

# Flashbulb memories of Paris attacks

## Recall of these events and subjective reliving of these memories in a case with Alzheimer disease

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### Abstract

**Rationale:** Flashbulb memories are detailed and vivid memories of attributes of the reception context of surprising and emotionally arousing public events.

**Patient concerns and diagnosis:** This paper offers a fine-grained view of flashbulb memories in a patient with mild Alzheimer's disease (AD).

**Interventions:** The patient underwent a directed interview about the 13 November 2015 attacks in Paris.

**Outcomes:** Unlike her memory about the date and month of the attacks, the patient provided accurate information about the year, time and places they occurred. The patient also provided accurate information about how she first became aware of the attacks, where she was, with whom, what she was doing, and what time it was when she learned about them. As for the affective characteristics of these memories, she tended to have high ratings of vividness and rehearsal. Negative emotional states and great surprise and novelty were also reported.

**Lessons:** By assessing the impact of flashbulb memories in this patient with AD, this paper offers a unique view into how such memories may trigger a considerable recall of context as well much subjective reliving.

**Abbreviation:** AD = Alzheimer disease.

**Keywords:** Alzheimer disease, context memory, flashbulb memories, Paris attacks, subjective reliving

### 1. Introduction

On the evening of Friday November 13, 2015, a series of coordinated terrorist attacks was perpetrated in Paris. Three suicide bombers struck near the Stade de France, followed by suicide bombings and mass attacks at cafés, restaurants, and a music venue in central Paris. The attackers killed and injured 130 and 368 people, respectively. The attacks were the deadliest in France since World War II. As a result, the country was placed on high alert, and a state of emergency was declared. Considering these social and political consequences, our paper assessed whether these attacks have triggered flashbulb memories in a patient with Alzheimer disease (AD).

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Flashbulb memories are detailed, vivid, and long-lasting autobiographical memories of attributes of the reception context of surprising and emotionally arousing public events.<sup>[1]</sup> According to Brown and Kulik,<sup>[1]</sup> people may retain for a long time not only the original public event itself but also the circumstances in which they first learned of the event, such as where they were when it occurred, their ongoing activities, who informed them about it, their reactions, and those of the informant. Since the pioneering work of Brown and Kulik,<sup>[1]</sup> flashbulb memories have been observed for a wide range of emotional and surprising public events, such as the fall of the Berlin Wall in 1989,<sup>[2]</sup> the beginning of operation Desert Storm in 1991,<sup>[3]</sup> the death of Princess Diana in 1997,<sup>[4]</sup> the attacks of September 11, 2001 in the United States,<sup>[4–10]</sup> and the attacks on the satiric journal “Charlie Hebdo” in France.<sup>[11]</sup> Although these studies addressed different events across cultures and countries, most of them emphasized the novelty and surprise that were triggered by them. They also highlighted a core feature of flashbulb memories, that is, significant recall of the context in which participants first learned about these events, even 1 year after they had occurred.

Because AD is mainly characterized by memory compromise,<sup>[12]</sup> it would be of interest to investigate whether AD patients derive a beneficial effect from flashbulb memories. Research tends to suggest compromised context memory in AD patients, that is, compromised ability to remember where and when an episodic event was encoded<sup>[13–16]</sup> (refer to Ref. <sup>[17]</sup> for a review). Because flashbulb memories are mainly characterized by high memory for the reception context, it would be of interest to assess whether these memories trigger high context recall in AD. A positive effect of flashbulb memories on episodic recall may occur in AD, thanks to the emotional nature of these memories. Research suggests that emotion has a beneficial effect on memory in AD. For instance, Kazui et al<sup>[18]</sup> used a story paradigm in which AD patients heard a neutral story and an emotional story describing a child badly

hurt in an automobile accident; recall was better for the emotional than for the neutral story. This pattern was confirmed by Satler et al,<sup>[19]</sup> who exposed AD patients to a neutral and an emotional story describing a medical operation of a child after a bad car accident. When answering a questionnaire about the stories, AD participants showed better memory for the emotional than for the neutral story. The beneficial effect of emotion on memory in AD was further shown by studies demonstrating better recall for emotional faces in AD patients.<sup>[20]</sup> Taken together, these studies suggest that emotion may alleviate AD-related memory decline, an effect that may also concern flashbulb memories as they are laden with emotional weight.

