A Longitudinal Investigation of the Reliability of Memories for Trauma and other Emotional Experiences

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SUMMARY

This study examined the relative consistency and characteristics of memories for trauma and other non-traumatic emotional experiences over time. A community sample of 52 participants who reported a recent traumatic event were asked to recall both the traumatic and a positive emotional experience in two interviews separated by approximately three months (M = 105.39 days). The recollections were elicited with either a free narrative, cognitive interview, guided imagery, or written narrative approach. Results indicated that traumatic experiences were recalled more reliably over time than other emotional experiences. Traumatic memory imagery tended to persist in memory (with no apparent impairment), whereas features of positive memories were subject to considerable distortion, regardless of interview style. The findings contribute to the understanding of the impact of trauma on memory with the passage of time. Copyright © 2004 John Wiley & Sons, Ltd.

The nature of traumatic memories has become a major focus of cognitive research and a heated debate in psychology (e.g. Read, 2001). Psychological ‘trauma’ is an affective/cognitive experience resulting from exposure to an event involving injury, threats, or death. These types of experiences are subjective, and based on the individual’s response to the event. The most severe psychological outcome of a traumatic experience is Posttraumatic Stress Disorder (PTSD), affecting about 9–15% of the population (Diagnostic and Statistical Manual of Mental Disorders; DSM-IV-TR, American Psychiatric Association, 2000; Breslau, Davis, Andreski, & Peterson, 1991). People with PTSD live with painful recollections of a horrific experience, typically characterized by extremes of recall: intrusive memories combined with avoidance of thoughts or feelings about the event. In fact, many people report being ‘haunted’ by memories of the experience (e.g. Schiraldi, 2000).

Not only would a better understanding of trauma and memory have basic implications for cognitive psychology (e.g. Porter & Birt, 2001), but could also have important applied implications. First, it could lead to knowledge of the processes that underlie and maintain PTSD. Secondly, information concerning traumatic memory is important in the courtroom, where judges and juries experience much difficulty in assessing the credibility of memories for traumatic events from the distant past (e.g. Porter, Campbell, Birt, & Woodworth, 2003). Further, there are widespread concerns relating to the reliability of

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historical allegations, memory for alleged violence that has been witnessed, and ‘recovered’ memories (e.g. Loftus, 2003; Read & Lindsay, 1997). There is evidence that memories for allegedly traumatic events can be highly distorted or even completely mistaken (e.g. Porter, Yuille, & Lehman, 1999).

Despite the growing scientific attention, there remain important controversies concerning the nature of traumatic memories (e.g. McNally, 2003). One issue is the degree to which they change or evolve with the passage of time, in terms of their phenomenological properties and factual consistency. For example, do memories of traumatic experiences decrease in their level of detail and coherence or, in contrast, can they become elaborated and more integrated with time? Further, what level of similarity can be expected between details recalled about a traumatic event soon after its occurrence and those recalled later? Studies of memory consistency have primarily focused on so-called ‘flashbulb’ events, such as the terrorist attacks on September 11, 2001 (e.g. Talarico & Rubin, 2003). Other research on memory consistency has focused on experiences that may not be emotionally salient or directly involve the participant (e.g. Hoyert & O’Dell, 2000). More research is needed on the reliability of memory for personally significant traumatic events (e.g. criminal victimization). Another issue that requires attention is the influence of the remembering context (such as various interviewing approaches) on the consistency of traumatic memories. In applied settings, memory reports are elicited using a wide variety of approaches that may influence the accuracy and consistency of memory differently. The present study was designed to address these questions via conducting a longitudinal evaluation of the consistency of emotional memories over time and elicited via different interview formats.

THE TRAUMATIC MEMORY DEBATE

A large body of research indicates that human memory is highly malleable and constructive (e.g. Loftus, 2003; Schacter, 2001), often deviating greatly from the objective reality of the experience. Although it has been theorized that trauma can influence both memory formation and retrieval, the issue of the degree to which constructive processes affect the quality and consistency of traumatic memories is the subject of much debate (e.g. Byrne, Hyman, & Scott, 2001; Porter & Birt, 2001). Some researchers have found that memories for emotional events (in general) are relatively static with the passage of time (e.g. Conway, Anderson, Steen, & Donnelly, 1994), whereas others have found them to be malleable and subject to substantial alteration (e.g. Neisser & Harsch, 1992; Southwick, Morgan, Nicolaou, & Charney, 1997). Although it is often argued that memory impairment increases with the severity of the stress or trauma, this claim is highly controversial. In general, there have been two main streams of thought concerning the impact of trauma on the reliability of memory. One perspective, known as the traumatic memory argument, contends that trauma results in memory impairment (see Kihlstrom, 1996). According to this view, traumatic memories exist as powerful sensory and emotional images, characterized by a lack of coherent verbal narrative (e.g. Herman, 1992). Highly emotional and sensory ‘fragments’ or flashbacks may be all that remain of the experience in memory. One basis for the traumatic memory argument is that trauma activates defence mechanisms, resulting in dissociation and a lack of conscious awareness for the ‘factual’ aspects of traumatic events. Traumatic events also are thought to be encoded differently from non-traumatic experiences leading to a lack of integration in memory (e.g. Herman & Schatzow, 1987). If these arguments are
correct, recollections of trauma should be poor (assuming they are available in some form for recall) and lacking in specific details, or the ability to verbalize such details. Some research has yielded findings in apparent support of the traumatic memory argument. Southwick et al. (1997) conducted a longitudinal examination of memory for combat related trauma associated with Operation Desert Storm. Gulf War veterans were asked about their experiences one month and two years after their return from the war. The results indicated that there was a considerable degree of inconsistency in recall for traumatic events. Overall, 88% (52/59) of participants provided inconsistent responses to one of the 19 memory items on a questionnaire (e.g. ‘extreme threat to your personal safety’, ‘seeing others killed or wounded’), and 61% (36/59) changed their responses on two or more items. In addition, the type of inconsistencies varied; 70% were due to added information (e.g. reporting an event at the two year interval not previously reported) and 46% were errors of omission (e.g. not reporting an event after the two year interval that had been previously reported). Byrne et al. (2001) examined the similarities and differences between memory ratings for traumatic, negative, and positive life experiences in a survey format. Analyses revealed that traumatic and negative experiences were recalled more poorly than positive experiences with regard to some sensory information and some aspects of the narrative structure of the event.

