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**ORDINARY MEMORY PROCESSES  
SHAPE FLASHBULB MEMORIES OF  
EXTRAORDINARY EVENTS**

A review of 40 years of research

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We review the shifting definition of “Flashbulb memory” in the 40 years since Brown and Kulik coined the term. We evaluate evidence for veridical, phenomenological, and metacognitive features that have been proposed to differentiate Flashbulb from ordinary autobiographical memories. We further consider the event conditions thought to be necessary to produce Flashbulb memories and discuss how post-event processing may distinguish Flashbulb memories. We conclude that a categorical dissociation between flashbulb and other autobiographical memories is untenable, but that Flashbulb memories still pose important, as yet unanswered, questions.

Brown and Kulik (1977) observed a phenomenon that captured the public’s attention – seemingly indelible memory for important, emotional events. They dubbed it “Flashbulb memory (FBM)” and conducted the first modern empirical study on the topic. The concept was equally effective in capturing the attention of memory researchers, and in the 40 years following their seminal publication, the topic has been investigated almost as often as the events that lead to such memories allow. During this time, the description of the phenomenon has undergone an interesting and important transformation.

The initial “special mechanism” hypothesis was that FBMs were a permanent, veridical (though not necessarily complete) memory record that resulted from a unique memorial process involving automatic encoding of all aspects of an important (emotional) event as it happened. However, this strong hypothesis did not last long, as evidence of both errors of omission and commission in the recall of FBMs were soon identified (Christianson, 1989; Neisser & Harsch, 1992; Neisser *et al.*, 1996). Consequently, the revised FBM hypothesis was more agnostic as to why they developed and how they were different from other autobiographical memories (AMs). Our task is to determine if FBMs are simply a subtype of autobiographical remembering or if they are a distinct category of memories. If there are special mechanisms involved in FBMs then there should be three factors that differentiate

them from everyday memories. First, with regards to memory properties, FBMs should be different from ordinary AMs in some way; they could be more accurate or more vivid, for example, than everyday memories. The second way to identify FBMs is that the conditions necessary to produce these memories should be different from ordinary events; for example, they could require strong emotions. Finally, how the individual processes the event (e.g. how one rehearses the memory) should differ for FBMs relative to AMs. For each of these, the claim of a special mechanism requires more than just a difference that could be seen as one extreme of a continuum; there should be some discontinuity between “ordinary” memories and “special” FBMs. In other words, there should be some a priori, objective threshold for defining whether a given memory meets the criteria for being considered an FBM.

In order to compare FBMs to ordinary AMs we need to define “ordinary.” Here, we will define ordinary AMs as easy-to-access memories that are brought to mind by a request for a particular kind of memory (e.g., a memory from a particular time, of a particular type of event, or in response to a particular word). The results would likely be different if FBMs were compared to trivial or noteworthy memories, but “trivial” and “noteworthy” require defining along which dimension the events are trivial or noteworthy. Unless noted otherwise, the comparisons we report from the literature are between ordinary AMs (as defined above) and FBMs.

We will proceed to review the various ways in which FBMs have been claimed to be different from AMs and the various mechanisms proposed to cause these differences. We will ask if FBMs have more of a given property and report whether there are consistent findings across studies showing that FBMs are more extreme. This is the minimal test of a special mechanism. If this test is met, we will ask if the differences are large enough to exclude a continuum on which FBMs are at one end and where there is little overlap in the distributions. For the proposed mechanisms, we will also ask whether they have been shown to be necessary (i.e. can FBMs exist when these mechanisms are not invoked), and whether they have been shown to be sufficient (i.e. can FBMs occur only when these mechanisms occur). As a summary, our conclusions are indicated in Tables 4.1 and 4.2. Table 4.1 has a list of the ways FBMs have been claimed to be unique. Table 4.2 describes the mechanisms proposed to account for these differences.

**TABLE 4.1** A summary of the differences between FBM and ordinary AM

	<i>FBM &gt; AM</i>		
	<i>No</i>	<i>Yes</i>	<i>Discontinuous</i>
<i>Memory characteristics</i>			
Longevity	X		No
Accuracy	X		No
Consistency	X		No
Vividness		X	No
Confidence		X	No

*Note:* Discontinuous implies a large difference with little overlap in the distributions; no characteristics exhibit this. We would have the same results if we replaced “discontinuous” with “as compared to noteworthy memories that were not in response to a flashbulb event.”

**TABLE 4.2** A summary of the evidence supporting the mechanisms proposed for enhancing FBM relative to ordinary AM

	<i>Sufficient</i>	<i>Necessary</i>	<i>Only in FBM</i>
<i>Event conditions</i>			
Consequentiality	No	No	No
Distinctiveness	Yes	No	No
Negative affect	No	No	No
<i>Memory processes</i>			
Significance	Yes	Yes	No
Surprise	No	No	No
Emotional intensity	?	No	No
Rehearsal	?	?	No

## Characteristics of FBMs

### *Longevity*

Surprisingly, there is a paucity of evidence in the FBM literature addressing the relative permanence of such memories. Anecdotally, FBMs are extremely long lasting. Empirically, studies that examine longevity typically obtain one retrospective report years after the event and evaluate it for vividness and completeness to determine whether it qualifies as an FBM. For example, using these criteria, between 50% and 99% of participants in any given study have FBMs for learning of historical events after delays of approximately ten years (Brown & Kulik, 1977; Hirst *et al.*, 2015), approximately 30 years (Colegrove, 1899), and approximately 60 years (Berntsen & Thomsen, 2005).