Two studies have investigated flashbulb memories in AD. In the weeks following the attacks of September 11, 2001, Budson et al<sup>[21]</sup> asked AD patients questions assessing context memory (e.g., “how did you first become aware of the attacks?,” “where were you?,” “what were you doing?,” and “who else was there?”), as well as fact memory (e.g., “what airline or airlines had planes hijacked?” and “where was President Bush when the attack occurred?”). AD patients were also asked to rate their emotions about the attacks. They demonstrated better context memory than fact memory. Also, AD patients and controls did not differ in the intensity of their reported emotional responses. Finally, large distortions were observed in AD patients for context memory. When Budson et al<sup>[22]</sup> carried out the same assessment 3 months later and 1 year later, AD patients demonstrated a large decline in context memory and fact memory between the initial assessment and 3 months later. They also showed some stability for context memory and a large decline in fact memory between 3 months and 1 year.

Budson et al<sup>[21,22]</sup> revealed the positive effect of flashbulb memories on context recall in AD and their considerable emotional effect. However, although Budson et al<sup>[21,22]</sup> offered a detailed analysis of the emotional categories (e.g., sadness, anger, and fear) that were prompted by the attacks, no similar analysis was undertaken for context memory (i.e., which component of context memory was influenced by flashbulb memories) or for fact memory. Furthermore, despite offering a global analysis of distortions,<sup>[21,22]</sup> they did not investigate which component of context memory was prone to these errors. In our view, such an “in-depth” analysis is difficult to be implemented in a group comparison design owing to the substantial number of analyses to be performed. Another factor preventing this “in-depth” view is that AD patients may differ widely in their recall of specific information (e.g., where they were when learning about an event, who they were with, what they were doing, etc.). This memory heterogeneity could be due to individual differences between AD patients, such as differences in cognitive reserve, professional history, educational level, age at disease onset, premorbid intellectual function, neuropsychiatric symptoms, neurological deficits, and comorbidities. In view of this complexity, we used a case study design to offer an in-depth exploration of context and fact recall as well as memory distortions for flashbulb memories in AD.

Case studies allow an in-depth investigation of complex issues, and their qualitative nature could provide a fine-grained description of the effect of flashbulb memories on many aspects of context memory (e.g., the where, when, how, with whom, etc.). We also considered a wide variety of variables that were not taken into account by Budson et al.<sup>[21,22]</sup> Unlike them, we assessed the vividness of flashbulb memories in terms of visual imagery, auditory imagery, and travel in time. Furthermore, we evaluated the surprise, novelty, and sense of importance that are triggered by flashbulb memories, together with a range of factors that are difficult to assess with quantitative data.

## 2. Method

### 2.1. Participant

Madame F, a patient with early-stage AD, is a right-handed 73-year-old woman with 9 years of formal education. She is a French native-speaker and lives in her own home with her husband who serves as her primary caregiver. One year ago, she reported memory difficulties such as trouble remembering names and groceries she wanted to purchase, as well as frequently losing her papers and keys. Seven months ago, she began to forget frequently to close the gas tap after cooking and tended to demonstrate spatiotemporal disorientation and decision-making difficulties. Five months before the beginning of the present study, a comprehensive clinical assessment including a brain magnetic resonance imaging scan demonstrated mild hippocampal atrophy. The neurologist made a diagnosis of early-stage AD according to standard National Institute of Neurological and Communicative Disorders and Stroke–Alzheimer’s Disease and Related Disorders Association diagnostic criteria.<sup>[12]</sup> Immediately after the diagnosis, she commenced pharmacotherapy with an acetylcholinesterase inhibitor but did not report any other significant general health comorbidities (e.g., diabetes or hypertension). She reported no history of strokes, seizures, or head injury, an affirmation confirmed by her husband.