Conversely, the trauma superiority argument asserts that trauma may enhance memory rather than impair it (e.g. Porter & Birt, 2001; Shobe & Kihlstrom, 1997). Research supporting the trauma superiority argument finds that memories for traumatic events are not recalled in fragments, but rather are continuously and clearly remembered (e.g. Berntsen, 2001; Pipe et al., 1997). Much research on personally involving traumatic events generally provides evidence against the notion that such experiences are poorly remembered (e.g. Yuille & Cutshall, 1986). For example, Wagenaar and Groeneweg (1990) examined memory reports from survivors of a Nazi concentration camp from the mid-1940s (at the Nuremberg Trials) and again at a trial in the mid-1980s. Overall, these people retained remarkably detailed, consistent memories of their personal experiences 40 years after they occurred. Although some inconsistencies were evidenced (e.g. forgetting having seen someone killed), these frequently involved experiences of less personal salience to the survivor. Yuille and Cutshall (1986) also found no evidence of memory impairment in 13 witnesses to a shooting incident (and murder) who had been interviewed by police immediately after the incident and by the researchers four to five months later. At both recalls, witnesses provided highly accurate and detailed accounts of the event’s actions (83% accurate), persons (76% accurate), and objects (90% accurate), as established by police reports. Some variations in accuracy between witnesses resulted from differences in the distance from the gunman, degree of involvement in the event, and the amount of times witnesses had discussed what they had seen with others (factors that are difficult to control in field research). Porter and Birt (2001) asked 306 adults to give an account of their most traumatic experience and most positive emotional experience. Unlike the findings of Byrne et al. (2001), traumatic events with a more severe impact were associated with greater vividness and detail in memory relative to events with lower stress levels. Using a similar methodology to the Southwick et al. (1997) study mentioned above, King et al. (2000) found that reports of combat experiences remained relatively consistent over a two-year period in male veterans. Although these studies using military samples examined memory consistency for particular traumatic experiences, the results should be interpreted with caution. Consistency was measured by comparing Yes/No responses on a standardized set of war experience items (e.g. did you see another get wounded or killed) on two
occasions, rather than allowing for a comparison of freely recalled responses and details. Overall, then, there is some variability in research findings concerning the reliability of traumatic memory. However, little research has investigated the reliability of traumatic memories over time under controlled conditions, and with a control group of non-traumatic memories within the same participants. It also remains unclear how the specific type of interview approach used to elicit the traumatic memory influences the reliability of the memory over longer periods.

THE INFLUENCE OF INTERVIEW FORMAT ON TRAUMATIC MEMORIES

It is possible that the manner in which traumatic accounts are elicited could influence the reliability of memory over time. There is evidence that certain memory elicitation approaches can lead to memory distortion. These include having the person repeatedly think about an event (e.g. Read, 1996), repeated questioning (e.g. Zaragoza & Mitchell, 1996), or multiple attempts to envision the scene (e.g. Hyman & Pentland, 1996). It is important to examine interview procedures that are commonly used in forensic and therapeutic settings. For example, the step-wise interview has been used extensively for interviewing both children and adults in forensic settings (e.g. Yuille, Hunter, Joffe, & Zaparniuk, 1993). Similarly, the cognitive interview (CI) has been used extensively in both American and British criminal investigations (e.g. Memon, 1998). Guided imagery (GI) techniques have been used extensively in research on memory distortion (e.g. Clancy, McNally, & Schacter, 1999; Porter et al., 1999) as well as in therapy settings. Finally, written narrative (WN) techniques are common in criminal investigations (e.g. having a witness write out a statement for police). For the present study, these four commonly used interview approaches were selected to compare changes in the consistency of memory reports across different interview formats.

