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Unexpected Positive Events Do Not Result in Flashbulb Memories

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Summary: The study of flashbulb memories has typically been confined to negative events such as the terrorist attacks of 11 September 2001. Previous studies that investigated the role of affect on memory formation have produced conflicting results, making it difficult to ascertain the properties of positive flashbulb memories. In the current study, we employ previously established methods to investigate flashbulb memory formation for the assassination of Osama bin Laden. This resonated as a highly positive event for many Americans evidenced by the thousands of people flooding the streets of Washington, D.C., and New York City to celebrate. Results confirm the fading of memory details over time and further suggest that positive events do not result in the heightened vividness and confidence seen in negatively valenced flashbulb memories. We argue that these findings are additional evidence against a special memory mechanism in flashbulb memory formation. Copyright © 2014 John Wiley & Sons, Ltd.

Learning of historical events that occurred prior to one's birth is a different experience than learning of historical events that have recently occurred (or are currently unfolding) as a first-hand experience. Berntsen (2009) has proposed that an individual will have an emotional reaction when learning of a public event if that event is relevant to some aspect of the individual's social identity. The resulting emotional salience will then encourage rehearsal, which results in a memory that is detailed, is believed to be accurate, and can last a lifetime. These vivid, confidently held, long-lasting memories of learning about important, emotional events are described as flashbulb memories. Typical examples of flashbulb memories include the assassination of John F. Kennedy (Brown & Kulik, 1977), the start of Operation Desert Storm (Weaver, 1993), and the events of 11 September 2001 (Talarico & Rubin, 2003). When Brown and Kulik (1977) first proposed the idea, they assumed that these memories were highly accurate over time, much like a photograph. Although the authors acknowledged that some pieces would go missing, they held that details would remain accurate over long periods. Recent research, however, has found that this is not necessarily true (Talarico & Rubin, 2003; Weaver & Krug, 2004; Winningham, Hyman, & Dinnel, 2000).

In most flashbulb research, the vital issue is less the event itself than the subjective elements and personal context evoked by the news. For instance, people can typically recall where they heard the news of the event and the people whom they were with (Bohn & Berntsen, 2007; Brown & Kulik, 1977). Although individuals often believe that their flashbulb memories are accurate, research has shown that these memories are often no more accurate than are those for everyday events (Neisser & Harsch, 1992; Schmolck, Buffalo, & Squire, 2000; Talarico & Rubin, 2003). Such research helps refute the hypothesis that special biological mechanisms are involved in recalling details of flashbulb events, as proposed by Brown and Kulik (1977).

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One of the seminal studies to refute the special mechanism hypothesis of flashbulb memories is that of Talarico and Rubin (2003). They collected both flashbulb and everyday autobiographical memory data immediately after the September 11th attacks and then again either 7, 42, or 224 days later. As a proxy for accuracy, researchers examined consistency of memory reports obtained immediately after the event to those obtained after a delay. They found that consistency of the flashbulb and everyday event memories did not differ. However, the ratings of vividness, recollection, and belief in the accuracy of the flashbulb memories remained stable over time, whereas these ratings declined for the everyday memories. This study is particularly interesting because it is one of the first to compare flashbulb memories to time-matched everyday autobiographical memories, thus empirically testing the presuppositions of accuracy over time set forth by Brown and Kulik (1977). However, the degree of accuracy in flashbulb memories, and how they are formed, is still a topic of debate (Curci & Luminet, 2006).

Affect and flashbulb memory formation

Whereas the importance of the relationship between the emotional impact and flashbulb memory consistency is well established (Luminet & Curci, 2009), little research exists on flashbulb formation in relation to positive events. This is problematic, given the research suggesting that emotions provide the interpretative framework for understanding events in our lives (Fivush & Baker-Ward, 2005). Furthermore, one might expect flashbulb memories for positive events to be more likely given that there is a positivity bias within autobiographical memory generally (Walker, Skowronski, & Thompson, 2003) and that socially relevant memories tend to be distorted such that they contribute to a positive image of the group (Baumeister & Hasting, 1997). Part of why flashbulb memories for positive events are less frequently examined than flashbulb memories for negative events is the lack of opportunity; public, surprising, positive events are rare. Because of this, one might expect fewer positive flashbulb memories in general and less accessibility of positive flashbulb memories that are present.

Several investigators have attempted to examine the differences between positive and negative flashbulb memories.

There are two basic strategies for conducting this work: comparing memories for two different events, one positive and one negative, within the same sample and comparing memories for the same event within two different samples, one who interpreted the event negatively and one who interpreted the event positively. We will now discuss representative findings from these previous investigations.

The first to compare memories for events that differed in emotional affect, Scott and Ponsoda (1996), did not find any significant differences in consistency or vividness between memories of a selection of positive events and those of negative events. Strict scoring criteria may have contributed to the null effect. Another consideration is the relatively low personal significance of the events examined to the sample tested. Personal significance is one of few event criteria consistently found to be necessary for flashbulb memory formation (Curci, Luminet, Finkenauer, & Gisle, 2001; Talarico & Rubin, 2009).

In contrast, Tekcan (2001) found that there were important differences between positive and negative event memories. Participants rehearsed the positive event (acceptance to college) more than they did the negative event (the Gulf War). Intuitively, however, this is not surprising given that the positive event was a private one of high personal significance, whereas the negative event was a public event with little personal importance.

Last, Berntsen and Thomsen (2005) studied the German invasion of Denmark (a negative event) and the ensuing liberation (a positive event) but did so retrospectively, decades after the initial events had taken place. Because of the retrospective nature of the study and their interest in assessing accuracy, Berntsen and Thomsen focused on details pertaining to the factual details of the event rather than the personal circumstances of learning about the event. Because reports were obtained long after the event occurred, it was impossible to verify the personal context of hearing the news. They found that most people could remember factual details for both the invasion and the liberation, but they had a harder time vividly remembering details for their personal circumstances of learning of these events, possibly because of rehearsal differences between the types of memories. Also, memory for the negative event was more accurate than for the positive event (Berntsen & Thomsen, 2005).

