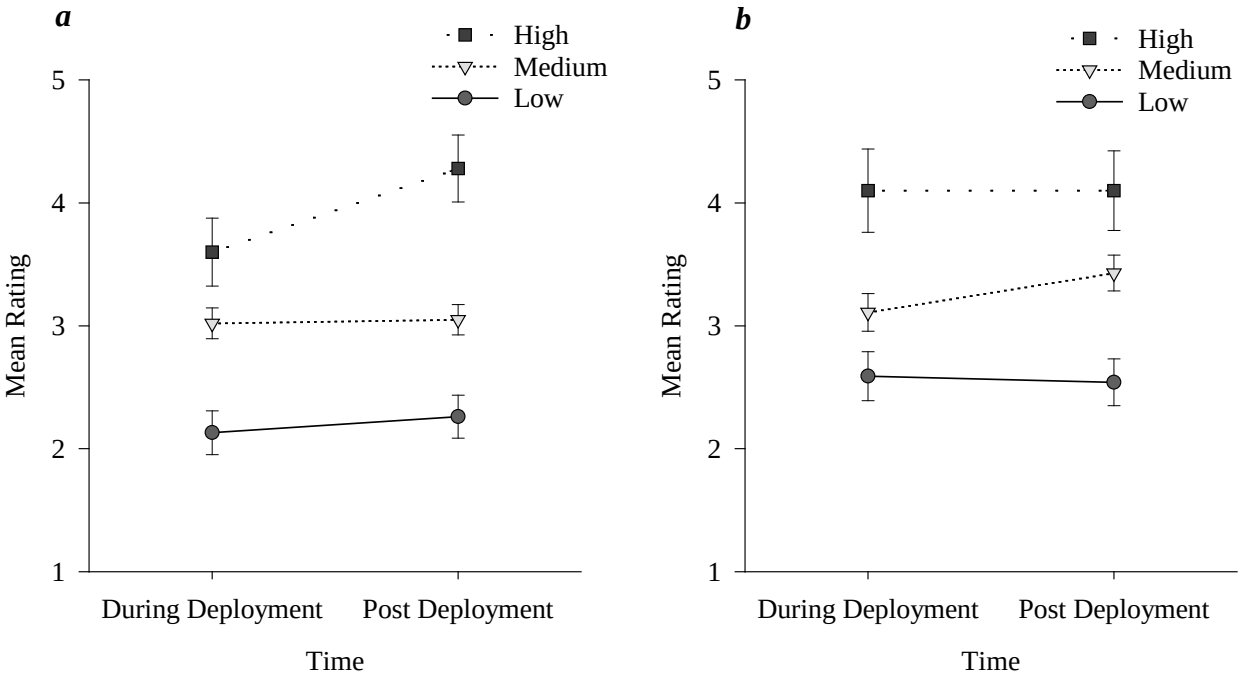

Figure 1. Reliving: a = Negative memory, b = Positive memory.

