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Flashbulb memories in patients with temporal lobe epilepsy

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ABSTRACT

Purpose: Flashbulb memories (FMs) are vivid and stable autobiographical memories associated with learning surprising news of high emotional impact. Patients with temporal lobe epilepsy (TLE) can have autobiographical memory deficits. This is the first investigation of FMs in TLE applying a consistency measure of FM quality controlling for confabulation.
Method: A sample of 12 patients with TLE and a matched group of 15 healthy controls (HCs) were tested on an FM test including a retest procedure. Scores of FM consistency were obtained by comparing answers across both testing occasions.
Results: In patients with TLE, FM consistency scores were significantly lower than in HCs. Exploratory subgroup analyses revealed FM deficits in both patients with left TLE and patients with right TLE compared with HCs.
Conclusion: The present study indicates that the FMs of patients with TLE are less consistent than those of healthy control subjects. Future investigations with larger samples are desirable, especially regarding separate analyses of patients with left TLE and patients with right TLE.

1. Introduction

Flashbulb memories (FMs) are memories associated with surprising news that has a high emotional impact, e.g., "How did you hear of the 9/11 attacks"? An FM is an autobiographical memory for the *reception event* [1], i.e., a memory of the personal circumstances when hearing about the event rather than the event itself. Flashbulb memories are usually vivid and rich in detail [2,3]. Brown and Kulik [2] found that in FMs, six categories of information were reported in more than 50% of the memory accounts (place, activity, informant, own affect, affect in others, and aftermath). The authors termed these "*canonical categories*" since these categories of information seemed to be more likely to be recalled than others. However, not everybody seems to use all six categories in their memory descriptions. Flashbulb memories are usually accompanied by a great deal of confidence in the accuracy of the memory [4–8]. They are also often complemented with visual images of the reception event [3,9] and sometimes contain completely irrelevant or idiosyncratic detail [2]. It is debatable whether rehearsal modulates the characteristics of FMs over time [3,4,7,10–12] resulting in elaboration of the content.

What causes an autobiographical memory to have FM characteristics? We hear many items of news and information in the course of our lives, but very few appear to have the phenomenology of FMs. Emotional reactions triggered by the event seem to be an important, if not crucial, determinant of FM formation [3,4,7,8,13–15]. Emotional reactions can be influenced by many variables. Surprise, interest in the subject matter, and the personal importance or consequentiality of the event can all be associated with emotional reactions and thereby with FM formation [7,13,15,16].

Some theories propose a special neurobiological mechanism for the formation of FMs [2,17–19] involving the basolateral limbic loop [20]. The fact that, unlike ordinary episodic memories, FM performance does not seem to decrease with age [21] seems to support the notion of a special memory mechanism for FMs.

Davidson et al. [22] conducted a flashbulb memory study on the 9/11 terrorist attacks with an etiologically heterogeneous group of patients with temporal or frontal lobe damage. They argued that FMs are a type of source memory which is known to be impaired in patients with frontal lesions [22,23]. Therefore, they hypothesized that patients with lesions to the frontal lobes (FL) should be more impaired on memory for the reception event (the actual flashbulb memory) than on memory for the actual terrorist attacks (event knowledge), whereas patients with temporal lobe lesions (TL) should be primarily impaired regarding event knowledge. Their results confirmed their predictions regarding patients with FL. However, patients with TL were impaired in both domains relative to the control group. In a further study, Davidson et al. [24] investigated the hypothesis that older age and impaired frontal lobe function are associated with impaired source memory for a flashbulb memory event, which could not be verified. These results show that FMs are a complex phenomenon and cannot be explained as a

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mere instance of source memory. Instead, it is probable that FMs comprise elements of source memory as well as episodic emotional autobiographical memory.

Memory impairment is a common finding in temporal lobe epilepsy, as mesial temporal structures are often affected [25]. Recently, memory research in epilepsy has focused on autobiographical memory deficits [26–29]. For the majority of people, damage to the left temporal lobe leads to impairments in verbal memory, while damage to the right temporal lobe leads to greater impairment of nonverbal materials [30–32]. There is also evidence for impairment in verbal memory consolidation among patients with left-sided temporal lobe epilepsy (LTLE) [33]. To the extent that FMs are represented as verbal information, we might therefore expect that LTLE would result in poor performance. However, a study by Buchanan et al. [34] raises the possibility that the right temporal lobe is important for recall of episodic information with negative emotional valence leading to the prediction that patients with right-sided temporal lobe epilepsy (RTLE) might also be impaired on FM tasks, as most events associated with FMs have negative emotional valence.

