Confabulation

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Memory distortion, rather than memory loss, occurs because remembering is often a reconstructive process. To convince oneself of this, one only has to try to remember yesterday's events and the order in which they occurred; or even, as sometimes happens, what day yesterday was. Damage to neural structures involved in the storage, retention, and automatic recovery of encoded information produces memory loss which in its most severe form is amnesia (see Squire, 1992; Squire, Chapter 7 of this volume). Memory distortion, however, is no more a feature of the memory deficit of these patients than it is of the benign, and all too common, memory failure of normal people. When, however, neural structures involved in the reconstructive process are damaged, memory distortion becomes prominent and results in confabulation, even though memory loss may not be severe. Though flagrantly distorted and easily elicited, confabulations nonetheless share many characteristics with the type of memory distortions we all produce. Studying confabulation from a cognitive neuroscience perspective, of interest in its own right, may also contribute to our understanding of how memories are normally distorted.

Confabulation is a symptom that accompanies many neuropsychological disorders and some psychiatric ones, such as schizophrenia (Enoch, Trethowan, and Baker, 1967; Joseph, 1986). What distinguishes confabulation from lying is that typically there is no intent to deceive and the patient is unaware of the falsehoods. It is an "honest lying." Confabulation is simple to detect when the information the patient provides is patently false, self-contradictory, bizarre, or at least highly improbable. These are called fantastic confabulations (Kopelman, 1987). Just as often, however, the tale fabricated by the patient is coherent, internally consistent, and relatively com-

monplace. It is identified as a confabulation only by consulting with the patient's friends or relatives or by cross-checking it with information provided by the patient on other occasions.

Confabulations also are not systematic in the sense that they are subordinated to a single theme. When confronted with the truth, the patient either clings to the story despite its implausibility or inconsistency, or readily abandons it in deference to the examiner. The indifference or apathy with which either course is taken, and the lack of thematic cohesiveness, stand in contrast to the attitude of some delusional psychiatric patients who fiercely defend their elaborately structured system of beliefs. In my experience, the only time indifference gives way to willfulness and tenacity is when confabulation is wedded to action. In such circumstances, the patient's attempt to carry out a plan of action consistent with the confabulation is not always easily thwarted or deflected. This last point suggests that confabulations are not restricted to verbal statements (Talland, 1961, 1965; Berlyne, 1972) but can include action and non-verbal depictions such as drawings (Joslyn, Grundvig, and Chamberlain, 1978; Kern, Van Gorp, Cummings, Brown, and Osato, 1992). The treatment by one of our patients of the nursing staff as office help and another patient's repeated attempts to leave the hospital for home in the evening indicated, as strongly as their verbal statements, that they mistook the hospital for their workplace.

Before proceeding further, I think it best to illustrate what confabulations are like with an example. On the basis of my own work, and of reports in the literature, I will then list what I think are the primary features of confabulation. The rest of this chapter will be devoted to a discussion of its causes, both structural and functional, and of the possible contribution that studies of confabulation can make to theories of normal and pathological memory, and to research on memory distortion. Finally, I will present two models that can accommodate the findings.

Excerpt from an Interview with Patient HW

HW is a 61-year-old right-handed man who had a sub-arachnoid hemorrhage clipped. Clipping near the anterior communicating artery (ACoA) was followed by widespread bilateral frontal ischemia and infarction. CAT scans confirmed widespread frontal damage with sparing of the temporal lobes medially and laterally. The interview took place in 1987. More detailed information about HW and his deficits appears in Moscovitch, 1989.

Q. Can you tell me a little bit about yourself? How old are you?
A. I'm 40, 42, pardon me, 62.
Q. Are you married or single?
A. Married.

Q. How long have you been married?
A. About 4 months.
Q. What's your wife's name?
A. Martha.
Q. How many children do you have?
A. Four. (He laughs.) Not bad for 4 months!
Q. How old are your children?
A. The eldest is 32, his name is Bob, and the youngest is 22, his name is Joe. (These answers are close to the actual age of the boys.)
Q. (He laughs again.) How did you get these children in 4 months?
A. They're adopted.
Q. Who adopted them?
A. Martha and I.
Q. Immediately after you got married you wanted to adopt these older children?
A. Before we were married we adopted one of them, two of them. The eldest girl Brenda and Bob, and Joe and Dina since we were married.
Q. Does it all sound a little strange to you, what you are saying?
A. (He laughs.) I think it is a little strange.
Q. Your record says that you've been married for over 30 years. Does that sound more reasonable to you?
A. No.
Q. Do you really believe that you have been married for 4 months?
A. Yes.
Q. You have been married for a long time to the same woman, for over 30 years. Do you find that strange?
A. Very strange.
Q. Do you remember your wedding well?
A. No, not particularly. (In other interviews he is able to describe his wedding in some detail.)
Q. Were your parents at the wedding?
A. Yes.
Q. How old were they?
A. My father is 95–96. My mother is 10 years younger so she is 85–86. (In fact, they died quite a few years ago when they were in their 70s.)
Q. So you got married the first time when you were 61 years old? You weren't married when you were younger?
A. This is my second marriage. The first woman was 2 years ago.
Q. That would make you how old when you got married the first time?
A. 50.
Q. What happened to your first wife?
A. Not a thing.
Q. Did you get divorced?
A. Yes.
Q. Are you Protestant or Catholic?
A. (He laughs.) I'm Catholic.
Q. That would make it pretty difficult, wouldn't it?
A. Yes, the first one was invalid.

Characteristic Features of Confabulation

With this interview in mind, it will be simple to review the prominent features of confabulation. I have used Talland's list (1965, pp. 49–50) as a guide and modified it to bring it up to date and to conform more closely to my own beliefs concerning the nature of the syndrome.