Berntsen and Thomsen (2005) asked participants to recall another event from the same time period (i.e. the most positive and most negative personal event during the occupation period) and found that most were able to do so. Contrary to the claims of Brown and Kulik (1977), there are other events that one can remember from equally long ago. Denver, Lane, and Cherry (2010) provide converging evidence for the objective longevity of FBMs without a relative superiority to ordinary AMs. When their participants were provided with a description of the FBM phenomenon and asked to freely recall public events for which they have this type of memory, their recall produced a standard reminiscence bump (Rubin & Schulkind, 1997). Denver *et al.* (2010) further showed few reliable differences between older adults' and younger adults' FBM despite vast differences in the delay intervals among events recalled by both groups. In conclusion, FBMs are long-lasting, but they are not indelible, nor are they more permanent than noteworthy everyday memories.

### *Accuracy*

Talarico and Rubin (2009) describe in detail the (surprisingly) few studies that investigate verifiable accuracy of FBMs. The two case studies report at least one

critical inaccuracy, though many accurate details (Greenberg, 2004; Neisser, 1982; Thompson & Cowan, 1986). Furthermore, those inaccuracies are systematically biased to enhance the features of the event that contribute to its personal significance. The day of Danish liberation is remembered as more sunny, less cloudy, less windy, less rainy, and/or warmer than it actually was by Berntsen and Thomsen's (2005) participants, and Neisser (1982, 1986) misidentified a football game as a baseball game (i.e. America's pastime) when remembering the attack on Pearl Harbor (Thompson & Cowan, 1986). The issue of objective accuracy is ripe for further investigation. Event features most likely to be recalled accurately, as well as the magnitude and direction of errors, should be examined whenever archival data are available to confirm self-reports (see Luminet & Spijkerman, in press, for a similar argument). A larger body of evidence has examined consistency between memory reports as a proxy for accuracy.

### Consistency

In order to obtain consistency data, two (or more) retrospective reports are collected. The report closer in time to the event is considered the standard. Later reports are then compared to that earlier report and inconsistencies are identified. Although two consistent reports are not necessarily accurate, an inconsistent report implies that at least one report is inaccurate. FBM consistency has also been shown to correlate with performance on the autobiographical Implicit Association Test (aIAT), itself a correlate of accuracy (Curci, Lanciano, Maddalena, Mastandrea, & Sartori, 2014; Lanciano, Curci, Mastandrea, & Sartori, 2013). Contrary to the arguments of Julian, Bohannon, and Aue (2009), we do not consider "wrong time slices" (Neisser & Harsch, 1992) to be accurate. Recalling an event that actually occurred (e.g. a 30th birthday party) but was not the event requested (e.g. "tell me about your 40th birthday party") is inaccurate recall. Because changes across recalls do not imply a lack of accuracy, investigators may want to emphasize explicit inconsistencies when drawing conclusions about FBMs.

The overwhelming evidence is that FBMs are incomplete (Brown & Kulik, 1977) and include inconsistencies (Christianson & Engelberg, 1999; Curci, 2005; Curci & Luminet, 2006; Curci, Luminet, Finkenauer, & Gisle, 2001; Greenberg, 2004; Larsen, 1992; Lee & Brown, 2003; Liu, Ying, & Luo, 2012; McCloskey, Wible, & Cohen, 1988; Nachson & Zelig, 2003; Neisser, 1982; Neisser & Harsch, 1992; Schmolck, Buffalo, & Squire, 2000; Talarico & Rubin, 2003, 2006; Weaver, 1993; Weaver & Krug, 2004; Wright, 1993). Memory for the general gist of the event is better than memory for specific details (Bohannon & Symons, 1992; Pillemer, 1984; Schmidt, 2004, 2012; Schmidt & Bohannon, 1988; Thompson & Cowan, 1986) and peripheral details are more likely to be inconsistent than are central details (Christianson, 1989; Romeu, 2006; Tekcan, Ece, Gulgoz, & Er, 2003). However, how one divides responses into central vs. peripheral information often coincides with whether the memory reports show consistency or inconsistency. Tekcan *et al.* (2003) considered "time" and "others present" to be peripheral details because

those two questions were responsible for the majority of inconsistencies found in their participants' memory reports. Which categories account for reliable recall is also variable. For example, both Christianson (1989) and Pillemer (1984) found reliable recall for "informant," and "location," information. Pillemer (1984), but not Christianson (1989), found "ongoing activity" to be reliably recalled. Importantly, in none of these investigations was recall of central vs. peripheral details of a non-FBM obtained. In Curci and Luminet's (2009) study of French President Mitterrand's death, French participants were more consistent in location and time details than were Belgian participants, even though both groups showed high overall consistency within these categories.

Moreover, inconsistencies in FBMs, once introduced, are repeated over time and not corrected or further altered (as they are for semantic details of the event) (Coluccia, Bianco, & Brandimonte, 2006; Hirst *et al.*, 2015; Tekcan *et al.*, 2003; Weaver & Krug, 2004). Further, delayed recall is highly related to initial recall (Conway, Skitka, Hemmerich, & Kershaw, 2009; Weaver, Terrell, Krug, & Kelemen, 2008). Longer delays between the event and the initial memory report often produce enhanced consistency scores (Coluccia *et al.*, 2006; Weaver *et al.*, 2008; Winningham, Hyman, & Dinnel, 2000), though not always (Coluccia, Bianco, & Brandimonte, 2010; Kvavilashvili, Mirani, Schlagman, Foley, & Kornbrot, 2009; Lee & Brown, 2003). Within AMs, the total number of consistent details has also been shown to increase with the number of rehearsals (Campbell, Nadel, Duke, & Ryan, 2011; Nadel, Campbell, & Ryan, 2007). Lastly, FBMs do not include fewer inconsistencies than everyday memories (Talarico & Rubin, 2003, 2006).

