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Coherence, Disorganization, and Fragmentation in Traumatic Memory Reconsidered: A
response to Rubin et al. (2016)

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Summary

Although clinical theories of posttraumatic stress disorder (PTSD) claim that in this condition trauma memories tend to be disorganized and fragmented, this has been disputed by some autobiographical memory researchers such as Rubin, Berntsen, and their colleagues (e.g., Rubin et al., 2016). In this article I review the evidence for and against the fragmentation hypothesis and identify important sources of methodological variability between the studies. This analysis suggests that fragmentation and disorganization are associated with differences in the type of narrative (specifically, with detailed rather than general narratives), and in the focus of the analysis (specifically, with a local focus on sections of text concerned with the worst moments of the trauma rather than with a global focus on the text as a whole). The implication is that apparently discrepant data and discrepant views can be accommodated within a more comprehensive formulation of memory impairment in PTSD.

Keywords

PTSD, trauma, memory, impairment

General Scientific Summary

This commentary is in response to a previous article (Rubin et al., 2016) that argued memories of traumatic events reported by people with posttraumatic stress disorder are not disorganized or fragmented, as is claimed by clinical theories. I describe two sets of research findings that have come to opposite conclusions, and suggest a resolution: Fragmentation and disorganization are demonstrated when people focus in detail on the most upsetting moments of their traumas but not when they describe the event from a more global perspective.

A number of authors have described posttraumatic stress disorder (PTSD) as a disorder of memory, but there are disagreements about precisely how memory is affected. The disagreements are part of a set of wider inter-related controversies that all emerge from a central debate concerning whether trauma strengthens or weakens corresponding memories. In this article I provide a brief overview of these disputed areas, and discuss the work of Rubin, Berntsen, and colleagues who have challenged the widespread view that in PTSD traumatic memories are disorganized or fragmented. Their studies, along with the data recently reported by Rubin et al. (2016), have important implications for traumatology as they imply the majority of clinical theories contain central flaws. It is therefore necessary to subject these claims to detailed scrutiny and map a pathway toward resolving areas of disagreement.

Controversies Concerning Trauma and Memory

The most notable controversy about the strengthening or weakening effects of trauma on memory has concerned whether traumatic events can be entirely forgotten (i.e., a permanent or temporary lack of semantic memory for the event). One prominent view is that traumatic events are likely to be exceptionally well-remembered and are rarely, if ever, forgotten (McNally, 2003 ; Shobe & Kihlstrom, 1997), a belief that is consistent with evidence that autobiographical memory is enhanced for events that are surprising, emotional, and personally important (Conway et al., 1994; Finkenauer et al., 1998), as well as with the persistent intrusive memories found in PTSD and with a large body of neurobiological research demonstrating that memory tends to be enhanced for emotion-arousing events (Cahill & McGaugh, 1998). Most commentators believe, however, that recovered memories of trauma are possible (Belli, 2012), and clinical observations and surveys routinely indicate that a reversible amnesia, particularly for early traumatic events, sometimes occurs

(Dalenberg, 2006). Such observations are consistent with experimental data demonstrating intentional forgetting (Anderson & Huddleston, 2012) and the forgetting and subsequent recovery of memories in the laboratory (Smith & Moynan, 2008).

A closely-related controversy concerns whether episodic memories of traumatic events the person has never forgotten are likewise exceptionally well-remembered or whether they can be weakened or impaired relative to non-traumatic memories. Although some authors have taken this question to apply to all individuals exposed to trauma (Porter & Birt, 2001; Shobe & Kihlstrom, 1997), the focus of most theorizing has been on individuals with stress-related disorders and the evidence suggests that memory impairment is most strongly associated with PTSD (Brewin, 2007). For example, one form of impairment is the forgetting of important aspects of the event: This symptom is part of the diagnosis of PTSD (American Psychiatric Association, 2013). Ehlers and colleagues have described how most of the trauma survivors seen by their research team remembered the gist of the trauma well but showed confusion about or inability to access some details, or were unclear about the exact temporal order of events (Ehlers, Hackmann, & Michael, 2004).