1. Confabulations are usually verbal statements but can also occur as non-verbal depictions or actions.

2. Typically, they are accounts concerning the patient but also can include non-personal information such as knowledge of historical events, fairy tales (Delbecq-Derouesné, Beauvois, and Shallice, 1990; Luria, 1976), geography (Moscovitch, 1989), and other aspects of semantic memory (Dalla Barba, 1993a; Sandson, Albert, and Alexander, 1986).

3. The account need not be coherent and internally consistent, as patient HW's belief about his marriages and the ages of his children indicates.

4. The account is false in the context in which it is related and often false in details within its own context.

5. Most often, the account is drawn fully or principally from the patient's recollection of his actual experiences, including his thoughts in the past and current musings. If the examiner is aware of the patient's history and his current concerns and perceptions, the source of the elements that enter into the patient's confabulations can be identified. HW once mistook me for an insurance salesman because we had been discussing a friend of his who was one. Talland describes a case in which a painting of a seascape in the examiner's office caught a patient's eye and served as the stimulus that launched him into a fantastic confabulation of his life as a sailor.

6. Information is presented without awareness of its distortions or of its inappropriateness and without concern when the errors are pointed out. Our patient merely laughed when confronted with the implausibility of having four children in four months; with little hesitation, he provided a preposterous explanation for this amazing feat. Indeed, the lack of awareness and concern is not confined to single accounts but extends to the patient's entire condition. In short, the patient is anosognosic (McGlynn and Schacter, 1989).

7. Usually confabulation serves no purpose; it is motivated in no other way than by the patient's attempt to relate his or her experiences. Initial or primary confabulations are not produced "to oblige the listener or to fill in gaps in their knowledge of facts" (Talland, 1965, p. 42), though "secondary" confabulations may arise to explain (away) the internal inconsistencies of the primary confabulations that are sometimes apparent even to the patient. Thus, HW's assertion that he was married for four months was a primary confabulation that was elicited as his honest answer to a question. Trying to resolve the discrepancy between that answer and the knowledge that he had four grown children, however, probably accounted for all the remaining "secondary" confabulations in his account.

8. The readiness to confabulate may be determined by the patient's "personality structure, the traits evolved in dealing with the environment and in monitoring his image" (Talland, 1965, p. 44). As Gainotti (1975) observed, demented patients with a premorbid pattern of denial or rationalization of illness and with a need for prestige and domination in interpersonal relations were two or three times more likely to confabulate than patients who did not have these traits. It is not known whether this observation also applies to patients with traumatic brain injury who are not demented.

Thus, like normal remembering, confabulation involves the reconstruction of the context and modification and combination of elements and can be influenced by personality. Confabulation occurs because one or more of the mechanisms of normal remembering are damaged. Exactly which ones are involved is a matter for later discussion. Because poor memory and reconstruction are prerequisites for memory distortion by normal people, the confabulating patient can be studied as an exaggerated example of what occurs normally. As is often the case, psychopathology can provide insight into the normal.

The Prevalence and Distribution of Confabulation in Neurological Disorders

Confabulation is not found exclusively in patients with memory disorders but can also be present in patients with other deficits. Confabulation occurs often in patients with dementia and in patients who are in a confusional state. In the latter case confabulation disappears as orientation is reestablished, but in patients with ACoA aneurysms confabulation is likely to persist (DeLuca, 1993; DeLuca and Cicerone, 1991). Confabulation has also been reported in cases of cortical blindness, hemiplegia, aphasia, and neglect that are accompanied by denial of deficit (anosognosia). In these cases, confabulation has the same characteristic as it does in patients with memory disorders (see McGlynn and Schacter, 1989), except that its manifestations are related to the particular deficit. Thus, patients with cortical blindness will assert that they see well and describe in detail the individual they believe they are observing although no one, in fact, is present (Kinsbourne, 1989). Patients with hemiplegia will deny that one of their limbs is malfunctioning and claim to be able to carry out activities that require the use of that limb. Aphasic confabulators will provide definitions for nonsense words. Our focus, however, will be on confabulations associated with memory disorders.

Locus of Lesions That Are Associated with Confabulation

Confabulation has been linked to damage to the ventromedial frontal lobes and related structures that are fed by the ACoA (see Figure 8.1). These in-

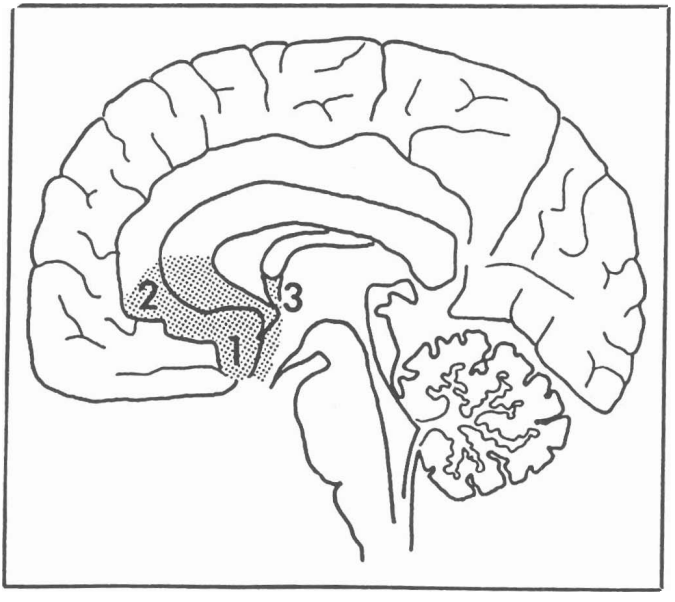

Figure 8.1 The dotted area indicates the distribution of the anterior communicating artery (ACoA) and its perforators. 1, basal forebrain; 2, anterior cingulate; 3, anterior hypothalamus. (From Parkin and Leng, 1993.)

