The purpose of this chapter is to provide a summary of our current knowledge of autobiographical memory at the behavioral and neural level and how it can be applied to posttraumatic stress disorder (PTSD), a disorder whose diagnostic criteria and symptoms depend on autobiographical memory. I start with everyday memories in nonclinical populations because it is unlikely on theoretical and empirical grounds that changes in autobiographical memory in PTSD occur for just trauma-related memories rather than for autobiographical memories in general (Rubin et al., 2008a; 2008b; 2011). In addition, based on just the diagnostic symptoms of PTSD, there is good reason to examine general changes in autobiographical memory. The reliving, avoidance, and arousal symptoms of PTSD are not exclusive to the memory of the index trauma on which diagnosis is made. Rather, they extend to memories related to the index trauma in various ways from low-level direct perceptual matches to very abstract and symbolic similarities. Even repetitive intrusive memories do not have to repeat verbatim but can relate to different aspects of a trauma (Berntsen & Rubin, 2008). Avoidance symptoms include avoiding situations a neutral observer may not think would be reminders of the trauma. Arousal symptoms involving hyper-vigilance extend to more than appropriate trauma-related vigilance, and the increased startle response symptom results from stimuli unrelated to the trauma.

The section immediately following this brief introduction is titled “Autobiographical Memories are Constructed.” Memories are constructed in the sense that processes create the memories anew each time they are recalled rather than retrieving a stored fixed version of the past. The constructive nature of memory is generally accepted by clinical and cognitive psychology, but for highly emotional events including flashbulb memories and trauma there has also been the conflicting proposal that an accurate image of at least fragments of the event remains unaffected by constructive processes or the passage of time, a proposal that I argue against. The next section, titled “The Basic System Model as an Account
of the Construction of Autobiographical Memory,” includes a review of everyday autobiographical memories in nonclinical populations using a model that considers the component systems needed to construct an autobiographical memory. The section following that, titled “Differences in the Construction of Voluntary and Involuntary Memories of Trauma in PTSD,” contains a review of what is known about the differences that exist among three clinically relevant dimensions whose extremes are (1) whether the autobiographical memory is for a trauma or an everyday event, (2) whether the person having the autobiographical memory has PTSD or not, and (3) whether the autobiographical memory is involuntary or voluntary (see Berntsen, Chapter 9). The basic findings for everyday voluntary memories in nonclinical populations can serve as a comparison for these three clinically relevant dimensions. I report on basic findings in key areas that have been of concern to PTSD, including sensory imagery, emotional intensity, the sense of reliving involved in flashbacks, involuntary memories and their relation to voluntary memories, and the role of the narrative coherence of memories.

The final section before the conclusion is titled “Are Special Autobiographical Memory Mechanisms Needed?” These have been called special mechanisms in the literature because it is claimed that there is something special about trauma memories in PTSD. I focus on four special mechanisms that are explicit or implied in the DSM-IV-TR and continued in the DSM-5 (American Psychiatric Association, 2000; 2013) and in some, but not all, theories of PTSD. The first is that there exists a fixed, accurate, though perhaps fragmented memory of the traumatic event. The second is that dissociation is common and is especially strong for trauma memories in individuals with PTSD. The third is the fragmentation and incoherence of trauma memories in individuals with PTSD. The fourth is that involuntary memory has privileged access to trauma memories in individuals with PTSD. To counter the first special mechanism I examine the active construction of memories and their similarity to imagining future events. To counter the second, third, and fourth special mechanisms, I examine the independent contributions of the three clinically relevant dimensions discussed earlier. Support for the second, third, and fourth special mechanisms requires an interaction of these dimensions that should lead to marked differences in memories of traumatic events (or just involuntary memories of traumatic events) in people with PTSD when they are compared with relevant comparison memories. Thus, support for special mechanisms would come from differences that cannot be explained as additive effects of the three dimensions of whether the event was traumatic, the diagnosis of the person, and the voluntary versus involuntary nature of the recall.
Autobiographical memories are constructed