Voltzenlogel et al. [26] found that both patients with LTLE and patients with RTLE had autobiographical memory deficits, but the group with RTLE was relatively less impaired. Further studies and reviews involving patients with RTLE and LTLE before or after temporal lobectomy have indicated that autobiographical memory deficits can occur in either group [29,35,36], but RTL resections might have less of an impact on postoperative autobiographical memory than LTL resections [37]. Recent neuroimaging studies have shown that autobiographical event memory seems to be associated with predominantly left hemispheric activations, in which the hippocampus seems to play an important role [28,38,39]. Sharot et al. [40] suggested a key role for the left amygdala in flashbulb memory recall. Considering the evidence from previous research, patients with TLE as a group can be hypothesized to show deficits in FM recall. Possibly, these deficits are greater in patients with LTLE than in patients with RTLE.

Few studies of neurological patients have looked at the consistency of their autobiographical memory recall. This is an important consideration both in terms of characterizing the nature of the deficit (e.g., a deficit in memory access versus an impairment of memory representation) and in order to control for distortions and confabulations. Confabulation can be observed in patients with neurological damage to the frontal part of the brain [41–43] and even in healthy subjects [44–46]. It is considered to be mainly related to episodic and autobiographical memory [41,42,47]. Hence, it is important to measure the consistency of FM recall by applying a retest procedure. The current investigation is the first to evaluate the flashbulb memory performance of patients with TLE by applying a consistency measure.

The present study investigated the hypothesis that the FMs of patients with TLE are of significantly lower quality (consistency over time) than those of healthy control subjects. Secondarily, we were interested in the FM performance of patients with LTLE and patients with RTLE.

2. Methods

2.1. Subjects

Fourteen patients with epilepsy were recruited from hospitals and research facilities in Cambridge, UK between September and December 2000. Twelve patients were available for the retest. Seven of these patients had left temporal lobe epilepsy (LTLE), four had right temporal lobe epilepsy (RTLE), and one had bilateral frontal lobe epilepsy (FLE). The latter patient was not included in the group analyses. Approximately half of the patients had undergone epilepsy surgery, evenly distributed across LTLE and RTLE. Patients were right handed, and/or left-hemisphere language dominance was determined by the Wada test. Ten out of 11 patients received anticonvulsant polytherapy.

Seventeen healthy control subjects without a history of neurological or psychiatric disorders were included. Fifteen subjects were retested.

2.2. Measures

The sudden and unexpected death of Princess Diana in a car accident in August 1997 - the chosen FM event - evoked a high level of arousal in many British citizens. This event also allowed for a time span between initial testing and the event itself long enough for the FM to have gone through the crucial stages of consolidation [8,12,14]. As a control event, Hong Kong's reunion with China was chosen, as it was a public event that took place around the same time as the flashbulb memory event, but it was neither very surprising nor very emotionally arousing for most people.

A questionnaire served as a cued recall condition for both reception events (FM and control event), as the 11 questions probed for the canonical categories and other details of the reception event (time of day, presence of others, and sensory detail [clothes worn, sounds, and smells]). The participants were asked to rate their confidence in the accuracy of their answer on a 5-point rating scale. If they did not remember the answer to one of the questions, they were instructed to write “d.k.” (don't know) and consequently did not have to provide a confidence rating. Emotional impact, surprise, and interest were rated on a 6-point rating scale for each event.

The questionnaires were completed twice with an interval of two months in between sessions. The scoring of consistency between the two testing occasions was adapted from the procedure developed by Neisser and Harsch [48]. Consistency could range from 0 to 2 points for each of the six categories. The consistency scores on the items related to the canonical categories were summed up to obtain an overall score, which could consequently range from 0 to 12 points. A further consistency measure comprised the answers to all questions (overall consistency). Higher consistency scores indicate a more stable FM. The questionnaires were assessed by two independent raters. Rater agreement was high. Inconsistencies were resolved by discussion. The order of events in the questionnaires (Diana and Hong Kong) was balanced across subjects and testing occasions.

2.3. Statistical analyses

A MANOVA across the subject groups with TLE and healthy controls was calculated for the consistency measures for the FM and control events. Subsequent single comparisons (T-tests) were calculated for group differences (including patient subgroups) if the MANOVA showed a significant result. In order to investigate whether the choice of the FM event was justified, background variables (emotion, surprise, interest, and confidence) were compared between the FM and the control event: Repeated measures ANOVAs and subsequent paired T-tests were calculated for the comparisons between the FM and the control event on consistency and secondary measures. Spearman's rank correlations between consistency and secondary measures as well as demographic measures were applied.

3. Results

3.1. Background variables

Fig. 1 shows the secondary variables emotion and surprise for the FM and the control event across the three subject groups.

3.1.1. Emotional reaction and surprise

The repeated measures ANOVAs showed highly significant effects of event ($p < 0.001$). The repeated measures ANOVAs showed no significant group differences on the ratings for emotional impact or surprise for the FM event, neither for the whole sample with TLE nor for the subgroups (LTLE and RTLE). Subsequent paired T-tests showed