Confabulation and the Control of Recollection

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It is argued that current models of memory do not adequately account for the confabulations that are found in the recall of certain neurological patients. A model of the relation between control processes and memory involved in recalling autobiographical episodes is put forward. It is based on detailed analysis of the protocols of healthy volunteers’ autobiographical recollections of recent everyday events. It is held that damage to different components of the model fits with the different patterns of performance found in confabulators, and examples of the errors that confabulators make are discussed in terms of those made by normal subjects.

INTRODUCTION

The last 20 years of research into the neuropsychology of memory has revealed a variety of surprising phenomena. Episodic retrieval can be grossly impaired when performance on tasks involving completion/cuing (Graf, Squire, & Mandler, 1984; Warrington & Weiskrantz, 1970), procedural learning (Brooks & Baddeley, 1976; Cohen & Squire, 1980), or semantic memory is spared. Moreover this third contrast can apply to both the retrograde and anterograde aspects of the amnesia (Warrington & McCarthy, 1988). Such phenomena have stimulated a large amount of research on normal subjects and have been incorporated in various ways into normal memory theory (e.g. for the completion/cueing effects see Roediger, 1990; Tulving & Schacter, 1990).

Discussion of confabulation remains however relatively isolated from theorising about normal memory. This disorder is seen together with classic amnesic phenomena rather infrequently in Korsakoff patients (e.g. Dalla Barba, Cipolotti, & Denes, 1990; Mercer, Wapner, Gardner, & Benson, 1977; Talland, 1965), but also relatively independently of more classic amnesic phenomena in some patients suffering from ruptured aneurysms of the anterior communicating...
artery (ACoAA), subarachnoid haemorrhage, or encephalitis (e.g. Burgess & Wood, 1990; Damasio et al., 1985; Delbecq-Derouesné, Beauvois, & Shallice, 1990; Kapur & Coughlan, 1980; Logue et al., 1968; Luria, 1976; Moscovitch, 1989; Stuss, Alexander, Liebermann, & Levine, 1978) and also in head injury (Baddeley & Wilson, 1986; Burgess, Baxter, Rose, & Alderman, in press).

Not all commentators see the varying manifestations of confabulation as equivalent. For instance a distinction has been drawn by Berlyne (1972) between “‘momentary’” and “‘fantastic’” confabulations. Momentary confabulation consists of real memories which are not in their proper temporal context, whereas fantastic confabulations are often markedly bizarre and bear little, if any, relation to real events (but see Kopelman, 1987, for criticisms). In this paper we will be concerned primarily with developing a theory to explain the less fantastic type of confabulations; those that are apparently sensible but untrue. They can occur frequently in patients who do not produce fantastic confabulations (e.g. the patients described by Dalla Barba, in press; Dalla Barba et al., 1990; Delbecq-Derouesné et al., 1990). We will consider the possibility that they correspond to the memory lapses shown in normal subjects, although occurring far more frequently due to a lack of supervisory control. The correspondence would then be analogous in the domain of memory to others in the domains of actions and thought where frontal lobe patients manifest normal behaviour in an extreme form. In the domain of action the disorder known as “‘utilisation behaviour’” (the tendency to make characteristic but unrequired actions with objects in the local environment) is shown in certain patients with frontal lobe lesions (Lhermitte, 1983; Shallice, Burgess, Schon, & Baxter, 1989); it has been held to correspond to the capture error type of action lapse shown in normal subjects (Norman, 1981; Reason, 1979; see Shallice, 1988, and Della Malva, Stuss, D’Alton, & Willmer, 1993, for a related example). In the domain of thought, “‘stuck-in-set perseveration’” shown by frontal lobe patients (Milner, 1963; Sandson & Albert, 1984) corresponds to the functional fixedness exhibited in normal subjects (Duncker, 1945; Luchins, 1942). In both cases the frontal lobe lesion is held to accentuate a normal tendency, such as behaviour being controlled by an inappropriate set, and this is held to be due to damage to high-level supervisory processes (see Shallice, 1988, Chapter 14 for discussion).

