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Retrospective Memory Bias for the Frequency of Potentially Traumatic Events: A Prospective Study

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We conducted a prospective study that tracked the frequency of potentially traumatic events (PTEs) and nontraumatic events among college students over a 4-year period using a weekly web-based survey. At the study's completion, participants attempted to recall the number of events they had endorsed on the web surveys. Although participants underrecalled the frequency of all types of life events, recollection was more accurate for PTEs than for non-PTEs. Recalled-frequency of PTEs was associated positively with distress at recall and inversely with trait self-enhancement. These effects were qualified by a distress X self-enhancement interaction. High distress at recall was associated with a greater recalled-frequency of PTEs, but only for people low in trait self-enhancement.

Keywords: memory, trauma, self-enhancement

It would be nice to simply forget the bad things that happen to us. Unfortunately, memories of serious traumas appear to be all but impossible to erase (McNally, 2005). To date, the majority of trauma literature has focused on cross-sectional studies that examine trauma experienced by those in military service or civilian disasters (e.g., Brewin, Andrews, & Valentine, 2000; Dohrenwend et al., 2006). It is crucial to note, however, that not all aversive events are traumatic. Rather, such events are best understood as "potentially traumatic events" (PTE) (Norris, 1992; Bonanno, 2004) that may become traumas depending on any number of factors, including the intensity and duration of exposure, demographic factors, and personality and situational variation (Bonanno, Rennicke, & Dekel, 2005; Brewin, Andrews, & Valentine, 2000). Moreover, although PTEs occur with surprising frequency (Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995; Norris, 1992), most people cope with such events extremely well (Bonanno, 2004; Bonanno & Mancini, 2008). This broader definition of trauma allows researchers to study a wider array of events and experiences that may have important implications for our understanding of psychological trauma.

This kind of variability in how trauma is experienced, or even defined, suggests therefore that memory for the frequency of PTEs should be less than perfect across individuals. Historically, recall deficits for potential traumas have been attributed to psychological defenses such as repression and dissociation that block the normal course of memory development and lead to incoherent recollections (Rothschild, 2000; Van der Kolk & Fisler, 1995). A common source of evidence cited by proponents of this view comes from survivors of child abuse who fail to acknowledge the abuse when questioned decades later (Briere & Conte, 1993; Williams, 1994). However, more parsimonious explanations for these failures are available, including interference from other memories, simple forgetting, and a lack of interest or willingness to disclose (Bonanno, 2006; Loftus, Garry, & Feldman, 1994; Piper, Lillevik, & Kritzer, 2008). Indeed, some have argued that there is nothing particularly unique about trauma encoding or retrieval and that inaccuracies in memory for PTEs are due to ordinary recall failure (Laney & Loftus, 2005).

A middle-ground position suggests that PTEs are poignant and more easily remembered than more mundane or positive events, but are nonetheless still subject to normal forgetfulness (McNally, 2005). Indeed, memories for personally significant PTEs have been found to be more factually consistent and more vivid than memories for mundane or positive events (Porter & Peace, 2007). Much of this research has focused on studying our recall for details surrounding a particularly poignant event (i.e., the attacks on 9/11, the O.J. Simpson verdict). The evidence suggests that an increased level of emotional involvement and arousal is connected with better memory recall of important events (Conway et al., 1994; Neisser et al., 1996; Pezdek, 2003; Schmolck, Buffalo, & Squire, 2000; Smith, Bibi, & Sheard, 2003). However, recollection for details surrounding these significant life events was still not perfect and became distorted over time.

Beyond remembering the details from one event or occurrence, recall of the overall frequency of multiple negative or potentially traumatic life events may have important implications for health and well-being. For example, a person beset by several untoward events in a short period of time may form the belief that "everything is going wrong" or "life is full of danger." Such beliefs may contribute to exaggerated recall of the overall frequency of potentially traumatic events and further propel the person toward a downward spiral of catastrophic thinking. How well we recall the frequency of PTEs also holds important implications for life event research. From health questionnaires which ask us about our exercise habits to consumer surveys which ask about a series of

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purchases, we are commonly asked to recall the number of times something has occurred in our lives. The reliability of such surveys has always been questioned because of the fallibility of retrospective memory. Despite the advances made in our understanding of memory, little is yet known about our memory for the frequency of PTEs, the factors that might inform recall accuracy for PTEs, and in what ways these factors might differ from the factors that inform memory for other life events.