Across the three studies, we have seen no difference between memories for positive and negative events, memories of positive events enhanced relative to memories of negative events, and memories of negative events as more accurate than memories for positive events. Therefore, we are no closer to understanding how positive flashbulb memories may (or may not) differ from more prototypical negative flashbulb memories.

The second technique for examining how affect influences memory is to compare memories for the same event as remembered by groups who interpreted the event positively versus negatively. In the traditional venue of political events, Bohn and Berntsen (2007) examined memories for the fall of the Berlin Wall among West and East Germans, finding that those who supported unification had more vivid memories that were accompanied by a greater sense of reliving the experience than did those who mourned the fall of Communism. However, a study of US voters in the 2004 presidential election found that those who voted for losing-candidate John Kerry (negative event) rated their memories for the election as higher in emotional intensity, visceral reactions, and reliving, in comparison with those who voted for the re-elected G. W. Bush (positive event) (Boals, Rubin, & Klein, 2008). Similarly, Holland and Kensinger (2012) found that individuals that had negative feelings about the outcome of the 2008 presidential election (Barack Obama defeating John McCain) reported a lower quantity of information but had higher consistency than those who felt positive about the election outcome.

Another popular context for studies examining differential interpretations of the same event is sports. Kensinger and Schacter (2006) found that although fans of both teams recalled the 2004 American League Championship Series baseball game equally vividly, fans of the winning Red Sox had more subjective confidence in their recollections than did losing Yankee fans. However, objective assessment demonstrated that Yankee fans had more consistent recall of the game than did Red Sox fans. Breslin and Safer (2011) also studied Yankee fans and Red Sox fans, this time examining their memories for two recent American League championship baseball games (one game won by each team). They, too, found that fans remembered the game their team won more accurately than the game that their team lost. Finally, Talarico and Moore (2012) found that Lehigh University fans remembered a rivalry football game that their team won more accurately than did fans of opponent Lafayette College. Lehigh fans rated the game as more emotional and also rehearsed the event more frequently. Although fans of both teams initially remembered the game equally vividly, the Lehigh fans' memories maintained that vividness over time, whereas Lafayette fans' memories decreased.

Across most of these studies, we have seen memories for events interpreted positively demonstrate more flashbulb memory phenomena (e.g., enhanced vividness, reliving, confidence, and rehearsal) than do events that are interpreted negatively. However, negative interpretations result in more accurate memory for event details. Therefore, we may expect memories for a public, surprising, positive event to be more representative of flashbulb memory phenomenology than the more traditional memories of negative events. However, flashbulb memory research has demonstrated that memories for the personal circumstances of hearing about negative public events are not more accurate than memories for everyday experiences, so it may be that such personal memories of consequential, unique events are remembered differently than are factual details of sporting events or even public events as assessed semantically rather than autobiographically (Bohannon, 1988; Pezdek, 2003; Shapiro, 2006; Smith, Bibi, & Sheard, 2003; Tekcan, Ece, Gülgöz, & Er, 2003).

Although these studies provide interesting information about the phenomena of positive flashbulb memories, it is difficult to surmise a definitive framework of positive flashbulb memory formation from them because of their conflicting results. Making the issue even more complicated, each study uses a unique methodology with little in common other than the phenomenon of interest, thus making meta-analytic techniques (Cooper & Hedges, 1994) difficult. Furthermore, all previous researches on positive affect and flashbulb memory

formation have been snapshots of experience. None have examined how these memories may change over time. Furthermore, although they have compared positive affect to negative affect, there have been no comparisons to everyday autobiographical memories of similar affect. Our study is the first to adapt longitudinal comparisons of memories to the study of a public, surprising, and positively valenced event—the announcement of the assassination of Osama bin Laden. For many Americans, particularly those of college age, bin Laden was the face of terrorism, making his death a joyous occasion that provided a sense of relief and safety. In fact, terrorism has been such a part of young Americans' lives that they are commonly referred to as the '9/11 Generation'. In addition, by replicating the design of Talarico and Rubin (2003, 2007), we can draw additional comparisons between positive and negative flashbulb memories (of similar content, from similar samples) for consistency with previous research in this area.

METHOD

Participants

The news of bin Laden's death first broke late on the evening of 1 May 2011. Thus, some people did not first hear about the news until the morning of 2 May 2011. Following Talarico and Rubin (2003) procedures, we ran a total of 329 participants from 2 May to 4 May 2011. Then, those participants were randomly divided in to three groups to be contacted for a follow-up session 7, 42, or 224 days later. All participants were also contacted 365 days later. At each follow-up interval, participants were given 48 hours to complete the online instrument (therefore, not everyone who was invited to participate was successfully able to complete the instrument). As a result of these procedures, we are left with three independent samples of participants: those who completed the initial instrument only, those who completed one-and-only-one follow-up (be it 7, 42, 224, or 365 days later), and those who completed three sessions (the initial session, the 365-day session, and either the 7-, 42-, or 224-day intermediate session). The last group included 60 participants (12:48 male : female, 4:56 Hispanic : non-Hispanic, and 45:15 White : non-White) ranging from 16.6 to 60.6 years old, with an average age of 24.4. The one-and-only-one follow-up group included 124 participants (41:83 male : female, 11:113 Hispanic : non-Hispanic, and 93:31 White : non-White) ranging from 17.1 to 56.5 years old, with an average of 24.1. Last, the group that only completed the initial session included 145 participants (61:84 male : female, 21:124 Hispanic : non-Hispanic, and 91:54 White : non-White) ranging from 18.5 to 56.3 years old, with an average age of 22.9.