Other forms of memory impairment have been seen as the cause of the difficulties PTSD patients have in producing narratives of their traumatic event. The impairment was characterized in an early, influential study (Foa, Molnar, & Cashman, 1995) both as a *fragmentation* and *disorganization* in the trauma memory record. Fragmentation, or a lack of flow in the narrative, was operationalized by Foa et al. as consisting of repetitions, unfinished thoughts and speech fillers. Disorganization was operationalized as utterances which implied confusion or disjointed thinking in contrast to utterances indicating realization, decision making, or planning which were coded as organized thoughts.

Finally, the occurrence of a traumatic event has been described as an encounter with information that is inconsistent with the person's beliefs leading to shattered assumptions (Janoff-Bulman, 1992; Schuler & Boals, 2016) as well as to repeated cycles of intrusion and avoidance until the new information is integrated with prior knowledge schemas (Horowitz, 1976). This problem with integration implies that the life narrative of the person with PTSD may be relatively *incoherent* in the sense of not possessing an overall structure in which all the elements are comprehensible and meaningfully related to one another.

In the remainder of the article I set out the opposing evidence for impairment in the trauma memories of PTSD patients before coming to a conclusion that incorporates much of the available data. The conclusion is based on well-recognized distinctions between different types of narrative (those focused on the wider context of the story versus those providing a detailed account of key moments) and different types of rating (those concerned with the narrative as a whole rather than with local parts of it). Analysis using this framework strongly suggests that apparent contradictions in the empirical data are due to differences in the methodology whereby narratives are elicited and rated.

Evidence for Lack of Impairment in PTSD Trauma Memories

The rationale for the series of studies culminating in Rubin et al. (2016) was spelt out in an early paper by Rubin, Berntsen, and their colleagues. They (Berntsen, Willert, & Rubin, 2003) challenged the idea that in PTSD trauma memories were incoherent and proposed that “Instead of leading to disintegration, highly emotional and (thus) distinctive events may help to keep the autobiography integrated by forming reference points for the organization of other less distinctive events” (p. 678) and that “the crucial difference between persons with PTSD and persons with traumas but no PTSD is the degree to which the traumatic memory has formed a landmark in the organization of autobiographical memory, with a continuous impact

on the interpretation of new experiences and the development of expectations for the future” (p. 679). Berntsen et al. (2003) noted that PTSD participants perceived more connections and similarities between the trauma and current experiences in their life than controls and agreed more with the statement that the trauma had become part of their identity, and concluded that both observations conflicted with the idea that the trauma memory is not integrated into the life story.

A major problem with these criticisms is that one of their premises, the description of clinical theories, is incorrect. Although, as we have noted above, theorists concerned specifically with severe early maltreatment have identified amnesia for traumatic events as a possible outcome (Reviere & Bakeman, 2001), in general trauma theorists have always emphasized the great significance traumatic events have for identity, often leading to dramatic changes in values, goals, and views of the self and others (Brewin, 2003; Ehlers & Clark, 2000). What these theories have said is not that the events are unconnected with everyday life but that there are serious discrepancies between the fact of the traumatic event and the person’s previous assumptions and expectations, or hopes for the future. These issues were not assessed by Berntsen et al. (2003), who toward the end of their article proposed that their results pointed not to a “lack of integration” but to a “dysfunctional integration”, and to a traumatic memory that is “too dominant in the organization of the life-story and in the attribution of meaning to old and new, non-traumatic experiences” (p. 690). This, despite their repeated claims to the contrary (Berntsen & Rubin, 2006; Rubin, Berntsen, & Bohni, 2008), is simply a rewording of what the majority of clinical theories have always suggested.

Rubin and Berntsen’s early investigations of memory fragmentation and disorganization in PTSD (Berntsen et al., 2003; Rubin, Dennis, & Beckham, 2011; Rubin, Feldman, & Beckham, 2004) mostly failed to find differences between PTSD and control

samples of students and military veterans. Their studies relied mainly on single-item self-report measures applied to the memory as a whole (e.g., “When you recall the traumatic event, do you then think of it as a continuous series of episodes or as some isolated incoherent fragments?”). In one study that aggregated memory judgements across a number of stressful, important and positive events, rather than focusing on exclusively on traumatic events, Rubin et al. (2011) found no differences between PTSD and control participants on a measure of narrative coherence (“It comes to me in words or in pictures as a coherent story”). However, on a measure of fragmentation (“My memory comes to me in pieces with missing bits”), the PTSD group rated their stressful memories as more fragmented than controls, and this pattern was significantly different to the way the groups rated their positive memories.