In the current investigation, we sought to advance research on the accuracy of memory for PTEs by assessing multiple PTEs over several years using a prospective design. Specifically, we measured the actual occurrence of PTEs as well as other more mundane stressful events over a 4-year period using a weekly web-based survey. Then, we assessed the accuracy of retrospective recall, at the close of the study, by asking participants to estimate how frequently they had reported each of the events over the previous 4 years. This approach had two advantages. First, and most obvious, the prospective design allowed us to document the actual occurrence of the PTEs and to compare these data directly with retrospective recall. Second, by measuring life events at repeated intervals over a multiple-year period, we were able to assess frequency recall for multiple PTEs. However, since most people experience several PTEs as well as other serious life events, we chose to focus our design on the frequency of these events, which replicates actual real-world retrieval conditions and thus enhances the ecological validity of the design.

In addition to these global issues, we examined several important but as yet understudied factors that were likely to influence memory for PTE frequency. One such factor pertained to the possible bias induced by respondent's emotional state at the time of recall. A growing body of research has shown that memory for the past states is at least partially built on present emotions and appraisals (Levine & Safer, 2002). Safer, Bonanno, and Field (2001) followed a sample of bereaved participants for five years, and at the end of that period asked them to recall how they had felt six months after the death of their spouse. The bereaved participants were able to recall their past emotional state with a moderate level of accuracy. However, some of the variability in the accuracy of recollection was predicted by participants' level of grief at the time of recall.

This same type of current state bias has been demonstrated in memories for emotional reactions to the 9/11 terrorist attacks (Levine, Whalen, Henker, & Jamner, 2005), and for preexam anxiety (Safer, Levine, & Drapalski, 2002). In the study investigating preexam anxiety, university students who learned that they had done well on the exam underestimated their original levels of anxiety, while those who did not do well overestimated preexam anxiety.

Another factor likely to influence memory for PTEs is the tendency toward self-serving biases, such as self-enhancement, that might bend recall in a way that favors the self (Taylor & Brown, 1988). Normal everyday cognition often involves exaggerated and self-enhancing biases in perception and attribution (Taylor & Brown, 1994). Research has consistently shown, for example, that most people view themselves as "better than average" (Alicke, Klotz, Breitenbecher, Yurak, & Vredenburg, 1995) and take disproportionate credit for successes while eschewing blame for failures (Miller & Ross, 1975). Self-enhancing biases have also been implicated in the recall of desirable outcomes related to, for example, sexual behavior, cholesterol test results, and self-relevant health information (Croyle et al., 2006; Garry, Sharman, Feldman, Marlatt, & Loftus, 2002).

Although self-enhancement bias is common, some people tend to utilize these biases more than others. This propensity, known as trait self-enhancement, is associated with positive affect and high self-esteem (Bonanno et al., 2005), but also social difficulties (Paulhus, 1998). Of particular relevance for trauma memory, however, trait self-enhancers also cope extremely well with PTEs (Bonanno et al., 2005; Bonanno, Field, Kovacevic, & Kaltman, 2002). One way they may do this is by minimizing the recall of past PTEs.

Based on the literature reviewed above, we predicted that (a) the recalled frequency of all events including PTEs would be less than perfect, but also that (b) the recalled frequency for PTEs would be better than for other classes of events; (c) that high distress at recall would be associated with greater recalled frequency of PTEs, while (d) trait self-enhancement would be associated with poorer recalled frequency of PTEs. Finally, we explored but made no specific predictions as to whether self-enhancement might moderate the influence of distress at recall.