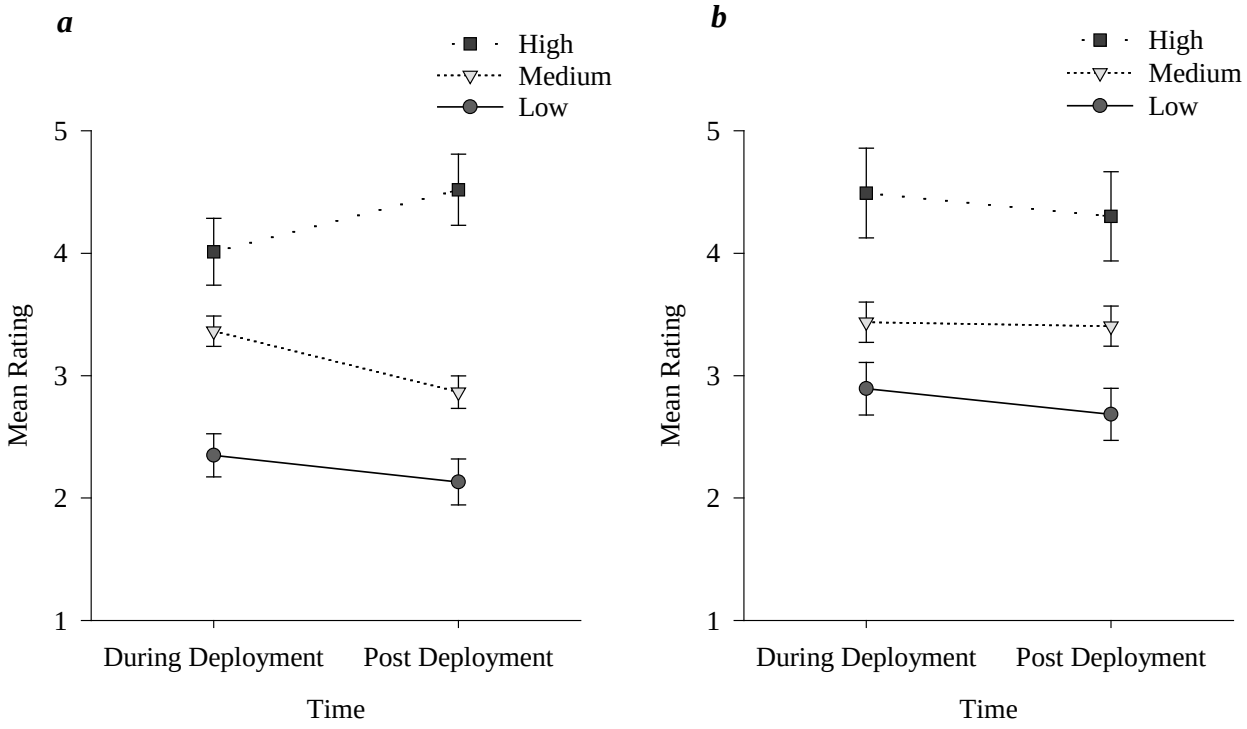

Figure 2. Emotion: a = Negative memory, b = Positive memory.

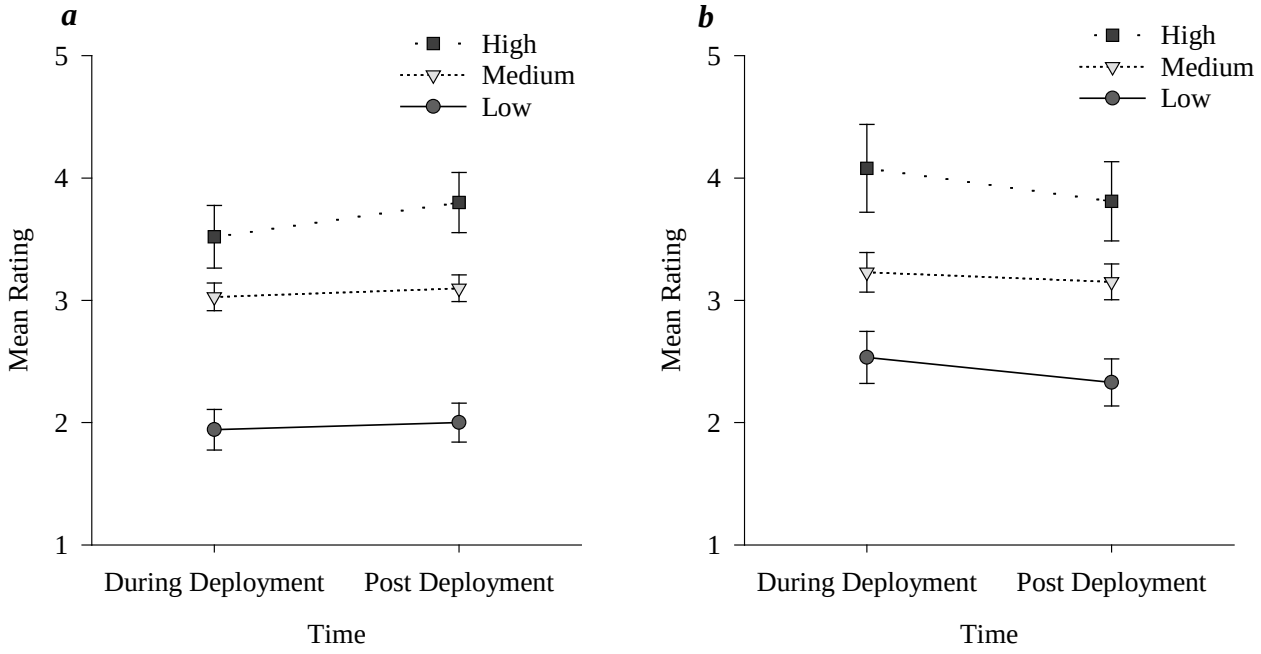

Figure 3. Rehearsal: a = Negative memory, b = Positive memory.