THE PRESENT STUDY

This study builds on existing work in several ways. First, consistency was measured for both traumatic and positive emotional (control) events over an interval of approximately three months. Although previous research has been conducted on the properties of emotional memories, little is known about the consistency of traumatic and positive memories over time. Second, detailed comparisons of participants’ memory for events at time 1 (T1) and time 2 (T2) were conducted on several self-report and objective characteristics. Third, the inclusion of four commonly used interview styles enabled a further examination of sources of potential bias in memory over time. The longitudinal design allowed an examination of descriptions of various components—both phenomenological and factual—of traumatic experiences in two interviews separated by a relatively lengthy period of time. We predicted that traumatic memories would be more reliable/consistent over time than positive emotional memories. However, it was also predicted that both types of emotional memories would be vulnerable to the influence of potentially biasing interview techniques. Specific biases associated with some interviewing techniques (e.g. GI) have not been thoroughly examined with respect to real-life recent traumatic events. It was hypothesized that interview techniques associated with the use of imagery, mental reinstatement, and reverse recall techniques (e.g. CI and GI) would be less
consistent over time (relative to the FN and WN techniques). These hypotheses were tested by using within-subjects comparisons of memory characteristics and self-reported responses at both recalls and across interview conditions. In addition, consistency scores were generated on 12 factual characteristics common to each type of event (e.g. date, time of day).

METHOD

Participants
Fifty-two participants were recruited from the community via television and newspaper advertisements. Respondents had to meet several criteria to be eligible to participate, including being over 18 years of age, having experienced a recent traumatic event (within the past year), having moderate to severe levels of traumatic stress in response to that event (see below), and consenting to two confidential interviews separated by several months. Participants provided informed consent and were offered $10 per interview. Of the 52 participants who were interviewed at T1, 49 (94%) were successfully re-contacted and agreed to complete the second interview. The mean age of the participants’ was 38.8 years ($SD = 13.1$; range 19–75 years). Participants were predominantly female, with 39 (75.0%) women and 13 (25.0%) men.

Design
The design was a 2 (memory type) × 2 (time) × 4 (interview) mixed multivariate factorial. This study had a longitudinal component, with two interviews separated by approximately three months ($M = 105.39$ days; $SD = 46.18$), with variations due to scheduling (in accordance with participant availability). Participants were randomly assigned to one of the four interview conditions: FN, CI, GI, or WN.

Materials
Impact of Event Scale (IES)
The IES, developed by Horowitz, Wilner, and Alvarez (1979), was used to provide a subjective measurement of the level of traumatic stress associated with a particular traumatic experience reported by the participants. This 15-item self-report questionnaire asked participants to rate the frequency of occurrence of various cognitive experiences in relation to a traumatic event (e.g. I tried not to think about it; any reminder brought back feelings about it). Ratings are scored as 0 (not at all), 1 (rarely), 3 (sometimes), and 5 (often). The IES contains two subscales that measure the extent to which the memories and ideas about the traumatic event intrude in daily life, as well as the degree of avoidance of memories and stimuli associated with the event. Total scores were generated by combining the subscale scores, and provided an assessment of the overall level of impact of the event (higher scores represent greater impact of the traumatic event). Scores on the IES were used as a measure of traumatic stress, to establish that the events reported were indeed ‘traumatic.’ This scale has been used extensively with trauma victims (Porter & Birt, 2001). Further, the IES has shown good test-retest reliability ($r = 0.87$) and is sensitive to measuring changes in levels of traumatic stress over time (Horowitz et al., 1979). A cut-off
score of 25 was used as the criterion for participation in order to select for moderate to severe levels of traumatic stress, and would reflect a ‘traumatic’ event as defined by the Post-Traumatic Stress Disorder criterion A-1 (e.g. *DSM-IV-TR*, American Psychiatric Association, 2000; Carlson, 1997).  

**Memory assessment procedure (MAP)**

The MAP was used as a tool to examine the qualitative aspects of traumatic memory (e.g. see Porter & Birt, 2001), as well as possible differences that arose over time and as a function of interview style. The MAP measured both phenomenological (self-report) and presentation-specific (rated by coders) characteristics of memory. This procedure evaluated a variety of characteristics, such as coherence, amount of detail, and emotional components (e.g. see Porter et al., 1999, for operational definitions of the items). Following transcription, each memory report was coded using this scheme. Inter-rater reliability was assessed on the subjective MAP criteria (amount of detail, emotional components, coherence, relevance) by trained research assistants, blind to the hypotheses of this study, for 20 interview transcripts (19.8% of the sample).

**Emotional memory survey (EMS)**

The EMS, which is the self-rated portion of the MAP, was modified for the present study, and measured participants’ self-reports about the characteristics of their memories. A 7-point scale was used to obtain subjective ratings of various characteristics (e.g. frequency of thinking about the event, perceived vividness/clarity of memory). Sensory experiences associated with both memory types were also measured using the EMS. Total sensory scores were calculated by summing the ‘yes’ responses to the presence of visual, auditory, tactile, olfactory, and gustatory sensory details in memory.