Therefore, in conjunction with the evidence described above, we must conclude that FBMs are not permanent, perfect copies of experienced events, nor are they so much more consistent than everyday memories that a special mechanism is required to differentiate the categories.

### Vividness

However, there are characteristics of FBMs that may still differentiate them from ordinary AMs. Vividness has been of interest to FBM research since Brown and Kulik (1977) described the "live quality that is almost perceptual" (p. 74). Julian *et al.* (2009) have suggested that elaboration (i.e. quantity of details recalled) may be of interest as well<sup>1</sup>. There are strong pragmatic advantages to assessing elaboration as it only requires obtaining a single memory report, irrespective of delay from the event. However, there are at least three methodological issues that undermine its utility. First, there is wide variability in both the total number of details and the nature of those details when defining FBM. Kizilöz and Tekcan (2013) asked a large sample of individuals to recall three separate FBMs and identified, without regard to accuracy or consistency, seven distinct categories that captured the majority of information provided in the narratives: *informant*, *location*, *others present*, *own ongoing activity*, *own affect*, *own thoughts*, and *aftermath*. Interestingly, although *time* had been asked of participants in more than half of the studies included in their review (as

were *location, ongoing activity, source, and others present*), it was rarely spontaneously mentioned and therefore not included in their group of canonical categories.

More generally, these who, what, where, when, and how-type questions are the foundation of good story-telling and so it is not surprising that they constrain the structure of autobiographical event recall (Neisser, 1982). Second, longer delays between the event and the initial memory report often result in longer memory narratives (Lee & Brown, 2003). In part, this may be due to narrative conventions regarding shared information as Bohannon (1988) found that *time* information was much more likely to be included in reports obtained after three years than in those recorded after only one week. The frequency and timing of retrievals can also influence total narrative length (Nadel *et al.*, 2007). Third, Marsh and Tversky (2004) have shown that the functional context of retrieval can influence what and how much individuals report. Similarly, reporting medium (e.g. verbal vs. typed) influences both absolute word count and the units of information provided in memory reports (Gryzman & Denney, 2016). Therefore, elaboration is a less useful measure than one might expect.

Instead, defining vividness as a phenomenological experience of remembering perceptual detail can be informative. Rubin and Kozin (1984) tried to reframe FBMs as “vivid memories”, as they thought that enhanced vividness was the defining feature of the phenomenon. In fact, FBMs often exhibit ceiling effects in vividness ratings regardless of the delay between event and memory report (Kvavilashvili, Mirani, Schlagman, Erskine, & Kornbrot, 2010; Kvavilashvili, Mirani, Schlagman, & Kornbrot, 2003; Niedzwienska, 2003; Talarico & Rubin, 2003; Tinti, Schmidt, Sotgiu, Testa, & Curci, 2009; Weaver & Krug, 2004). Therefore, FBMs are more vivid than some ordinary memories (see Kvavilashvili *et al.*, 2010 for direct comparison), but other types of AMs, such as those with high emotional intensity, are as vivid as FBMs (Talarico, LaBar, & Rubin, 2004). That is, the distributions of vividness overlap so there is no discontinuity that would require a special mechanism.

### Confidence

In contrast to objective evidence of memory inaccuracy, participants consistently report enhanced confidence in FBM accuracy. FBMs are usually recalled with a higher degree of confidence than other memories of equal age (Brown & Kulik, 1977; Kvavilashvili *et al.*, 2010; Paradis, Solomon, Florer, & Thompson, 2004; Talarico & Rubin, 2003, 2006; Weaver, 1993; see Denver *et al.*, 2010 for equally high confidence ratings in FBMs and ordinary AMs), even when individuals are confronted with evidence that the event in memory could not have occurred as it is remembered (Neisser & Harsch, 1992). Confidence is often at ceiling for FBMs (Christianson & Engelberg, 1999; Curci *et al.*, 2014; Denver *et al.*, 2010; Neisser *et al.*, 1996; Niedzwienska, 2003; Talarico & Rubin, 2003, 2006; Weaver, 1993; Weaver & Krug, 2004) and often remains that high for at least months after the event (Christianson & Engelberg, 1999; Coluccia *et al.*, 2010; Conway *et al.*, 2009; Denver *et al.*, 2010; Hirst *et al.*, 2015; Kraha & Boals, 2014; Kvavilashvili *et al.*, 2009;

Liu *et al.*, 2012; Niedzwienska, 2003; Weaver & Krug, 2004). It may be that confidence ratings are based on equally reliably enhanced vividness ratings, as the two are correlated (Neisser & Harsch, 1992).

Therefore, along with vividness, the second distinctive property of FBMs is a discrepancy between metacognitive perception and objective reality. In fact, this discrepancy may have led to the identification of the phenomenon in the first place and may well lead to the most interesting applications of the phenomenon to ordinary memory processing. Thus, it is the secondary, phenomenological characteristics like vividness and confidence that may serve to retain the utility of FBM as a distinct category. If FBMs are differentiated by phenomenological experience, then the mechanisms responsible for the phenomenon must account for these differences, not explain (non-existent) encoding or retrieval differences.

The primary question in FBM research then becomes why we are more likely to maintain vivid, confidently held memories of these particular events. Enhancements to the subjective experience of remembering support Berntsen's (2009) model of FBM formation being driven by social group identification and a subsequent feedback loop where the memory itself serves to perpetuate identification with the social group. This may be considered a special case of Fernández's (2015) epistemic function of AMs more generally (e.g. an individual benefits from believing herself to be a patriot by relying on her vivid memory for learning about the September 11th attacks as evidence for that belief). However, we are still left to identify which event features are necessary to produce the defining memory characteristics.