Materials and procedure

Open-ended questions

To begin, we asked open-ended questions typical to flashbulb memory studies (Conway et al., 1994; Tekcan & Peynircioglu, 2002; Weaver, 1993) about the assassination announcement. We asked who the participant was with when they first heard the news, when they heard the news, where they were, if there were others present, and what their dominant emotion was. In addition, we asked if there were any other distinctive details that they would like to share. Similar questions were asked of a self-nominated event from the preceding weekend (Friday–Sunday). We asked for a description of the event, when and where the event occurred, if there were others present, and what the individual was personally doing. We also asked for any additional distinctive details. Participants were also required to 'title' this event with a cue specific enough to remind them of this particular event in the future. Because participants responded to specific prompts (e.g., where they were and who they were with) rather than providing narratives, measures of elaboration were not obtained.

Autobiographical Memory Questionnaire (Rubin, Schrauf, & Greenberg, 2003)

The Autobiographical Memory Questionnaire was used to assess the phenomenological and meta-cognitive aspects of memories. *Key properties* involved recollection of the event and belief that the event occurred as remembered. These are defining characteristics of autobiographical memory (Conway, 1995). Recollection was assessed by collapsing responses to 'I feel as though I am reliving' the experience (from 1, *not at all*, to 7, *as clearly as if it were happening now*) and 'while remembering the event now, I feel that I travel back to the time it happened' (from 1, *not at all*, to 7, *completely*). Belief in the accuracy of the memory was assessed by combining questions regarding whether the participants 'believe the event in my memory really occurred in the way I remember it' and if they could 'be persuaded that your memory of the event was wrong' (from 1, *100% imaginary*, to 7, *100%* real, and 1, *not at all*, to 7, *completely*, respectively). Vividness was assessed by collapsing responses to ratings of how well participants could 'see it in my mind', 'hear it in my mind', and 'know the setting where it occurred' (from 1, *not at all*, to 7, *as clearly as if it were happening now*). Last, we assessed whether participants 'actually remember it rather than just knowing it happened' (from 1, *not at all*, to 7, *completely*).

We assessed *language and narrative* by asking if the memory came 'in words or pictures as a coherent story or episode and not as an isolated fact, observation, or scene'; 'in pieces with missing bits'; and 'in words'; and whether it was 'based on details specific to my life, not on general knowledge that I would expect most people to have' (all rated from 1, *not at all*, to 7, *completely*).

Emotion was assessed by asking about the current emotional affect and intensity of the memory. We also asked a series of questions about physical reactions, 'I feel my heart pound or race', 'I feel tense all over', 'I feel sweaty or clammy', and 'I feel knots, cramps, or butterflies in my stomach' (all rated from 1, *not at all*, to 7, *more than for any other memory*), and collapsed these in to one visceral response measure. We also asked participants if they felt the emotions 'as strongly as I did then' (same intensity: from 1, *not at all*, to 7, *as clearly as if it were happening now*) and if they felt 'the same particular emotions I felt at the time of the event' (same emotion: from 1, *completely different*, to 7, *identically the same*).

To assess *consequentiality* of the events, participants were asked to rate (from 1, *not at all*, to 7, *very*) how 'common', 'unusual', 'ordinary', and 'expected' the event was. These were collapsed to form a measure of surprise. In addition, participants used the same rating scale to indicate how important the event was on international, national, family, and personal levels. Finally, participants indicated the extent to which the event had consequences for them, from 1, *not at all*, to 7, *many consequences*. The last three formed our personal importance measure and the first two our global importance measure.

To assess rehearsal rates, participants indicated the degree to which they 'thought about', 'talked about', and how often the memory came to them 'out of the blue' (all rated from 1, *not at all*, to 7, *more than for any other memory*). These items were averaged for an overall *rehearsal* measure. *Field versus observer* modes of remembering were assessed by asking participants if they saw the event 'out of my own eyes rather than those of an outside observer' (from 1, *not all*, to 7, *completely*).

Participants were also asked a number of questions about their interest in US anti-terrorism policy and their familiarity with the 'flashbulb memory' concept. However, these variables are not discussed here because they are not relevant to the central hypothesis. After completing the questionnaire, participants were asked if they would be willing to participate in additional research sessions and to provide contact information if they were.

Second session

A second session, identical to the first, was conducted after 7, 42, or 224 days. The only difference is that, in the second session, everyday event memories were cued with the brief description of the event provided during the first session. All participants completed the second session online. Participants were invited—via e-mail, Facebook, and telephone—to complete the subsequent phases of the study and received $5 compensation for doing so. All participants who completed the 1-year follow-up received $10 for doing so.

Data scoring

Two independent raters separately coded the open-ended questions for consistency. To do this, we employed a method similar to Curci and Luminet (2006). With this scoring, answers that are exactly similar received a score of 2, answers with a minor gain or loss of information received a score of 1, and answers with completely inconsistent information received a 0. For example, a minor gain of information would be if someone originally (during initial testing) said that they were at home when they heard the news, but at follow-up, they indicate that they were at home in their bedroom. Likewise, a minor loss of information would be when someone originally said they were in the living room but then report that they were at home when they heard the news. These individual scores were summed to arrive at a total consistency measure with a range of 0 to 12. Inter-rater reliability was assessed, and disagreements were resolved by discussion (lowest $r_{t1-2} = .60$, lowest $r_{t1-3} = .71$).

RESULTS

Preliminary analysis

First, we should demonstrate that those participants who completed only the initial instrument (and their initial memory reports) were not significantly different than those who completed at least one follow-up. Because of the number of comparisons, we used a conservative alpha of .01 for these analyses. For event characteristics, there were no differences between ratings of emotional intensity of hearing the news of the assassination, visceral emotional reactions, emotional valence, rehearsal of their memory for hearing the news, nor personal and global importance of the event itself, largest $t = 1.72$, all $p > .09$. However, those participants who completed at least one follow-up rated the assassination as significantly more surprising [$M = 5.90$, standard error of the mean (SEM) = 0.08] than did those who did not complete a follow-up ($M = 5.54$, $SEM = 0.10$), t (314) = 2.81, $p < .01$. As for the initial memory reports, those participants who completed at least one follow-up rated their memories as more specific to their own life ($M = 4.47$, $SEM = 0.15$) than did those who did not complete a follow-up ($M = 3.75$, $SEM = 0.15$), t (300) = 3.40, $p < .01$. No other ratings were significantly different between the two groups, largest $t = 2.11$, $p > .04$.