As with all memories, autobiographical memories are not stored and recalled; they are constructed anew at each recall (Bartlett, 1932). Both cognitive and clinical researchers believe this at a general level; in practice clinicians use the constructive nature of memory in therapies that change the evaluation and even the basic observations of their clients’ memories. However, there are additional pressures on clinicians that purely academic researchers do not have. Clinicians must work within legal systems, diagnostic systems, and their clients’ belief systems, which at times view memories as fixed and accurate representations of the past. I therefore stress a fully constructive view of memory here to counteract the nonconstructive views that are present in the cognitive and clinical literature. It may seem odd to have or to make claims about such a highly constructive autobiographical memory when accuracy would seem to be of value. It is especially odd to assume such a constructive memory for a crime or trauma when both the legal system and the diagnostic system assume that memory for such events can be recalled accurately enough a month or more after they occurred for testimony in court or for the basis of meeting the criterion for PTSD. For trauma, even in cases where the memory cannot be recalled, many theories assume the memory remains hidden in the individual as an accurate picture of the event waiting to be cued or uncovered. This is discussed later in the chapter (for general reviews, see Bryant, Chapter 2, and Dalgleish, 2004; for reviews more critical of the inclusion of nonconstructed memory, see Frankel, 1994; McNally, 2003; Rubin et al., 2008a; Smith, 2011). In contrast to the allure of photographic memories, there is a long and well-supported intellectual history arguing for constructive memory at the behavioral and neural level going back at least to Bartlett (1932). Moreover, how the memory is constructed and the person’s reaction to it may play a more important role than the objective severity of the actual event (Rubin & Feeling, 2013; Rubin et al., 2008a). Therefore, before describing the constructive process in the next section, I provide two nonclinical examples, disputed memory ownership and future negative events, which illustrate in as radical fashion as I can find many of the points to be made later.

Twins often have similar memories of the same event, in which both twins remember the event in similar ways, except that each twin remembers that the event happened to them. When we first documented this phenomenon, we called it disputed memory ownership (Sheen et al., 2001). In it, the basic facts about the event are not disputed; only the “self” is in dispute. To ensure demand characteristics were not
producing the effect, we first presented twins with cue words and asked for memories. Seventy percent of the twins produced disputed memories. For example, to the cue word *birthday*, in one set of twins each recalled having her ear glued to her head by a guest. In another set, both thought he was the one not invited to a friend’s birthday party. Next, a different sample of twins who indicated they had disputed memories were asked to produce both disputed and nondisputed memories and to rate them on scales similar to those described later in the section on behavioral measures. The disputed memories were recalled with more reliving, emotion, and sensory vividness involving vision, audition, and spatial layout, even though for some events one twin may not have been present. Disputing to whom an event occurred is interesting for autobiographical memories in which the self is a defining feature, and could be seen as a form of out-of-body experience, extreme dissociation, or confabulation. For current purposes, it argues strongly for the constructive nature of memory in a nonclinical and less controversial way.

In recent years, both cognitive and clinical psychologists have noted with increased frequency that the same processing used to reconstruct events to examine the past can also be used to construct future events, to plan the future in realistic situations, and to imagine the future in more creative ones (see McNally and Robinaugh, Chapter 12). In such situations, construction is not in doubt because there is no event to remember. The basic finding from the existing literature on future episodic thought is that the behavioral and neural processes involved are generally similar to those used in the recall of past events (for reviews, see D’Argembeau, 2012; Miles, 2013; Rasmussen, 2013; Schacter & Addis, 2007; 2009; Szpunar, 2010).

For examples of events that must be imagined and how they compare to remembered events, I consider future negative events and undergraduates’ reactions to them because this will be the most relevant to the negative memories to be considered here (Rubin, 2014). Undergraduates were asked to describe three negative events that would affect them that might occur in the near future or that did occur in the recent past; to rate the events on the scales of reliving, emotion, sensory vividness, and other measures; and to complete a widely used self-report test of PTSD symptom severity, the Posttraumatic Checklist (PCL; Weathers et al., 1994). Several findings are of interest. First, undergraduates’ expectations of future events were generally consistent with culturally shared schemata. In particular, academic problems were reported by 58% of the students; own, family member, or friends’ injury or illness by 42%; family member or friend’s death by 39%; application rejected by 21%; and end of a romantic relationship by 21%. Together these
categories accounted for 60% of the undergraduates’ three responses. Second, PTSD symptom severity scores on the PCL for past events were typical of these students, but for future events PTSD symptom severity scores were well into the clinical range and would clearly be of concern if they were reporting actual reactions to remembered past events. The high PTSD severity scores were especially surprising because many expected events were relatively mild in terms of those that cause PTSD and most would not qualify as a trauma for clinical purposes. Nonetheless, imagining future events allowed the participant to consider much more troubling events than had actually happened in the past. Third, in spite of the higher PTSD severity scores and consistent with the literature on constructing future events, future events had fewer sensory details than past events unless extra effort was devoted to developing the descriptions of the events. Fourth, the correlations between individuals’ ratings of properties of these past and future events often approached their reliabilities, indicating that the extent to which individuals varied in the degree that they used the processes rated were the same for past and future events. For example, individuals who had high visual imagery ratings for past events also had them for future events.

Thus, the constructive processes were similar. The worst events for the future were expected to produce more severe PTSD symptoms than did the actual worst events of the past, and the contents reflected common cultural expectations. The ability to construct past events allows future events to be constructed and allows preparation in case they occur, but the processes used for autobiographical memory could also support worry, anxiety, and clinical disorders involving expectations for the future when done to excess.