More recently Rubin (Rubin, 2011) employed multiple self-ratings addressing different aspects of coherence (e.g., “it comes to me in words or in pictures as a coherent story or episode and not as an isolated fact, observation, or scene”, “while remembering the event, I know the setting where it occurred”) and independent judge ratings. These were applied to traumatic, most important, and most positive events in samples of undergraduates with or without PTSD. The judge ratings included comprehension, a global rating of disorganization (“How much of the text is disorganized – that is, how much of the writing does not add to the development of the narrative and our understanding of the narrator?”), and an assessment of the amount of relevant information provided by narrators with their development of an overall theme. Rubin reported that, except for the memories of the PTSD group being rated by judges as generally more disorganized, there were no significant differences between the groups or interactions between group and type of event. In this study it is hard to interpret the negative results because of the study’s very low power ($n = 15$ in each group). The obtained group x memory type interactions had very small effect sizes, and the sample size would need to be approximately doubled (assuming 80% power and $\alpha =$

.05) to provide an adequate test of the average effect size of $d = .72$ obtained in the judge-rated fragmentation studies reviewed below (Faul, Erdfelder, Lang, & Buchner, 2007). Nor is it clear whether the different measures of coherence were related to each other or were assessing rather different constructs.

In the most recent study (Rubin et al., 2016) the authors recruited two samples of 30 community-dwelling adults who had all experienced traumatic events, one with and without PTSD. Five sets of measures of narrative coherence were employed: Individual single-item participant self-ratings, independent judge ratings of various aspects of narrative coherence and of overall coherence, and two sets of measures scored by computer algorithms assessing such constructs as word concreteness, referential cohesion, temporal connectives, and mentions of cognitive mechanisms and insight. There were low levels of agreement among the judge and computer-scored measures, but no agreement between these and the self-rated measures. Coherence was assessed in relation to participants' three most stressful, important, and positive memories. No effects of group or group by memory type interaction were observed, including when the analyses were restricted to stressful events corresponding to trauma as defined by the American Psychiatric Association, and to the index traumas of the PTSD participants.

Rubin et al. (2016, pp. 12-13) relied on a further assertion in support of their claim that in PTSD traumatic memories are not incoherent or fragmented: That incoherence is part of the PTSD diagnosis yet does not appear to be an important symptom. They argued, correctly, that the symptom "inability to recall an important aspect of the traumatic event(s)", attributed in DSM-5 to dissociative amnesia, implies that the memory is likely to be incoherent. Their next step was to suggest this means incoherence itself is included in the diagnosis of PTSD, in the form of this symptom. They then pointed to numerous studies that

find this dissociative amnesia symptom has rather low loadings in factor analyses of PTSD symptoms, implying that incoherence is therefore not an important aspect of PTSD.

However, unless incoherence only ever arises through dissociative amnesia, the amount of variance explained by this symptom is of doubtful relevance to establishing the importance of incoherence. As we have seen, there are a number of sources of incoherence, disorganization, and fragmentation that do not rely on the person being unable to recall important aspects of the event. There are also likely to be many individuals who obtain a diagnosis of PTSD or ASD (acute stress disorder) without endorsing this symptom, contradicting Rubin et al.'s statement that "the claim that people with ASD (acute stress disorder) have incoherent memories of their stressful event is true by definition" (p. 14).

Summary

The idea that in PTSD trauma memories are prominent and a frequent focus of attention, but that their content is inconsistent with other autobiographical information in memory, is generally accepted. At this more semantic level, there appears to be little disagreement. Addressing a separate question, Rubin, Berntsen, and their colleagues have compared groups diagnosed with PTSD and controls on numerous measures of coherence, including self-ratings, judge ratings of narrative qualities, and computer-scored indices. Importantly they have included comparison memories to test whether any observed group differences are specific to traumatic events, as clinical theories would predict. With one or two minor exceptions, mainly to do with ratings of fragmentation, the data from this series of studies are consistent in failing to locate systematic differences between groups or interactions between group and memory type, thus calling into question clinical claims concerning narrative coherence.