We should also demonstrate that this event has similar properties to other events that have led to flashbulb memories. For the sample of participants who completed only-one follow-up and looking to the initial ratings only, the death of bin Laden was rated as more surprising and of greater global importance than the everyday events nominated by participants [t (99) = 11.51 and 16.58 respectively, $p < .001$]. Although both events were rated as pleasant (i.e., above the midpoint on the valence scale), the everyday event was significantly more positive than learning of bin Laden's death, t (97) = −3.58, $p < .001$. The assassination of bin Laden was not rated as significantly higher on emotional intensity, visceral emotional reactions, or ratings of personal importance (largest $t = 1.17$, $p > .25$). For the sample of participants who completed an interim follow-up session and the 1-year session, and again looking to the initial ratings only, the death of bin Laden was rated as more surprising and of greater global importance than the everyday events nominated by participants [t (49) = 5.82 and 13.93, respectively, $p < .001$]. The two events were not significantly different in emotional valence, intensity of emotional reactions, visceral emotional reactions, or ratings of personal importance (largest $t = -0.81$, $p > .42$).

Comparing positive flashbulb memories versus everyday memories over time

Using the sample of participants who completed only-one follow-up session ($N = 124$), we can compare memories for a public, surprising, positive event to personal autobiographical memories from approximately the same time to see if/how both change over time. To do so, we computed a session (2: initial vs. follow-up) by delay group (4: 7-day vs. 42-day vs. 224-day vs. 365-day follow-up) by memory type (2: flashbulb vs. everyday) mixed factorial analysis of variance (ANOVA) with session and memory type as within-subjects factors and delay interval as a between-subjects factor.

As can be seen in Table 1, for the main effects of session, all properties diminished with time except personal and global importance ratings and emotional ratings of visceral reactions and surprise. This is generally consistent with the Talarico and Rubin (2003) findings for a public, surprising, and negative event.

For the main effects of memory type, surprise and global importance ratings were significantly higher for the bin Laden assassination than for the everyday event. Valence and feelings that the memory was specific to one's own life, on the other hand, were higher for the everyday event. These findings are all to be expected given the event characteristics. This nicely confirms that participants were able to provide reliable ratings of mnemonic and event features that differ between the events as expected. There were no other differences between flashbulb and everyday memories nor any memory type by time interaction effects (i.e., no type by session, type by group, or three-way interactions). Talarico and Rubin (2003) showed type by session interactions for all four key properties as well as emotional intensity, visceral emotional reactions, and field/observer perspective as well as a type by session by group interaction for belief in the memory's accuracy when examining a negative flashbulb memory to an everyday autobiographical memory. Here, we showed no similar effects when examining a positive flashbulb memory. Descriptive statistics from these analyses can be seen in Appendix A.

The current study used a slightly different consistency metric than that used by Talarico and Rubin (2003). They assessed consistency of each unit of information provided by participants in response to each open-ended question. Here, the delayed memory responses for each open-ended question were compared with the initial response, and a score of 0, 1, or 2 was assigned to the overall consistency of that report. A score of 2 meant that the two reports were completely consistent with one another, a score of 1 meant that there were minor changes (e.g., adding or subtracting details), and a score of 0 meant that the two reports were inconsistent with each other. Because the consistency scores themselves account for session effects (i.e., initial vs. delay), we computed a delay group (4: 7-day vs. 42-day vs. 224-day vs. 365-day follow-up) by memory type (2: flashbulb vs. everyday) mixed factorial ANOVA.

Overall, there were no differences between flashbulb and everyday memories nor did the memories change much as a function of delay. In all cases, as shown in Figure 1, there was little consistency between memory reports. As can be seen in Table 2, one interesting exception is for spatial memory, where flashbulb memories are more consistent than everyday memories. Where prior investigators have examined details separately, there does appear to be a trend where spatial details are more reliably recalled in flashbulb memories than are other details (Christianson, 1989; Tekcan et al., 2003). Recent research on verifiable autobiographical memories has

Table 1. ANOVA results using the sample that completed one-and-only-one follow-up

	Effect of delay			Effect of flashbulb versus everyday memory			
					Interaction		
	Session	Group	Session × Group	Main effect	Memory × Group	Memory × Session	Memory × Session × Group
Key properties							
Recollection	36.04*	0.76	1.14	4.13	0.69	0.07	0.31
Belief	10.46*	0.87	2.42	0.01	2.15	0.01	1.84
Remember/know	32.09*	0.58	3.28	7.69	0.35	0.16	0.67
Vividness	57.08*	0.78	4.31	0.03	0.18	0.00	1.21
Language and narrative							
Coherent story	36.65*	1.64	1.49	2.61	0.28	0.00	1.55
In pieces	25.43*	0.70	4.24	1.13	0.32	5.03	0.33
In words	17.17*	1.95	0.33	0.03	0.05	1.94	1.27
Specific own life	20.46*	1.58	1.49	11.76*	1.46	0.00	0.18
Emotion							
Valence	18.65*	0.12	2.48	12.80*	0.76	0.43	0.21
Same intensity	41.33*	1.89	0.73	0.41	0.05	0.15	0.87
Intensity	17.67*	0.60	2.06	0.07	0.66	0.53	0.59
Visceral	0.72	1.95	0.34	2.93	2.27	1.53	1.08
Same emotion	26.27*	1.40	0.08	2.90	0.48	0.18	0.46
Other							
Field/observer	22.58*	0.25	2.15	0.72	0.32	0.10	1.07
Rehearsal	28.06*	0.71	0.32	5.02	0.73	0.97	0.48
New							
Surprise	1.68	1.31	0.75	156.84*	0.91	0.11	2.76
Global importance	0.24	1.74	1.23	322.83*	0.77	0.00	1.07
Personal importance	5.45	0.39	0.38	1.81	0.55	2.89	0.40

Note: Session refers to the first versus follow-up session. Groups differed by whether the follow-up occurred after 7, 42, or 224 days. Memory type refers to flashbulb versus everyday. Degrees of freedom are 2, 105 for all analyses involving group and 1, 105 for all others. (Because of missing values, the denominator in each case sometimes falls as low as 82.)
ANOVA, analysis of variance.
Bonferroni correction due to multiple comparisons, $*p < .002$.