clude the basal forebrain, septum, fornix, cingulate gyrus, cingulum, anterior hypothalamus, and the head of the caudate nucleus (Alexander and Freedman, 1984; Irle, Wowra, Kunert, Hampl, and Kunze, 1991; Vilkki, 1985). Confirmed or suspected frontal damage, especially in the right hemisphere (Joseph, 1986), is a common feature of confabulation in patients with memory disorders (Stuss, Alexander, Lieberman, and Levine, 1978; Kapur and Coughlin, 1980; Baddeley and Wilson, 1986; Moscovitch, 1989) and in patients with anosognosia related to other deficits (McGlynn and Schacter, 1989). Some authors believe, however, that confabulation is associated with lesions of the cingulate (Lhermitte and Signoret, 1976) or of the basal forebrain and hypothalamus (Luria, 1976). Their view gains support from recent reports of confabulating patients who perform normally on standard neuropsychological tests that are sensitive to frontal damage (Delbecq-Derouesné et al., 1990; Dalla Barba, 1993b). Deficits on these tests, however, are typically associated with damage to the lateral frontal cortex and not with the ventromedial cortex that is usually implicated in confabulation. Damage to the ventromedial frontal cortex may nonetheless be accompanied by deficits of executive function (Shallice and Burgess, 1992) which are not picked up by traditional tests but which may contribute

to confabulation. The possibility still remains that damage restricted to the ventromedial frontal lobes, possibly on the right, may be sufficient to produce confabulation; and, even if not sufficient, ventromedial frontal damage may be a necessary condition.

Explanations and Theories of Confabulation

Compensation

Among the earliest theories of confabulation are those that can be classified as compensatory: patients confabulate as a means of compensating for a deficiency. Bonhoffer's (1901; cited in Talland, 1965) *confabulation of exigency or embarrassment* is of this type. Patients confabulate in order to cover lapses in memory or fill in gaps of knowledge (Barbizet, 1963), as much to oblige a listener as to satisfy a patient's own needs. We can see these factors operating in HW's clumsy attempt to account for his having four adult children after being married for four months. As noted earlier, these can be considered as *secondary confabulations* that are devised to reconcile beliefs, based on *primary confabulations,* that are incompatible with each other. The compensatory theory does not explain why HW said he was married for only four months in the first place.

Similarly, proposals that confabulation is attributed to suggestibility (Pick, 1905) or to psychological defense mechanisms associated with certain types of premorbid personality (Weinstein and Kahn, 1955; Gainotti, 1975) also fail to capture the cause of primary confabulations in most patients. HW, like other confabulating patients, volunteers erroneous information with little prodding and, as often as not, continues to hold onto his beliefs despite suggestions to the contrary (see interview). Admittedly, some patients with degenerative dementing disorders may confabulate in order to protect themselves from knowledge that can be devastating. Most confabulating patients with traumatic brain damage, however, are so apathetic and indifferent to their disorder that it is difficult to believe that their confabulations are a means to defend against anxiety, let alone catastrophic reactions.

Temporal Disorder and Loss of "Source" Memory

One of the more popular theories is that confabulation arises from "the disruption of [the patient's] temporal frame of reference" (Talland, 1965, p. 56; Van Der Holst, 1932, cited in Williams and Rupp, 1938). The temporal disorder prevents patients from establishing a point of reference in time around which they can place events in sequence. As a result, memories of events that are related but are widely separated in time and place become fused or are misattributed to another context. *A disturbed sense of chronology* will also lead to erroneous dating of even single events. Such a process

can produce *primary confabulations* and, once produced, may give rise to *secondary confabulations* that function to reconcile discrepant beliefs.

The temporal theory is consistent with evidence that frontal lobe lesions or dysfunction lead to deficits in judgments of temporal order (Kopelman, 1989; Milner, Petrides, and Smith, 1985; Shimamura, Janowsky, and Squire, 1991; Vriezen and Moscovitch, 1990) and, perhaps, to impaired attribution of temporal or spatial context to any event (Schacter, 1987; Shimamura and Squire, 1987). "Confabulation is source amnesia (Schacter, Harbluk, and McLachlan, 1984) magnified and extended to include a lifetime of experience" (Moscovitch, 1989, p. 138).

Although a deficit in chronology and attribution of context is a prominent feature of confabulation, I do not think it is the cause of confabulation but is itself a symptom of a deeper underlying disorder. An impaired chronological mechanism cannot account for spontaneous, fantastic confabulations which are not just incorrectly reassembled memories but true inventions. Similarly, the compensatory, secondary confabulations can be so farfetched that they cannot be explained as normal reactions to conflicting beliefs caused by an impaired chronological process. Besides, implicit in this interpretation is that confabulation is restricted to the patient's personal experiences or what he or she takes to be those experiences. I will provide evidence that confabulation also involves semantic memory which includes general, rather than personal, knowledge.

Retrieval Theories

There is general agreement that confabulation is primarily a deficit in retrieval more than encoding, consolidation, or storage (Lhermitte and Signoret, 1976), "of the ability to 'ecphoria' than of engram formation" (Williams and Rupp, 1938, p. 403). The strongest evidence in favor of the retrieval hypothesis is that confabulation affects remote memories as well as those that were acquired postmorbidly. Retrieval, however, is not a simple, unitary process. The question remains as to which aspect of retrieval is impaired in patients who confabulate. Because damage is not localized to a single structure and because the symptoms, apart from confabulation, are variable, it is by no means simple to isolate the retrieval deficit that underlies confabulation.

The suggestion that confabulation is related to an *impaired ability to withhold responses* and *to monitor* those that are given (Mercer, Wapner, Gardner, and Benson, 1977; Shapiro, Alexander, Gardner, and Mercer, 1981; Stuss et al., 1978; Stuss and Benson, 1986; Talland, 1965) places the deficit at a late stage of retrieval, after the memory had been retrieved but before a response was emitted. Consistent with this proposal is that memory for content is better preserved than memory for temporal order and context.

There are indications, however, that early retrieval processes involved in memory search are also impaired. Patients do not always confabulate in response to every question which they do not answer correctly. In fact, the most common error is one of omission—they simply do not supply any answer or, if one is supplied, it is sparse in detail. In itself this is not peculiar except that such failures also occur in circumstances in which the answer would be readily available to them if only they could devise a proper strategy to retrieve it.