**Consistency questionnaire (CQ)**

This questionnaire was designed for use in the present research, and was intended to assess consistency in the details of memory reports. Questions consisted of details from 12 factual categories (e.g. time of day, number of people at the scene, what the participant was wearing, etc.) that would be applicable for both traumatic and positive emotional memories. Responses to direct questions (e.g. Do you remember your emotional state just before the event?) were written down by the interviewer, and later coded. The coding scheme compared responses from each interview format and time interval, and answers were rated as: (0) inconsistent, (1) partially inconsistent, (2) partially consistent, or (3) consistent. Responses were coded as inconsistent if they differed between T1 and T2 and contained one or more contradictions of fact. When the responses differed between interviews, but there was no direct contradiction of fact (e.g. omissions), they were coded as partially inconsistent. Partially consistent responses involved information (at least one component or fact) that was the same across T1 and T2, as well as additional information that was not presented previously (and was not a contradiction). Finally, responses were coded as consistent when the words or the semantic meaning of the responses were the same at both interview times.  

Total consistency scores were calculated for each memory type by summing the numerical ratings across the 12 event categories. Responses on the CQ were rated by a second trained

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1Participants were also assessed on their PTSD symptoms using the Modified PTSD Symptom Scale (Falsetti, Resnick, Resick, & Kilpatrick, 1993). However, these data will be addressed in another article focusing on the psychological impact of traumatic events.

2Contact the authors for further description and coding criteria using this consistency coding scheme.
coder, blind to the hypotheses of the current study, for 51% of the sample (25 randomly selected participants), to allow an examination of inter-rater reliability.

**Interview protocols**

*Free narrative (FN)*

Based on an element of the step-wise interview protocol (e.g. Yuille et al., 1993), the FN approach encouraged participants to provide a detailed description of the event of interest from start to finish, with no interruption by the interviewer. The second phase involves careful use of general, open-ended questions, to allow the elaboration of information elicited during the FN phase. Direct questions arise only from previously presented information, to reduce the likelihood of memory distortion. For example, ‘You mentioned that it was late when the attack occurred, do you remember what time that was?’

*Cognitive interview (CI)*

Developed by Geiselman and Fisher (e.g. see Geiselman et al., 1984), the CI uses several mnemonic techniques to maximize information retrieval from memory (e.g. Memon, 1998). Here, the first CI technique was context reinstatement, which encouraged participants to mentally recreate the context of the original experience (including environmental context, emotional reactions and feelings, as well as sensory perceptions). Secondly, participants were asked to change perspectives during recall to broaden the ‘field of view’ in memory (e.g. field and observer perspectives, see Porter & Birt, 2001; Porter et al., 1999). Finally, participants were asked to begin their recall from varying starting points within the original event (e.g. recall in reverse order, or starting from the middle of the event).

*Guided imagery (GI)*

The GI has been used as a therapeutic and research technique to explore traumatic memories, and is highly variable in application (e.g. Lindsay & Read, 2001). For the present study, the GI interview began with an imagination exercise, followed by free recall of the emotional events. The next phase involved mental reinstatement of the event in question by imagining components of his/her surroundings during the original emotional experience (such as the weather, objects or people), followed by questions about the event (e.g. Hyman & Pentland, 1996; Porter et al., 1999). Participants then were asked to repeatedly visualize particular aspects of the event (e.g. emotionally salient information), and engage in altered visualizations (e.g. imagining the event happening at a different time of day; a series of ‘what would have happened if . . .?’ statements). The preceding visualization techniques are used in GI (and in the present study), although GI exercises are not limited to those discussed above.

*Written narrative (WN)*

The use of WN of emotional events has been examined in several studies of factors influencing mental health following a stressful event (e.g. Francis & Pennebaker, 1992; Porter & Birt, 2001), and appears to have a positive effect on health (e.g. Pennebaker & Francis, 1996). Instructions given to participants were as follows: think back to the traumatic event that you experienced during the past year, and write everything you can remember about the incident from the beginning to the end in as much detail as possible.
Procedure

Interview one (T1)
Participants were asked to first recall either their traumatic experience or their most positive emotional experience within the past year (counterbalanced). Method of disclosure varied according to interview condition, with the FN, CI, and GI interviews involving verbal dialogues (recorded on audio cassette for later transcription) and the WN being handwritten. Immediately following the recall of the first emotional memory (traumatic/positive), participants completed the EMS. The next phase of the interview involved participants recalling their second emotional event (either traumatic or positive) depending on which they recalled first. Recall of this event was elicited via the same interview style used for recall of the first memory. After recall of each emotional memory type and completion of the EMS, participants were asked 12 direct questions from the CQ (in the form of ‘Do you remember . . . ’ questions).

Interview two (T2)
In the second interview, participants were required again to recall both the positive and traumatic memory discussed in Interview One. The structure of this interview consisted of free recall only for all conditions, followed by completion of the EMS, and direct questions from the CQ (identical to those in Interview One). After completing the interview, participants were paid and thanked for their assistance.