### **Event conditions necessary to produce FBM**

The vast majority of research in this field has been done in the aftermath of a public tragedy. This has been because consequentiality, distinctiveness, and emotional affect have been the primary features of the event thought to influence the formation of FBM (i.e. a memory report which satisfies the criteria described above for vividness and confidence, longevity and/or consistency). Here, we will discuss objective characteristics of the event thought to produce FBMs. Subjective assessments of the events will be discussed later.

#### ***Consequentiality***

Consequential events most often studied include disasters with loss of life (e.g. earthquakes, terrorist attacks) or events with political implications (e.g. assassinations, resignations, invasions). FBM research is differentiated from traumatic memory research as the participants in the latter are directly affected by the events being studied. In the case of FBMs, participants are rarely so personally involved (see Pillemer, 2009 for a review of this distinction). However, the events being investigated are often on such a scale that the aftermath affects the lives of participants in other, more subtle ways.

Is this comprehensive consequentiality responsible for FBMs? In short, no. The best evidence for the importance of consequentiality is indirect – an association between physical proximity to the event location and FBM formation. Cross-national studies have found this effect (Conway *et al.*, 1994; Curci *et al.*, 2001; Curci & Luminet, 2006; Kvavilashvili *et al.*, 2003) as have national studies with participants sampled from multiple locations (Er, 2003; Neisser *et al.*, 1996; Sharot, Martorella, Delgado, & Phelps, 2007), although Luminet *et al.* (2004) found few differences in FBM specificity by nationality, and Pezdek (2003) found that those closest to the event were less likely to recall their personal circumstances than were those living far away. For consistency, some studies have found differences as a result of proximity (Conway *et al.*, 1994; Er, 2003) whereas others have not (Curci *et al.*, 2001; Curci & Luminet, 2006). Enhanced vividness, however, does seem to be associated with being physically closer to the event (Kvavilashvili, *et al.*, 2003; Sharot *et al.*, 2007).

Many of the studies examining distance conflate directly experiencing the event with closest physical proximity. In cases involving political events (Conway *et al.*, 1994; Curci *et al.*, 2001), simply living in the affected nation ought to be less consequential than experiencing a natural disaster (Er, 2003; Neisser *et al.*, 1996) or terrorist attack (Sharot *et al.*, 2007), for example. The bulk of the empirical evidence fails to support the claim that objective consequentiality is relevant for the formation (Er, 2003; Tekcan, 2004), accuracy (Berntsen & Thomsen, 2005), consistency (Niedzwienska, 2003; Weaver, 1993), or vividness (Berntsen & Thomsen, 2005; Rubin & Kozin, 1984) of FBMs. However, Koppel, Brown, Stone, Coman, and Hirst (2013) showed that different factors predicted consistency for consequential (i.e. the first inauguration of U.S. President Obama) and non-consequential (i.e. the emergency landing of US Airways Flight 1549) public events; emotional intensity and significance predicted consistency of memories for a consequential event, whereas rehearsal predicted consistency for a non-consequential event. So, although (inter)national events may retain value by generating large numbers of potential participants, exclusively examining such events simply because they are assumed to have a requisite degree of consequentiality seems unnecessary.

### ***Distinctiveness***

The evidence in support of distinctiveness effects is much stronger than was found for consequentiality, as it has been correlated with the formation (Edery-Halpern & Nachson, 2004; Larsen, 1992; Wright & Gaskell, 1992) and vividness (Bohn & Berntsen, 2007; Edery-Halpern & Nachson, 2004) of FBMs. Mahmood, Manier, and Hirst (2004) found no relationship between distinctiveness and the formation or vividness of FBMs, but, distinctiveness in their study was defined as the first event in a series of similar, emotional, personally significant events (i.e. the deaths of lovers, friends, and/or family members due to AIDS). An event may be distinctive for reasons other than that it is the first of its kind, however; Brown and Kulik (1977) studied memory for a series of assassinations of political figures in a

relatively brief period of time, yet each was a distinctive event. Edery-Halpern and Nachson (2004) found that the least distinctive event in their sample of terrorist attacks within a two-year period in Israel was also significantly less well remembered (i.e. fewer details were recalled and more responses were left blank for this memory compared to the other events). This is not surprising given that the episodic memory literature includes ample evidence of a distinctiveness advantage (i.e. *von Restorff effect*; see Schmidt, 2012 for a review within an FBM context). Brewer's (1988) study of AM suggests that the lower the frequency of event occurrence, the greater the likelihood of later cued recall. Thus, any effects of distinctiveness that might be present may be similar for FBM and AM.

### **Emotional Affect**

Another event feature known to enhance ordinary memory and thought to influence FBMs is negative emotional affect. For example, negative stimuli "pop-out" in a neutral context to a greater extent than neutral stimuli in a fearful context (Ohman, Flykt, & Esteves, 2001). As they typically involve disasters, attacks, and assassinations, most FBM studies have included only negative events. Kraha, Talarico, and Boals (2014) examined the surprising announcement of Osama bin Laden's death, which was interpreted positively by the U.S. students sampled, and found little evidence of FBM. However, this lack of phenomenological enhancement was attributed more to lack of emotional intensity (see below) than to positive affect per se.

