4 Flashbulb memories result from ordinary memory processes and extraordinary event characteristics[1]

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Brown and Kulik (1977) observed a phenomenon that had 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 (for an earlier study, see Colegrove, 1899). The concept was equally effective in capturing the attention of memory researchers, and in the 30 years following that 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 hypothesis was that FBMs were the result of a unique memorial process. People had a specially designed means of automatically encoding all aspects of an important (emotional) event as it happened. This was advantageous because it enabled the individual to re-evaluate the circumstances of the event after the fact and to determine which details were important and which were inconsequential (Brown & Kulik, 1977; Gold, 1992). The prediction from this hypothesis was permanent, veridical recall of the event, though "far from complete" (Brown & Kulik, 1977, p. 75).

However, this strong hypothesis did not last long, as evidence of errors in the recall of FBMs was soon identified (Christianson, 1989; Neisser & Harsch, 1992; Neisser et al., 1996). Consequently, the FBM hypothesis underwent its first major revision. The new hypothesis argued that such a standard was unreasonable. Instead, the refined hypothesis stated that FBMs were still more consistent than one could predict with ordinary memory mechanisms (Cohen, McCloskey, & Wible, 1988, 1990; McCloskey, Wible, & Cohen, 1988; Pillemer, 1990; Schmidt & Bohannon, 1988). This new hypothesis still argued for a special, unique memorial process.

If there are special mechanisms involved in FBM then there should be three ways of detecting them: the properties of the FBMs, the conditions necessary to produce FBMs, and the way in which FBMs are processed. With regard to memory properties, the memories should be different from ordinary memories in some way; they could be more accurate, or more consistent, or more vivid, or show less loss over time than everyday memories. The second way to identify FBMs is that the conditions necessary to produce

these memories should be different from ordinary events; they could require surprise, or consequentiality, or strong emotions, for example. Finally, how the individual processes the event should differ for FBMs relative to ordinary autobiographical memory. 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 order to compare FBMs to ordinary autobiographical memories we need a description of "ordinary". Ideally we would sample all FBMs and all other autobiographical memories that an individual had, and compare them. If we are to use the literature, however, it is better to define ordinary autobiographical memories 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" beg the question of the dimension along which events are trivial or noteworthy: emotion, significance, importance, and so forth. Unless noted otherwise, the comparisons we report from the literature are between ordinary memories (as defined above) and FBMs.

We will proceed to review the various ways in which FBMs have been claimed to be different from other memories and the various mechanisms proposed to cause these differences. With respect to all of these we will ask if FBMs have more of some property; we will 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 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 lists the ways FBMs have been claimed to be unique. Table 4.2 describes the mechanisms proposed for these differences.

CHARACTERISTICS OF FBMs

Accuracy

As is often the case in naturalistic studies of personally experienced events, objective measures of accuracy are rare. However, in the case of President George W. Bush and the events of September 11th 2001, video and photographic evidence exists in addition to published accounts of his recollections. Greenberg (2004) examined those available data and found that Bush's

Table 4.1 A summary of the differences between FBM and ordinary autobiographical memory

	FBM > AM		
Memory characteristics	*No*	*Yes*	*Discontinuous*
Accuracy	X		
Consistency	X		
Longevity	?		
Vividness		X	
Confidence		X	

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 autobiographical memory

	Sufficient	*Necessary*	*Only in FBM*
Event conditions			
Consequentiality	No	No	No
Distinctiveness	Yes	No	No
Emotional affect	?	?	No
Memory processes			
Significance	Yes	Yes	No
Surprise	No	No	No
Emotional intensity	?	No	No
Rehearsal	?	?	No

memory includes one prominent inaccuracy (that of seeing the first plane hit the first tower of the World Trade Center—footage that was not available until days after the attacks) and other, accurate details (his Chief of Staff Andy Card interrupting Bush's reading a story to children in a classroom and whispering in his ear that a second plane had crashed).

In another case study approach, Thompson and Cowan (1986) concluded that Neisser was most likely listening to a football game between the Giants and the Dodgers at the Polo Grounds broadcast by Red Barber when he learned of the attack on Pearl Harbor, not a baseball game as Neisser (1982) had previously recalled. Neisser (1986) argued that the particular error was important and informative, as it indicated his identification with the "American pastime" during an attack on his adopted homeland.

