

# Reality confusion in spontaneous confabulation

**Abstract**—A woman produced spontaneous confabulations after rupture of an anterior communicating artery aneurysm. She confused currently irrelevant with currently relevant information in implicit memory; confabulations about people concerned only new acquaintances; false reality could be induced by an intensive 5-minute discussion; and in a recognition task, she confused false repetitions in another modality with real item repetitions. The findings support the theory that the defect causing spontaneous confabulation precedes conscious memory processing.

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Confabulations have long fascinated clinicians.<sup>1</sup> Spontaneous confabulation is a distinct form,<sup>2</sup> emanating from damage or disconnection of the orbitofrontal cortex (OFC).<sup>3</sup> It is characterized by confusion of reality in thought; the patients act according to plans that are incompatible with current reality.<sup>1</sup> Defective verification processes have been hypothesized to account for confabulations.<sup>4–7</sup> We have introduced an experimental paradigm that reliably separates spontaneous confabulators from nonconfabulating amnesics.<sup>2,3,8</sup> An evoked potential study using this paradigm indicated that selection of currently relevant memories is conveyed by an early, preconscious filtering process (200 to 300 milliseconds) preceding recognition and reencoding of evoked memories (400 to 500 milliseconds).<sup>9</sup> In this study, we test predictions from this theory in a patient with severe spontaneous confabulation.

**Case report.** A 63-year-old woman (MmeB), a psychiatrist until 15 years previously, experienced hemorrhage from an anterior communicating artery aneurysm. CT at 4 months revealed destruction of the right OFC and basal forebrain bilaterally (see figure E-1 on the *Neurology* Web site at [www.neurology.org](http://www.neurology.org)).

At 10 weeks, she was extremely amnesic but unaware of it. She thought she was 50 years old and hospitalized because of a ruptured vessel in her leg (operated on 15 years previously), or that she was medical staff. She recounted visits from her mother, who had died 13 years previously.

Neuropsychological testing at 3 to 5 months (time of experimental investigation) revealed preserved intelligence but severe amnesia and disorientation (see table E-1).

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After 7 months, the patient was discharged to her home. After 17 months, she started to realize her memory problems, stopped to confabulate and to enact inadequate plans.

**Experimental tasks.** Experiments were conducted to explore MmeB's reality confusion. Where appropriate, her performance was compared with that of five severely amnesic, nonconfabulating patients (see table E-2). The study was approved by the local ethical committee.

**Experiment 1: Temporal context confusion in implicit memory.** We tested MmeB's ability to sort out memories pertaining to the present with the task used in our previous studies.<sup>2,10</sup> It has two runs of a continuous recognition test, composed of the same pictures, differing only in the order of presentation (Appendix E-1). A marked performance decrease in the second run, due to increased false positives,<sup>8</sup> seems to be highly sensitive and specific for spontaneous confabulation.<sup>2,10</sup> This decrease is described with quotient "temporal context confusion" (TCC), which is typically 0.3 or greater in spontaneous confabulators and less than 0.3 in nonconfabulating amnesics.

In eight test sessions (2.5 to 6 months), MmeB repeatedly performed at chance in the first run (signal detection theory,  $d' < 1.65$ ), thus precluding reliable estimation of TCC. However, when the data were pooled, an increase of false positives from the first ( $2.4 \pm 2.7$ ) to the second runs ( $10.5 \pm 6.2$ ; paired  $t$  test,  $p = 0.004$ ) emerged, despite a stable hit rate (first runs,  $15.3 \pm 6.1$ ; second runs,  $17.4 \pm 4.9$ ). TCC calculated with mean values was 0.45, highly predictive of spontaneous confabulation.<sup>2</sup> Thus, MmeB had increased TCC in implicit memory (random explicit recognition).

At 18 months, recognition was significant; TCC was 0.26, below the threshold of spontaneous confabulation.<sup>2,10</sup>

**Experiment 2: Recognition of people.** This experiment tested the patient's tendency to confabulate the identity of people. Thirty photographs were presented: 10 long-standing celebrities, 10 clinic collaborators, and 10 strangers. The question was, "Do you know this person?"