Other studies have shown both positive and negative events can lead to FBMs (Berntsen & Thomsen, 2005; Bohn & Berntsen, 2007; Demiray & Freund, 2015; Liu *et al.*, 2012; Scott & Ponsoda, 1996; Tekcan, 2001). Positive interpretations of an event are more likely to produce FBMs (Bohn & Bernsten, 2007) and increase accuracy, vividness, and rehearsal of that event relative to the memories of those who interpret the event negatively (Breslin & Safer, 2011; Talarico & Moore, 2012). Kensinger and Schacter (2006) and Holland and Kensinger (2012) both found that consistency was higher (although confidence was lower) for positive interpretations of a sporting event and an election outcome, respectively. (However, in their examination of a sporting event, Talarico and Moore [2012] found no differences in consistency or confidence among fans of the winning and losing teams.) Generally, these results are consistent with pleasantness biases in autobiographical recall (see Walker, Skowronski, & Thompson, 2003 for a review). Furthermore, there is evidence from collective memories that even profoundly negative events are more likely to persist in the culture if they evoke positive connotations. For example, Hirst and Meksin (2009) describe how the assassinations of Lincoln and Kennedy endure because each President was subsequently deified by popular culture. Similarly, there is often an emphasis on patriotism and heroism in the face of tragedy (e.g. the Pearl Harbor or September 11th attacks) in societal recollections of those events (see Stone & Jay, Chapter 8, this volume, for further discussion of FBM for positive events).

Summarizing the conditions necessary to produce FBMs, what could be a unique characteristic of FBMs (consequentiality) fails to predict the memory phenomenon, and well-characterized features of AM moderately account for the key characteristics of vividness and confidence, suggesting that subjective interpretations of events may be more responsible for the phenomena.

### Individual processing of the subjective flashbulb event

Characteristics of how an individual processes the event at encoding and during rehearsal/retrieval are thought to be important determinants of FBMs. Encoding factors are closely tied to event features: distinctiveness with surprise, emotional affect with emotional intensity, and consequentiality with significance. What differentiates them is the objective vs. subjective nature of assessment. How these characteristics contribute to the FBM phenomenon individually and interactively is the focus of much current work in this area.

#### *Significance*

Significance, or personal importance, refers to the individual's subjective assessment of the event. This assessment can be based on any number of felt criteria and is not necessarily related to any material changes in the individuals' circumstances. As with consequentiality and emotion, group membership is frequently used as a proxy for significance. This provides a methodological advantage in identifying large numbers of participants for whom individual reactions to a common event are expected to vary. There are also theoretical reasons to justify this technique.

Berntsen (2009) argues quite persuasively that it is an event's importance to our social identity specifically that determines whether an event will produce an FBM. Because FBM research has emphasized recall of public events, it is not surprising that social identity is the most salient criteria for determining significance. Various traits have been used to demarcate social groups, including race (Brown & Kulik, 1977) gender, (Wright, Gaskell, & O'Muircheartaigh, 1998), language (Stone, Mercy, Licata, Klein, & Luminet, 2013), religion (Curci *et al.*, 2014; Lanciano, Curci, & Soleti, 2013; Tinti *et al.*, 2009), and explicit membership in social movements (e.g. participation in resistance activity during military occupation by foreign forces (Berntsen & Thomsen, 2005). Across all operational definitions, social group membership (and therefore personal significance) was positively associated with FBM formation (Brown & Kulik, 1977; Wright *et al.*, 1998), enhanced accuracy (Berntsen & Thomsen, 2005), greater consistency (Curci *et al.*, 2014; Lanciano *et al.*, 2013; Tinti *et al.*, 2009), increased elaboration (Curci *et al.*, 2014; Stone *et al.*, 2013), and enhanced vividness (Berntsen & Thomsen, 2005; Tinti *et al.*, 2009), though it was unrelated to confidence (Curci *et al.*, 2014).

Lanciano *et al.* (2013) further showed that ratings of importance (a conflation of event consequentiality and personal significance) for the death of Pope John Paul II differed as a function of religious affiliation, consistent with Berntsen's (2009)

social identity model. Similarly, Tinti *et al.* (2009) used national origin as an alternate avenue to identification with the Pontiff, allowing it to serve as a proxy for significance. After controlling for religiosity, they found that participants with no particular affiliation to Pope John Paul II (i.e. Swiss individuals) had less consistent and less vivid FBMs for his death than did participants who could identify with him (i.e. Italian and Polish individuals). Luminet *et al.* (2004) showed that U.S. versus non-U.S. citizenship status was more predictive of developing an FBM for the September 11th attacks than was nation of residence. In Stone *et al.*'s (2013) examination of linguistic groups within Belgium, both French and Dutch speakers thought the division of the University of Leuven was equally important, but Dutch speakers were more likely to be personally and/or politically involved in the division and, as a result, had more elaborate FBMs and rehearsed those memories more frequently than did French speakers.

Not all FBM studies rely on group membership to examine this characteristic; individual ratings of personal importance have also been investigated (when sufficient variability exists to do so). Participant ratings of significance are positively correlated with FBM formation (Bohannon & Symons, 1992; Conway *et al.*, 1994; Larsen, 1992; Mahmood *et al.*, 2004; Wright & Gaskell, 1992; but see Wright *et al.*, 1998). Paradis *et al.* (2004) found that their New York City participants rated both September 11th and 12th as personally important and their sample developed FBMs for both of those days, in terms of initial recall and later consistency. Niedzwienska (2003) also found significance to be correlated with consistency of the FBM report. Furthermore, personal significance has been reliably related to vividness ratings (Mahmood *et al.*, 2004; Nachson & Zelig, 2003; Niedzwienska, 2003; Rubin & Kozin, 1984) and to the number of details reported (i.e. elaboration) in German, Turkish, British, and American samples, though not within a Chinese sample (Kulkofsky *et al.*, 2011). The authors attributed this anomaly to collectivist cultural expectations to de-emphasize personal goals and activities that therefore potentially dampened significance ratings within this group.

However, individual ratings of personal significance are not universally found to predict FBM phenomena. Otani *et al.* (2005) classified memory reports as FBMs or non-FBMs, yet found no difference in the significance ratings of participants in each group. Davidson and Glicksly (2002) also found no differences in the significance ratings of two events, yet one event led to reliably more FBM reports than the other.