Berntsen and Thomsen (2005) developed a *documentary* method for evaluating factual information about individual participation in historical events (specifically the invasion and liberation of Denmark in World War II). Here,

too, we see evidence of general accuracy, with specific features biased to match other elements of the narrative. Participants who experienced the events were more accurate in recalling the day of the week for each event, the exact time of the liberation announcement on the radio, and other factual questions than a younger control group who did not experience the events directly. Berntsen and Thomsen were able to evaluate the accuracy of participants' memory for the weather using archival data from various meteorological stations throughout the country. They concluded that although mostly accurate (65% overall vs < 5% for controls), when memory reports were inaccurate they were systematically biased to match the emotional tone of the event (e.g., the day of the liberation was remembered as more sunny, less cloudy, less windy, less rainy, and/or warmer than it actually was). These are not "rare recollective inconsistencies" (see Julian, Bohannon, & Aue, Chapter 5, this volume) found in anecdote, but are systematic patterns of recall found throughout this literature that cannot be ignored when convenient. Perhaps surprisingly, the issue of objective accuracy is ripe for further investigation. Identifying which event features are likely to be accurately recalled as well as the magnitude and direction of errors should be examined whenever archival data are available to confirm self-reports. However, there is a larger body of evidence that 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. Contrary to the arguments of Pillemer (Chapter 6, this volume) and Julian, Bohannon, and Aue (Chapter 5, this volume), we do not consider "wrong time slices" (Neisser & Harsh, 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. Therefore, although consistency data may mistake a wrong time slice provided at time one as "accurate" and a correct time slice provided at time two as "inaccurate", the functional result will be a low consistency score correctly denoting unreliable recall over time.

The overwhelming evidence is that FBMs include inconsistencies (Christianson & Engelberg, 1999; Curci, 2005; Curci & Luminet, 2006; Curci, Luminet, Finkenauer, & Gisle, 2001; Greenberg, 2004; Larsen, 1992; Lee & Brown, 2003; McCloskey et al., 1988; Nachson & Zelig, 2003; Neisser, 1982; Neisser & Harsch, 1992; Schmolck, Buffalo, & Squire, 2000; Talarico & Rubin, 2003, 2006; Weaver, 1993; Weaver & Krug, 2004; Wright, 1993). Even those who argue for consistency allow that memory for specific details is not as good as memory for the general gist of the event (Bohannon & Symons, 1992; Pillemer, 1984; Schmidt, 2004; Schmidt & Bohannon, 1988; Thompson & Cowan, 1986) and that reports may be incomplete (Brown & Kulik, 1977). Furthermore, FBMs include no fewer inconsistencies than everyday memories (Talarico & Rubin, 2003, 2006). Therefore, in conjunction with the accuracy evidence described above, we must conclude that FBMs are not perfect copies of experienced events.

Longevity

There is a paucity of evidence in the FBM literature addressing the relative permanence of such memories due to predominant attention in the literature to claims requiring test–retest measures and the consequent difficulties in conducting such studies over lengthy delays. 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 a FBM. Using these criteria, 54% of Americans had a FBM for the assassination of civil rights activist Martin Luther King after 10 years (Brown & Kulik, 1977), 90% of Americans and 84% of Canadians had a FBM for President John F. Kennedy's assassination after 12 years (Yarmey & Bull, 1978), 71% of Americans had a FBM for the assassination of President Abraham Lincoln after 30 years (Colegrove, 1899), and 95% of Danes remembered the invasion and liberation of Denmark during World War II after 60 and 55 years, respectively (Berntsen & Thomsen, 2005).

Only Berntsen and Thomsen (2005) asked participants to recall another autobiographical event from the same time period (i.e., the most positive and negative personal event during the occupation period) and found that 77.1% and 85.5% were able to do so, respectively. Contrary to the claims of Brown and Kulik (1977), there are other events that one can remember from equally long ago. These data lead us to conclude that FBMs are long lasting, but they do not support the claim that FBMs are indelible nor that they are more permanent than noteworthy everyday memories. Therefore, for the two quintessential characteristics of FBMs—permanence and accuracy—there is little empirical support and yet room for more research if objective accuracy data are available from event samples of adequate age.

Vividness

However, there are characteristics of these memories that may still differentiate them from ordinary memories. Vividness has been of interest to FBM research since Brown and Kulik (1977) described the "live quality that is almost perceptual" (p. 74). 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, & Kornbrot, 2003; Niedzwienska, 2003; Talarico & Rubin, 2003; Weaver & Krug, 2004; Yarmey & Bull, 1978). Therefore, on average, FBMs are more vivid than ordinary memories, but some ordinary autobiographical memories are as vivid as FBMs (Talarico, LaBar, & Rubin, 2004). That is, there is an overlap in the distributions of vividness and 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; Paradis, Solomon, Florer, & Thompson, 2004; Talarico & Rubin, 2003, 2006; Weaver, 1993), 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; 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; 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 meta-cognitive 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 the concept. 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 question for future research must be, why are we more likely to maintain vivid, confidently held memories of these particular events? We now turn our attention away from their characteristics and to the conditions necessary to produce FBMs.

CONDITIONS NECESSARY TO PRODUCE FBMs

The vast majority of research in this field has been done in the aftermath of a public tragedy. This is because consequentiality, distinctiveness, and negative emotional affect are the primary features of the event thought to influence the formation of FBMs (i.e., a memory report that satisfies the FBM criteria

for vividness and/or completeness, or a memory report that includes answers to one or more canonical questions—informant, location, ongoing activity, time/date, affect, others' reactions—in the absence of any objective accuracy or test–retest consistency data). Here, we will discuss objective characteristics of the events thought to produce FBMs. In the next section we will discuss subjective assessments of the event also thought to produce FBMs.