The basic system model as an account of the construction of autobiographical memory

Having claimed that autobiographical memories are constructed, a theory of how is in order. The construction of such memories cannot be considered as a simple unitary process with a highly localized neural basis; rather, autobiographical memories are constructed using a host of standard cognitive and emotional systems. The basic systems model is a comprehensive theory that I summarize here only briefly, as it appears in more detail elsewhere (Greenberg & Rubin, 2003; Rubin, 2005; 2006; 2014). According to the model, all autobiographical memories are constructed through the interaction of basic systems. Stability and change in autobiographical memories are due to the schemata of each system (e.g., narrative schemata, visual schemata, auditory schemata) as well as how
the various systems interact. Properties of autobiographical memories that are centered in a single system can be measured by self-reports and by neural activity in that system. Properties that depend on multiple systems, such as metacognitive judgments of reliving, can be predicted by the degree of activity in the multiple systems. That is, autobiographical memories are constructed not from an abstract, propositional cognitive structure, but rather from sensory, language, emotion, and other systems, each of which uses fundamentally different structures and processes for fundamentally different kinds of information. Each system has its own functions, processes, structures, kinds of schemata, and types of errors, which have been studied individually. Figure 3.1 is a simplified schematic of the model.

Each component system in the basic systems model has a long intellectual and experimental history. Most of the components date back as far as the recorded history of speculation about the mind (e.g., the five senses, narrative, and emotion). Exceptions are the separate components for language and narrative, a division that is based on current behavioral and neuropsychological data (Rubin & Greenberg, 2003); the search-and-retrieval system, a construct that in memory research has roots in Atkinson & Shiffrin’s (1971) control processes and Baddeley’s (1986) central executive; and the event memory system, which has been a subject of study at least since the 1960s. In earlier work (Rubin, 2006),

Figure 3.1 A schematic of the basic system model.
I called the hippocampus based event memory system the explicit memory system, but event memory is more accurate (Rubin & Umanath, in press).

It would be exceedingly difficult to deny that the basic systems are useful scientific concepts that describe components of the mind and brain. Perception, cognition, and neuroscience textbooks divide the mind and brain into these basic systems, including separate systems for each of the senses, language, emotion, and motor output (Rubin, 2006). The scientists who study the mind and the brain divide their journals and societies along these lines. Each system can be supported by results from (1) neuroanatomy, (2) neuropsychology, (3) neuroimaging, (4) cognitive-experimental psychology, and (5) individual differences research. Knowledge from all five sources sharpens and constrains predictions regarding memory functions of all the basic systems. Moreover, each system, with the possible exception of the event memory system, is used for tasks other than memory. Thus, each system is the only system of its kind in a model that could be extended to explain cognition in general, and so the considerable amount already known about each system from its nonmnemonic functions further constrains its functioning as a component system of memory (see Barsalou, 1999, for a similar approach to semantic memory).

**Neuropsychological results**

If the basic systems model is to be supported by and offer insight into the effects of neuropsychological damage, then damage to different systems should have different effects on autobiographical memory (Greenberg & Rubin, 2003; see also Rathbone and Moulin, Chapter 14). The three systems shown at the left of Figure 3.1 have long been known to affect autobiographical memory. The frontal lobe based search system is needed to find information relevant to a memory and inhibit information that is irrelevant to the memory. Its damage leads to confabulation. The hippocampus/medial temporal lobe based event memory system binds information that has been active at the same time in a relatively automatic fashion. Its damage leads to a general loss of autobiographical memory in the form of a general amnesia for events occurring after the damage and less loss for events before the damage. But neither of these systems stores the information that is used to construct an autobiographical memory; rather, they coordinate the storage and retrieval of information from the other systems. The emotions system is also placed to the left of the figure as its main function here is to modulate the other systems, affecting storage and retrieval of information from them. Of the systems on the right, damage to vision produces the most dramatic losses. Damage that results in visual memory loss, defined by the inability to identify an object...
by sight and to draw the object given its name or function (Farah, 1984), results in visual memory-deficit amnesia, which is marked by a dense general amnesia for all events that occurred before the damage and loss of visual information for events after the damage (Greenberg et al., 2005; Rubin & Greenberg, 1998). In contrast, damage to the other senses provides minimal loss to autobiographical memory beyond the loss of information in the memory related to the particular sense. Given the location of most of the lesions producing visual memory loss, it is likely that scenes as well as objects are affected. Loss of narrative reasoning has obvious effects on the organization of memories, whereas language loss does not seem to have major effects if extended time or other means are allowed to support the communication of the memory. Although this description is not the way the effects of neural damage on autobiographical memory are usually described, it is well documented and evolved from an early version of the conceptual model shown in Figure 3.1 (Greenberg & Rubin, 2003; Rubin 1995; 2006).