Strategic versus Associative/Cue Dependent Retrieval

To understand the nature of the retrieval deficit in confabulation it is necessary to distinguish between two types of retrieval processes: associative/cue dependent and strategic (see also Conway's [1992] distinction between direct and generative retrieval). The former is a relatively automatic process that is engaged when a specific, proximal cue interacts with information stored in memory, a process termed "ecphory" (Seman, 1922, cited in Schacter, Tulving, and Eich, 1978). The recovered product of that interaction is either the memory that is being sought or provides the material for subsequent, strategic retrieval processes. Strategic retrieval processes are self-initiated, goal-directed, effortful, and intelligent. When the retrieval cue is inadequate, strategic processes are involved in initiating and organizing a search that uses whatever knowledge is available, whether semantic or episodic, to reinstate the appropriate context and locate the cue that allows local, associative processes to operate. Once the memory trace is recovered, other strategic processes then monitor the output. Among other things, this would involve determining whether the recovered trace satisfies the goals of the memory search and whether it is consistent with other information in semantic and episodic memory. If not, new search processes are initiated and the entire sequence is repeated until a solution is found or the search is abandoned.

Strategic retrieval processes are essentially problem-solving routines applied to memory. They help frame the problem and recruit general and personal knowledge to constrain it further until local routines can arrive at a possible solution. The solution is then evaluated to see if it is correct.

The order in which associative and strategic retrieval processes are applied is not fixed. Sometimes a highly distinctive cue may lead to recovery of the target, and only then do strategic processes use that information to reconstruct the context in which the event occurred. At other times, the processes are reversed.

Confabulation as a Deficit in Strategic Retrieval

I wish to argue that impairment of processes involved in strategic retrieval causes the major positive and negative signs of confabulation. These can

be exacerbated by two factors: (1) deficiencies in associative retrieval and (2) damage to the system from which information is recovered. In the case of memory, the system includes the medial temporal/diencephalic structures involved in engram formation and storage. A damaged system is more likely to produce faulty output when it is queried. Because strategic retrieval is itself impaired, the faulty output cannot be monitored and evaluated properly. In general terms, errors of omission occur when specific cues are inadequate and do not trigger responses, and there is a subsequent failure to initiate and implement strategic search. On the other hand, confabulation occurs when the outcome of disturbed strategic search and associative retrieval is faulty and a response is emitted without proper monitoring and evaluation.

This hypothesis is consistent with the idea that the frontal lobes are implicated in confabulation. Studies of patients with frontal damage or dysfunction suggest that the frontal lobes contribute to strategic memory functions at encoding and retrieval—the use to which memory is put rather than its mere storage and reactivation (for review see Moscovitch, 1989; Moscovitch and Winocur, 1992a, 1992b). In particular the frontal lobes have been implicated in the temporal organization of memory (Milner, Petrides, and Smith, 1985; Schacter, 1987), which may be particularly sensitive to disturbances in strategic retrieval processes (Moscovitch, 1989). This may explain why temporal disorders are such a prominent feature of confabulation.

One difficulty with this hypothesis is that much of our knowledge of the cognitive deficits that are associated with frontal lesions is based on studies of patients with damage to the dorsolateral or ventrolateral regions, whereas it is the ventromedial region that is implicated in confabulation. The extent to which damage to each of these regions contributes to the symptom complex that is characteristic of confabulation has yet to be determined. Until it is, we will work on the assumption that at least as far as memory is concerned, disorders of strategic processes are also associated with damage to the ventromedial region and related subcortical structures.

The strategic retrieval hypothesis is meant to be applied equally across all domains: episodic memory as well as semantic, recently acquired memories as well as remote ones, regardless of content. At first glance, this hypothesis would appear to have difficulty in accounting for reports that confabulation involves episodic more than semantic memory (Dalla Barba, 1993b) and that, in both cases, it is particularly temporal aspects of memory that are especially affected. There are a number of reasons why confabulation is so unevenly distributed across various domains even though the strategic retrieval hypothesis may be correct. One reason is that the semantic memory tests or questionnaires that were administered by Dalla Barba made fewer demands on strategic retrieval processes than episodic memory tests. Were the two types of tests equivalent, then performance on both tests would be similar. The other reason, which was mentioned earlier, is that damage to systems involved in associative retrieval and storage of domain-specific in-

formation will exacerbate confabulation. It may be argued that some memory disorder may be a prerequisite for confabulation. These issues will be examined in the following sections. In the remaining part of the chapter I will discuss in more detail some aspects of confabulation as well as associated memory problems.

The Domain of Confabulation

Episodic versus Semantic Memory

Dalla Barba (1993a, 1993b; Dalla Barba, Cipolotti, and Denes, 1990) reports two cases in which confabulation is confined to episodic or autobiographical memory and a third case in which it also includes semantic memory. It is significant that only episodic memory was deficient in the two former cases whereas semantic memory was also impaired in the latter.

Impaired semantic memory and aphasia were associated with semantic and lexical-semantic confabulations, respectively, in Baddeley and Wilson's (1988) and Sandson et al.'s (1986) patients. These findings are consistent with the prediction that such damage would exacerbate confabulation in the affected domain. The reason is that a damaged system is more likely to produce faulty output. Because the strategic retrieval system itself is damaged, that output cannot be monitored and evaluated properly. Patients may confabulate more about episodic than semantic memory because it is episodic memory that is more often impaired, perhaps because of the proximity of structures involved in episodic memory to those involved in strategic retrieval.

Yet another reason for the greater prevalence of confabulation about episodic memory is that retrieval of episodic memories in the laboratory and in real life is likely to make greater demands on strategic processes than retrieval of semantic memories. Examination of the 15 questions used by Dalla Barba (1993b, pp. 19–20) to probe episodic memory shows that at least 12 of them had a temporal component which requires strategic retrieval, whereas this was true of only three of the semantic memory questions. In addition, all the episodic memory questions involved a narrative that probably required strategic search processes to ferret out details, whereas more than half the semantic memory questions could be answered by a single word or sentence.