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 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. However, the events being investigated are often on such a scale that the aftermath affects the lives of participants in other, more subtle ways. For instance, all air passengers must now submit to enhanced security procedures at US airports as a direct result of the September 11th attacks (to name one of the least significant changes in everyday life as a result of a major tragic event). Is this comprehensive consequentiality responsible for FBMs? In short, no. The empirical evidence fails to support the claim that objective consequentiality is relevant for the formation (Er, 2003; Tekcan, 2001), accuracy (Berntsen & Thomsen, 2005), consistency (Niedzwienska, 2003; Weaver, 1993), or vividness (Berntsen & Thomsen, 2005; Rubin & Kozin, 1984) of FBMs. So, although these types of events may retain value as they are common to large numbers of potential participants, their consequentiality seems to be of little memorial value.

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. Furthermore, Edery-Halpern and Nachson (2004) found that the least distinctive event in their sample 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). 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. In fact, all distinctive events (using their definition of the first AIDS-related death to be experienced) fit the FBM criteria. This is not surprising given that the episodic memory literature includes ample evidence of a distinctiveness advantage (i.e., *von Restorff effect*; see Hunt & Worthen, 2006, for a review). In Brewer's (1988) study of ordinary autobiographical memories, the lower the frequency of event occurrence, the greater the likelihood of later cued recall.

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. However, both positive and negative events have been found to lead to FBMs (Berntsen & Thomsen, 2005; Bohn & Berntsen, 2007; Scott & Ponsoda, 1996; Tekcan, 2001). In fact, Bohn and Berntsen (2007) showed that the same event (in this case, the fall of the Berlin Wall) was more likely to produce FBMs when it was interpreted as a positive event, consistent with pleasantness biases in autobiographical recall (Matlin & Stang, 1978; Thompson, 1985; Thompson, Skowronski, Larsen, & Betz, 1996; Walker, Skowronski, & Thompson, 2003; Walker, Vogl, & Thompson, 1997). 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 (Chapter 10, this volume) 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.

Other valence effects in FBMs have been neglected, with the notable exception of Berntsen and Thomsen's (2005) biased recall of whether to match the emotional tone of the invasion and liberation of Denmark during World War II (see above). Related biases have not been investigated because of the almost exclusive focus on negative, consequential events. We have already shown that consequentiality does not seem to be important for the formation of FBMs, therefore further study of positive FBMs or of valence effects in FBM in general should no longer be unnecessarily limited in this way.

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 ordinary autobiographical memory successfully account for FBM data (distinctiveness and emotional affect).

PROCESSING THE FLASHBULB EVENT

In addition to features of the event, characteristics of how an individual processes the event are thought to be important determinants of FBMs. Three encoding factors (significance, surprise, and emotional intensity) and one retrieval factor (rehearsal) are thought to have effects on FBMs. How these characteristics contribute to the FBM phenomenon individually and interactively is the focus of most current work in this area.

Significance

Significance, or personal importance, refers to the individual's assessment of the event, not to objective criteria concerning the influence of the event (i.e., consequentiality as described above). 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, Gaskell, & O'Muircheartaigh, 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. Vividness has been consistently related to personal importance (Mahmood et al., 2004; Nachson & Zelig, 2003; Niedzwienska, 2003; Rubin & Kozin, 1984).

Self-report ratings are only one method of measuring personal importance, however. Cross-cultural studies are often undertaken largely to investigate differences in consequentiality and, as a corollary, significance. Event memory (i.e., memory for the factual details of an event) is consistently enhanced for those closest to the event (Curci & Luminet, 2006; Curci et al., 2001; Edery-Halpern & Nachson, 2004; Luminet et al., 2004; Pezdek, 2003; Tekcan, Ece, Gulgoz, & Er, 2003). Correspondingly, numerous investigators have found that those physically closer to an event or those more directly affected by an event are more likely to develop FBMs (Conway et al., 1994; Curci et al., 2001; Edery-Halpern & Nachson, 2004; Er, 2003; Kvavilashvili et al., 2003; Luminet et al., 2004; Neisser et al., 1996; Sharot, Martorella, Delgado, & Phelps, 2007).

In addition to cross-cultural studies, group membership has been used as a proxy for personal importance, resulting in similar conclusions. Brown and Kulik (1977) found that African-Americans were more likely to report FBMs for civil-rights-relevant events than were White participants. Berntsen and Thomsen (2005) reported enhanced vividness and accuracy for FBMs of the invasion and liberation of Denmark among those participants who had been active in the resistance movement at the time, and Wright et al. (1998) found that men (assumed to have greater knowledge of and interest in sports) were more likely to develop FBMs for the Hillsborough football stadium disaster than were women.