Neuroimaging results
Reviews of the neuroimaging literature on autobiographical memory converge on a network of brain regions involved in autobiographical memory retrieval that involve the search, narrative reasoning, emotion, event memory, and vision systems in a fashion that is generally consistent with the neuropsychological results (Cabeza & St. Jacques, 2007; St. Jacques 2012; Svoboda et al., 2006). They also include midline areas, especially in the anterior cingulate, that are involved in self-referential processing. The voluntary retrieval of an autobiographical memory can take on the order of 10 seconds. Because functional magnetic resonance imaging (fMRI) typically provides an image of the whole brain every 1.5 to 2 seconds, one can observe activity in the basic systems over time (Daselaar et al., 2008; St. Jacques et al., 2011b). There is less research on the changes in autobiographical memory in PTSD (St. Jacques et al., 2011a; 2013). However, there are consistent changes in script-driven imagery and a host of other procedures that indicate that the changes in PTSD are more widespread than in other anxiety disorders (Etkin & Wager, 2007).

Behavioral results
The way that we have measured the components of the model shown in Figure 3.1 behaviorally is to make rating scales intended to show how actively each system contributes to the underlying process. Table 3.1 shows a sample of the kind of scales chosen for their relevance to the
discussion of changes in the activity of the systems in PTSD and in the trauma memories. The emotion section provides intensity measures for the emotion circle on the left of Figure 3.1. The rehearsal section measures not a basic system but rather the availability of the memory for voluntary and involuntary recall. There are two sections on measures of narrative reasoning, measuring two levels of integration: how integrated the memory is to the broader life narrative and how internally coherent it is. The senses section of the table measures the systems in the right of Figure 3.1. Finally, there is a metacognitive judgments section to measure phenomenological judgments about the memories that play important roles in cognition and clinical issues. Reliving, which is a key aspect in cognitive theories of everyday autobiographical memory, appears in clinical theories of trauma memories, especially for intrusive memories where high levels are flashbacks (see Bryant, Chapter 2). The top three sections measure properties that show the greatest change for trauma memories and for PTSD.

Depending on the goals of the research we modify, add, and omit scales; thus they are public-domain attempts to capture many individual

<table>
<thead>
<tr>
<th>Variable</th>
<th>Brief Description of Rating Scales</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Emotions</strong></td>
<td></td>
</tr>
<tr>
<td>Intensity</td>
<td>While remembering, the emotions that I feel are extremely intense.</td>
</tr>
<tr>
<td>Reaction</td>
<td>I had a physical reaction (laughed, felt tense, sweaty, heart pounding).</td>
</tr>
<tr>
<td>Mood Change</td>
<td>The memory changed my mood.</td>
</tr>
<tr>
<td><strong>Frequency with Which the Memory Comes to Mind</strong></td>
<td></td>
</tr>
<tr>
<td>Rehearsal</td>
<td>Since it happened, I have thought or talked about this event.</td>
</tr>
<tr>
<td>Involuntary</td>
<td>This memory has come to me out of the blue, without my trying.</td>
</tr>
<tr>
<td><strong>Narrative Integration into Life Story</strong></td>
<td></td>
</tr>
<tr>
<td>Life Story</td>
<td>The event in my memory is a central part of my life story.</td>
</tr>
<tr>
<td><strong>Narrative Integration Internal to Event</strong></td>
<td></td>
</tr>
<tr>
<td>Story</td>
<td>It comes to me in words or in pictures as a coherent story.</td>
</tr>
<tr>
<td>Pieces</td>
<td>My memory comes to me in pieces with missing bits.</td>
</tr>
<tr>
<td><strong>Senses</strong></td>
<td></td>
</tr>
<tr>
<td>See</td>
<td>While remembering the event, I can see it in my mind.</td>
</tr>
<tr>
<td>Setting</td>
<td>While remembering the event, I know the setting where it occurred.</td>
</tr>
<tr>
<td>Hear</td>
<td>While remembering the event, I can hear it in my mind.</td>
</tr>
<tr>
<td>Smell</td>
<td>While remembering the event, I can smell it.</td>
</tr>
<tr>
<td><strong>Metacognitive Judgments</strong></td>
<td></td>
</tr>
<tr>
<td>Reliving</td>
<td>While remembering the event, I feel as though I am reliving it.</td>
</tr>
<tr>
<td>Belief</td>
<td>I believe the event in my memory really occurred – not imagined.</td>
</tr>
</tbody>
</table>
processes of interest rather than a normed single scale. Collectively, these scales are the Autobiographical Memory Questionnaire (AMQ). We have participants rate their voluntary and involuntary memories and future constructions while they are producing them, as this provides a more valid indication of the ongoing processes than retrospective reports (Ericsson & Simon, 1993). The rating scales have been used extensively in studies of autobiographical memory, so we know a great deal about how they normally function and relate to each other and to personality and other individual differences measures as well as in other cultures and in clinical populations; we know not only how the means on the scales vary with task, but also how they correlate with each other (Rubin, 2014; Rubin & Siegler, 2004; Rubin et al., 2003; 2004; 2007; 2008a; 2008b; 2011; Sheen et al., 2001).