Evidence for Incoherence or Fragmentation in PTSD Trauma Memories

Although, as noted above, memory is often enhanced by emotion-arousing events, this enhancement is selective. Arousal does not lead to the enhancement of all aspects of a memory, particularly if some elements are strongly attention-grabbing, and the same processes that enhance central memory can also result in memory for peripheral, adjacent, or unrelated material being poorer (Kensinger, 2009). Moreover, high levels of anxiety or stress *in the individual* are associated with generally poorer memory (Deffenbacher, Bornstein, Penrod, & McGorty, 2004; Kim, Pellman, & Kim, 2015), and with a greater preservation of central over peripheral information (Waring, Payne, Schacter, & Kensinger, 2010). In terms of underlying mechanisms, high levels of stress appear to have opposite effects on the amygdala and hippocampus, with negative effects on long-term potentiation, neuronal morphology, and neurogenesis in the latter (Kim et al., 2015). Animal studies suggest that in the context of stress high levels of corticosteroids impair contextual learning (including the learning of which contexts are safe), an effect that may be enhanced by repeated traumatic experiences (Fensterwald, Steinmetz, Travaglia, & Alberini, 2015; Kaouane et al., 2012). Models of PTSD grounded in neurobiology have specifically identified a deficit in contextual learning such that trauma results in enhanced memory for specific sensory aspects but a relative inability to locate the event within its temporal and spatial circumstances (Brewin, Gregory, Lipton, & Burgess, 2010; Desmedt, Marighetto, & Piazza, 2015).

Consistent with this literature, impairment to voluntary trauma memory in PTSD, along with enhanced involuntary intrusion of specific trauma scenes, was identified in a number of early research reports (Foa et al., 1995; Koss, Figueredo, Bell, Tharan, & Tromp, 1996; van der Kolk & Fisler, 1995), has featured in all the major psychological theories of this condition (Brewin, Dalgleish, & Joseph, 1996; Ehlers & Clark, 2000; Foa & Rothbaum, 1998), and was confirmed in a series of reviews (Brewin, 2007, 2011, 2014). The most recent review (Brewin, 2014) detailed six studies that, using independent judge ratings of trauma

accounts, all found evidence for greater disorganization or fragmentation in the trauma memories of adults or children with acute stress disorder (ASD) or PTSD than in healthy controls. Some of these differences were highly significant, and the average effect size was substantial (Cohen's $d = .72$). Studies using self-ratings of disorganization had more varied results, but none found significantly greater disorganization in a control than in a PTSD sample.

Rubin et al. (2016) recognized that there is support for the proposition that trauma memories are more incoherent or fragmented in PTSD than control samples, but suggested that this is not enough: They should be “incoherent to the degree that would be needed to argue for incoherence as an explanatory mechanism” (p. 13). They then concluded that because the differences in some studies (Halligan, Michael, Clark, & Ehlers, 2003) were numerically small and fell in the lower half of measures of incoherence, they were unimportant. This argument is problematic for a number of reasons. First, incoherence or fragmentation are usually thought to reflect problems in fully encoding the memory (Foa et al., 1995) – it is this altered encoding that is the explanatory mechanism, not incoherence and fragmentation which are a product of it. Second, even if incoherence is accepted as an explanatory mechanism, it is far from being the only cause of PTSD, so it is unclear why it is necessary to demonstrate very large case-control differences. Finally, scores in the lower half of a measure of coherence do not mean the problem is clinically unimportant (for example, Beck Depression Inventory scores of 18 fall in the lower part of the scale range of 1-63 but are still associated with clinically diagnosable conditions). Moreover, Rubin et al. did not draw attention to evidence which contradicts their assertion, such as the moderate to large size of the obtained effects with fragmentation/disorganization, and the fact that five separate studies now show how these same impairments in voluntary trauma memory predict the

course of PTSD, in some cases over and above the effects of initial symptom levels (Brewin, 2014).