RESULTS

Descriptive statistics

Event characteristics
For the positive events, the event categories were as follows: 23.4% relationship related, 19.1% celebrations, 17.0% personal accomplishments, 14.9% employment related, 14.9% vacations, and 10.6% other types of events (e.g. employment, unexpected significant surprise). For the traumatic events, the participants reported 32.7% witnessing death of loved one, 25.0% violent (including sexual) personal victimization, 19.2% serious injury/accident, and 23.1% other types of events (e.g. abortion, September 11th). All of the latter experiences constituted ‘traumatic events’ in accordance with the DSM-IV-TR (American Psychiatric Association, 2000) definition of trauma (Criterion A-1). There were no statistically significant differences in the mean ratings of emotionality for positive ($M = 4.54, SD = 2.11$) and traumatic ($M = 5.30, SD = 1.69$) events, indicating that both memory types in this sample were similarly emotional ($p > 0.05$).

Time interval characteristics
The second interview was conducted an average of 105.39 days ($SD = 46.18$) after the initial interview, depending on the participants’ availability (although we originally planned a standard three-month follow-up, this was not possible due to the availability of the participants). The average interval between the occurrence and initial recall of positive experiences was 180.89 days ($SD = 171.16$) and 222.69 days ($SD = 343.49$) for traumatic experiences. There were no significant differences between the amount of time elapsed for both memory types, $t(42) = 0.52, p > 0.05$. In addition, consistency did not vary according to whether there were short (less than 150 days) or long (150+ days) intervals between the
experience and recall for both positive ($F(1, 42) = 0.029, p > 0.05$) and traumatic ($F(1, 47) = 0.008, p > 0.05$) events.

**Level of trauma reported**

Events were considered traumatic if IES scores fell within the 25 to 75 range (moderate to high impact). The mean total score on the IES at the time of the first interview was 44.0 ($SD = 12.38$), with mean subscale scores of 23.46 ($SD = 8.12$) for intrusion and 20.53 ($SD = 7.76$) for avoidance. At the time of the second interview, the mean total score was 30.9 ($SD = 16.91$), with mean subscale scores of 15.55 ($SD = 9.68$) for intrusion and 15.38 ($SD = 8.68$) for avoidance. Results suggested that the overall impact of the traumatic event decreased over time ($t(48) = 7.27, p < 0.001$), as did intrusive ($t(48) = 6.81, p < 0.001$) and avoidant ($t(48) = 4.92, p < 0.001$) psychological experiences.

**MAP reliability check**

The six subjective components of the MAP (amount of detail, emotional components relating to the self and others, coherence, relevancy, repeated details, and reasons for lack of memory) were re-coded. All MAP characteristics for both memory types were highly reliable (all $p$s < 0.05), with correlations between $r = 0.70$ and 0.99. There were no significant mean differences between Rater 1 and Rater 2 according to paired $t$-test analyses.

**Consistency coding scheme reliability**

An intercoder reliability check was conducted on the coding scheme by a trained coder (blind to the hypotheses) who followed the same coding guidelines as the first coder. Each T1 and T2 response set was coded on a continuum of inconsistent, partially inconsistent, partially consistent, and consistent. The reliability check (using 49 files with T1 and T2 data) indicated that the coded scores for both positive and traumatic consistency questions were highly reliable; total consistency scores for Rater 1 (original scores) and Rater 2 (reliability check scores) were highly positively correlated for both positive, $r(44) = 0.97, p < 0.001$, and traumatic memories, $r(49) = 0.96, p < 0.001$.

**Consistency of emotional memories**

Overall, of a possible total consistency score of 36, the mean total consistency score for traumatic memories was 30.20 ($SD = 3.41$), significantly higher ($t(43) = 6.82, p < 0.001$) than the consistency of positive memories ($M = 23.25, SD = 5.41$). To examine this difference in greater detail, differences between positive and traumatic memories for each event category were calculated (see Table 1). Four of 12 event categories (environmental aspect, calendar date of the event, presence/absence of personal belonging, and sensory component) were not significantly different between positive and traumatic memories. The remaining categories were all significant in that traumatic memory responses were more consistent over time than those relating to positive memories. In addition, a one-way ANOVA was conducted on consistency scores across the types of events reported. There were no significant differences in levels of consistency across all positive ($F(5, 38) = 1.67, p > 0.05$) and traumatic ($F(3, 45) = 1.70, p > 0.05$) types of events.

Consistency also was investigated by examining changes in MAP memory characteristics over time. A two-way multivariate analysis of variance (MANOVA) was conducted

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3This category approached significance at $t(43) = -1.97, p = 0.055$. 

with memory type and time as the independent variables, and memory characteristics as the dependent measure (e.g. vividness/clarity, amount of detail). The MANOVA yielded an overall significant Memory Type \times Time interaction (Wilks’ lambda = 0.80, \(F(1, 41) = 10.09, p < 0.01\)). Specifically, characteristics of traumatic memories tended to remain consistent over time relative to positive memories. Post-hoc analyses revealed significant differences between traumatic and positive memories over time on their vividness/clarity (\(F(1, 41) = 14.89, p < 0.001\)) and overall quality (\(F(1, 41) = 12.47, p < 0.001\)) (see Figure 1). The amount of detail in memory reports also was significantly higher in traumatic memories at T1 and T2 compared to positive memories, \(F(1, 43) = 10.18, p < 0.01\).