In an attempt to equate the strategic retrieval demands of semantic and episodic memory, we used a word-cue test first developed by Galton (1879) to study autobiographical memory and revived by Crovitz (1973; Crovitz and Schiffman, 1974). We devised a semantic, historical version to complement the traditional episodic memory version of the Crovitz Test (see Table 8.1). In the episodic version, the subject was presented with a set of 12 cue words, one at a time, and was asked to use it to retrieve a memory of a

Table 8.1 List of words used to cue personal (autobiographical) and historical (generic) memories in the Crovitz Test

Personal	Historical
Happy	Revolt (Rebellion)
Find	Explorer
Letter	Invention or Discovery
Throw	Saint
Lonely	Battle
Game	Assassination
Successful	Sea
Make	King or Queen
Break	Indians or Settlers
Dog	Miracle
Angry	Train
River	Fire or Natural Disaster

particular event he or she had experienced and to describe it in detail. In the semantic version, one of another set of 12 words served as cues for the subject to describe a historical event that occurred before he or she was born. We chose the Crovitz test because we thought that retrieving detailed information in response to such minimal, non-specific cues would necessarily involve strategic retrieval processes. The test was scored according to the procedure described by Zola-Morgan, Cohen, and Squire (1983, 1984). Three points were awarded for a detailed description that provided temporal information. Two points were awarded for a proper description of an event but one that lacked detail or temporal specification, and 1 point was awarded for providing general (non-specific) information in response to the cue. When no response was given to the cue or if the response was lacking in detail, subjects were prompted to provide additional information.

We tested four patients with confabulation, five amnesic patients whose memory was at least as poor as that of the confabulating patients, and twelve normal adults between the ages of 65 and 70. The results appear in Tables 8.2 and 8.3. One of the confabulating patients could not produce any response on either version, presumably because strategic search was too impaired. Significantly, she also confabulated least in daily life. As noted earlier, recovering some information is a prerequisite to confabulation. The other three confabulators scored more poorly on both the semantic and the episodic versions of the test than either amnesic patients or normal control subjects who did not differ from each other. In comparison to amnesic and control subjects, confabulators had more difficulty in producing a description of a personal episode or a historical event or personality and needed prompting, but when they did respond, confabulation was present on half

Table 8.2 Examples of the cue-word responses and the scores they received

Cue-Word	Points	Response
Personal		
ANGRY	1	I've been angry an awful lot in my life, but OK a specific incident. I've always been an angry type . . . (angry—at a person?) Don't know specifics (angry at wife?) no (what makes you angry?) I'm Irish. (is it waiting that makes you angry? or when you can't do something?) no—people. When I see somebody doing something I think they're doing it on purpose.
LONELY	2	I have been very lonely for the past 4 years since I had my cardiac arrest. I spend most of my time by myself, I used to be very active, belonged to clubs, played tennis, traveled a great deal, and I was very active. Since my cardiac arrest, I haven't done any of those things. My wife went to work shortly after my cardiac arrest so she was at work all day and the children were at school, so I was always alone. (can you think of a specific time during this period that you were especially lonely?) No . . . I was always lonely. I lost most of my friends, my best friend wasn't much of a talker and I was the one who used to keep the conversation going. But when you have two people who don't talk much it's not much fun, so I lost most of my friends that way.
LETTER	3	I wrote a letter to a lady in response to a letter she had written to me. It was unusual, it was a girlfriend I had had in Med School. She lives in Brooklyn, New York, and I was in school in New York, and I dated her. She's in New Jersey now, I think, and in the letter she told me about her family and how she is married and has I think 2 kids. I got that letter in January of this year.
Historical		
SEA/OCEAN	1	All I can think about is the Black Sea, having to do with the time of Christ, and I don't know what it's about it just came into my head.
QUEEN/KING	2	Henry VIII had 5, 6, 7, or 8 wives. Quite a few events or fights. 1500, 1600? He had his wives executed and then he would marry another one. I think he had a navy and 2 of the boats sank but others he still had. Didn't go on crusades or anything like the earlier kings . . . I don't think they had railways then.

Table 8.2 (continued)

Cue-Word	Points	Response
		(wives' names?) I don't know. (Why executed?) maybe he wanted things done a certain way and they didn't do it, or maybe they had friends he didn't like. He carried a sword. They had horses then. (How were wives executed?) maybe they tied them down or something, chopped off their heads with hatchets . . . before the guillotine in France.
INDIANS/ SETTLERS	3	George Custard decided he had to change to be elected president, if he could be a "hero" so he decided to destroy the "Sioux" nation as there was gold there. He cut off at a pass at the little big horn, and massacred them, Chief Crazy Horse killed Custard who they called "Golden Hair" . . . There were no survivors.

the trials. For example, in response to the word "Queen," one patient produced "Victoria." When prompted to provide additional information all he said was, "One day she didn't want to go to school so now we have a holiday named after her." Victoria Day is a holiday in Canada but it celebrates her birth. In response to "Assasination," another patient told a story about David and Goliath who had a contest involving Jesus, to see whether one could shoot as straight with a rifle as with a slingshot. Goliath was killed by accident during the match.

Data are also presented from one patient with a right dorsolateral frontal lesion who did not confabulate, though she did provide fewer, less detailed answers than controls and amnesics. This suggests that the dorsolateral fron-

Table 8.3 Average scores obtained in the personal and historical version of the Crovitz Test

	Personal				Historical			
Group	N	Without Prompt	With Prompt	Confabulations	N	Without Prompt	With Prompt	Confabulations
Controls	9	19.9	24.4	0.0	7	24.0	26.1	0.7
Mid Frontal + Amn	4	12.2	22.0	9.0	2	6.0	10.0	11.5
Lateral Frontal	1	15.0	21.0	1.0	1	12.0	12.0	0.0
Amnesic	6	24.7	31.4	1.2	3	21.6	31.2	3.6

Note: Twelve cue words were used in each version and scored separately for details given with and without prompts. Maximum score is 36 (see text for details).

tal cortex may be necessary for initiating strategic search whereas the ventromedial frontal cortex may play a greater role in monitoring.