### 2.2. Cognitive and clinical assessment

The assessment took place approximately 2 months after the attacks. After the informed consent of Madame F was obtained, assessment was conducted in her home. General cognitive functioning as assessed with the Mini-Mental State Examination<sup>[23]</sup> showed a score of 25 out of a total of 30 points owing to difficulty in delayed recall (30 minus 3 points) and temporal orientation (30 minus 2 points). Episodic memory was evaluated with the French version of the Grober and Buschke<sup>[24]</sup> task. She had to retain 16 words and after immediate cued recall, there was a 20-second distraction phase during which she had to count numbers aloud. This phase was followed by 2 minutes of free recall during which she had to correctly remember 6 words (according to the French norms of the Grober and Buschke task, her percentile was below 5%). For working memory evaluation, she had to repeat a string of single digits in the same order (i.e., forward span) or in the reverse order (i.e., backward span); her forward and backward spans were 5 and 4, respectively. Depression was assessed with the self-report Hospital Anxiety and Depression Scale,<sup>[25]</sup> which consists of 7 items scored on a 4-point Likert scale ranging from 0 (not present) to 3 (considerable); with a score of 10 points, her score was below the threshold of depression (i.e., 11 points).

### 2.3. Flashbulb memory assessment

Flashbulb memory was assessed using a directed interview technique. The interview included questions on event memory, flashbulb memory, vividness, rehearsal, emotion, surprise, novelty, and importance. Questions on vividness were based on the Autobiographical Memory Questionnaire,<sup>[26]</sup> whereas the others were based on classic flashbulb memory questionnaires.<sup>[1,27–29]</sup>

Event memory was assessed with 4 questions concerning general information about the Paris attacks: the date, time, and location of the attacks, the fourth question being a free-response question. Flashbulb memory was assessed with 6 questions concerning the context in which she first learned of the attacks. Vividness was assessed with 3 questions about visual imagery, auditory imagery, and mental time travel (ranging from “not at

all” to “extremely”). Rehearsal was assessed with 3 questions about following the media, ranging from “never” to “everyday”. Emotional valence was assessed with 1 question ranging from “very negative” to “very positive”, and emotional state was assessed with 1 question about 9 different feelings (e.g., sadness, confusion, frustration, etc.). Surprise and novelty were each assessed with 1 question. Finally, appraisal of importance was assessed with questions on which she rated to what extent the event was important to herself, families/friends, the country, and the international community (ranging from “not at all important” to “very important”). The interview and her answers are transcribed below.

### 2.3.1. The interview

#### 2.3.1.1. Event memory.

- On what date (day/month/year) did the attacks occur?  
Madame F: Saturday/October/2015
- At what time did the attacks occur?  
Madame F: in the evening
- Where did the attacks occur?  
Madame F: at the Stade de France then in several streets in Paris, there was a bar that was particularly attacked. I cannot remember its name but I know that there was a concert inside.
- Do you remember anything else about the attacks?  
Madame F: there were many suicide bombers.

#### 2.3.1.2. Flashbulb memory.

- Please describe how you first became aware of the attacks (radio, television, friend, etc.)  
Madame F: my husband came to my room, he seemed shocked, he stood beside me without saying any word, I was in the bed, and he turned on the TV
- Please describe where you were when you learned about the attacks  
Madame F: in my room
- Please describe whom you were with when you learned about the attacks  
Madame F: my husband
- Please describe what you were doing when you learned about the attacks  
Madame F: I was lying in my bed
- What day of the week was it when you first learned about the attacks?  
Madame F: the same day of the attacks, Saturday I guess
- What time was it when you first learned about the attacks?  
Madame F: very late in the evening

#### 2.3.1.3. Vividness.

- When you think about the moment when you first learned about the attacks, do you see this moment in your mind? (not at all, a little, moderately, quite a bit, and extremely)  
Madame F: extremely
- When you think about the moment when you first learned about the attacks, do you hear this moment in your mind? (not at all, a little, moderately, quite a bit, and extremely)  
Madame F: extremely
- When you think about the moment when you first learned about the attacks, do you feel that you travel back to the time it happened? (not at all, a little, moderately, quite a bit, and extremely)  
Madame F: quite a bit