Table 1. Mean consistency differences (SDs) on the consistency questionnaire (CQ) between positive (PM) and traumatic (TM) memories as a function of event category

<table>
<thead>
<tr>
<th>CQ event category</th>
<th>Mean (SD) for PM</th>
<th>Mean (SD) for TM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time of day*</td>
<td>1.73 (1.188)</td>
<td>2.22 (1.006)</td>
</tr>
<tr>
<td>Number of people present***</td>
<td>1.98 (1.338)</td>
<td>2.71 (0.791)</td>
</tr>
<tr>
<td>Weather*</td>
<td>1.98 (1.131)</td>
<td>2.51 (1.003)</td>
</tr>
<tr>
<td>Clothing*</td>
<td>2.09 (1.074)</td>
<td>2.47 (0.868)</td>
</tr>
<tr>
<td>Day of the week***</td>
<td>2.09 (1.137)</td>
<td>2.78 (0.654)</td>
</tr>
<tr>
<td>Environmental aspect</td>
<td>1.98 (1.210)</td>
<td>2.18 (1.185)</td>
</tr>
<tr>
<td>Emotional state before***</td>
<td>1.68 (1.308)</td>
<td>2.55 (0.818)</td>
</tr>
<tr>
<td>Calendar date of event</td>
<td>2.07 (1.149)</td>
<td>2.51 (0.869)</td>
</tr>
<tr>
<td>Personal belonging</td>
<td>2.09 (1.158)</td>
<td>2.55 (0.792)</td>
</tr>
<tr>
<td>Duration of event***</td>
<td>1.41 (1.207)</td>
<td>2.39 (1.017)</td>
</tr>
<tr>
<td>Emotional state after*</td>
<td>2.25 (1.014)</td>
<td>2.63 (0.698)</td>
</tr>
<tr>
<td>Vivid sensory component</td>
<td>1.91 (1.117)</td>
<td>2.22 (1.159)</td>
</tr>
</tbody>
</table>

*\(p = 0.05\); **\(p = 0.01\); ***\(p = 0.001\).

Figure 1. Mean differences on ratings of memory quality (panel 1) and vividness/clarity (panel 2) for traumatic (TM) and positive (PM) memories across time 1 (T1) and time 2 (T2).

To examine whether consistency varied as a function of trauma severity, a one-way ANOVA was conducted with IES groups (low, moderate, severe) as the independent variable and total consistency scores for traumatic memories as the dependent measure. Mean consistency scores for the IES groups were as follows: low ($M = 29.80$, $SD = 4.05$), moderate ($M = 30.48$, $SD = 3.23$), and severe ($M = 27.63$, $SD = 5.24$), with no significant differences between groups ($F(2, 46) = 1.53$, $p > 0.05$), indicating that the severity of trauma did not impair memory consistency.

Finally, a one-way ANOVA was conducted with interview style as the independent variable and total consistency scores for both memory types as the dependent measures. There were no significant differences on consistency between interview styles for either positive ($F(3, 40) = 0.37$, $p > 0.05$) or traumatic memories ($F(3, 45) = 1.14$, $p > 0.05$). To examine possible differences in both qualitative and phenomenological properties of traumatic memories across interview styles, a two-way MANOVA was conducted with interview time (within subjects) and interview style (between subjects) as the independent variables, and eight memory characteristics (e.g. amount of detail, repeated details) as the dependent variables (as measured by the MAP). Overall, there was no significant main effect of interview style on traumatic memory characteristics. However, there were several interactions. The MANOVA yielded an overall significant Interview Time × Interview Style interaction, Wilks’ lambda $= 0.55$, $F(3, 45) = 12.21$, $p < 0.001$, as well as a significant Interview Time × Memory Characteristic × Interview Style three-way interaction, Wilks’ lambda $= 0.30$, $F(21, 98) = 2.81$, $p < 0.001$ (see Table 2). Follow up one-way ANOVAs revealed that traumatic memories differed across interview styles at T1 on the following MAP characteristics: amount of detail ($F(3, 48) = 4.30$, $p < 0.01$), emotional components relating to the self ($F(3, 48) = 3.20$, $p < 0.05$), repeated details ($F(3, 48) = 5.67$, $p < 0.01$), and number of words ($F(3, 48) = 4.81$, $p < 0.01$). However, one-way ANOVAs conducted with T2 data revealed no significant differences between interview styles on MAP characteristics, with the exception of coherence ($F(3, 45) = 5.69$, $p < 0.01$). Tukey’s HSDs revealed that memory reports given by participants in the WN condition were significantly more coherent than those elicited by the FN condition at T2 ($p < 0.001$). These results indicate that interview styles influenced initial reporting of traumatic memories, but that differences in memory characteristics were not maintained over time.