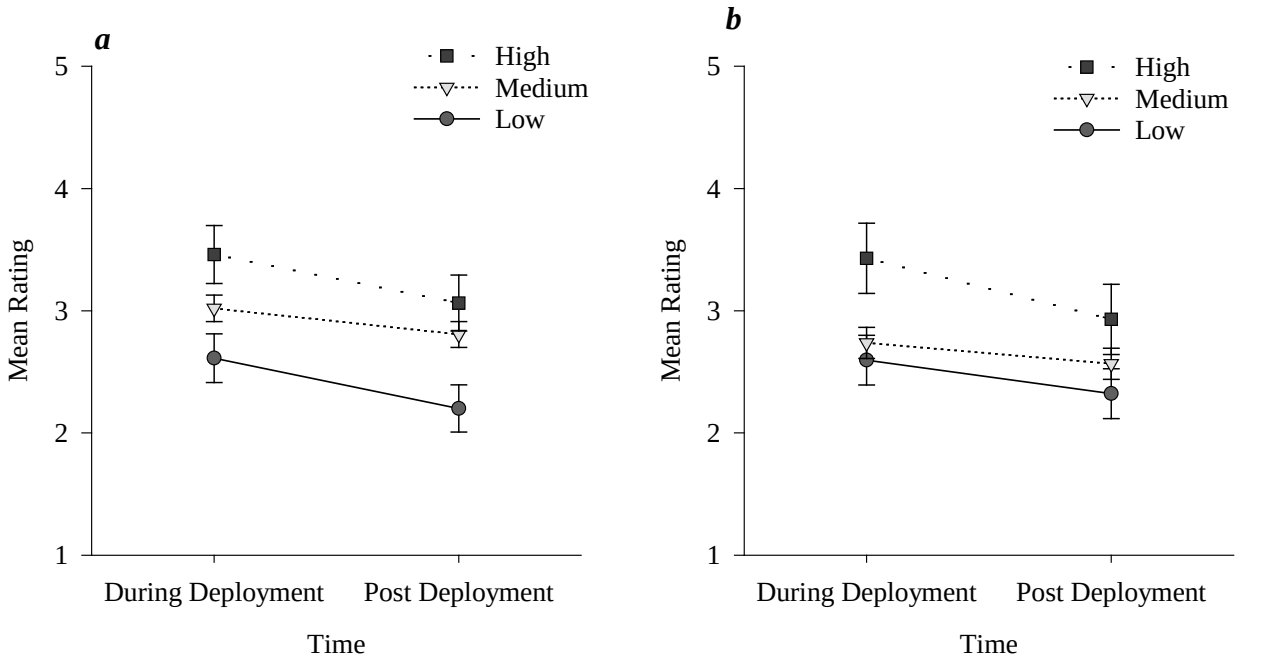

Figure 4. Coherence: a = Negative memory, b = Positive memory.

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Appendix A

The following are examples of memory descriptions of the most negative and most positive memories given by soldiers at both time points. All memories were translated from Danish to English and anonymized. Soldiers gave us permission to quote their memories.

During Deployment:

Most Negative Memory

"When we had four wounded from IED's. No one died, but it was close. It was a feeling of helplessness because I was not out there myself and could not return fire. That is generally the unpleasant thing about IED's, that you cannot shoot back."

"Repeatedly bad management by the leaders. They lack social competences and the ability to listen to specialists who can contribute to the decision-making process."

Most Positive Memory

"When I shot my LMG while under fire at a 105mm. My anger, bitterness, etc. I had accumulated from my missions in Iraq disappeared when I opened up."

"Leave"

"The solidarity and comradeship and that there have only been a few damages and casualties in general in Team"

2-4 Months After Deployment:

Most Negative Memory

"I was the CO of a patrol base in B. and it was therefore also me who delivered the message to the soldiers that three Danes were killed by an IED on Highway 1. On the day where the three soldiers were killed, it was the mortar section who was in charge of the camp. Two of the three had previously been in the mortar section which made it even more difficult to inform about because I knew that several of the guys were close friends with them. The killed soldiers' squad was, by the way, on its way to B. to replace the mortar section and looked forward to the reunion."

"After a suicide bomb blew up in the town, all the wounded were carried into the FOB where I had to remove metal pieces from his stomach before I bandaged him. He had a hole in his stomach the size of my fist. Since it was the first time I saw a real wound of that caliber, it hit me hard"

Most Positive Memory

"The whole mission, my section and colleagues during in mission, the comradeship and experiences we have had. People's positive and professional attitude to tasks."

"I lived in G. town for a week. There were lots of kids whom I talked with and gave candy to every time I was on guard duty. Seeing kids like these full of life and joy in such a tough world as theirs really gave me huge respect for them. The highlight of the day was giving them food and candy"