Rubin et al. (2016) criticized a second study that supported memory impairment in PTSD (Jelinek, Randjbar, Seifert, Kellner, & Moritz, 2009) on the grounds that it “found a similar interaction for one rater-coded measure but not for another rater-coded measure or for a self-reported coherence questionnaire” (p. 14) . Their statement gives the impression that across the three measures there was less rather than more support for the hypothesis. However, the key analysis reported by Jelinek et al. is the MANOVA assessing the hypothesis when all three measures were taken into account simultaneously and, although the self-report measure showed the weakest effect, the measures taken together did show the predicted interaction. Similar evidence of memory impairment has been demonstrated in children with ASD (Salmond et al., 2011) but was also dismissed by Rubin et al. Contrary to their argument, the diagnosis of ASD does not require either an incoherent trauma memory, nor that any incoherence is demonstrated to be specific to the trauma memory. Rubin et al cite a fourth investigation (Römisch, Leban, Habermas, & Döll-Hentschker, 2014) that did fail to find the predicted interaction between fragmentation and the presence of PTSD, but this negative result cannot be meaningfully interpreted because of the study’s very low power ($n = 14$ in each group). The sample size would again need to be approximately doubled to provide an adequate test of the average effect size of $d = .72$ obtained in the other fragmentation studies.

Summary

The idea that specific episodic representations of traumatic events can be partially incomplete, fragmented, or disorganized is consistent with clinical theory and current knowledge concerning the neurobiology of memory. Although the differences so far

identified between PTSD and control groups are modest in numerical terms, when measures utilize independent judge ratings of text the effect sizes are moderate to large, show the predicted differences between trauma and non-trauma memories, and demonstrate predictive validity.

Toward a Resolution of the Coherence/Fragmentation Controversy

Although the sets of studies that do and do not support the coherence/fragmentation hypothesis are frequently described as though they are measuring the same thing, a careful reading of the articles reveals important differences both in how narratives are elicited and how coherence is measured. Foa and colleagues (Foa et al., 1995) conducted their original study in the context of a PTSD treatment trial and elicited the kind of narratives used in reliving sessions: Participants were given specific instructions to imagine the events were happening again, to keep their eyes closed, and describe the event in as much detail as possible, including the surroundings and the activities of the actors in the event as well as everything they thought and felt. In such recall there is a strong emphasis on describing sensations in all modalities. The event was defined as beginning with the first expressed realization of danger and ending with the first expressed realization that threat had terminated.

These methods allow for the fact that trauma memories are often complex and extended in time, with the most threatening moments liable to occur prior to or after the event itself (e.g., the person may fear they are going to die when subsequently in an ambulance or in hospital). Moreover, narratives of the same event often vary considerably, with specific versions being bound by time and context (Habermas & Bluck, 2000). Consistent with this, PTSD patients become adept at producing a variety of well-rehearsed narrative versions of their traumatic event to communicate with family, acquaintances, the police etc. These

typically summarize their experience in varying amounts of detail but generally avoid the most painful moments that are liable to trigger reliving experiences. These moments have been referred to as ‘hot spots’ in the trauma literature (Grey, Holmes, & Brewin, 2001; Holmes, Grey, & Young, 2005). This is an aspect of the avoidance that characterizes the disorder, and one that therapists recognize they have to overcome if the narrative produced is to be clinically valuable. The explicit requirement to immerse oneself in the memory and report as much as possible, whether in therapy or in the clinical studies of trauma narratives that have mostly followed the Foa et al. methodology, tends to trigger reliving, usually in the form of vivid and detailed visual images or flashbacks (Brewin, 2014; Hellowell & Brewin, 2004). In contrast, the narratives collected by Rubin (2011) and Rubin et al. (2016) do not appear to have included any of these specific instructions.