**DISCUSSION**

_I remember his hands as he was choking me, I thought he was going to kill me. The whole event is just ingrained in my brain, I can remember it all so clearly.—Participant at T2._

The influence of trauma on memory is the subject of intense debate in psychology (e.g. Lindsay & Read, 2001; McNally, 2003). Although diverse methodologies have been applied to its study, relatively little research has focused on the consistency of traumatic memories over time, with the inclusion of a comparison memory condition. The major goal of the current study was to examine the consistency of traumatic and positive emotional memories longitudinally. The primary hypothesis—that traumatic memories would be more consistent over time than positive emotional memories—was strongly supported. The statement above by one of our participants exemplifies this main finding. Traumatic, often
horrific, events were very well remembered over time, and not fragmented or impaired in memory. The above statement was made more than five months after a near-fatal attack that a female participant had experienced. Clearly, her memory for this event was not poor or fragmentary, as proponents of the traumatic memory argument might have predicted. Instead, she was able to recall the event coherently, vividly, and with a great amount of detail, even after an extended interval. The details in her recollection had changed little over time. In fact, overall, total consistency scores were higher for traumatic events than positive emotional events, with eight of the 12 event categories from which consistency scores were derived being significantly more consistent in traumatic memories. A number of significant interactions lent additional support to the conclusion that traumatic memories are more consistent over time than positive emotional memories. Traumatic memory characteristics such as vividness/clarity, overall quality of memory, and the amount of detail all remained high over time, whereas corresponding ratings for positive memories

<table>
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<tr>
<th>MAP characteristic</th>
<th>T1</th>
<th>T2</th>
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<tr>
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decreased between T1 and T2. Thus, not only were traumatic events retained in memory with more detail and vividness than positive events at the time of the first interview, they remained consistent over the interval between interviews. These findings demonstrate the persistence of traumatic events in memory. Positive memories appeared to fade over time, and were subsequently less detailed and less vivid than traumatic memories by the time of the second interview. Together, the results of the present study provided evidence for the trauma superiority argument. Contrary to fragmentation theories that propose traumatic memories exist as incoherent, non-verbal, sensory images, memories for trauma were not impaired in the current sample. Rather, they were superior to positive emotional memories and, within traumatic memories, severity of trauma was unrelated to memory quality.

These findings contradict those reported by Southwick et al. (1997) who found that 88% of veterans changed their responses between T1 and T2. There were several methodological differences between these studies may have influenced the extent to which the results varied. First, the Southwick et al. (1997) study used Yes/No responses to measure consistency, whereas the present study allowed for a free recall response to questions. The use of a free recall style of questioning gave participants the opportunity to generate responses that were specific to their individual traumatic experience. Participants may be more likely to consistently remember personally relevant responses, as compared to simply indicating Yes or No on a standardized form. Secondly, the types of traumas involved in these studies differed substantially. The present study examined memory differences for a variety of isolated traumatic events, whereas the Southwick et al. (1997) study looked at memory for war experiences. It is possible that the length of exposure to the trauma in the Southwick et al. (1997) study may have had a detrimental effect upon later consistency. Although exposure to different types of traumatic events has been studied previously (e.g. Porter & Birt, 2001), we are not aware of any studies that have examined this specifically in relation to memory consistency. Findings from this research indicated that trauma severity did not influence memory consistency. That is, there was little variation in consistency scores between low, moderate, and severe traumatic memories. Third, consistency questions in the Southwick et al. (1997) study focused on war experiences, whereas the present study could only examine consistency questions that could be asked of both positive and traumatic events. The presence of these event characteristics in other types of events may be related, again, to a more individualized response pattern. This allowed us to compare consistency across different types of memories. Consistency was not measured for any additional types of recall in the Southwick et al. (1997) study. Finally, the time intervals between these two studies were considerably different, two years compared to approximately three months in the present study. It may be the case that levels of consistency will decline over time (as shown with the veterans). The relatively small amount of change in responses to consistency questions between T1 and T2 suggests that traumatic memories changed little over a period of a few months. In addition, the well-known study of Holocaust survivors by Wagenaar and Groeneweg (1990) further substantiates the idea that even over a duration of 40 years, memory for traumatic events may not change drastically. Together, these findings suggest that traumatic memories are relatively consistent over time (as compared to positive memories), regardless of the interval between recall attempts.

One surprising finding was that there were no significant differences in overall consistency across interview styles. It was predicted that interview conditions involving a higher degree of visualization and imagery exercises would result in greater reconstruction in memory. Accordingly, consistency in these conditions (i.e. GI, CI) was predicted to be
lower than in both FN and WN conditions. Memory distortions that arise from the use of these techniques have been well established in research (e.g. Paddock et al., 1998). At the time of the second interview, there were no differences in memory characteristics between interview styles, with the exception of higher ratings of coherence in the WN condition. This finding suggests that interviewing methods used to elicit memory reports initially did not have any lasting influence on subsequent recall, at least in terms of the dependent measures examined here. Thus, the interview manipulation at T1 produced differences in memory reports, but these were not maintained over time. Comparable amounts of detail, emotional components, repeated details, and word counts were found across FN, CI, and GI conditions. However, participants who initially wrote out their traumatic memory report evidenced more coherent verbal recall during the second interview. A possible explanation for this finding is that participants in the WN condition organized their memory into a ‘trauma composition’ when providing their initial memory reports. The act of writing out their traumatic experience on a previous occasion seemed to allow participants to organize components of their memory in a sequential fashion, as opposed to being relatively spontaneous in the verbal memory reports. Thus, when interviewed at T2, these participants were able to recall their event in a more coherent fashion.