Differences in the construction of voluntary and involuntary memories of trauma in PTSD

The cube shown in Figure 3.2 contains the mechanisms postulated to account for the general changes in autobiographical memory. Three cognitive and affective mechanisms on the vertical (y) axis are properties of the memory that increase the ease with which the memories come to mind, that is, their availability (Tversky & Kahneman, 1973) or accessibility (Tulving & Pearlstone, 1966). They are (1) the emotional intensity of the memory; (2) when and how often the memory has been retrieved in the past, as measured here by the retrospective reported frequency of voluntary and involuntary recall; and (3) the centrality of the memory to the person’s life story and identity (see Boals and colleagues, Chapter 4). Because centrality involves how a memory fits into the core events of a person’s life, it requires, but is more than, a normal integration with other autobiographical memories. These three mechanisms, which increase the encoding and maintenance of memories, are greater for extremely stressful events than for most other events (for reviews, see Rubin et al., 2008a; 2008b). They also work by augmenting each other. Independent of their valence, more emotionally intense events come to mind more frequently both voluntarily and involuntarily (Berntsen & Rubin, 2014; Hall & Berntsen, 2008), have more vividness and reliving (Talarico et al., 2004), and tend to be about current concerns and so become more integrated into a person’s autobiographical memory and identity (Conway, 2005). Similarly, rehearsal and centrality help maintain the memory and its emotional intensity.

These three mechanisms, which vary across all memories, also vary across all people as indicated in the individual differences factor on the
In terms of individual differences, rather than the remembered event, people vary in the degree of emotional intensity with which they experience all kinds of events (Larsen & Diener, 1987) and in how central events are to their life stories (Berntsen & Rubin, 2007; Rubin et al., 2008b). Because emotional intensity and centrality to the life story affect availability, availability will also vary across people, causing differential rehearsal that results in differences in the retention of memories and their emotional impact. PTSD is associated with increases in these three mechanisms (Rubin et al., 2008b; 2011).

Emotion regulation is indicated on the front-to-back (z) axis of Figure 3.2. In terms of individual differences, rather than the remembered event, people vary in the degree of emotional intensity with which they experience all kinds of events (Larsen & Diener, 1987) and in how central events are to their life stories (Berntsen & Rubin, 2007; Rubin et al., 2008b). Because emotional intensity and centrality to the life story affect availability, availability will also vary across people, causing differential rehearsal that results in differences in the retention of memories and their emotional impact. PTSD is associated with increases in these three mechanisms (Rubin et al., 2008b; 2011).

Emotion regulation is indicated on the front-to-back (z) axis of Figure 3.2. Because involuntary memories of all kinds, including those of traumatic events, come “unbidden” or “out of the blue,” cued by thoughts or
the environment in ways that are unexpected to the person instead of by a directed, voluntary search (Clark and colleagues, Chapter 7; Moulds and Krans, Chapter 8; Berntsen, Chapter 9; Berntsen, 2009), they benefit less from mechanisms of emotion regulation (Gross, 2001). Therefore, all involuntary memories will occur with more emotional reaction and mood change (Berntsen & Hall, 2004). For traumatic events they will be more “intrusive” than their voluntary counterparts, producing more of the reliving symptoms of PTSD than voluntary memories. Such involuntary memories can be especially disturbing because their unbidden nature can be interpreted as a lack of control. Thus, the arousal and avoidance symptoms of PTSD will result as an attempt to monitor and avoid situations and thoughts that might cue involuntary memories of the stressful event.

Starting in the lower left front cube, which is transparent, increases in emotional intensity, rehearsal, and centrality are illustrated by moving once up or to the right and are indicated by light gray. Two moves result in an even greater increase, as indicated by medium gray. A move to the back, which is from voluntary to involuntary memory, decreases emotion regulation, and thus the increases for moving in this direction involve only emotional intensity. Combining all three moves is indicated in the dark gray cube. Moderate changes on each dimension can add to substantial differences when the voluntary everyday memories of people without PTSD are compared with the involuntary trauma memories of people with PTSD. The next four sections examine the effects of behavioral changes in each of these three dimensions and of changes in more than one.