As the study of irrelevant characteristics (e.g. consequentiality, negative valence) declines and is replaced by more systematic study of relevant characteristics, the nuanced nature of such effects can be determined. It is our belief that personal significance as assessed by social group membership will remain a determining feature of FBM formation, but that other criteria for personal significance may also lead to vivid, confidently held FBMs as well. As with distinctiveness, there is an abundance of data for a self-referential effect in memory performance, with personally relevant material enhancing memory (see Symons & Johnson, 1997 for a review). Thus, the influence of significance on FBMs can be predicted from more general features of AMs.

### **Surprise**

As significance is differentiated from consequentiality, so, too, is surprise different from distinctiveness. Surprise is a personal, emotional reaction to the event, not a property of the event. Note that although an event can be expected, and therefore not surprising, it can still be distinctive, as was seen in the case of several terrorist attacks in Israel, the sad inevitability of which does not prevent each attack from being distinct (Edery-Halpern & Nachson, 2004).

Although surprise is a key component in many models of FBM formation (Brown & Kulik, 1977; Er, 2003; Finkenauer *et al.*, 1998), there is little data to support its inclusion. Only when comparing FBM for two similar events (the deaths of Princess Diana and Mother Theresa), were higher ratings of surprise associated with greater initial recall and later consistency of FBM. Surprise only seems to be directly influential when tied to social identity, otherwise it plays no direct role in FBM formation (Curci & Luminet, 2009).

FBMs have been found for expected events (Curci *et al.*, 2001; Lanciano *et al.*, 2013; Tekcan, 2001; Tinti *et al.*, 2009; Winograd & Killinger, 1983). Additionally, Coluccia *et al.* (2010) found no differences between expected and unexpected events in the relationships between delay and consistency, confidence, or elaboration. Equal surprise ratings were provided by those who did and those who did not develop FBMs for the Kobe earthquake (Otani *et al.*, 2005). There is even evidence that surprise and FBM phenomena are negatively correlated. Berntsen and Thomsen (2005) found that participants rated the invasion of Denmark as more surprising than its liberation, but were more likely to have FBMs for the liberation than for the invasion. It may be that surprise is a retrospective evaluation that is based on the emotional intensity of one's reaction. If this is the case, we would expect surprise to play a role in FBM formation when it is present, but it would be neither a necessary nor a sufficient condition for the phenomenon.

Interestingly, the effect of surprise in AM has not been thoroughly investigated. We do know that surprise tends to be a positive emotion in ordinary AMs (Talarico *et al.*, 2004). In other words, when cued to generate memories of surprise, participants are more likely to recall pleasant events (e.g. a surprise birthday party) than unpleasant events (e.g. an unexpectedly low score on an exam). Yet, when evaluating positive and negative events generally, positive events tend to be expected (e.g. weddings) whereas negative events are typically unexpected (e.g. divorce) (Berntsen, 2002; Rubin & Berntsen, 2003). The public events studied in FBM research are predominantly surprising and negative, therefore the scope of FBM research has been limited by what may be coincidental, not causal, event features. Anticipatable public events (e.g. elections) may be ripe for additional exploitation by FBM investigators (Boals, 2010; Holland & Kensinger, 2012).

### **Emotional Intensity**

Some of the most contradictory findings in the FBM literature are those involving emotional intensity<sup>2</sup>. The positive-negative valence dimension depends primarily

on the nature of the event itself (though some events may be interpreted differently among different groups). Depth of feeling, however, is necessarily a subjective reaction to a given event within a valence category.

There are data supporting emotional intensity's role in FBM formation using participant ratings (Berntsen & Thomsen, 2005; Bohannon, 1988; Bohannon & Symons, 1992; Davidson & Glisky, 2002; Paradis *et al.*, 2004) and using culture as a proxy for emotion (Brown & Kulik, 1977; Curci *et al.*, 2001), but nearly as many studies that fail to find a correlation with participant ratings (Otani *et al.*, 2005; Smith, Bibi, & Sheard, 2003; Tekcan, 2001), or with culture as a proxy (Luminet *et al.*, 2004). Wright *et al.* (1998) found that men, who rated the Hillsborough football disaster as less emotional than women, were more likely to develop FBM, not less. The same contradictory pattern emerges for intensity and consistency, with some studies finding a positive relationship between the two (Bohannon & Symons, 1992; Conway *et al.*, 1994; Davidson & Glisky, 2002; Schmolck *et al.*, 2000), but more that fail to find such a relationship (Christianson & Engelberg, 1999; Kvavilashvili *et al.*, 2009; Nachson & Zelig, 2003; Neisser *et al.*, 1996; Neisser & Harsch, 1992; Schmidt, 2004; Talarico & Rubin, 2003). Vividness of the FBM is equally divergent. Rubin and Kozin (1984) failed to find a correlation between emotional intensity and vividness, whereas others have found the two to be related (Berntsen & Thomsen, 2005; Nachson & Zelig, 2003; Pillemer, 1984). Lastly, Hirst *et al.* (2015) failed to find a relationship between emotional intensity and confidence at either three-year or ten-year intervals. Even if the effects of emotional intensity were more reliable, the advantage of emotionally intense experiences over neutral events is well established in the episodic and AM literatures and so it cannot be seen as unique to FBM.