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 Glisky (2002) also found no differences in the significance ratings of two events, yet one event led to reliably more FBM reports than the other. Although significance contributes to FBM formation, it is not always greater in FBMs. Berntsen (Chapter 9, this volume) argues quite persuasively that it is an event's importance to our social identity specifically that determines whether an event will produce a FBM. Because FBM research has emphasized recall of public events, it is not surprising that social identity is the most salient criterion for determining significance. As irrelevant characteristics (e.g., consequentiality, negative valence) are replaced by more systematic study of relevant characteristics, the nuanced nature of such effects can be determined. It is our belief that social identity 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.

We have substantial converging evidence of personal significance contributing to FBMs. As with distinctiveness, there is an abundance of data for a self-referential effect in memory performance, with personally relevant material enhancing memory (Rogers, Kuiper, & Kirker, 1977; see Symons & Johnson, 1997, for a review). Thus, the influence of significance on FBM can be predicted from more general features of autobiographical memories.

Surprise

As significance is differentiated from consequentiality, so too is surprise different from novelty. 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 novel, 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). Davidson and Glisky (2002) found that both initial recall and later consistency of FBMs for the death of Princess Diana were greater than for the death of Mother Theresa, which was rated as less surprising. However, equal surprise ratings were provided by those who did and those who did not develop FBMs for the Kobe earthquake (Otani et al., 2005). 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. Therefore, each possible relationship between surprise and FBM has been identified in the literature.

What is certain is that FBMs can be found for expected events, including the moon landing or Nixon's resignation (Winograd & Killinger, 1983), the first US-led invasion of Iraq (Tekcan, 2001), and Mitterrand's death (Curci et al., 2001). Novelty effects in autobiographical memory appear more similar to the distinctiveness effects described above, but surprise per se has not been investigated in ordinary autobiographical memory. Therefore this is one of

the least understood mechanisms, yet it has been one of the key determinants of event selection for FBM research and so has limited the scope of FBM research to date. The major difference between positive and negative events, for example, is that positive events tend to be expected whereas negative events are typically unexpected (Berntsen, 2002; Rubin & Berntsen, 2003; Tromp, Koss, Figueredo, & Tharan, 1995). Because surprise is thought to be important to FBMs, the vast majority of FBM research has examined negative events. However, if surprise is irrelevant to FBM, valence differences in FBM can, and should, be examined. This is especially true given that surprise tends to be a positive emotion in ordinary autobiographical memories (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).

Emotional intensity

The most contradictory findings in the FBM literature are those involving emotional intensity. There are data supporting its 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 almost as many that fail to find a correlation (with participant ratings: Otani et al., 2005; Smith, Bibi, & Sheard, 2003; Tekcan, 2001; with culture as a proxy: Luminet et al., 2004). The same contradictory pattern emerges for intensity and consistency, with four studies finding a positive relationship between the two (Bohannon & Symons, 1992; Conway et al., 1994; Davidson & Glisky, 2002; Schmolck et al., 2000) and five failing to find such a relationship (Christianson & Engelberg, 1999; Nachson & Zelig, 2003; Neisser & Harsch, 1992; Neisser et al., 1996; 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). Wright et al. (1998) found that men, who rated the Hillsborough disaster as less emotional than women, were more likely to develop FBMs.

One explanation for this variability has been to differentiate the effects of emotion on central and peripheral information individually. Brown and Kulik (1977) believed that the presence of idiosyncratic peripheral details supported the idea of an obligatory, indiscriminant encoding process resulting from emotional intensity. Other investigators have shown that emotion tends to enhance central details of an event, often to the detriment of peripheral information (Christianson & Loftus, 1991; Reisberg & Heuer, 1992). Schmidt (2004) found that although peripheral detail consistency declined over time more than did central details, moderate emotions were associated more with reliable recall of each detail type than were high emotions.

Therefore another mechanism described in the canonical memory literature, non-linear influences of emotion on memory (Yerkes & Dodson, 1908), can explain FBM formation. Furthermore, the advantage of emotionally intense experiences over neutral events is also well established in the episodic and autobiographical memory literature and is replicated in FBM. For FBMs, inconsistencies are often found for peripheral details only (as defined by some subset of the canonical questions) (Christianson, 1989; Romeu, 2006; Tekcan et al., 2003). However, how one divides the canonical questions into central vs peripheral information often coincides with whether the memory reports show consistency or inconsistency. For example, Christianson (1989) found reliable recall for "informant", "time", "location", and "others present" information and less reliable recall for "ongoing activity", "clothes worn at the time", and "first thought upon hearing the news" information. Tekcan and colleagues (2003) considered "time" and "others present" to be peripheral because those two questions were responsible for the majority of inconsistencies found in their participants' memory reports. Importantly, in none of these investigations was recall of central vs peripheral details of a non-FBM obtained.