Method

Participants and Procedure

Within one month after beginning college in New York City, undergraduates were contacted by campus mail and invited to enroll in a 4-year study of adjustment to college life sponsored by the university administration. Once enrolled in the study, participants completed group questionnaire sessions once each semester. The current study used questionnaire data from the first session, taking place one month after beginning college (T1), and the last session, taking place one month before graduation (T2). In addition, participants were asked to engage in a weekly online web survey for life events that continued for all four years of the study. Data for the current study are based on 69 participants (25 males and 44 females) who completed at least 10 weekly web tasks per year ($M = 22.30$, $SD = 2.84$). Participants were paid $250 for each year they participated in the study.

Measures

Weekly web-based life events survey. The weekly web task is an online questionnaire consisting of 50 potentially significant life/daily events (based on and adapted from Holmes & Rahe, 1967). Items were removed, added, or amended to make the inventory more appropriate for a university-age sample. For example, events concerning children or career were not included, while events related to school changes and performance were added. Also, the original point values of each event were not used for this study. Furthermore, while the Holmes and Rahe inventory was designed to capture events that happened within the past year, the inventory in this study was administered on a weekly basis. For the analyses, the list of possible stressful events was split into four categories: potentially traumatic events (PTE; 9 items, e.g., serious illness, robbery/mugging), academic and financial stressors (AFS; 9 items, e.g., difficulties with personal finances, significant change in academic demands), interpersonal and family stressors (IFS; 18

items, e.g., significant change in family demands, end of a romantic relationship), and changes in lifestyle (CL; 14 items, e.g., significant increase or decrease in weight, significant voluntary change in physical appearance). This measure was chosen for its inclusion of both potentially traumatic and minor events, as well as for its relative brevity and ease of administration.

Every week, participants were asked to access a web site and log on with an anonymous ID and password. They were then asked whether or not they had experienced any of the 50 events since they had last completed the survey. For the vast majority of responses, this period was one week. However, at the beginning of the fall semester (September), participants indicated the events they had experienced since last completing the survey in the late spring (May). Participants indicated the events they had experienced since last completing the survey by changing the default setting ("no") to "yes." In addition, for each event participants endorsed, they were asked to indicate on a 0 to 4 scale how much the event impacted their life and how distressing the event was at the time it was experienced. A small percentage of respondents endorsed the same event for more than one concurrent week. We address this issue in the results section.

Retrospective questionnaire. This questionnaire consisted of 50 items that were in the weekly web-based life events survey. Participants were asked to indicate the number of weeks they had experienced the event throughout the four years of the study and how much distress they experienced with relation to each event on the same 0 to 4 scale.

Self-enhancement. The disposition toward self-enhancement was measured using the enhancement items from the Self-Deceptive Enhancement Scale (SDE), a subscale of the Balanced Inventory of Desirable Responding (Paulhus & Reid, 1991), that contains 20 self-descriptive statements that suggest arrogance and overconfidence (e.g., "I am fully in control of my own fate" and "I always know why I do things"). Respondents indicate whether they endorse each statement on a scale ranging from 1 (not true) to 7 (very true). Only extreme responses (e.g., 6 or 7) are scored self-enhancing. The SDE is comparable with other measures of self-enhancement (Bonanno et al., 2002; Paulhus, 1998; Taylor, Lerner, Sherman, Sage, & McDowell, 2003). Factor analyses have established the independence of the SDE from the general tendency toward social desirability or impression management (Paulhus & Reid, 1991).

Distress. Self-reported distress from psychological symptoms was measured using the Symptom Check List (SCL-90–R; (Derogatis, 1983). Following previous research, a brief distress measure was created using items from the Depression, Anxiety, and Hostility subscales of the SCL-90–R (Bonanno, Notarius, Gunzerath, Keltner, & Horowitz, 1998; Lehman, Wortman, & Williams, 1987). Self-reported initial distress (T1) was measured simultaneous to the administration of the SDS–E at the beginning of the participants' first semester of university. Current distress was assessed by repeating the distress measure at the end of the fourth academic year, just prior to graduation (T2).

Results

Over the four years of web surveys, participants experienced the greatest number of lifestyle changes (CL)($M = 38.12$, $SD = 30.69$). Not surprisingly, PTEs was the least frequently endorsed event category, occurring on average 6.06 ($SD = 5.27$) times over the four years of the web survey (see Table 1). It should be noted, however, that even this low frequency meant that PTEs occurred on average more than 1.5 times a year.