#### 2.3.1.4. Rehearsal.

- Since the announcement of the attacks, how closely have you followed the media coverage? (never, once, once a week, many times a week, and every day)  
Madame F: every day
- Since its announcement, how many times have you thought about the attacks? (never, once, once a week, many times a week, and every day)  
Madame F: every day
- Since its announcement, how many times have you talked about the attacks? (never, once, once a week, many times a week, and every day)  
Madame F: every day with my husband

#### 2.3.1.5. Emotion.

- Generally speaking, how do you evaluate your emotional reaction when you first learned about the attacks? (very negative, negative, neutral, positive, and very positive)  
Madame F: negative

When you first learned about the attacks, you were

- (not at all shocked, a little shocked, moderately shocked, quite a bit shocked, and very shocked)  
Madame F: very shocked
- (not at all confused, a little confused, moderately confused, quite a bit confused, and very confused)  
Madame F: moderately confused
- (not at all sad, a little sad, moderately sad, quite a bit sad, and very sad)  
Madame F: very sad
- (not at all angry, a little angry, moderately angry, quite a bit angry, and very angry)  
Madame F: moderately angry
- (not at all afraid, a little afraid, moderately afraid, quite a bit afraid, and very afraid)  
Madame F: very afraid
- (not at all anxious, a little anxious, moderately anxious, quite a bit anxious, and very anxious)  
Madame F: quite a bit anxious
- (not at all disappointed, a little disappointed, moderately disappointed, quite a bit disappointed, and very disappointed)  
Madame F: a little disappointed
- (not at all insecure, a little insecure, moderately insecure, quite a bit insecure, very insecure)  
Madame F: very insecure
- (not at all frustrated, a little frustrated, moderately frustrated, quite a bit frustrated, and very frustrated)  
Madame F: moderately frustrated

#### 2.3.1.6. Surprise.

- When you first learned about the attacks, you were (not at all surprised, a little surprised, moderately surprised, quite a bit surprised, and very surprised)?  
Madame F: very surprised

#### 2.3.1.7. Novelty.

- In your opinion, this event is (very unusual, a little unusual, moderately unusual, quite usual, and very usual)  
Madame F: very usual

### 2.3.1.8. Importance.

- Is this event important to you? (not at all important, a little important, moderately important, quite a bit important, and very important)

Madame F: moderately important

- Is this event important to your family/friends? (not at all important, a little important, moderately important, quite a bit important, and very important)

Madame F: quite a bit important

- Is this event important to your country? (not at all important, a little important, moderately important, quite a bit important, and very important)

Madame F: very important

- Is this event important to the international community? (not at all important, a little important, moderately important, quite a bit important, and very important)

Madame F: moderately important

## 2.4. Analysis of memory distortions

Madame F provided correct answers about the year, time (the attacks occurred in the evening), and place of the attacks (attacks at “Le Bataclan” theater were particularly bloody as there were many people gathering for a concert). However, her answers were inappropriate about the day and the month. As for flashbulb memory, her husband confirmed all her answers, except for the day (i.e., his wife learned about the attacks on Friday and not Saturday).

## 3. Discussion

The purpose of the present paper was 2-fold. The first objective was to offer a fine-grained view of flashbulb memories as well as of their vividness, rehearsal, and emotional value in a patient with mild AD. The second objective was to assess the authenticity of memories about the reception context. Unlike her memory about the date and month of the attacks, Madame F provided accurate information about the year, time, place, and the suicide bombers (there were, indeed, 3 suicide bombers). Unlike her memory about the day, she gave accurate information, as confirmed by her husband, about how she first became aware of the attacks, where she was, who she was with, what she was doing, and what time it was when she learned about the attacks. This suggests extensive memories of the reception context. As for the affective characteristics of these memories, she had high ratings for vividness and rehearsal. Negative emotional states and great surprise were also reported. Finally, she rated the events as very unusual and as having some importance to herself and her family.