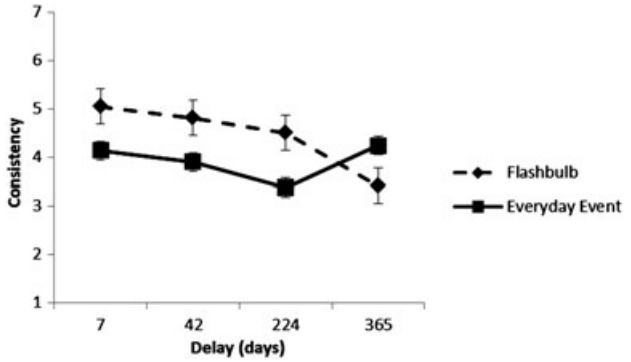

Figure 1. Mean consistency scores for both the flashbulb and everyday events. Error bars represent standard error of the mean. Participants included were those that completed one-and-only-one follow-up session

Table 2. ANOVA consistency results using the sample that completed one-and-only-one follow-up

	Group	Memory	Memory × Group
What	0.44	0.68	2.53
When	1.98	4.86	1.20
Where	0.21	13.99*	0.14
Others	1.74	0.60	1.20
Prior activity	3.76	3.50	7.19*
Distinctive	0.78	0.01	0.43
Total	1.12	5.58	2.80

Note: Degrees of freedom are 3, 105 for analyses involving group and 1, 105 for analyses with memory type. (Because of missing values, the denominator in each case sometimes falls as low as 82.)
*$p < .002$.

also shown that spatial details are more accurately remembered than are temporal details (Talarico, 2012).

Although relatively small, the group of participants who completed three total sessions ($N = 60$) allows for an internal replication of our findings from an independent sample of participants remembering the same flashbulb event. This sample also allows us to examine similar questions about change over time with an additional within-subjects comparison. To do so, we computed a session (3: initial vs. follow-up vs. year) by delay group (3: 7-day vs. 42-day vs. 224-day follow-up) by memory type (2: flashbulb vs. everyday) mixed factorial ANOVA.

As can be seen in Table 3, main effects of session and type were generally consistent with the findings from the previous sample. Surprise and global importance were greater for flashbulb than everyday memories, and the only other effects were that phenomenological and meta-cognitive characteristics diminish with time. Descriptive statistics from these analyses can be seen in Appendix B.

Here, both the interim report (from 7, 42, or 224 days later) and the final report (from 365 days later) were compared with the initial memory report. Again, consistency scores were rated from 0 to 2 for each individual question, and the sum was used as a total consistency measure (range 0–12). Higher scores indicate greater consistency between the two reports. This allowed us to compute a session (2: initial-intermediate vs. initial-final) by delay group (3: 7-day vs. 42-day vs. 224-day follow-up) by memory type (2: flashbulb vs. everyday) mixed factorial ANOVA.

As can be seen in Figure 2, although the 7-day and 224-day groups are essentially flat at their initial delay and the 1-year mark, the 42-day group is more consistent at 1 year than they were at their initial delay interval. For the individual questions, as can be seen in Table 4, only memory for other people present shows any significant effects, and it seems to decrease over time. Given the small sample sizes for each between-subjects delay group and the conservative *p*-value, it is difficult to draw firm conclusions from these data. However, all memories seem to be relatively unreliable.

DISCUSSION

Although bin Laden's death was rated as more surprising and of greater global importance than the everyday events, it was not more emotionally intense nor more personally significant. Furthermore, all memory properties diminished over time regardless of memory type, and there was little consistency between reports for either event. This was true for two independent samples of participants. This finding is inconsistent with Talarico and Rubin (2003) who showed differences in autobiographical memory characteristics between a negative flashbulb memory and an everyday autobiographical memory using the same method as that used here. In their sample, participants rated the terrorist attacks of September 11th as more emotionally intense than their everyday memories and showed enhanced vividness and confidence in the accuracy of their memories for the September 11th attacks relative to their memories of a personal event. Prior research has shown that increased emotional intensity predicts enhanced autobiographical memory phenomenology (Talarico, LaBar, & Rubin, 2004). Talarico and Rubin (2003) did not ask their participants to rate the personal significance of either event, but in our samples, both events were rated at the midpoint of our scale of personal significance (and the events were not different from one another). Therefore, it could be that the characteristics of the assassination of Osama bin Laden were not sufficient to produce flashbulb memory phenomena. Events likely to produce flashbulb memories vary along multiple dimensions, including emotional affect, emotional intensity, personal significance, public consequentiality, and surprise. Hence, it is difficult to isolate any one of these for investigation.

Previous evidence has shown that surprise is not necessary for flashbulb memory formation (e.g., as seen with memories of the moon landing (Winograd & Killinger, 1983) and the death of Pope John Paul II (Tinti, Schmidt, Sotgiu, Testa, & Curci, 2009)). Here, too, we have shown that surprise is not sufficient for flashbulb memories (i.e., enhanced surprise did not lead to enhanced vividness and belief in the accuracy of the memory ratings). Public, surprising, positive events are rare, yet novelty alone is insufficient to result in a flashbulb memory.