Characteristics of Confabulation

In his extensive account of confabulations in Korsakoff patients, Talland (1965) provided a summary of their clinical characteristics, which has also been held to apply to the confabulation shown by certain patients having lesions to the frontal lobe and related structures (e.g. ACoAA and head injury patients; Moscovitch 1989). Moscovitch (1989) adds three further characteristics to Talland’s list, one taken from Talland himself, and one from a study by McGlynn and Schacter (1989). The nine characteristics are listed in Table 1.
Characteristic (a) is of doubtful validity. Thus patient LE reported by Shallice et al. (1989) suggested that Harold Wilson, a former Prime Minister, was one of the examiner’s friends, and the confabulations of patient RJ (Baddeley & Wilson, 1986) included details about his mother in which he played no direct part. Moreover, in experimental settings (e.g. Kopelman, 1987; Wyke & Warrington, 1960) patients also confabulate on tasks that do not require the giving of “an account . . . concerning the patient”. Rather, the spirit of Talland’s characteristic (a) is that confabulation is often most noticeable when a patient is asked to recount autobiographical experiences (see Talland, 1965, pp.41–42). This suggests the reformulation that the processes damaged in confabulators are most taxed when autobiographical recollection is required {characteristic (a₁)} (see also Dalla Barba, in press).

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Reformulation</th>
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<tr>
<td>a. Typically, but not exclusively, an account, more or less coherent and internally consistent, concerning the patient.</td>
<td>a₁. Most apparent when autobiographical recollection required.</td>
</tr>
<tr>
<td>b. The account is false in the context named and often false in details within its own context.</td>
<td>As original.</td>
</tr>
<tr>
<td>c. Its content is drawn fully or principally from the patient’s recollection of their own experiences, including their thoughts in the past.</td>
<td>c₁. Not true of all confabulations. c₂. Some aspects are derived from semantic memory.</td>
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<tr>
<td>d. It reconstructs this content, modifies and recombines its elements, employing the mechanism of normal remembering.</td>
<td>d₁. Confabulations are not intentionally produced—redundant in context of (i). d₂. Produced by impaired memory processes and not compensatory procedures.</td>
</tr>
<tr>
<td>e. It is presented without awareness of its distortions or its inappropriateness.</td>
<td>Redundant in context of (i).</td>
</tr>
<tr>
<td>f. It serves no other purpose, is motivated in no other way than factual information based on genuine data.</td>
<td>Evaluation impossible until further evidence available.</td>
</tr>
<tr>
<td>g. The readiness to do so may be determined by the patient’s personality structure, their traits involved in dealing with the environment, and in monitoring the self-image.</td>
<td>Evaluation impossible until further evidence available.</td>
</tr>
<tr>
<td>h. Such patients at times act on their confabulations.</td>
<td>As original.</td>
</tr>
<tr>
<td>i. Such patients suffer from an anosognosia; an unawareness of their memory deficit.</td>
<td>As original.</td>
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Characteristic (b) is axiomatic to confabulation, and is in any case generally accepted. As far as the content of the confabulations is concerned, accounts of certain confabulations fit with (c), as will be discussed later. However it would be more appropriate to treat (c) as true of some but not all confabulations {characteristic (c\textsubscript{1})}. Other confabulations appear to be derived from inappropriate retrieval from semantic memory rather than misdirected episodic retrieval {characteristic (c\textsubscript{2})}. Thus in his confabulations during recall of short stories, patient RW (Delbecq-Derouesné et al., 1990) produced a number of types of incorrect response significantly more often than normal controls. These included seemingly appropriate but actually incorrect responses derived from the material in previously presented stories (PI), and also responses based on semantic memory. Thus instead of ‘church, school, farm’ he said ‘church, school, town hall {mairie}’ a standard French expression.

Characteristic (d) might appear internally inconsistent, as remembering cannot be normal. We take it that the proposal is that the confabulations are not intentionally produced—and are produced by the mechanisms involved in normal recall (albeit damaged) and not by some compensatory procedure essentially unrelated to the normal retrieval process, as has been suggested for the apparently analogous phenomenon of neologisms in speech production (Butterworth, 1979) {characteristic (d\textsubscript{2})}. Characteristic (d\textsubscript{2}) is agreed by all commentators on the syndrome. However, it is at present an assumption rather than a finding and we will take it as a premise. Characteristic (e) like (d\textsubscript{1}) is well supported; indeed it is necessitated by characteristic (i), that such patients appear to be unaware of their deficit or at best grossly underestimate its severity (see McGlynn & Schacter, 1989). There is as yet little evidence relating to the other characteristics (f) and (g) described by Talland. We will therefore take the characteristics that should direct initial theorising to be: (a\textsubscript{1}), (b), (c\textsubscript{1}), (c\textsubscript{2}), (d\textsubscript{2}), (h), and the ‘‘awareness’’ cluster of (d\textsubscript{1}), (e), and (i) from which (d\textsubscript{1}) and (e) will be dropped as redundant.