MmeB recognized 6 of 10 celebrities (figure 1) and denied familiarity with 4 celebrities and all strangers. Similar to three amnesic patients, she had difficulty in identifying clinic collaborators. However, she confabulated identities relating to her confabulated activities for seven collaborators.

**Experiment 3: False reality induction.** On 10 different days, MmeB was shown a photograph depicting a family event. For 5 minutes, the examiner pushed MmeB to provide details. One minute later, and again after 5 and 30 minutes, the examiner asked, "Where have you been today?"

At 3 months, MmeB indicated the discussed event after 1 minute as having really occurred on 9 of 10 days (figure 2). This proportion rapidly decreased after 5 and 30 minutes. By 6 months, when she retained some information, false reality could no longer be induced with this procedure. Two amnesic controls never produced the discussed event.

**Experiment 4: Intermodal confusion.** Two continuous recognition tasks with 40 words and 40 pictures of objects were compiled. After initial presentation, half reappeared in the same (40 true repetitions) and half appeared in the other modality (40 false repetitions, modality switch). Subjects were asked whether they had seen "precisely the same word/picture during the run" (stimu-

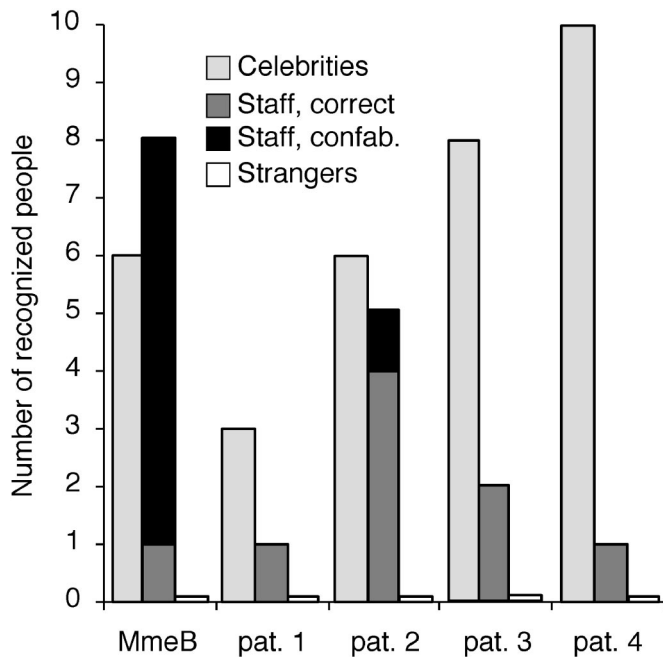


Figure 1. Recognition of people (experiment 2). The number of recognized people indicates the number of portrait photographs for which subjects indicated a name or another precise description of identity (e.g., profession and role). Staff, confab. designates confabulated identities. Pat. 1 through 4 refer to the patients listed in table E-2 (on the Neurology Web site at [www.neurology.org](http://www.neurology.org)).

lus presentation, 1.5 seconds; next stimulus, 1 second after verbal response).

In the One-Back version, items were immediately repeated in the same or the other modality (figure 3A). In the Two-Back version, one stimulus intervened before an item's repetition (figure 3C). Five amnesics and four healthy women (aged 46 to 60 years) served as controls.