In addition, Laney, Heuer, and Reisberg (2003) showed that the enhancement of central information is not due to emotion per se, but to the attention-capturing properties of the central information that leads to a decrease in recall of peripheral details. For FBMs, the perceptually central element is the informant and the conceptually central element is the news itself, neither of which is distinctive enough to impair peripheral recall sufficiently to generate a central detail enhancement. Because the central–peripheral distinction lacks precision in definition and consistency in application within the FBM literature as of yet, we remain unclear as to the influence of emotional intensity on FBMs.

Rehearsal

The final individual characteristic is the only non-encoding-specific mechanism discussed in this literature. Although consequentiality is often not known until after the initial news, consequentiality seems to be unimportant for FBM formation. Significance, on the other hand, is more likely to be known immediately as determined by interest in the general event domain (whether that be politics in the case of assassinations or resignations, or personal safety and national identity in the case of natural disasters or military/terrorist attacks). Although this should not imply that such evaluations are static or immune to post-event factors, rehearsal is still the only mechanism to operate exclusively post event.

Rehearsal effects 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), 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).

For consistency, the pattern is quite variable. After a delay of 6 months, Pillemer (1984) found no relationship with consistency. After a 1-year delay, Davidson and Glisky (2002) found a significant correlation, as did Schmolk and colleagues (2000) at 15 months. However, at 32 months, Schmolk and colleagues (2000) found no relationship between the two. Finally, with a delay of 3 years, Bohannon and Symons (1992) again found a correlation between rehearsal and FBM. Either this relationship is completely unreliable (due to deficiencies in the measurement or due to variability in the phenomenon) or differences in other aspects of the event make such cross-experiment comparisons untenable. Bohannon and Symons (1992) report data that may support the latter explanation. They found a three-way interaction of emotion, rehearsal, and consistency for FBM probed recall data. Those who were not upset by the *Challenger* explosion displayed no differences in consistency due to rehearsal, whereas those who were upset by the accident showed decreased consistency with enhanced rehearsal. To add even greater complexity, with free recall responses there was a main effect of emotion, no effect of rehearsal, and no interaction for consistency data. Yet we know that rehearsal is a potent mechanism for sustaining memory. In fact, Hirst and Meksin (Chapter 10, this volume) describe evidence for how rehearsal via media exposure enhances long-term recall of collective memories.

Combining factors

Most events are chosen as subjects of FBM research because they exhibit many of the features we have noted here. Thus, correlations among these variables of interest are common. This has led some investigators to adopt statistical techniques such as latent variable modelling and structural equation modelling to determine the relationships among these features (see, e.g., Er, 2003; Finkenauer et al., 1998). Each of these models defined FBM as recall of some number of canonical categories or some measure of completeness and specificity, and then compared memories that satisfied the FBM criteria to those that did not. None examined vividness or confidence, the most reliable characteristics that differentiate FBMs from ordinary autobiographical memories. Their focus was to differentiate which statistical model was a better fit to the FBM data.

What we have tried to show here is that a FBM-specific model is unnecessary, as the mechanisms responsible for producing FBMs are the same as those for any other autobiographical memories. Furthermore, the data presented here suggest that significance and distinctiveness are the predominant mechanisms responsible for FBMs. This is inconsistent with the models identified above, each of which considers significance and distinctiveness to be indirect factors in FBM formation. It could still be that a unique combination

of variables might substitute for a definition or description of FBMs, but the existing studies do not appear to be converging on such a combination. However, differences in measurement and definition may account for this inconsistency and the true nature of the influence of these mechanisms on the resultant characteristics of FBMs is far from understood.

SUMMARY

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 autobiographical memories in accuracy, consistency, or longevity. However, there are characteristics of the event and of the individual that can enhance each of these memory properties.

For the event conditions, consequentiality seems to be irrelevant to FBM, distinctiveness is the most predictive, and emotional affect is as yet understudied. For the individual characteristics, significance is correlated with formation, consistency, and vividness of FBMs. Of the processes discussed, significance is the most promising determinant of FBM. Surprise is one of the most common yet least understood memory process involved in FBM. 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. It is likely that some of the enhanced confidence or vividness associated with FBMs is due to emotionality. However, the exact nature and scope of that influence have yet to be determined. Lastly, rehearsal is correlated with the formation of FBMs, is not correlated with vividness, and has an unreliable correlation with consistency. Because rehearsals often serve to underscore the significance of the event (e.g., increased media attention to events that affect more individuals or enhanced likelihood of retelling personally important events), disentangling the effects of rehearsal from the functions those rehearsals serve is an important goal for future investigators.

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REFERENCES

Berntsen, D. (2002). Tunnel memories for autobiographical events: Central details are remembered more frequently from shocking than from happy experiences. *Memory and Cognition, 30*, 1010–1020.