The mean actual- and recalled-frequency of events was similar in all the categories. However, the relatively large standard deviations demonstrate considerable variability among the participants' ability to recall accurately. In fact, although in general participants underestimated the total number of events, this varied greatly across participants ($M = 100.70$, $SD = 104.86$).

Across all categories a majority of participants (59.4%) underestimated the number of events that they had endorsed over the four years. However, the proportion of discrepancy (recalled-frequency/actual-frequency) differed significantly across event category, $F(3, 45) = 2.87$, $p < .05$. Pairwise comparisons indicated that the average discrepancy proportion was lower for AFS events and IFS events relative to PTEs ($p < .05$, $p_{rep} = .88$, $p_{rep} = .95$). Average distress associated with the events at the time they were originally reported also differed significantly by event category, $F(3, 44) = 7.98$, $p < .001$, $p_{rep} > .99$. Pairwise analyses indicated that the average distress at the time of the event was significantly higher for PTEs than for each of the other event categories: AFS ($p < .05$, $p_{rep} = .94$), IFS ($p < .05$, $p_{rep} = .88$), and CL ($p < .001$, $p_{rep} > .99$). Together, these analyses show that PTEs were the most distressing at the time they were experienced and also the most accurately recalled later.

We conducted preliminary exploratory analyses to identify demographic and methodological factors that may have influenced recall. The number of web task entries was not meaningfully associated with any recall effects. Gender evidenced a significant relation only to number of recalled AFS events, $r(68) = .28$, $p < .05$, $p_{rep} = .93$, with females reporting a larger number of AFS events. To explore possible recency effects on recall, we also examined correlations between recall and the proportions of events that occurred for each event category across each of the four years.

Table 1
Mean Frequencies and Recall Bias by Category of Events

	Actual mean frequency	Recalled mean frequency	% Under-estimating	% Over-estimating
Potentially Traumatic Events (PTE)	6.06 (5.27)	6.48 (14.90)	66.7	23.2
Academic/Financial Stressors (AFS)	27.51 (26.30)	29.64 (49.58)	72.5	26.1
Interpersonal/Family Stressors (IFS)	34.93 (25.84)	24.48 (27.07)	73.9	23.2
Changes in Lifestyle (CL)	38.12 (30.69)	40.10 (56.90)	62.3	34.8
Total Number of Events	106.61 (77.79)	100.70 (104.86)	59.4	39.1

The only significant correlation emerged for AFS events in year 4, $r(68) = .24$, $p < .05$, $p_{rep} = .88$, indicating a modestly greater recall accuracy for more recent AFS events. To control for these effects, gender and the year 4 proportion of events were included in the analyses reported below. These factors failed to influence any subsequent effects and, therefore, are not discussed further.

Next we explored the hypothesized predictors of retrospective bias for PTEs (distress at recall and trait self-enhancement) by conducting simultaneous regression analyses for each of the four categories of events. For each analysis, recalled-frequency for the event category was regressed on the actual-frequency of events in the category and either distress at the time of recall or trait self-enhancement. For the nontraumatic event categories (AFS, IFS, and CL), the only factor that evidenced a significant relation to recall was actual-frequency of the events. Neither distress at recall not self-enhancement emerged as significant predictors for recall of these events.

A very different picture emerged for PTEs. Actual-frequency again emerged as a significant predictor of recalled frequency ($\beta = .34$, $p < .01$, $p_{rep} = .98$). However, as predicted, distress at recall also emerged a significant positive predictor of recalled PTEs ($\beta = .34$, $p < .01$, $p_{rep} = .98$). In a similar regression, self-enhancement also emerged as a significant but inverse predictor of recalled PTEs ($\beta = -.27$, $p < .05$, $p_{rep} = .93$).