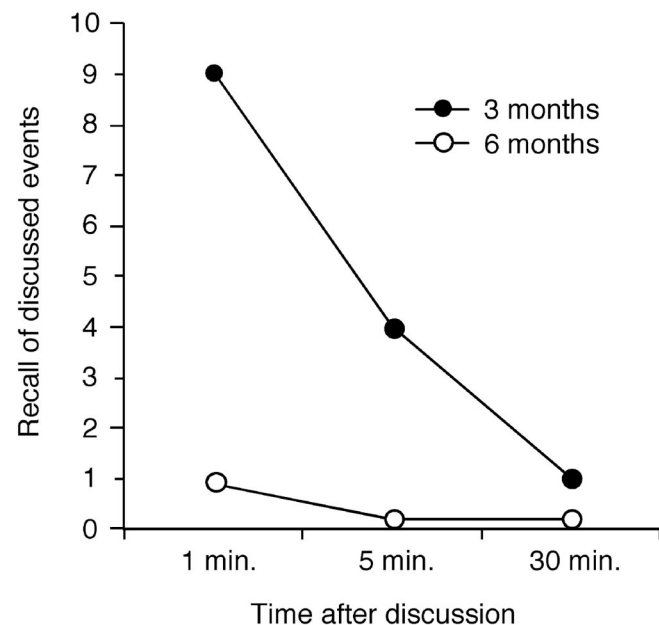


Figure 2. Induction of a false reality (experiment 3). Recall of discussed events refers to the number of occasions (days) in which MmeB recalled the discussed event as having really occurred on the same day.

In six sessions (4 to 6 months), MmeB had difficulty in recognizing true item repetitions, especially in Two-Back (figure 3D), demonstrating her severe amnesia. Patients 1 and 5 had a similarly low hit rate, but only MmeB produced many false positives to false repetitions. She produced few false positives to new items:  $1.2 \pm 1.4$  in One-Back (amnesics,  $1.0 \pm 1.4$ ; healthy controls,  $0.2 \pm 0.4$ ),  $4.8 \pm 3.5$  in Two-Back (amnesics,  $1.8 \pm 2.2$ ; healthy controls,  $0.2 \pm 0.4$ ).

At 18 months, MmeB produced similar false positives as the amnesic controls (figure 3B and D, MmeB post), despite a continuing low hit rate in Two-Back (figure 3 D).

**Discussion.** This patient had severe spontaneous confabulation; for 17 months, her concept of reality was determined by memories relating to a personal reality of 15 to 20 years ago. The current observations are compatible with hypotheses interpreting confabulation as a problem of memory verification.<sup>4-7</sup> Moreover, they support the idea that the mechanism at fault in spontaneous confabulation is preconscious,<sup>3</sup> preceding and independent of the conscious recognition of a memory's content.

Experiment 1 measured the tendency to confuse ongoing reality (current run) with the past (previous run). Despite nonsignificant explicit recognition, MmeB had an isolated increase of false positives in the second run, the typical pattern of spontaneous confabulators.<sup>2,8</sup> This result indicates that the filtering (monitoring) mechanism, which seems to be defective in spontaneous confabulators,<sup>3</sup> also pertains to implicit memory and also adapts unconscious behavior to ongoing reality.

In experiment 2, MmeB only confabulated the identity of people met after brain damage, not the identity of long-standing celebrities or strangers. Our interpretation is that MmeB only vaguely encoded information about clinic collaborators, but these vague memories sufficed to evoke mental associations, which, unfiltered in the early phase of activation, induced the confabulations.

Experiment 3 shows that the mere thinking about a past event may induce a false reality when the evoked memories fail to be filtered regarding their relation with reality. The procedure worked only while MmeB encoded virtually no information and constructed her reality with the little information briefly retained in active memory. The observation makes it plausible that a patient's environment influences the content of his or her confabulations.

In experiment 4, items repeated in another modality were often judged to represent the same stimulus. This failure cannot be attributed to defective response inhibition, because false positives only occurred to false repetitions (modality switches), not to new items, or to the severe amnesia: nonconfabulating amnesics did not have this difficulty, nor did the patient after the confabulatory phase, when her recognition was still very deficient (Two-Back, figure 3D). The result underscores the idea that the orbitofrontal filter mechanism affects the feeling of a memory's current relevance early on, before its precise content (including modality) is processed. Future studies should probe the specificity of this finding for