To pursue these three dimensions, I use a single study that allows all the comparisons illustrated in Figure 3.2 to be made in a clinical sample (Rubin et al., 2011), though the results changed in only minor ways when an analog sample of undergraduates that varied in PTSD symptom severity was measured (Rubin et al., 2008b). The clinical sample consisted of 117 community-dwelling participants, 75 with PTSD and 42 controls. Individuals in the control group were not required to have a trauma as defined by the DSM-IV-TR diagnosis, but 73% reported one during their clinical interview. Participants were excluded from the control group if they met criteria for lifetime PTSD or current subthreshold PTSD. All participants provided ratings for measures, including those in Table 3.1, for their three most-stressful or traumatic events, their three most-positive events, their seven most-important events not included in their most-stressful or most-positive events, and fifteen word-cued memories. The most-positive memories are the closest match for the most-stressful ones, being both important and of high emotional intensity. The
most-important memories differed further from the most-stressful ones by having less intense emotions. The word-cued memories differed even further by also being less important. In addition, 90 of the participants agreed to carry a personal data assistant for a period of two weeks on which they could answer the questions in Table 3.1 as well as note whether the memory was related to one of their three most-stressful memories. Of these participants, 86 recorded seven or more involuntary memories (59 in the PTSD and 27 in the control group) and are included in the involuntary memory analyses. These participants also recorded and rated a comparison voluntary memory from the same period of life as each involuntary memory.

**Behavioral differences in trauma memories**

Compared with the most-positive memories, the most-stressful memories were higher on the intensity, involuntary, and reliving ratings. Compared with the most-important memories, the most-stressful memories were higher on these ratings and also reaction, rehearsal, life story, and hear. Compared with the word-cued memories, the most-stressful memories were higher on these ratings and also see, setting, and story. The only exception to this pattern for the scales listed in Table 3.1 was that the most-stressful memories came more in pieces when compared with the most-positive memories. Thus, the comparison memory is crucial to the amount of differences seen, with the differences increasing as the comparison memories become less emotional and less important. Overall, consistent with Figure 3.2, ratings associated with the mechanisms of more intense emotions, more prior voluntary and involuntary recall, and more centrality to identity were higher for the most-stressful memories in all people; ratings of the sensory variables and narrative differences internal to the memories showed fewer differences.

**Behavioral differences in PTSD**

When the ratings of participants with and without PTSD were examined, a similar pattern arose, though with larger differences. In particular, for all four kinds of memories, participants with PTSD rated their memories as higher on intensity, reaction, rehearsal, involuntary, life story, hear, smell, reliving, and belief. See and setting were higher on three of the types of memories but not for the most-positive memories. Ratings of story were higher for participants with PTSD for word-cued and most-important memories, and ratings of pieces were higher for participants with PTSD for their most-stressful memories. Consistent with Figure 3.2, ratings
associated with the mechanisms or more intense emotions, more prior voluntary and involuntary recall, and more centrality to identity were higher for people with PTSD in all four kinds of memories; ratings of the narrative differences internal to the memories showed fewer differences.

**Behavioral differences in involuntary memories**

In this comparison involuntary memories were rated as they occurred for two weeks; comparison voluntary memories from the same period of life were obtained immediately after each involuntary memory. In involuntary memories had higher ratings on intensity, reaction, mood change, and reliving. Prior voluntary rehearsal was rated higher for voluntary memories. Thus, there were differences in ratings of associated emotions as noted in Figure 3.2 as well as in the metacognitive judgment of reliving. For these data we did not have three kinds of comparison memories but did have the participants’ ratings of whether each memory was related to their three most-stressful memories. For this comparison, all the ratings associated with our three mechanisms (e.g., intensity, reaction, mood change, life story, rehearsal, and involuntary) were higher for memories related to most-stressful events, as was hear, story, and reliving. There were no interactions of being related to most-stressful memories and whether the memory was voluntary or involuntary for any of the measures listed in Table 3.1.

**Behavioral differences when multiple dimensions are considered**

The model proposed here and shown in Figure 3.2 does not require that all effects be additive; theoretically motivated interactions could exist, but it is simplest if there are no interactions. Moreover, alternative conceptions of the role of autobiographical memory in PTSD often rely on special mechanisms that apply to PTSD, and these often imply interactions when both differences in people and memories are considered. When a mechanism is postulated to account for an effect that occurs only in trauma memories in people diagnosed with PTSD, an interaction is always implied, as additive effects cannot make such a prediction. Thus, interactions play a key role here in testing the simplest form of the model to see if it needs modification.

When interactions with the most-stressful versus the other three kinds of memory as one factor and whether the participant had PTSD or not as the other were examined for all measures present in the main study, three interactions were found from 39 independent ANOVAs. They were for ratings of reliving for word-cued memories, of involuntary for word-cued
memories, and of pieces for positive memories. In all cases, participants with PTSD had a larger difference for their most-stressful memories. None of these interactions was a “crossover” interaction in which people with PTSD were higher on a measure for one kind of memory and lower for another. For the online involuntary memory task, one factor corresponded to whether participants had PTSD or not; another corresponded to whether the memory was involuntary or voluntary; and a third factor corresponded to whether the memory was related to a stressful event or not. One of 56 possible interactions from 28 independent ANOVAs was observed. Memories related to a stressful event had a larger difference in their ratings of smell for participants with PTSD. All four interactions from both analyses were reasonable and did not indicate a pattern challenging the mechanism proposed here.