Comparable deficits in episodic and semantic memory tasks were observed if subjects had to date, or place in proper temporal order, events that they had experienced and historical events that were part of their semantic knowledge. For example, after having said that America was discovered in 1492 (aside from Jesus' birth, the only event that one of our patients could date correctly), he then claimed that the American Declaration of Independence was signed in 1400. On repeated tests, he thought that World War II began between 1940 and 1976 and ended as early as 1954 and as recently as 1979. What was interesting was that he dated the events that he had experienced within the time of his birth; those he had not experienced, he assigned to the distant past. Thus, when semantic and episodic memory tests are comparable, similar deficits associated with strategic retrieval processes are observed in both.

Temporal, Spatial, and Procedural Knowledge

Temporal ordering and dating may be especially prone to confabulation. Memories are not typically recovered via associative retrieval processes in a correct chronological sequence or with temporal dating tags. Instead, strategic retrieval processes operating on available episodic and semantic knowledge are used to estimate the date and temporal order of all but highly overlearned events by relating them to known landmarks. Freidman (1993) reached a similar conclusion in reviewing an extensive literature on temporal ordering and dating in normal people.

Confabulation about place is less readily elicited than that about time because associative retrieval is likely to be more effective in dealing with space than with time. Associative retrieval may be sufficient to answer the question "Where is Paris?" but not "When were you in Paris last?" which often requires a strategic search. Nonetheless, questions about place can be devised that require strategic search, and these should elicit confabulations as readily as do questions about time. Such questions usually involve locations about which the subject has imperfect knowledge. Informal tests on one of our patients confirmed this prediction. He identified the location of familiar landmarks in Toronto, claimed ignorance about unfamiliar locations, but confabulated about less familiar but recognizable places (Moscovitch, 1989).

Our hypothesis suggests that confabulation should be least likely for knowledge about procedures or skills. Strategic search is not needed to determine whether or not one has a particular skill. Despite prodding and strong suggestions to the contrary, HW insisted correctly that he could not

fix a typewriter or a camera, but that he could change a tire and described how he would do it.

This does not mean that patients would not confabulate about their skills under any circumstances. If the patient had some knowledge about a task, and perhaps had even attempted to execute it, or wished that he could, then he might confabulate. Little children, whose frontal lobes are not fully developed (Diamond, 1991; Kates and Moscovitch, 1994; Smith, Vriezen, and Kates, 1992), often engage in such confabulations when they talk about their abilities or plans (see Ceci, Chapter 3 of this volume).

Correlation of Confabulation with Memory and Cognitive Function Sensitive to Frontal Damage

A number of investigators have noted that confabulation is not correlated with severity of memory loss but rather with performance on cognitive tests sensitive to frontal lobe damage (e.g., Stuss and Benson, 1986; Stuss et al., 1978; Baddeley and Wilson, 1986; Kopelman, 1987). In the case reported by Kapur and Coughlan (1980) confabulation cleared as frontal functions returned. The same may probably be true of Parkin, Leng, and Stanhope's (1988) patient who had severe memory problems with confabulation for some time after rupture of an ACoA aneurysm. Two years later when formal testing began, however, he was left with a severe memory loss but his confabulation had cleared and performance on tests of fluency and Wisconsin Card Sorting was normal.

Delbecq-Derouesné et al. (1990), however, reported that their confabulating patients performed normally on a battery of standard cognitive tests of frontal lobe function. The one exception was tests of letter fluency. Dalla Barba et al. (1990) claimed that their patient also had no frontal deficits, but the tests were far less extensive.

These two opposing patterns of results are to be expected if the ventromedial frontal cortex that is implicated in confabulation is adjacent to, but not overlapping with, areas that are involved in the cognitive tests (Johnson, O'Connor, and Cantor, 1994). Typically, damage is likely to affect both regions, but on occasion it will be restricted to the ventromedial area.

Thus, no strong predictions about general memory loss or impaired performance on non-memory tests of frontal function follow from the retrieval deficit hypothesis. What is predicted, however, is that confabulation should be associated with deficits on memory tests that have a strong strategic retrieval component. Insofar as the majority of confabulating patients perform abysmally on tests of free recall but within the normal range on tests of recognition, this prediction is upheld (see Moscovitch, 1989; Parkin and Leng, 1993).

One exception is the case reported by Delbecq-Derouesné et al. (1990),

who ostensibly showed exactly the reverse pattern. Recall was normal if only hits were scored, though there were a large number of intrusions in recounting events and stories as befits a confabulating patient. Recognition was poor and characterized by a large number of false positive responses to lures. To account for these results, one would have to assume that different aspects of strategic retrieval are impaired in the patients of Delbecq-Derouesné et al. than in the others. Specifically, an initial search process may need to be distinguished from a later, post-ecphoric monitoring process. Poor performance on free recall may result from an inadequate initial search process in the majority of patients, a process which is relatively preserved in Delbecq-Derouesné et al.'s patient. Although post hoc, this explanation is consistent with the observation that it is only this patient whose frontal cognitive functions seem to be intact.

Active initial search is circumvented on recognition tests where the target can act as its own, strong associative retrieval cue and lead to good performance in most patients. To account for their patient's poor recognition, Delbecq-Derouesné et al. proposed that post-ecphoric monitoring is too impaired to distinguish between familiarity based on episodic memory (the target) and that based on semantic memory (the lures). According to this interpretation, the patient uses a familiarity heuristic on which to base recognition judgment but cannot monitor whether the item is familiar because it had been studied recently or because it is an item that is experienced often, such as a word that occurs frequently in the language. If correct, this interpretation suggests that recognition performance would have been improved had the targets and lures been infrequent so that the studied item would gain disproportionately in familiarity. Conversely, performance may have dropped significantly lower than chance if the targets had been rare but the lures frequent.