The ratings of emotional intensity for the bin Laden assassination announcement were less than the ratings for the terrorist attacks of September 11th as reported by Talarico and Rubin (2003). Yet, the death of Pope John Paul II (Tinti et al., 2009) and the resignation of Margaret Thatcher (Conway et al., 1994; Wright, Gaskell, & O'Muircheartaigh, 1998) and the

Table 3. ANOVA results using the sample that completed all follow-up sessions

	Effect of delay			Effect of flashbulb versus everyday memory			
					Interaction		
	Session	Group	Session × Group	Main effect	Memory × Group	Memory × Session	Memory × Session × Group
Key properties							
Recollection	8.07*	0.74	0.90	1.93	0.36	0.40	0.26
Belief	12.10*	0.35	0.25	0.10	0.52	0.72	1.13
Remember/know	17.40*	3.99	1.66	0.00	0.01	1.69	0.80
Vividness	16.55*	0.33	0.64	0.01	0.17	0.92	0.52
Language and narrative							
Coherent story	14.27*	0.19	1.51	1.78	0.02	0.43	0.80
In pieces	31.70*	1.43	2.43	1.02	0.63	0.93	1.79
In words	5.67	4.06	1.73	0.03	0.63	1.64	1.08
Specific own life	2.26	1.20	2.38	8.11	1.87	0.34	1.36
Emotion							
Valence	1.87	1.46	2.63	1.37	2.63	0.32	0.96
Same intensity	18.69*	0.32	2.00	0.01	0.10	0.04	0.52
Intensity	8.30*	2.66	2.01	0.00	0.21	0.93	0.60
Visceral	1.79	2.53	0.82	0.00	0.01	0.04	1.00
Same emotion	19.16*	0.82	1.19	1.40	0.47	0.51	0.34
Other							
Field/observer	8.03*	0.94	1.16	1.70	0.30	0.61	0.24
Rehearsal	31.00*	0.86	2.47	2.31	0.04	2.87	0.31
New							
Surprise	0.09	0.15	1.65	41.45*	2.00	1.04	1.62
Global importance	0.23	2.87	2.17	331.86*	0.82	0.46	2.26
Personal importance	2.84	1.33	1.14	7.57	3.80	3.25	1.09

Note: Session refers to the first versus follow-up session. Groups differed by whether the follow-up occurred after 7, 42, or 224 days. Memory type refers to flashbulb versus everyday. Degrees of freedom are 2, 48 for all analyses involving group and 1, 48 for all others. (Because of missing values, the denominator in each case sometimes falls as low as 36.)
ANOVA, analysis of variance.
*$p < .002$.

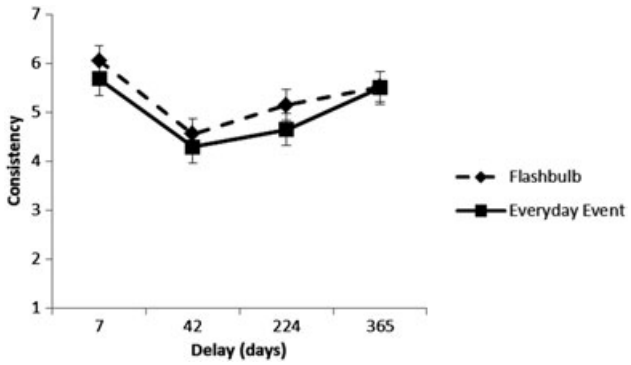

Figure 2. Mean consistency scores for both the flashbulb and everyday events. Error bars represent standard error of the mean. Participants included were those that completed all follow-up sessions

announcement of the O. J. Simpson verdict (Winningham et al., 2000) have been identified in the literature as valid flashbulb-producing events; they seem comparable with the announcement of Osama bin Laden's death, especially to a sample of undergraduate students.

One possible limitation of the current study is that the majority of participants came from the University of North Texas undergraduate research participation pool. This has several implications, the first being that most participants were geographically located in Texas, far from the physical locations of the 2001 attacks perpetrated by bin Laden. Potentially, these individuals would have less personal investment in the search for Osama bin Laden than those closer to the sites of the 2001 attacks and would be less likely to form an intense memory for the announcement of his death. In addition, the mean age of participants (about 23 years old) was rather young, which means that participants were very young (around 12 years old) during the 2001 terrorist attacks. It is quite possible that our sample was not old enough to completely understand the complexity and importance of the 2001 events at the time the events occurred, which would theoretically make them less likely to follow the search, and less likely to react strongly to the assassination of Osama bin Laden. However, the reaction in Denton (which houses the University of North Texas) was strong, and some even launched fireworks in celebration after hearing the news (Lewis, 2011). It should be noted that this strong reaction was not seen uniformly across the country, perhaps resulting in a special situation for the current data and participants. Potentially as a consequence of this somewhat unique reaction, participants rated the death of bin Laden at least as personally significant as a private, personally experienced event.

Perhaps as a result of this reduced significance, bin Laden's assassination may have been rehearsed less than other flashbulb events, both individually and collectively. Very low rehearsal rates were reported both initially and over time (Appendices A and B). These numbers are much lower than rehearsal rates found by Talarico and Rubin (2003, 2007). Similarly, media coverage of the bin Laden event dissipated rather quickly (Pew Research, 2011), particularly in comparison with typical flashbulb memory-producing

Table 4. ANOVA consistency results using the sample that completed all follow-up sessions

	Effect of delay			Effect of flashbulb versus everyday memory			
					Interaction		
	Session t1–t2, t1–t3	Group 7-, 42-, and 224-delay	Session × Group	Main effect	Memory × Group	Memory × Session	Memory × Session × Group
What	0.69	0.16	3.70	4.22	0.09	5.43	1.43
When	0.03	3.76	3.58	4.79	1.01	1.12	0.29
Where	3.06	3.43	1.37	3.51	0.29	0.03	0.17
Others	12.40*	0.05	5.32	3.94	0.23	0.01	1.54
Prior activity	0.18	0.35	2.59	0.37	0.10	0.85	0.12
Distinctive	0.13	3.39	1.03	0.30	0.31	3.18	2.36
Total	1.92	2.22	7.48*	0.16	0.00	1.03	0.09

Note: Degrees of freedom are 2, 48 for analyses involving group and 1, 48 for analyses with session or memory type. (Because of missing values, the denominator in each case sometimes falls as low as 36.)
ANOVA, analysis of variance.
*$p < .002$.

events. Others have argued that increased rehearsal maintains both accurate and inaccurate details over time (Loftus & Kaufman, 1992; Winningham et al., 2000), leading to the enhanced vividness and confidence seen in flashbulb memories (Talarico & Rubin, 2007).