Behavioral difference: conclusions and implications

The main differences that were observed were additive and were in ratings related to the mechanisms shown in Figure 3.2. There were few differences in narrative measures internal to the memories, though there were large differences in narrative measures of whether the memories were important to the participants’ life stories. Most clinical research focuses on trauma memories, so less is known about the substantial changes that occur in PTSD in nontrauma autobiographical memories even though these nontrauma memories also contribute to the general functioning of the individual. Such nontrauma autobiographical memories should be easier to probe in a therapeutic setting because they are less distressing, so relevant characteristics of nontrauma memories such as emotional intensity, availability, centrality, and reliving that are also impacted may also be of use in the therapeutic process.

Are special autobiographical memory mechanisms needed?

The purpose of reviewing the literature that argues that memories are constructed using the well-established cognitive and affective systems shown in Figure 3.1 and the mechanisms shown in Figure 3.2 has been to see if they could account for phenomena noted in the recall of trauma memories in people with PTSD. So far the chapter has argued that they can. However, other explanations of the same phenomena have been offered that directly contradict the theory and evidence presented here; they are special mechanisms in that they claim that there are special
processes for trauma memories in PTSD. Four of these special mechanisms have generated considerable debate, and I address them here.

The first special mechanism is that there exists somewhere in the mind and brain an accurate memory of the traumatic event, perhaps etched indelibly by the high emotion of the trauma (Pitman, 1988). This memory could be accessible and of the “I will never forget it” variety, but more often it is hidden from conscious recall, with the exception of possible fragmentary versions that break through, often in dreams or involuntary memories. The idea can be seen as a particular version of repression or dissociation in which accuracy is preserved. It thus has a long intellectual tradition. There certainly can be mechanisms that could keep a memory from conscious recall, such as active inhibitory mechanisms, passive lack of effective cuing, or forgetting mechanisms. Most troubling, however, is the assumption of a fragmentary or intact accurate enduring memory that is often confounded with this view (e.g., Ehlers et al., 2004; Horowitz & Reidbord, 1992). For example, it is assumed that the memory of the trauma needed for a diagnosis of PTSD is accurate for at least a month after the event, and studies of repeated intrusive memories often assume that the exact same memory fragment returns without change. Much has been written on this issue (Berntsen, 2001; 2009; Berntsen & Rubin, 2008; Frankel, 1994; Kihlstrom, 2006; McNally, 2003; Rubin et al., 2008a), which is paralleled by debates within cognitive literature on flashbulb memories and in earlier debates on repressed memories of childhood abuse. Here I simply note that an accurate memory that is unaffected by the passage of time and changes in the person is counter to everything that is known from the scientific study of memory at the behavioral and neural level as reviewed, in part, earlier in the chapter. It is possible for some texts to remain stable for centuries over countless retellings through numerous individuals, but the stability is within limits and requires mnemonic systems; it is never unchanging (Lord, 1960; Rubin, 1995). In fact, the basic systems model shown in Figure 3.1 was first devised to account for such stability. In a situation of highly negative emotional intensity in which a person’s life is in danger, and in which resources should be focused on survival, accurate memory would not be expected (Rubin et al., 2008a).

The second special mechanism is that dissociation is especially strong for trauma memories in individuals with PTSD (Ehlers et al., 2003; van der Kolk & van der Hart, 1989; see Bryant, Chapter 2, for a review). Without addressing the vexing question of exactly what dissociation is (Giesbrecht et al., 2008; Hacking, 1995), dissociative experiences such as those measured by the dissociative experiences scale (Bernstein & Putnam, 1986) are a personality trait that in the extreme can qualify as
the basis of its own disorder and as well as a part of other clinical disorders. Dissociation and dissociative experiences may be increased by chronic childhood trauma, abuse, or neglect (e.g., Chu & Dill, 1990) or other factors, though Goodman et al. (2010) note that reduced memory for negative events has not been adequately demonstrated in maltreated children, and Giesbrecht et al. (2008, p. 617) found that “evidence for a link between dissociation and either memory fragmentation or early trauma based on objective measures is conspicuously lacking.” Because dissociative experiences by definition exist for a wide variety of behaviors, it is not clear that any evidence indicates dissociation or dissociative experiences appear at especially high levels specifically for the index trauma leading to the diagnosis of PTSD. Specific dissociative-like behaviors, such as the traumatic event being seen from a third-person or out-of-body perspective, can be understood in terms of regular cognitive mechanisms such as tunnel memory (Bryant, Chapter 2; Rice & Rubin, 2009; 2011; Rubin et al., 2008a). The arguments about which dimensions in Figure 3.2 act as main effects and which act as interactions apply here as much for the theoretical claim of a special mechanism of dissociation as for the data for evaluating it. Although the DSM-5 allows for PTSD “with dissociative symptoms” (American Psychiatric Association, 2013, p. 272) if there is depersonalization and derealization in addition to the other symptoms, two of the general symptoms of PTSD and two of acute stress disorder are framed in terms of dissociation.