In interpreting our results concerning positive and traumatic memories, it should be noted that previous research has indicated that memory is positively biased in general (e.g. Walker, Skowronski, Gibbons, Vogl, & Thompson, 2003). According to one view, this results from a fading affect bias, in which the emotional intensity associated with positive experiences does not subside over time relative to negative emotions (see Walker, Skowronski, & Thompson, 2003). The positivity bias has been found in diary studies requiring participants to record unique daily events. Later testing typically reveals that ratings of ‘pleasant/unpleasant’ fade faster for negative experiences than affective fading for positive events (e.g. Walker, Vogl, & Thompson, 1997). That is, perceptions about the ‘pleasantness’ of positive experiences lessened over time, whereas ratings of the ‘unpleasantness’ of positive experiences remained stable. However, while ratings of affective intensity associated with negative events may have declined, corresponding memory properties (e.g. vividness, quality, coherence, details) have not been addressed in these studies. It is possible that the positivity bias (Walker, Skowronski, & Thompson, 2003) may account for the way in which highly traumatic experiences are well-remembered. Traumatic events may be more persistent in memory as they are distinctive experiences, whereas positive events are encountered on a relatively regular basis. If the emotional atmosphere of daily life was derived from negative and violent environments (e.g. persons living in Iraq, Palestine at present), the opposite pattern may be revealed. However, several studies on traumatic experiences of a repeated nature have still shown consistent and detailed recall of these experiences (e.g. Pipe et al., 1997; Wagenaar & Groeneweg, 1990). In the present study, participants recalled their most positive emotional experience that had occurred within the past year. Ratings of emotional intensity that were comparable to those associated with traumatic events indicated that these were not ‘everyday’ positive experiences, allowing for a detailed comparison of emotional memories. Further studies examining highly traumatic and highly positive experiences (relative to day-to-day negative and positive events) will increase our understanding of memory and emotional consistency. Findings from the present study indicate that although both positive and traumatic experiences were rated as highly emotional, the features of traumatic memories were better retained in memory over time. In fact, as the levels of traumatic stress decreased (as measured by the IES), the characteristics of traumatic memories remained stable over time.
Memory researchers focusing on trauma have struggled to find a balance between experimental control and ecological validity. In order to better understand the impact of trauma on memory, real-life personally relevant circumstances must be used. However, there are limitations associated with this type of research. One issue is difficulty in recruiting representative participants. The sample being examined was restricted to trauma victims who were willing to volunteer and describe their experiences. Although the majority of individuals may retain access to traumatic experiences occurring in adulthood, not everyone would choose to discuss these with researchers. Fortunately, the rate of attrition was low. Second, this study only dealt with individuals who had access to their traumatic memories. Empirical research using more participants, varied selection procedures, and a broader scope of traumatic experiences would enhance the scientific understanding of traumatic memories. Third, the conclusions drawn from the present study can only be generalized to individuals who experience personal trauma in adulthood. Memory distortions may be more likely to emerge in traumatic memories from the distant past, such as childhood (not to mention that childhood is associated with increased suggestibility; e.g., Ceci & Bruck, 1993). However, other studies examining recall of childhood traumas have demonstrated clear, detailed, and continuous memories for these events (e.g., Peterson, Parsons, & Dean, 2004; Pipe et al., 1997). Fourth, a longer interval between interviews may enable researchers to better understand how traumatic experiences are retained in memory. Although the three month interval in this study allowed for sufficient time for memories to fade, it is possible that higher levels of inconsistency may be introduced over longer time periods. Traumatic memories may still be subject to distortion and forgetting over time. Finally, the present research did not examine the accuracy of memory for trauma but rather consistency, as it was not possible to establish the ground truth of the traumatic event. It is important to acknowledge that consistency could only be determined between initial and subsequent recall interviews. However, it is possible that both traumatic and positive emotional events had been reconstructed in memory prior to the initial recall interview in this study, and may be less accurate than immediately after the experience occurred. Unfortunately, memory reports immediately after traumatic experiences are difficult to obtain, thus consistency could not be assessed in this manner. Despite this, past research where this type of sampling has been possible evidenced high rates of consistent recall (e.g., Yuille & Cutshall, 1986). Overall, this study offered a balance between maintaining some experimental control, while promoting ecological validity.

In conclusion, this study offered a comprehensive and detailed comparison of emotional memories, consistency, and recall context. As well, this study applied empirical research techniques to real-world situations, increasing the ecological validity of results. The trauma superiority argument was supported by the findings in this study. Traumatic memories were more consistent over time than positive emotional memories, independent of interview style. This study has contributed to further theoretical and scientific understanding of how trauma influences recall.

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REFERENCES