Damage to the right prefrontal cortex has been associated with confabulation and with a heightened tendency to make a large number of false alarms to novel items on tests of recognition (Delbecq-Derouesné et al., 1990; Parkin, Dunn, Lee, O'Hara, and Nussbaum, 1993; Schacter and Curran, in preparation, cited in the Introduction to this volume). The idea that the right prefrontal cortex is involved in monitoring and verifying memories (Shallice et al., 1994) is consistent with these observations and with recent evidence from PET studies of right prefrontal activation during recollection (Tulving, Kapur, Craik, Moscovitch, and Houle).

Implication for Theories of Normal and Pathological Memory

Components of Retrieval

Perhaps more than any other syndrome, confabulation provides support for theories of memory that distinguish between two types of retrieval processes

or two components to retrieval. One is an automatic component in which a proximal specific cue elicits the target, what we have termed associative/cue dependent retrieval. The other is an effortful search component in which semantic information and episodic information are recruited in response to non-specific distal cues to home in on the target or, more likely, on the proximal cue and to monitor and evaluate the outcome of this search. We have termed this second type strategic retrieval. Thus, strategic retrieval itself consists of two components: an initial effortful, guided *memory search* and a *post-ecphoric monitoring process* that evaluates the outcome of that search.

Broadly similar proposals have been advanced in the literature on normal (e.g., Mandler, 1980; Joulia and Atkinson, 1974; Tulving, 1983; Morton, Hammersley, and Bekerian, 1985) and pathological memory (Baddeley and Wilson, 1986; Delbecq-Derouesné et al., 1990; Goldberg and Bilder, 1986; Rozin, 1976; Schacter, 1987; Shapiro et al., 1981; Shimamura, 1994; Stuss and Benson, 1986, among others).

Models of Feeling of Knowing and Confabulation

Recent studies and theories of feeling of knowing by Koriat (1993) and Metcalfe (1993) seem to capture the essence of the type of strategic retrieval process that is impaired in confabulating patients. "Feeling of knowing" refers to the condition in which the requested target is not retrieved but the individual feels that he knows the answer and would recognize it if it were provided. These theories postulate a basic memory storage system and a monitoring-control system that assesses novelty and the amount and type of information that is accessible during retrieval. Feeling-of-knowing judgments are based on the accessibility of pertinent, but not necessarily correct, information during retrieval. Thus, in a series of experiments Koriat (1993) has shown that it is the total amount of partial but accessible information about the target that determines feeling-of-knowing judgments and not whether the information that was accessed is correct or wrong. Using a composite-trace distributed model of memory, called CHARM, Metcalfe successfully simulated the performance of normal people on tests of feeling-of-knowing and release from PI. When the monitoring-control device of the model was "damaged," the output of the model resembled the impaired performance of patients with frontal lesions or dysfunction on these tests (feeling of knowing: Janowsky, Shimamura, and Squire, 1989; Shimamura and Squire, 1986; release from PI: Cermak, Butters, and Moreines, 1974; Moscovitch, 1982; Squire, 1982; Winocur, Kinsbourne, and Moscovitch, 1981). Although there are no reports on how confabulating patients performed on these tests, it is very likely that they would perform even more poorly than patients with frontal damage who did not confabulate. Indeed, Koriat's experiment in which normal people are led to provide high feeling-

of-knowing judgments to erroneous but pertinent information approximates what I believe happens in patients with confabulation. Because their monitoring-control device is damaged, the output of erroneous retrieval becomes expressed overtly rather than being withheld, as it is in normal people, where it may give rise to a feeling-of-knowing state.

Memory Storage Is Random and Lacking in Temporal Information

The fact that confabulations often refer to actually experienced events that are chronologically distorted suggests that temporal order is a property that is conferred on memories by post-ecphoric strategic retrieval processes. The idea that memories are stored randomly, without regard to sequence except immediate contiguity, was proposed by Landauer (1975), who described how such a system would operate and give rise to a number of phenomena, such as interference, that are cue-dependent. This device, however, must be coupled with a strategic retrieval component that allows access to stored memories when local, proximal cues are inadequate, monitors recovered memories, and organizes them into proper sequence and context. We refer to this context as *historical* because that word most fully captures the temporal, spatial, and situational aspects that comprise a context.

Two Models of Memory, Functional and Neuropsychological, to Account for Confabulation

Of the various models that deal with two types of retrieval, Conway's (1992) model and my own (Moscovitch, 1989, 1992) incorporate most fully those features of strategic and associative retrieval that are discussed in this chapter. In Conway's *generative retrieval* model, strategic retrieval processes construct a context or memory description in the first phase. The second phase is an access phase which involves a search through knowledge structures such as general themes and schemas (Schank, 1982) to recreate the situation in which a particular event occurred. Specific, local cues are then used to retrieve information about details of the event from a random memory storage system which holds phenomenological records of consciously experienced events. It is significant that production of general schemas is impaired after frontal damage (Godbout and Doyon, 1994; Grafman, 1989) which would contribute to these patients' difficulties in engaging in strategic search. In the final evaluation phase, the recovered records are evaluated in terms of the original context, i.e., task demands, metaknowledge of what an appropriate outcome should be, consistency with other episodic and semantic knowledge, and so on.