Her relatively high and accurate memory of the reception context of the Paris attacks is important, since AD has been widely associated with a decline in context memory (refer to Ref. [17] for a review). Research in AD tends to suggest compromised ability to remember where and when an episodic event was encoded.<sup>[13–16]</sup> For instance, a study demonstrated difficulties in AD participants in remembering the location in which letters were previously exposed.<sup>[30]</sup> This context memory deficit seems to be alleviated by flashbulb memories, an assumption that fits with the work of Budson et al<sup>[21,22]</sup> who observed extensive memory of the reception context in their participants. Regardless of the findings concerning context memory, our findings and those of Budson et al<sup>[21,22]</sup> are of interest as they demonstrate some ability to encode/retrieve recent events in AD (assessment

with Madame F took place mid-January 2016). This positive effect of flashbulb memories challenges the notion of anterograde amnesia in AD, that is, difficulties to form new memories.<sup>[31]</sup> This effect also demonstrates, at least in this case study, that small distortions may be observed for flashbulb memories in AD.

Besides demonstrating the positive effect of flashbulb memories in a case with AD, the present paper suggests that these memories trigger strong vividness. Research tends to suggest that the ability to mentally relive past events is compromised in AD patients (refer to Ref. [31] for a review). Piolino et al<sup>[32]</sup> used the “Remember/Know” paradigm<sup>[33]</sup> with AD participants who had to provide a “Remember” response if they were able to retrieve a specific event with its encoding context and a “Know” response if they knew the event had happened to them but could not recall any contextual detail. The subjects had great difficulty in mentally reliving the events (i.e., they provided few “remember” responses), findings that were confirmed by subsequent studies.<sup>[31,34–36]</sup> However, Madame F reported high visual imagery, auditory imagery, and mental time travel for flashbulb memories. To our knowledge, this is the first study to assess the subjective experience of flashbulb memories in AD. In our view, despite their compromised ability to mentally relive past events, AD patients may succeed in retaining some subjective reliving of highly emotional events. This assumption is supported by research suggesting some preservation of the ability of AD patients to access memories that are highly relevant for self-images (i.e., self-defining memories).<sup>[37,38]</sup>

Another finding was the negative emotional valence and states that were reported by Madame F for the attacks. This emotional value fits the definition of flashbulb memories,<sup>[28]</sup> according to which such memories are primarily related to emotionally arousing public events. The effect of emotion on memory has been observed in several studies reporting a beneficial effect of emotion on memory for stories<sup>[18]</sup> words,<sup>[39,40]</sup> texts,<sup>[41]</sup> and faces<sup>[20]</sup> in AD. This supports the assumption about the beneficial effect of emotion on flashbulb memories in Madame F. The emotional involvement in flashbulb memories is also highlighted by the assumption of Luminet et al,<sup>[29]</sup> according to which appraisal of novelty of an unexpected public event triggers an appraisal of importance and consequentiality which, in turn, leads to emotional feeling states that underlie flashbulb memories.

One may argue that a case study approach limits the generalization of results. Although this is a clear limitation, case studies provide insight into a subject before more complete research. Moreover, case studies address challenges associated with the analysis of a multitude of factors that are difficult to grasp with quantitative data; in the present paper, many factors (e.g., event memory, flashbulb memory, and subjective reliving) were tested in an exploratory fashion and in an amnesic patient. It was hence important to test the effect of these procedures in a case study fashion before suggesting them for wider research. Future research should consider our results in designing empirical tests and interpreting statistical results. Another shortcoming is that we did not control for confounding factors related to personality or intelligence.

To summarize, there are few, if any, laboratory stimuli that are sufficiently salient to trigger memory over long periods of time in AD; the attacks in Paris provide an opportunity to overcome this challenge. The flashbulb memories related to these attacks also provide an opportunity to study memory for everyday life events in AD. Because AD patients may differ widely with regard to their educational background, physical activity, lifestyle, and cognitive

reserve, it is not surprising that they demonstrate selective recall of details related to everyday life events, at least those in the mild stages of the disease. In view of this heterogeneity, this case report offers a unique view into how flashbulb memories may trigger a considerable context recall in an AD patient. By providing a fine-grained description of the impact of flashbulb memories on a case with AD, the present paper paves the way for the detailed quantitative description of memory functioning in AD, at least for emotional memory.

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