Berntsen, D., & Thomsen, D. K. (2005). Personal memories for remote historical events: Accuracy and clarity of flashbulb memories related to World War II. *Journal of Experimental Psychology: General, 134*, 242–257.

Bohannon, J. N. (1988). Flashbulb memories for the space shuttle disaster: A tale of two theories. *Cognition, 29*, 179–196.

Bohannon, J. N., & Symons, V. L. (1992). Flashbulb memories: Confidence, consistency, and quantity. In E. Winograd & U. Neisser (Eds.), *Affect and accuracy in recall: Studies of "flashbulb" memories* (pp. 65–91). New York: Cambridge University Press.

Bohn, A., & Berntsen, D. (2007). Pleasantness bias in flashbulb memories: Positive and negative flashbulb memories of the fall of the Berlin Wall among East- and West Germans. *Memory and Cognition, 35*(3), 565–577.

Brewer, W. F. (1988). Memory for randomly sampled autobiographical events. In U. Neisser & E. Winograd (Eds.), *Remembering reconsidered: Ecological and traditional approaches to the study of memory* (pp. 21–90). New York: Cambridge University Press.

Brown, R., & Kulik, J. (1977). Flashbulb memories. *Cognition, 5*, 73–99.

Christianson, S. (1989). Flashbulb memories: Special, but not so special. *Memory and Cognition, 17*, 435–443.

Christianson, S., & Engelberg, E. (1999). Memory and emotional consistency: The MS *Estonia* ferry disaster. *Memory, 7*, 471–482.

Christianson, S., & Loftus, E. F. (1991). Remembering emotional events: The fate of detailed information. *Cognition and Emotion, 5*, 81–108.

Cohen, N. J., McCloskey, M., & Wible, C. G. (1988). There is still no case for a flashbulb-memory mechanism: Reply to Schmidt and Bohannon. *Journal of Experimental Psychology: General, 117*, 336–338.

Cohen, N. J., McCloskey, M., & Wible, C. G. (1990). Flashbulb memories and underlying cognitive mechanisms: Reply to Pillemer. *Journal of Experimental Psychology: General, 119*, 97–100.

Colegrove, F. W. (1899). Individual memories. *American Journal of Psychology, 10*, 228–255.

Conway, M. A., Anderson, S. J., Larsen, S. F., Donnelly, C. M., McDaniel, M. A., McClelland, A. G. R., et al. (1994). The formation of flashbulb memories. *Memory and Cognition, 22*, 326–343.

Curci, A. (2005). Latent variable models for the measurement of flashbulb memories: A comparative approach. *Applied Cognitive Psychology, 19*, 3–22.

Curci, A., & Luminet, O. (2006). Follow-up of a cross-national comparison on flashbulb and event memory for the September 11th attacks. *Memory, 14*, 329–344.

Curci, A., Luminet, O., Finkenauer, C., & Gisle, L. (2001). Flashbulb memories in social groups: A comparative test–retest study of the memory of French President Mitterrand's death in a French and a Belgian group. *Memory, 9*, 81–101.

Davidson, P. S. R., & Glisky, E. L. (2002). Is flashbulb memory a special instance of source memory? Evidence from older adults. *Memory, 10*, 99–111.

Edery-Halpern, G., & Nachson, I. (2004). Distinctiveness in flashbulb memory: Comparative analysis of five terrorist attacks. *Memory, 12*, 147–157.

Er, N. (2003). A new flashbulb memory model applied to the Marmara earthquake. *Applied Cognitive Psychology, 17*, 503–517.

Finkenauer, C., Luminet, O., Gisle, L., El-Ahmadi, A., van der Linden, M., & Philippot, P. (1998). Flashbulb memories and the underlying mechanisms of their formation: Toward an emotional-integrative model. *Memory and Cognition, 26*, 516–531.

Gold, P. E. (1992). A proposed neurobiological basis for regulating memory storage for significant events. In E. Winograd & U. Neisser (Eds.), *Affect and accuracy in recall studies of "flashbulb" memories* (pp. 141–161). New York: Cambridge University Press.

Greenberg, D. L. (2004). President Bush's false "flashbulb" memory of 9/11/01. *Applied Cognitive Psychology, 18*, 363–370.

Hornstein, S. L., Brown, A. S., & Mulligan, N. W. (2003). Long-term flashbulb memory for learning of Princess Diana's death. *Memory, 11*, 293–306.

Hunt, R. R., & Worthen, J. B. (Eds.). (2006). *Distinctiveness and memory*. New York: Oxford University Press.

Kvavilashvili, L., Mirani, J., Schlagman, S., & Kornbrot, D. E. (2003). Comparing flashbulb memories of September 11 and the death of Princess Diana: Effects of time delays and nationality. *Applied Cognitive Psychology, 17*, 1017–1031.

Laney, C., Heuer, F., & Reisberg, D. (2003). Thematically-induced arousal in naturally-occurring emotional memories. *Applied Cognitive Psychology, 17*, 995–1004.