To examine the unique contributions of current distress and self-enhancement, we regressed the recalled-frequency of PTEs on the actual-frequency of PTEs, distress at the time of recall, trait self-enhancement, and the interaction of distress at recall and trait self-enhancement. This model proved significant, $F(4, 64) = 12.06$, $p < .001$, $p_{rep} > .99$, and explained 43% of the variance in recalled-frequency for PTEs. Both actual number of PTEs ($\beta = .31$, $p < .01$, $p_{rep} = .98$) and distress ($\beta = .85$, $p < .001$, $p_{rep} > .99$) were significant individual predictors. Trait self-enhancement was not ($\beta = .17$, $p = .23$, $p_{rep} = .70$). Importantly, however, the interaction of distress at recall and self-enhancement did enter into the model significantly ($\beta = -.68$, $p < .001$, $p_{rep} > .99$). A graph of the simple slopes of the interaction (see Figure 1) revealed that participants who experienced low distress at the time of recall also recalled a low frequency of PTEs regardless of their self-enhancement status. For high distress participants, however, self-enhancement determined recall frequency. High distress participants who were not high in self-enhancement recalled a greater frequency of PTEs. By contrast, high distress participants who were also high in self-enhancement recalled even fewer PTEs.

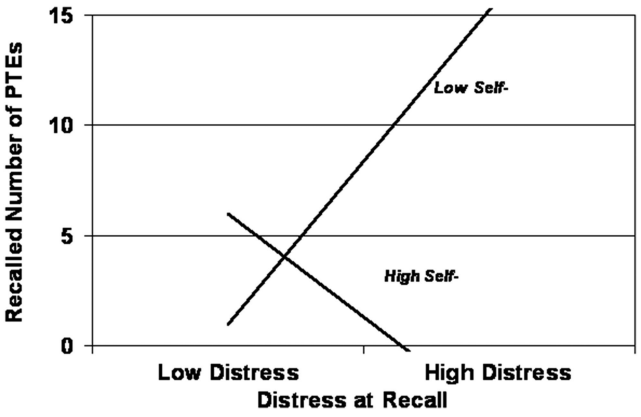

Figure 1. Interaction of distress at recall and Self-enhancement.

We ran a similar analysis using an actual-recalled frequency discrepancy score (actual number of PTEs subtracted from recalled number of PTEs) as the dependent variable. The analysis evidenced the same pattern of results and replicated the significant interaction of distress at recall and self-enhancement ($\beta = -.73$, $p < .001$, $p_{rep} > .99$).

Finally, we considered the small percentage of responses (7%) in which participants endorsed the same PTE for two weeks or more in a row. Using an adjusted total of PTEs after subtracting the repeated weeks, these analyses evidenced the same pattern of results as reported above, including the significant interaction of distress and self-enhancement ($\beta = -.68$, $p < .001$, $p_{rep} > .99$).

Discussion

Using a prospective design and a web-based measure that allowed for a continuous tracking of life events, the current study examined retrospective recollection for the frequency of both PTEs and various types of nontraumatic events, as well as the factors that inform that recollection. Our results provided strong evidence that PTEs are remembered more accurately than nontraumatic events. Moreover, recall frequency for nontraumatic events was unrelated to distress at the time of recall and or self-enhancement. By contrast, the recalled frequency of PTEs was influenced by the interaction of both factors.

As anticipated we observed a significant and positive relationship between distress and recalled number of PTEs. Previous studies have evidenced an exaggeration of past events and their emotional correlates (Levine, 1997; Safer et al., 2001). Although 23.2% of the participants in our study overestimated the number of PTEs they had experienced, in general higher distress was not associated with overremembering. Rather, higher distress at recall tended to reduce the underremembering of life events, a finding consistent with other studies suggesting that distress at the time of recall produces more accurate memory for difficult events. For example, Klimes-Dougan, Safer, Ronsaville, Tinsley, & Harris (2007) asked young adults to recall whether they had reported suicidal ideation or behavior six years earlier. In recalling the content of the interview six years earlier, the majority of participants were accurate in their recall. However, 38% of participants who had previously reported suicidal ideation or behavior failed to provide accurate recall. More compelling was their finding that those who did recall accurately were also more distressed and functioning more poorly compared to their peers. Along similar lines, a population-based study found that persons at higher levels of distress were more likely to report accurately their use of mental health services (Rhodes & Fung, 2004).