Given Berntsen's (2009) proposed mechanism for producing flashbulb memories, the moderate personal significance leading to weak emotional intensity resulting in less frequent rehearsal predicts that memories for this event should be less vivid, less confidently held, and be more likely to be forgotten over time. Therefore, our data are consistent with the argument that personal significance is more important to flashbulb memory formation than is broad consequentiality (Talarico & Rubin, 2009). Further, these data seem to support mechanisms that rely on negative affect and high emotional arousal to produce flashbulb memory phenomena (Sharot & Phelps, 2004). Even though the death of bin Laden included enhanced surprise and consequentiality ratings relative to the personal event, this positive event did not result in flashbulb memories including enhanced and stable vividness and confidence ratings relative to ordinary autobiographical memories. (Yet, we have replicated the lack of differences between memory content/consistency in flashbulb and everyday autobiographical memories (Talarico & Rubin, 2003, 2007), providing further evidence against the special memory mechanism hypothesis.)

The fact that the announcement of the assassination of Osama bin Laden did not result in prototypical flashbulb memories does not mean that these data are irrelevant to the further study of flashbulb memory or of autobiographical memory generally. The current study has many methodological strengths. Within 48 hours of a major public event, we had collected data from 334 participants. This is a large sample size for the flashbulb literature; studies using immediate event follow-up typically have approximately 100 participants. Furthermore, we were able to obtain follow-up data from participants for up to 1 year after the event itself, a lengthy delay for most memory research. Last, we were able to test two independent samples of participants with the same technique allowing for internal replication of key findings.

There are also a number of theoretical contributions of the current study. Unexpected major events that affect millions of people are typically negative (e.g., assassinations of political leaders, terrorist attacks, and natural disasters). To date, there have been only a handful of studies on positive flashbulb events, but many of these events (e.g., sporting events) lack the consequentiality and uniqueness of the major negative flashbulb events. Therefore, this study is more directly comparable with traditional flashbulb memory studies than many prior attempts to examine the influence of emotional affect.

Future research is needed to confirm the lack of prototypical flashbulb memories in response to positive events, and the strategies discussed earlier are likely to be promising in this regard. In these contexts, though, we would encourage investigators to test memory over longer delays and to include comparisons with everyday autobiographical memories. Emotions are said to provide the interpretative framework for understanding events in our lives (Fivush & Baker-Ward, 2005), and it holds that autobiographical memory is a large part of the self-concept. It makes sense, then, that these two issues should be investigated to uncover the interplay between them.

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APPENDIX A

Descriptive statistics for the sample that completed one-and-only-one follow-up session

		Time 1		Time 2							
				7		42		224		365	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Key properties											
Recollection	FB	3.26	1.76	2.72	1.25	2.50	1.11	2.17	1.32	2.39	1.39
	EV	3.58	1.91	3.19	1.45	2.54	1.64	2.44	1.27	2.57	1.49
Belief	FB	5.68	1.21	5.62	1.18	5.57	1.35	4.85	1.03	5.00	1.44
	EV	5.72	1.30	5.66	1.18	5.04	1.45	5.62	0.91	4.74	1.53
Remember/know	FB	4.61	2.07	4.00	1.87	3.85	1.61	3.50	1.61	3.18	1.97
	EV	5.04	1.82	4.67	1.92	3.81	2.13	4.17	2.12	3.41	2.11
Vividness	FB	4.69	1.76	4.28	1.67	3.79	1.22	3.29	1.28	3.13	1.92
	EV	4.81	1.70	4.29	1.83	3.63	1.69	3.51	1.53	3.16	1.97
Language and narrative											
Coherent story	FB	4.02	1.98	3.34	1.78	3.21	1.69	3.11	1.95	2.74	1.77
	EV	4.45	1.91	3.90	2.05	3.29	2.01	3.50	1.78	2.91	1.87
In pieces	FB	2.79	1.76	3.39	1.69	4.42	2.04	4.94	1.91	4.22	2.11
	EV	3.20	1.79	3.04	1.69	3.62	1.94	4.22	1.82	4.00	2.11
In words	FB	3.26	1.76	3.14	1.69	2.68	1.43	2.94	1.10	2.26	1.34
	EV	3.40	1.72	3.25	1.48	2.61	1.85	2.44	1.44	2.17	1.44
Specific own life	FB	4.32	1.98	4.21	2.38	3.75	1.96	3.60	1.47	2.96	1.77
	EV	5.02	1.90	4.14	2.22	4.50	2.38	4.73	1.90	3.61	2.06
Emotion											
Valence	FB	4.68	1.31	4.26	1.40	4.46	1.11	4.17	1.16	4.14	1.03
	EV	5.28	1.49	5.19	1.56	4.82	1.43	4.73	1.43	4.41	1.36
Same intensity	FB	3.60	1.76	3.17	1.56	2.50	1.16	2.28	1.57	2.65	1.87
	EV	3.55	1.71	3.28	1.78	2.50	1.69	2.06	1.15	2.22	1.58
Intensity	FB	2.93	1.65	2.69	1.45	2.00	1.38	1.94	1.48	2.48	1.68
	EV	2.84	1.40	2.62	1.51	2.46	1.75	1.71	1.15	2.48	1.34
Visceral	FB	1.53	0.77	1.51	0.90	1.24	0.58	1.65	0.97	1.54	0.86
	EV	1.45	0.79	1.49	0.95	1.21	0.37	1.45	0.89	1.60	1.01
Same emotion	FB	4.46	1.76	3.82	1.90	3.39	1.69	3.44	1.74	3.48	1.68
	EV	4.16	1.90	3.61	1.85	3.07	1.96	3.00	1.61	3.04	1.77
Other											
Field/observer	FB	4.63	2.20	3.76	2.15	3.93	2.06	3.88	2.23	3.30	1.92
	EV	4.84	2.10	4.21	1.99	4.11	2.17	4.18	2.14	3.13	2.11
Rehearsal	FB	3.60	1.42	3.00	1.38	2.60	1.17	2.47	1.28	2.56	1.60
	EV	3.16	1.33	2.82	1.38	2.22	1.63	2.37	1.36	2.44	1.65
New											
Surprise	FB	5.82	1.09	5.94	1.02	6.09	0.73	6.22	0.72	5.64	1.01
	EV	3.87	1.62	3.65	1.67	3.56	1.56	4.48	3.15	4.33	1.68
Global import	FB	6.34	0.98	6.02	1.56	6.31	1.35	6.22	1.32	6.46	0.86
	EV	2.46	2.22	2.17	1.99	1.76	1.77	2.31	2.21	3.33	2.73
Personal import	FB	4.07	1.64	3.31	1.51	3.50	1.51	3.94	1.40	3.57	1.68
	EV	4.13	1.72	4.14	1.51	3.93	1.97	3.86	1.74	4.04	1.97