Larsen, S. F. (1992). Potential flashbulbs: Memories of ordinary news as the baseline. In E. Winograd & U. Neisser (Eds.), *Affect and accuracy in recall: Studies of "flashbulb" memories* (pp. 32–64). New York: Cambridge University Press.

Lee, P. J., & Brown, N. R. (2003). Delay related changes in personal memories for September 11, 2001. *Applied Cognitive Psychology, 17*, 1007–1015.

Luminet, O., Curci, A., Marsh, E. J., Wessel, I., Constantin, T., Gencoz, F., et al. (2004). The cognitive, emotional, and social impacts of the September 11 attacks: Group differences in memory for the reception context and the determinants of flashbulb memory. *Journal of General Psychology, 131*, 197–224.

Mahmood, D., Manier, D., & Hirst, W. (2004). Memory for how one learned of multiple deaths from AIDS: Repeated exposure and distinctiveness. *Memory and Cognition, 32*, 125–134.

Matlin, M. W., & Stang, D. J. (1978). *The Pollyanna Principle: Selectivity in language, memory, and thought*. Cambridge, MA: Schenkman Publishing Company.

McCloskey, M., Wible, C. G., & Cohen, N. J. (1988). Is there a special flashbulb-memory mechanism? *Journal of Experimental Psychology: General, 117*, 171–181.

Nachson, I., & Zelig, A. (2003). Flashbulb and factual memories: The case of Rabin's assassination. *Applied Cognitive Psychology, 17*, 519–531.

Neisser, U. (1982). Snapshots or benchmarks? In U. Neisser & I. E. Hyman (Eds.), *Memory observed: Remembering in natural contexts* (pp. 68–74). San Francisco: Worth Publishers.

Neisser, U. (1986). Remembering Pearl Harbor: Reply to Thompson and Cowan. *Cognition, 23*, 285–286.

Neisser, U., & Harsch, N. (1992). Phantom flashbulbs: False recollections of hearing the news about *Challenger*. In E. Winograd & U. Neisser (Eds.), *Affect and accuracy in recall: Studies of "flashbulb" memories* (pp. 9–31). New York: Cambridge University Press.

Neisser, U., Winograd, E., Bergman, E. T., Schreiber, C. A., Palmer, S. E., & Weldon, M. S. (1996). Remembering the earthquake: Direct experience vs. hearing the news. *Memory, 4*, 337–357.

Niedzwienska, A. (2003). Misleading postevent information and flashbulb memories. *Memory, 11*, 49–558.

Ohman, A., Flykt, A., & Esteves, F. (2001). Emotion drives attention: Detecting the snake in the grass. *Journal of Experimental Psychology: General, 130*, 466–478.

Otani, H., Kusumi, T., Kato, K., Matsuda, K., Kern, R. P., Widner, R., Jr., et al. (2005). Remembering a nuclear accident in Japan: Did it trigger flashbulb memories? *Memory, 13*, 6–20.

Paradis, C., Solomon, L. Z., Florer, F., & Thompson, T. (2004). Flashbulb memories of personal events of 9/11 and the day after for a sample of New York City residents. *Psychological Reports, 95*, 304–310.

Pezdek, K. (2003). Event memory and autobiographical memory for the events of September 11, 2001. *Applied Cognitive Psychology, 17*, 1033–1045.

Pillemer, D. B. (1984). Flashbulb memories of the assassination attempt on President Reagan. *Cognition, 16*, 63–80.

Pillemer, D. B. (1990). Clarifying the flashbulb memory concept: Comment on McCloskey, Wible, and Cohen (1988). *Journal of Experimental Psychology: General, 119*, 92–96.

Reisberg, D., & Heuer, F. (1992). Remembering the details of emotional events. In E. Winograd & U. Neisser (Eds.), *Affect and accuracy in recall: Studies of "flashbulb" memories* (pp. 162–190). New York: Cambridge University Press.

Rogers, T. B., Kuiper, N. A., & Kirker, W. S. (1977). Self-reference and the encoding of personal information. *Journal of Personality and Social Psychology, 35*, 677–688.

Romeu, P. F. (2006). Memories of the terrorist attacks of September 11, 2001: A study of the consistency and phenomenal characteristics of flashbulb memories. *Spanish Journal of Psychology, 9*, 52–60.

Rubin, D. C., & Berntsen, D. (2003). Life scripts help to maintain autobiographical memories of highly positive, but not highly negative, events. *Memory and Cognition, 31*, 1–14.

Rubin, D. C., & Kozin, M. (1984). Vivid memories. *Cognition, 16*, 81–95.

Schmidt, S. R. (2004). Autobiographical memories for the September 11th attacks: Reconstructive errors and emotional impairment of memory. *Memory and Cognition, 32*, 443–454.

Schmidt, S. R., & Bohannon, J. N. (1988). In defense of the flashbulb memory hypothesis: A comment on McCloskey, Wible, and Cohen (1988). *Journal of Experimental Psychology: General, 117*, 332–335.