### **Rehearsal**

The final processing feature we will examine is the only non-encoding-specific mechanism discussed in this literature. The effects of rehearsal on FBM seem to dissociate based on the dependent variable of interest. Increased rehearsal has been correlated with the formation of FBMs (Bohannon, 1988; Bohannon & Symons, 1992; Curci *et al.*, 2001; Davidson & Glisky, 2002; Otani *et al.*, 2005; Tekcan & Peynircioglu, 2002; Tinti, Schmidt, Testa, & Levine, 2014), although Hornstein, Brown, and Mulligan (2003) found that to be true only for covert, not overt, rehearsal. For vividness, there seems to be no relationship with rehearsal (Pillemer, 1984; Rubin & Kozin, 1984). Hirst *et al.* (2015) found that confidence was correlated with rehearsal after a three-year delay (as did Kvavilashvili *et al.*, 2009), but not after a ten-year delay.

For consistency, the pattern is quite variable. There are studies showing a positive correlation between rehearsal and consistency (Bohannon & Symons, 1992; Conway *et al.*, 2009; Davidson & Glisky, 2002; Schmolck *et al.*, 2000), a negative correlation between the two (Kvavilashvili *et al.*, 2009), and no relationship (Kvavilashvili *et al.*, 2009; Pillemer, 1984; Schmolck *et al.*, 2000), across delays ranging from six

months to three years. There is no systematic relationship among delay, type of rehearsal (overt vs. covert), or consistency.

Moreover, rehearsal via media exposure can increase errors of commission as is seen in the “crashing memories” phenomenon (Crombag, Wagenaar, & van Koppen, 1996) of reporting false memories of non-existent footage (Ost, Granhag, Udell, & Roos af Hjelmsäter, 2008). Media exposure can also serve to increase omissions via retrieval-induced forgetting (Coman, Manier, & Hirst, 2009). These details are unlikely to be reintroduced into the memory narrative because there are few opportunities for correction. As with most AMs, there is little evidence of what actually occurred, therefore little can be presented to refute or corroborate one’s personal recollection.

Yet, we know that rehearsal is a potent mechanism for sustaining memory. Repeated overt retrieval attempts lead to more consistent and more elaborated AM reports (Campbell *et al.*, 2011; Nadel *et al.*, 2007). In other words, individuals add details to their memory reports while also maintaining the originally provided information. Kvavilashvili *et al.* (2010) found a positive correlation between rehearsal and consistency for a staged autobiographical event in contrast to a negative correlation for FBM of the September 11th attacks. Specifying the differences between public and private, overt and covert rehearsal behaviors may help make sense of these disparate results.

### **Combining factors**

Most events are chosen as subjects of FBM research because they exhibit many of the features we have noted here. This has led some investigators to adopt statistical techniques such as latent variable modeling and structural equation modeling to determine the relationships among these features (see Luminet, Chapter 3, this volume) frequently within FBM and non-FBM of the same event. Each of these models defined FBM as recall of some number of canonical categories or some measure of completeness and specificity, not vividness or confidence, the more reliable characteristics to differentiate FBMs from ordinary AMs. Further, these models consider significance and distinctiveness to be indirect factors in FBM formation, though the data presented here suggest that they are among the predominant mechanisms responsible for FBM.

Day and Ross (2014) are the only investigators to model confidence, one of the more reliable FBM characteristics. They found that the strongest predictor of confidence when remembering Michael Jackson’s death was a sense of attachment to the performer (which lead to greater initial surprise, increased emotional intensity, and enhanced rehearsal). Furthermore, they found that individuals’ beliefs about the persistence of FBM also correlated with their later confidence in their own memories, but not with the consistency of those memory reports. Models like this suggest a high degree of interrelatedness among metacognitive features (i.e. beliefs about memory generally and beliefs about one’s own memory) and between the ways in which events are processed and their resulting phenomenology. In contrast,

there seems to be little predictive value of event features on resulting mnemonic characteristics.

### Summary and future directions

FBMs are distinguished from ordinary memories by their vividness and the confidence with which they are held. There is little evidence that they are reliably different from ordinary AMs in longevity, accuracy, or consistency. Features of the event and processing characteristics of the individual identifiable in ordinary AM explain enhancements to each of these memory properties. Curci and Lanciano (2009), Lanciano and Curci, (2012; see also chapter 1, this volume) have argued that FBMs are better viewed as a category separate from ordinary memories rather than along a continuum with them. To support this claim they conducted two studies, each with a large number of participants who were asked to recall details of a single public event on two occasions. The consistency of their responses to canonical FBM questions were rated and analyzed statistically. In both studies, the authors found a better fit of the empirical data to a categorical (taxonomic) model than to a continuous (dimensional) model of memory.

Further, guidance for interpreting the claim of distinct categories is based on a limited theory of episodic/autobiographical memory. Specifically, Conway (1995) has argued that FBMs are stable clusters of sensory-perceptual details that are highly integrated and therefore accessed holistically. They are contrasted with ordinary AMs which are dynamic reconstructions of information drawn from event-specific knowledge and generalized autobiographical themes. Brewin (2014) reinforces this idea when suggesting that FBMs are defined by “a more detailed perceptual record of experience than ordinary memories” (p. 73). He goes on to argue that FBMs are evidence of a distinct perceptual memory system, separate from episodic memory, and particularly linked with emotional reactivity. It is this specific, empirically unsupported difference between FBM and AM that is discussed in both papers, and thus is not an ideal assumption for testing the nature of categories.