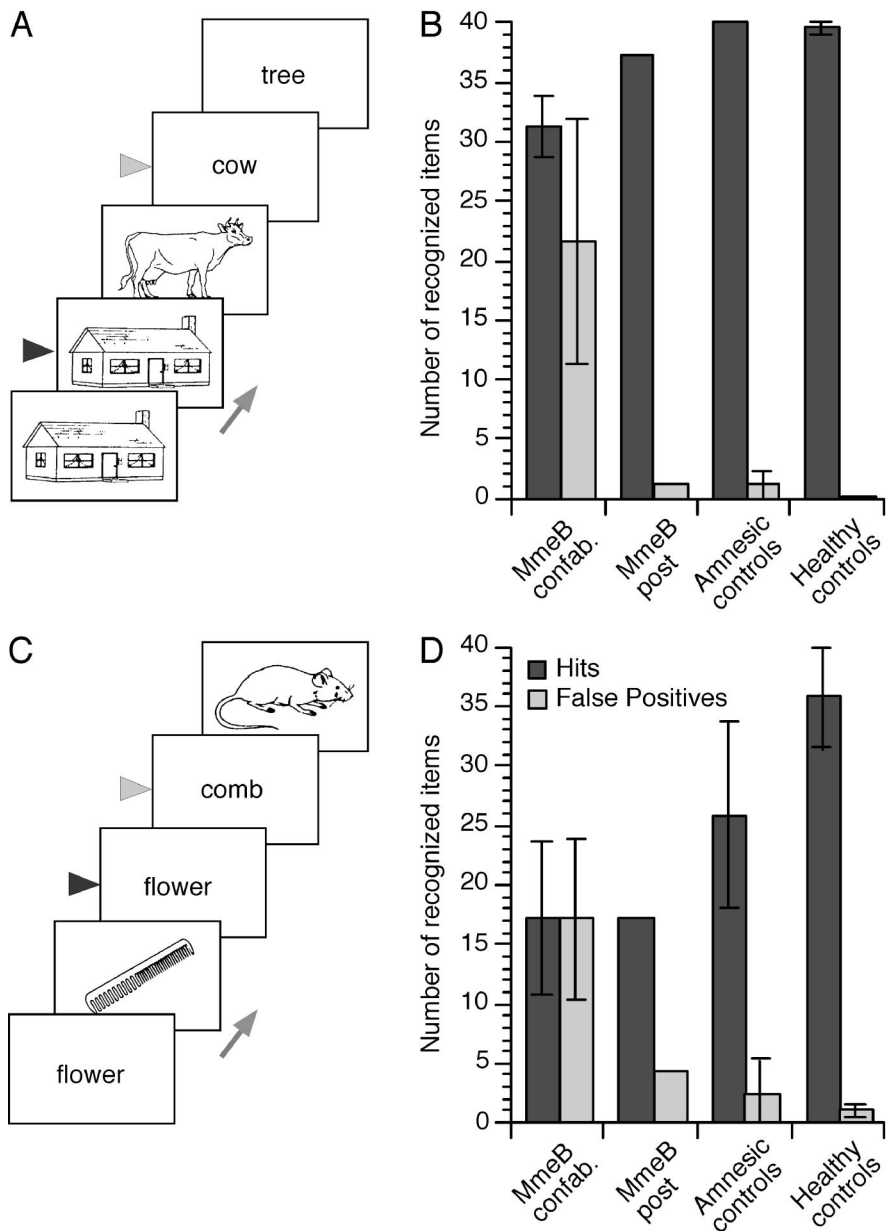


Figure 3. Intermodal confusion (experiment 4). Design of the One-Back version (A) and the Two-Back version (C). The dark arrowheads indicate true repetitions, and the bright arrowheads indicate false repetitions (modality switch). Results of the One-Back version (B) and the Two-Back version (D). The number of recognized items indicates the items that the subjects thought to be true repetitions. Black columns show hits (correct positives), and gray columns show false-positive responses in response to false repetitions (modality switches; false positives in response to new items were very rare [see text] and are not shown in the figure). MmeB confab. indicates the patient's performance over six test sessions 4 to 6 months after hemorrhage; MmeB post indicates her performance after cessation of spontaneous confabulation at 18 months.

spontaneous confabulation and clarify to what degree it also depends on defective encoding.

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