Schmolck, H., Buffalo, E. A., & Squire, L. R. (2000). Memory distortions develop over time: Recollections of the O. J. Simpson trial verdict after 15 and 32 months. *Psychological Science, 11*, 39–45.

Scott, D., & Ponsoda, V. (1996). The role of positive and negative affect in flashbulb memory. *Psychological Reports, 79*, 467–473.

Sharot, T., Martorella, E. A., Delgado, M. R., & Phelps, E. A. (2007). How personal experience modulates the neural circuitry of memories of September 11. *Proceedings of the National Academy of Science, 104*, 389–394.

Smith, M. C., Bibi, U., & Sheard, D. (2003). Evidence for the differential impact of

time and emotion on personal and event memories for September 11, 2001. *Applied Cognitive Psychology*, *17*, 1047–1055.

Symons, C. S., & Johnson, B. T. (1997). The self-reference effect in memory: A meta-analysis. *Psychological Bulletin*, *121*, 371–394.

Talarico, J. M., LaBar K. S., & Rubin, D. C. (2004). Emotional intensity predicts autobiographical memory experience, *Memory and Cognition*, *32*, 1118–1132.

Talarico, J. M., & Rubin, D. C. (2003). Confidence, not consistency, characterizes flashbulb memories. *Psychological Science*, *14*, 455–461.

Talarico, J. M., & Rubin, D. C. (2006). Flashbulb memories are special after all; in phenomenology, not accuracy. *Applied Cognitive Psychology*, *21*, 557–578.

Tekcan, A. I. (2001). Flashbulb memories for a negative and a positive event: News of Desert Storm and acceptance to college. *Psychological Reports*, *88*, 323–331.

Tekcan, A. I., Ece, B., Gulgoz, S., & Er, N. (2003). Autobiographical and event memory for 9/11: Changes across one year. *Applied Cognitive Psychology*, *17*, 1057–1066.

Tekcan, A. I., & Peynircioglu, Z. F. (2002). Effects of age on flashbulb memories. *Psychology and Aging*, *17*, 416–422.

Thompson, C. P. (1985). Memory for unique personal events: Effects of pleasantness. *Motivation and Emotion*, *9*, 277–289.

Thompson, C. P., & Cowan, T. (1986). Flashbulb memories: A nicer interpretation of a Neisser recollection. *Cognition*, *22*, 199–200.

Thompson, C. P., Skowronski, J. J., Larsen, S. F., & Betz, A. L. (1996). *Autobiographical memory: Remembering what and remembering when* (pp. 67–82). Mahwah, NJ: Lawrence Erlbaum Associates Inc.

Tromp, S., Koss, M. P., Figueredo, A. J., & Tharan, M. (1995). Are rape memories different? A comparison of rape, other unpleasant, and pleasant memories among employed women. *Journal of Traumatic Stress*, *8*, 607–627.

Walker, W. R., Skowronski, J. J., & Thompson, C. P. (2003). Life is pleasant—and memory helps to keep it that way! *Review of General Psychology*, *7*, 203–210.

Walker, W. R., Vogl, R. J., & Thompson, C. P. (1997). Autobiographical memory: Unpleasantness fades faster than pleasantness over time. *Applied Cognitive Psychology*, *11*, 399–413.

Weaver, C. A., III. (1993). Do you need a "flash" to form a flashbulb memory? *Journal of Experimental Psychology: General*, *122*, 39–46.

Weaver, C. A., III, & Krug, K. S. (2004). Consolidation-like effects in flashbulb memories: Evidence from September 11, 2001. *American Journal of Psychology*, *117*, 517–530.

Winograd, E., & Killinger, W. A. (1983). Relating age at encoding in early childhood to adult recall: Development of flashbulb memories. *Journal of Experimental Psychology: General*, *112*, 413–422.

Wright, D. B. (1993). Recall of the Hillsborough disaster over time: Systematic biases of "flashbulb" memories. *Applied Cognitive Psychology*, *7*, 129–138.

Wright, D. B., & Gaskell, G. D. (1992). The construction and function of vivid memories. In M. A. Conway, D. C. Rubin, H. Spinnler, & W. A. Wagenaar (Eds.), *Theoretical perspectives on autobiographical memory* (pp. 241–261). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Wright, D. B., Gaskell, G. D., & O'Muircheartaigh, C. A. (1998). Flashbulb memory assumptions: Using national surveys to explore cognitive phenomena. *British Journal of Psychology*, *89*, 103–118.

Yarmey, A., & Bull, M. P. (1978). Where were you when President Kennedy was assassinated? *Bulletin of the Psychonomic Society*, *11*, 133–135.

Yerkes, R. M., & Dodson, J. D. (1908). The relation of strength of stimulus to rapidity of habit-formation. *Journal of Comparative Neurology and Psychology*, *18*, 459–482

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