A more common and better supported view of AM organization is based on a more flexible view of the construction of autobiographical memories at all levels (e.g. Bartlett, 1932; Hirst & Phelps, 2016; Neisser, 1982; Rubin, 2012; Rubin & Umanath, 2015). This view allows for more flexible use of non-hierarchical knowledge bases and can adequately account for the findings reviewed in our chapter for both FBM and ordinary AM. For the event conditions, consequentiality seems to be irrelevant to FBM, distinctiveness is the most predictive, and emotional affect is as yet understudied. Of the processes discussed, significance is the most promising determinant of FBM, especially as related to social group membership in the context of public events. It is correlated with formation, consistency, vividness, and confidence of FBMs. Surprise has an unreliable influence on the formation and consistency of FBMs (the least reliable features of FBMs overall) and its effects on vividness and confidence (the most reliable features) have not been systematically investigated. Therefore, this seems to be one of the more promising areas for future

investigation. Emotional intensity is an unreliable predictor of FBM, yet this is most likely due to inconsistencies in defining FBM. At least some of the enhanced confidence and/or vividness associated with FBMs are probably due to enhanced emotionality; however, the exact nature and scope of that influence has yet to be determined. Lastly, rehearsal tends to be correlated with the formation of FBMs, but the relationships between rehearsal and consistency, vividness, and confidence are quite variable. Because rehearsals can take multiple forms (public vs. private, overt vs. covert) and can simultaneously enhance recall of some details while introducing erroneous details, disentangling the specific effects of rehearsal on particular features of FBM is an important goal for future investigators.

We have no doubt that FBM will remain a topic of frequent investigation. After 40 years of wandering, we may be finally approaching the promised land of understanding this fascinating and complex phenomenon. Berntsen's (2009) resurrection and expansion of the social aspects of Brown and Kulik's (1977) hypothesis may be the most significant contribution to the FBM literature in recent years, in part because it did not rely on any claims to special mechanisms; these factors are important to all AMs. By reclaiming the public nature of events from mere methodological convenience to an important theoretical feature, Berntsen's (2009) model helps to sustain FBM as a distinctive phenomenon and as a fruitful area for inter- and multi-disciplinary work on remembering.

Listening to news is not an inherently memorable activity (Larsen, 1992). The counterintuitive enhancement of memory for otherwise mundane activities was what spurred initial interest in FBM. Neisser's (1982) suggestion that "we remember the details of a flashbulb occasion because those details are the links between our own histories and History" (p. 48) was prescient, but perhaps too broad. Evidence of FBM phenomena from events that are public, but on a relatively smaller scale than is typical of natural disasters or political events, are proof of this. For example, memories of sporting events for fans of a given team underscore the role of personal significance (and the irrelevance of objective consequentiality) in Flashbulb memory. These memories are likely only among those who consider the event to be important, and therefore emotionally intense. Groups of fans observing subsequent games serve as a natural context for rehearsal and sharing one's memory serves as a potent symbol of one's identity as a "true" fan. Rehearsing one's personal relationship to an event rather than the factual details of the event itself is consistent with the role of the feedback loop in creating and maintaining FBMs. Telling one's personal story of learning about a shared event serves narrative conventions to introduce novel details to a conversation and serves larger social functions by building group cohesion. The expectation of remembering, of having that story to share, is an underappreciated characteristic of the FBM phenomenon. Both individuals and groups have that expectation. There is presumed judgment of one's failure to remember a given event and what that failure implies about the individual's understanding or interpretation of a given event.

One important direction for future research ought to be moving away from indirect assessment of social identity (e.g. cross-cultural studies) and toward a

priori measures of group identification and selection of samples who vary significantly on those measures. One should predict that FBM phenomenology is likely to be greatest when membership in a social group is important (not just incidental) to an individual and when that membership is vulnerable. Because every individual is simultaneously a member of multiple social groups, each of those groups is not of equal importance. Feelings of insecurity about one's group membership should enhance the perceived significance of both the event itself and of the FBM for its symbolic function. The pressure to prove one's status should correlate with phenomenological features of the memory such as vividness and confidence in its accuracy. For groups wherein one's status is more established or more assured, the FBM phenomenology may still be at the higher end of a continuum within AM, but they may not be at the extreme ceiling seen for other events.

In his book, *Extraordinary memories for exceptional events*, Schmidt (2012) defines FBM methodologically (i.e. studies asking individuals "how did you first learn the news of public event X"), phenomenologically (i.e. as a detailed, long-lasting, vivid, and confidently-held AM), and theoretically (i.e. accurate and detailed memories that are the result of a special remembering mechanism). We argue here that the theoretical definition is unsustainable. There is insufficient evidence to support a categorical dissociation between FBMs and other AMs. The phenomenological definition is nearing refinement but there are still some unanswered questions. We believe this to be the most fruitful and therefore most important direction for FBM research in the coming years. Most importantly, we believe that a clear, a priori definition of what constitutes an FBM or, better, a set of alternative definitions that can be contrasted to see which provides a better understanding of the data, is necessary in future empirical work. Clearly stating what data are required to identify a given memory as an FBM or a non-FBM will increase the utility of new studies in addressing these important questions. Without such definitions, studies risk simply repeating past studies on new events and merely describing the phenomenon rather than explaining it. We have also argued that the methodological definition may be more than a simple convenience. The personal memory of learning about a public event remains a unique domain within AM. This characteristic ties event features to memory features and therefore provides clues to potential mechanism(s) for the phenomenon. It also captures why the phenomenon is of such enduring interest. Long-lasting, detailed, vivid, confidently-held memories of directly-experienced, emotional, significant, and well-rehearsed events is not unexpected, but the idea that simply receiving news can change a mundane experience into a noteworthy memory remains surprising and is why FBMs deserve to remain a distinct phenomenon.

## Notes

- 1 The stronger claim by Julian *et al.* (2009) that elaboration may be used as a proxy for accuracy is supported by some evidence within semantic memory for event details, not within AM.

- 2 Note that most of the AM literature relies on self-reports of emotional intensity and are therefore best characterized as a measure of depth of feeling. Physiological arousal is a related, but independent, construct not addressed here.

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