In my own model, any event that is experienced consciously is automati-

cally picked up by the hippocampus and related limbic structures in the medial temporal lobe and diencephalon. The hippocampal component helps form a memory trace of that event which is stored in cortical structures that gave rise to the conscious experience. The neural substrate that made the experience conscious is as much part of the trace as the neural substrate coding other features of the event. Thus, "consciousness" is built into the trace. Memory traces are laid down randomly and, except for simultaneity or immediate temporal contiguity, they are not organized by theme or temporal order with regard to any other event. In short, the memories lack historical context. They may, however, have *associative context,* which refers to the multimodel spatial background within which the target is embedded and which comprises an event. Recovery of memory traces involves associative cue-dependent retrieval processes (ecphory) that may activate the cortical engrams directly if the memories are fully consolidated or via the hippocampus if they are new. The frontal lobes act as "working-with-memory" structures that initiate and organize strategic retrieval search when the associative cue is inadequate. The frontal lobes are also involved in monitoring, evaluating, and verifying recovered memory traces in accordance with the goals of the memory task, and in organizing memory traces into the correct *historical context,* i.e., by the theme and temporal order. The search component is likely mediated by different regions of the prefrontal cortex than the post-ecphoric monitoring and verification component. A possible candidate for the former is the lateral frontal cortex and for the latter, the ventromedial frontal cortex, with the right side playing a more prominent role in both instances.

Implications for Research on Memory Distortion in Normal People

By now it should be apparent that confabulation is similar in many ways to the type of memory distortion observed in children and in adults in the laboratory and in real life (see, in this volume, Ceci, Chapter 3; Loftus, Chapter 1; Schacter, Introduction). Evidence from both lines of research supports the view that remembering is a reconstructive process and suggests that the more heavily recollection depends on reconstruction, the greater the possibility for distortion. This view places the primary locus of memory distortion at retrieval. Rather than discuss these and other similarities, I thought it would be more informative to focus on those findings and hypotheses that research on confabulation has produced that are distinctive or at odds with those from studies of normal people.

Research on normal people (see Schacter, Introduction) has suggested that distortion is more likely to occur if a memory is weak and its source is not known. This stands to reason because the worse the memory, the

greater is the need for reconstruction in order to fill the gaps in one's memory (see Joseph, 1986). This explanation, a variant of the compensation hypothesis, may account for the type of memory distortions seen in everyday life, but it has difficulty explaining confabulations in clinical populations. Some memory loss may be a prerequisite for confabulation, as it is for any sort of memory distortion, but the upper limit for the extent and severity of memory loss as a contributing factor to confabulation is reached pretty quickly; it may not even exceed the level found in normal people. Certainly, there is no correlation between the severity of memory loss and that of confabulation. On the other hand, the evidence from confabulation identifies the ability to monitor, evaluate, and verify recovered "memories" as the critical factor that leads to gross distortions. All these are strategic memory functions that are impaired in patients with frontal-lobe damage. Likewise, loss of source, rather than being the cause of memory distortion, is itself a symptom of impaired strategic retrieval caused by frontal damage (see Schacter, 1987), though "source amnesia" may provide the occasion for yet further distortions.

Studies of confabulation also support the idea that memory traces of consciously experienced events, what Conway (1992) calls phenomenological records, are stored randomly without a temporal or thematic tag. The only relations among traces are simple contiguity and association by similarity. Temporal order and thematic organization, what I have called the historical context of memory, is conferred on recovered traces only at retrieval. If this view is correct (and I believe it is; see also Freidman, 1993), then it is easy to see why memory is so prone to distortion even if the traces themselves are intact. In a system that does not honor temporal order, the possibility of one event influencing the memory of another is very great, especially if they bear some similarity to each other. Similarly, if the assignment of events to their proper context and sequence depends on strategic retrieval, then post-event suggestions, which themselves become memory traces, can be mistaken, at yet another point in time, for true memories. In confabulating patients these distortions are frequent and exaggerated.

The question to be asked, given that the memory system is organized in this way, is why memory is as good as it is. Why don't we all confabulate? There are two answers to this question. One is that we do confabulate—all the time, but the distortions are sufficiently small so as not to matter. For most occasions our memory is good enough, though we may wish it were better. When precision of content and sequence is demanded, as it is in eyewitness testimony (see Loftus, Chapter 1 of this volume), our memory is notoriously poor and distorted.

The other answer is that what prevents gross confabulations is proper monitoring, evaluation, and verification of memory traces. These strategic retrieval operations are dependent on the prefrontal cortex. It is significant

that confabulation occurs in other disorders, such as schizophrenia, that are associated with frontal dysfunction (Weinberger, Berman, and Zec, 1986; Weinberger, Berman, and Daniel, 1991) and in children whose frontal lobes are poorly developed (Diamond, 1991; Kates and Moscovitch, 1994; Smith et al., 1992). Depleting cognitive resources in normal people by manipulating attention has been shown to affect strategic retrieval associated with frontal function (Moscovitch, 1992, 1994) and to lower frontal activation associated with memory (Shallice et al., 1994). These observations suggest that such manipulations may also play a role in altering the degree of memory distortion in normal people. In a more speculative vein, these studies suggest that variation in frontal function across time in a single individual, or across individuals, may be a contributing factor to memory distortion.

Summary

Confabulation is a joint function of the accessibility of associatively retrieved memories and of the viability of the strategic retrieval process (Moscovitch, 1989). Damage to the associative retrieval system (which includes memory storage) will produce memory loss and faulty output. Impaired strategic search processes may have a similar consequence. These alone are not sufficient to produce confabulation, though they can account for errors of omission that are the most common response of patients with confabulation. Because damage to the hippocampus and related structures is spared in many patients with confabulation, and because performance improves tremendously when associative cues are adequate, I believe that the principal source of errors of omission is poor strategic search. Confabulation arises because of deficient strategic retrieval processes at output that are involved in monitoring, evaluating, and verifying recovered memory traces, and placing them in proper historical context. The ventromedial frontal cortex and related structures in the basal forebrain, cingulum, and striatum are the structures that are most likely to mediate strategic retrieval processes and whose damage leads to confabulation. As I have argued in the previous section, even with these structures intact and functioning well, the nature of the memory system is such that some distortion is likely at retrieval. When ventromedial prefrontal structures are damaged or dysfunctional, the likelihood is greatly increased that gross memory distortions typical of confabulation will occur.

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