Scholars investigating life narratives have distinguished local coherence, concerned with neighboring clauses in a text, and global coherence, concerned with an entire text (Habermas & Bluck, 2000). Studies of narrative coherence, whether focused on the life story or more specific autobiographical events, typically focus on the global level and address features such as the provision of a context in which events take place, their temporal organization, the causal connections between elements, and the way elements are organized into themes (Reese et al., 2011). The majority of the self-report, observer, and computer-based ratings employed by Rubin, Berntsen, and their colleagues, including those more specifically focused on the centrality of the trauma memory (Berntsen & Rubin, 2006), have assessed aspects of global coherence. Echoing these data, other studies have failed to find consistent differences in global coherence either when they used computer-generated ratings to compare the narratives of PTSD and control samples (Gray & Lombardo, 2001), or when they compared memories of intensely negative events with other events (Porter & Birt, 2001; Waters, Bohanek, Marin, & Fivush, 2013; Waters, Shallcross, & Fivush, 2013). In contrast,

most of the clinically-based studies have followed Foa et al. (1995) in segmenting trauma narratives into utterance units and conducting analyses on local coherence (or *cohesiveness*, as Foa et al. termed it) and on content relating to specific moments of disorganized thought.

This suggests a refinement to trauma theories, which have sometimes been imprecise about distinguishing which aspects of coherence, disorganization, or fragmentation are typical of PTSD (Ehlers et al., 2004). The data are clear that these terms include a variety of processes that are not necessarily correlated. The new proposal is that at the global level, and when the individual is producing a general, well-rehearsed narrative that focuses on the outline of the trauma story, trauma and non-trauma memories are essentially similar in their levels of coherence. This is line with predictions derived from Rubin's (2011) account. An event for which the person has a coherent memory can nevertheless represent a turning point or mark a discontinuity in the life narrative (Berntsen et al., 2003; Horowitz, 1976; Janoff-Bulman, 1992). At the local level, however, amnesic gaps, other types of fragmentation, and evidence of disorganized thoughts will be present when a highly detailed narrative is elicited that includes a focus on the most frightening moments. Some of these effects may be produced by spontaneous reliving interrupting the expression of the trauma memory (Brewin, 2007). This is in line with the observations and proposals made by Ehlers et al. (2004).

This revised formulation of trauma memory impairment incorporates the separate evidence that exists for discontinuities in memory associated with intensely emotional moments, including the experience of flashbacks (Brewin, 2015), dissociation (Harvey & Bryant, 1999), hot spots (Holmes et al., 2005), memory gaps (Ehlers et al., 2004), and spontaneous verb tense shifts (Hellowell & Brewin, 2004; Pillemer, Desrochers, & Ebanks, 1998). One study that specifically investigated memories for the worst moments of a trauma found that in individuals with PTSD, these moments involved more unfinished thoughts,

fewer words indicating reflective processing, and more words in the present tense than the remainder of the narrative, which was not the case for the non-PTSD comparison sample (Jelinek et al., 2010).

The revised formulation is consistent with the observation that of the very small amount of evidence found by Rubin and colleagues to support the fragmentation hypothesis, almost all involved ratings of local rather than global text features (e.g., “my memory came back to me in pieces”). It also accounts for Rubin’s observation that differences in fragmentation ratings of trauma memories typically involve relatively small differences in the lower half of a global rating scale. This is to be expected if what is being rated are features to be found in local areas of memory rather than characteristics of the event memory taken as a whole. From this perspective it also makes sense that independent judge ratings based on an analysis of individual utterances are more consistent in their findings than global ratings of the memory, whether made by the participant or an independent judge. Finally, the revised formulation accounts for the fact that previous reviews (Crespo & Fernández-Lansac, 2016; O’Kearney & Perrott, 2006), which did not make these distinctions, were unable to come to definite conclusions regarding fragmentation in traumatic memory. Although there may be additional sources of variability that could explain the contradictory findings, none were identified in the earlier reviews.

Testing the revised formulation should be relatively straightforward, but requires eliciting trauma narratives using contrasting instructions emphasizing overall gist versus a focus on highly emotional moments, and then analysing both narratives with measures of global and local coherence. In addition it will likely be useful to utilize the techniques of authors who have focused on subsections of text corresponding to hot spots and flashbacks (Hellawell & Brewin, 2004; Jelinek et al., 2010), and to investigate the relative contribution

of disturbances at encoding and at retrieval. Hopefully the coherence/fragmentation debate can move on from a current tendency to deny the validity of opposing data while ignoring the very different methods with which they have been collected. A more constructive outcome would be to seek better precision of terms as well as more comprehensive theories that do a better job of identifying the cognitive locus of memory disturbance in PTSD.

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