Note: FB= Flashbulb event, EV= everyday event.

APPENDIX B

Descriptive statistics for the sample that completed all follow-up sessions

		Time 1		Time 2							
				7		42		224		365	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Key properties											
Recollection	FB	3.38	1.75	2.64	1.41	2.25	0.98	2.85	1.30	2.48	1.47
	EV	3.39	1.89	2.93	1.61	2.65	1.44	3.23	1.70	2.77	1.70
Belief	FB	5.93	0.91	5.55	1.24	5.67	1.06	5.40	1.39	5.08	1.24
	EV	5.74	0.96	5.43	1.12	5.34	1.08	5.24	1.66	5.09	1.39
Remember/know	FB	5.47	1.52	4.14	1.59	4.83	1.44	4.05	1.16	3.95	1.84
	EV	5.29	1.80	4.15	1.83	4.94	1.57	4.40	1.83	4.10	2.23
Vividness	FB	5.01	1.46	3.98	1.17	4.29	1.20	3.86	1.31	3.81	1.47
	EV	4.85	1.46	4.12	1.57	4.39	1.53	4.43	1.88	3.82	1.86
Language and narrative											
Coherent story	FB	4.25	2.00	3.71	1.60	3.67	1.74	3.70	1.34	2.93	1.70
	EV	4.70	1.91	3.90	1.92	3.71	2.27	3.80	2.01	3.25	2.17
In pieces	FB	2.92	1.84	3.29	1.60	4.06	1.78	5.05	1.52	4.69	1.69
	EV	3.04	1.76	3.00	1.74	3.71	1.77	4.50	1.92	4.20	2.00
In words	FB	2.97	1.77	2.75	1.43	2.33	1.32	2.90	1.43	2.40	1.51
	EV	3.13	2.11	2.60	1.48	2.06	1.36	2.55	1.97	2.50	1.70
Specific own life	FB	4.78	1.92	0.41	1.92	4.00	1.95	4.40	1.61	4.31	2.00
	EV	5.30	1.91	4.20	1.92	5.29	1.98	5.05	1.97	4.82	2.09
Emotion											
Valence	FB	4.63	1.14	4.66	0.94	4.58	1.02	4.40	1.16	4.38	1.01
	EV	4.72	1.67	4.87	1.35	5.12	1.24	4.29	1.92	4.50	1.63
Same intensity	FB	3.64	1.84	2.36	1.13	2.17	1.32	3.16	1.48	2.32	1.55
	EV	3.67	1.91	2.74	1.74	2.18	1.20	2.90	1.88	2.43	1.78
Intensity	FB	2.97	1.52	1.95	1.08	2.00	1.24	2.55	1.48	2.13	1.39
	EV	2.66	1.53	1.95	1.18	1.76	1.03	3.05	2.06	2.27	1.70
Visceral	FB	1.46	0.92	1.19	0.66	1.01	0.04	1.46	0.76	1.30	0.70
	EV	1.39	0.80	1.24	0.67	1.01	0.04	1.70	1.30	1.36	0.93
Same emotion	FB	4.53	1.54	3.77	1.64	3.39	1.40	4.20	1.61	3.45	1.55
	EV	4.41	1.62	3.80	1.57	3.41	1.61	3.75	1.92	3.03	1.86
Other											
Field/observer	FB	4.92	2.00	3.76	1.70	4.33	2.25	4.65	1.57	4.13	2.09
	EV	5.35	1.91	4.50	1.83	4.82	2.27	4.90	1.88	4.08	2.23
Rehearsal	FB	3.51	1.46	2.71	1.22	2.33	1.07	2.83	1.30	2.16	1.01
	EV	3.14	1.46	2.27	1.48	1.61	0.74	2.78	1.92	2.19	1.47
New											
Surprise	FB	6.07	0.97	6.15	0.94	6.53	0.47	5.84	1.25	5.98	0.93
	EV	4.32	1.75	4.12	1.88	3.94	1.73	4.72	1.74	4.61	1.70
Global import	FB	6.37	1.12	6.27	1.17	6.28	.76	6.28	1.16	6.33	1.01
	EV	2.02	1.97	1.23	0.72	1.91	1.90	2.55	2.33	2.06	1.94
Personal import	FB	3.95	1.42	3.27	1.36	3.00	1.23	4.10	1.83	3.28	1.70
	EV	4.08	1.75	4.40	1.65	3.59	1.53	3.98	2.24	3.94	1.78

Note: FB= Flashbulb event, EV= everyday event.