An additional finding from our study was that trait self-enhancers recall fewer PTEs than other participants. More compelling was our finding that although distress at recall generally led to more accurate recollections of PTEs, this was the opposite for self-enhancers. In other words, self-enhancers who were distressed at recall showed an even stronger propensity toward underremembering! In the end, distressed self-enhancers recalled fewer PTEs than even their peers who were reporting low levels of distress and were coping well at the time of recall.

Table 2
Mean Frequencies and Recall Bias of Potentially Traumatic Events

	Actual mean frequency	Recalled mean frequency	% Under-estimating	% Over-estimating	% Accurate recall
Death of close one (n = 38)	.96 (1.28)	1.36 (4.57)	52.6	26.3	21.1
Parents divorce (n = 3)	.09 (.45)	.01 (.12)	100	0	0
Personal injury or illness (n = 48)	1.83 (2.52)	.94 (2.85)	83.3	10.4	6.3
Injury or illness of close one (n = 39)	.97 (1.26)	.67 (2.60)	74.3	23.1	2.6
Personal hospitalization (n = 14)	.20 (.50)	.20 (.68)	42.9	35.7	21.4
Hospitalization of close one (n = 46)	1.51 (2.13)	1.01 (2.95)	71.7	21.7	6.5
Personal attempt or serious contemplation of suicide (n = 8)	.42 (1.78)	2.10 (12.30)	25	75	0
Attempt or serious contemplation of suicide by close one (n = 7)	.16 (.53)	.04 (.28)	71.4	0	28.6
Personal robbery or mugging (n = 12)	.16 (.44)	.13 (.45)	41.7	33.3	25

Although this study advances research on memory bias for PTEs, several limitations should be noted. Owing to the labor-intensive nature of the longitudinal design, we did not use a time-lagged design that would have made it possible to fully control for the length of recall period. This concern is reduced, however, by the fact that we found no evidence for primacy or recency effects. Nonetheless it will be imperative for future research on memory bias for PTEs to further examine the possible influence of these effects as well as more subtle processes of reconstructive memory that might influence recall (Gramzow & Willard, 2006). Perhaps a more serious concern is the small sample size of the current investigation, as well as the relatively small frequency of occurrence for some of the PTEs. The small number of PTEs begs the question as to whether accurate recall was explained by the fact that there were fewer events to recall. Moreover, our life events survey did not include all possible PTEs. We adapted the survey from a well-known index of stressful life events (Holmes & Rahe, 1967). Although we augmented that list to include a wider variety of PTEs, we did not intend the list to be exhaustive. For example, we included general assault events (e.g., personal robbery or mugging) but not more specific types of assault events (e.g., sexual assault). Clearly, however, it will be imperative to replicate these findings using a larger sample and to explore possible variations or even reversals of the general memory effects as a function of a wider variety of specific PTEs. For example, in the current study, eight participants recalled contemplating suicide. However, 6 of those participants (75%) overestimated the number of times they had done so (see Table 2). This was the only event among the PTEs that produced a frequency overestimation. A larger sample would have allowed us to investigate more closely the inaccuracies and biases that occur when recalling suicidal thoughts and behaviors in comparison to other very stressful life events.

In conclusion, this study joins others in finding that memory's primary service is not to be an exact record of past events (Conway & Pleydell-Pearce, 2000; Levine & Safer, 2002). Memory for trauma and other life events is not only susceptible to ordinary forgetfulness, but it is in fact a dynamic record keeper influenced by factors such as trait self-enhancement and distress. Current emotional state and the cognitive motive of self-enhancement influenced our participants' ability to recall PTEs in opposing directions. High levels of distress served to highlight the frequency of PTEs and were associated with a higher number of recalled PTEs, while self-enhancement served as a sort of "buffer" among distressed participants and was associated with a lower number of recalled stressful events. Since most people exposed to PTEs do not experience lasting emotional damage (Bonanno, 2004), the tendency to forget the occurrence of at least some of these events may be one mechanism by which people maintain a stable mental health over time.

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