A third special mechanism, which is often seen as a part of dissociative behavior, but which I separate out here because it is often measured independently and need not require dissociation, is the fragmentation and incoherence of trauma memories in individuals with PTSD. Fragmentation and lack of coherence are observations made by PTSD researchers (e.g., Brewin et al., 1996; 2010; for reviews, see Bryant, Chapter 2; Brewin & Holmes, 2003; Dalgleish, 2004; Kihlstrom, 2006; McNally, 2003; 2009; Rubin et al., 2008a; Shobe & Kihlstrom, 1997). Fragmentation is also included as a PTSD symptom, described as an “inability to recall an important aspect of the trauma” (American Psychiatric Association, 2000, pp. 467–468). Again the arguments used for Figure 3.2 apply. Main effects of the form shown in Figure 3.2 abound for people with and without PTSD or who are high and low on PTSD symptom severity. Because the coherence with which a memory is given is related to education and general levels of stress, the interpretation of these data is unclear, though in any case they can be seen as a simple main effect in most studies, as comparison memories were not usually obtained. There are also studies showing that trauma memories are less...
(or more) coherent than nontrauma memories both in people in general and in those with PTSD, another main effect. There is only one study that appears to show the needed interaction, but it was found for only one of the three measures of coherence used in that study (Jelinek et al., 2009). In addition, there is one study that uses six measures of coherence and fails to find the interaction (Rubin, 2011). In all studies I have seen, there is no report of a level of real incoherence in any group or condition; the ratings obtained are all in levels that range from very coherent to slightly less coherent. For reviews of what has become a fairly substantial literature, see Berntsen and Rubin (2014) and Rubin (2011). Thus, when the logic used in Figure 3.2 is applied to the findings, the data do not support this special mechanism.

A fourth special mechanism is that involuntary memory has privileged access to trauma memories in individuals with PTSD. This idea is central to Horowitz’s stress response syndromes (1976), which was the theoretical basis for the initial introduction of PTSD into the current diagnostic system. It is reflected in the current diagnostic listing of involuntary (intrusive) recollections as symptoms of PTSD with no mention of voluntary remembering except as being fragmented (Berntsen & Rubin, 2014). This view continues in current theories (Brewin et al., 1996; 2010; Ehlers & Clark, 2000; for reviews see Bryant, Chapter 2, and Berntsen, Chapter 9). In contrast to this view, the results reviewed here from Rubin et al. (2011) showed two additive effects with no interaction: the same ratings were higher for all voluntary and involuntary memories in participants with PTSD, and voluntary and involuntary memories related to very stressful and traumatic events in all participants. Thus, we reported no privileged status for trauma memories in PTSD beyond that which could be accounted for by additive effects. Four other studies show similar main effects in nonclinical populations (Berntsen & Rubin, 2014; Ferree & Cahill, 2009; Hall & Berntsen, 2008; Rubin et al., 2008b); I know of no exceptions. Thus, this special mechanism lacks support.

In all of these examples, the data and literature review presented here are inconsistent with the need for special mechanisms. Moreover, the use of the dimensions presented in Figure 3.2 helps to clarify the exact nature of some of these claims in terms of whether support for them requires just general properties of the person, the memory, or involuntary versus voluntary recall, or rather requires an interaction effect that should lead to a behavior being markedly higher with respect to memories of traumatic events (or just involuntary memories of traumatic events) in people with PTSD. Once this issue is clear, the existing studies can be more fairly reviewed, and future studies not subject to the critique of a lack of proper comparisons can be designed to test these mechanisms.
Conclusions

The purpose of this chapter was to review what we know about everyday autobiographical memory as it applies to behaviors that become symptoms of PTSD. As part of this exploration, I considered the properties of memories that are needed to produce the various behaviors considered as symptoms and how they change for traumatic events, for people with PTSD, for involuntary memories, and for these dimensions considered in combination. There were clear main effects of all dimensions that were consistent with proposed mechanisms, but few interactions. The results support the conclusion that involuntary and voluntary memories of traumatic events in people with PTSD can be understood in terms of standard mechanisms of cognition, emotion, and personality. There was no support for additional special mechanisms. This does not mean that such special mechanisms do not exist. It does mean that serious attempts to find them should demonstrate effects beyond the additive effects shown here by including appropriate comparisons on the dimensions needed for the claim.

Acknowledgments

I wish to thank Kaitlyn Batt, Dorthe Berntsen, Samantha Deffler, Christin Ogle, and Lynn Watson for comments and discussions, and National Institute of Mental Health grant R01 MH066079 and the Danish National Research Foundation grant DNRF93 for support.

REFERENCES