What is Impaired in Confabulation?

There are a variety of theories regarding the mechanisms that are impaired in confabulation. As pointed out by Stuss et al. (1978), most are unsatisfactory in providing a comprehensive explanation of the phenomenon, although some do well in explaining certain aspects. Stuss et al. (1978) also summarise the arguments against the older positions. Thus confabulation cannot only be a consequence of memory loss (as proposed by Barbizet, 1970), because many dense amnesics do not confabulate. Nor does it seem to be a consequence of increased suggestibility (one mechanism proposed by Berlyne, 1972), because experimental investigation has shown this not to be a factor (Mercer et al., 1977). Vanderhorst (see Berlyne, 1972) suggested that confabulation was a consequence of a disorder of chronology, but many amnesic patients have
disordered chronology and yet do not confabulate (Stuss et al., 1978). Other theories have emphasised the role of psychological defence mechanisms and/or personality changes as pathognomic of confabulation. However, this again has not been supported by clinical investigation (Talland, 1965).

A frequently offered account of confabulation is to emphasise the role of “frontal lobe dysfunction” in addition to a memory disorder (e.g. Kapur & Coughlan, 1980; Stuss et al., 1978). Kapur and Coughlan suggest that the differing forms of confabulation can be explained by the degree of frontal lobe dysfunction (see also Kopelman, 1987). This is akin to the view taken by Baddeley and Wilson (1986, 1988) who suggest that confabulation is a consequence of a general “dysexecutive syndrome” overlaid on an amnesic disorder of the classical type, the severity of the confabulation probably representing the severity of the dysexecutive disorder (for discussion of this view, see Burgess & Shallice, 1994). Moscovitch (1989) articulates a position of the sort in more detail. He distinguishes between two types or components of retrieval—strategic/organisational and associative. The strategic process is held to be largely self-initiated and goal-oriented, and to be concerned with reinstating the temporal and spatial context of the target. This process is likened to problem-solving, where relevant knowledge is recruited to analyse the nature of a problem, then once the way in which the problem is to be solved is found, lower-level routines are employed. Moscovitch argues that the associative retrieval process is analogous to the lower-level routines, and explains confabulation as a deficit in the strategic retrieval process. Thus, according to Moscovitch (1989, p.155), the confabulating patient “haphazardly combines information from disparate events, jumbles their sequence, and essentially accepts as veridical whatever the ephemoric process delivers to consciousness”. In the case of fantastic confabulations, the output reflects “recent thoughts, perceptions or fantasies, rather than relevant past experiences”. Moscovitch bases his contentions on examination of those confabulators who show poor performance on free recall tasks and yet are unimpaired on tests involving recognition, arguing that free recall tasks might be expected to tap strategic retrieval processes.

The “frontal dysfunction” (or “dysexecutive”) accounts of confabulation are however compromised by the performance of certain patients who show little or no deficit on executive tasks (e.g. Dalla Barba et al., 1990; Delbecq-Derouesné et al., 1990; see also Della Sala, Laiacca, Spinnler, & Trivelli, 1993) and Moscovitch’s more sophisticated account also has problems because of its reliance on evidence from the memory test performance of a particular subgroup of confabulators. Thus although certain confabulators show preserved recognition and impaired recall (e.g. Kapur & Coughlan, 1980; Moscovitch, 1989), others show the converse pattern (e.g. Delbecq-Derouesné et al., 1990; Stuss et al., 1978, case 4).

The present study does not, however, present a position directly opposed to these views. Instead, a related position will be developed in detail without resort
to evidence on the patterns of performance on tasks which are not typical of all confabulators, and which may be unrelated to the domain in which confabulators show their primary deficit, i.e. autobiographical recollection (characteristic \(a_1\)).

**Confabulation from the Perspective of Normal Memory Theory**

A few attempts have been made to consider “frontal amnesia”, including confabulation, from the perspective of normal memory theory (Dalla Barba, in press; Delbecq-Derouesné et al., 1990; Conway, 1990; Johnson, Hashtroudi, & Lindsay, 1993; Moscovitch, 1989; Schacter & Tulving, 1982; Shallice, 1988). In nearly all those attempts, confabulation has been considered a phenomenon of retrieval rather than of encoding or storage (Delbecq-Derouesné et al., 1990; Moscovitch, 1989; Williams & Rupp, 1938; but see Schacter, 1987). Thus the content of confabulations often concern the period before the patient became ill (e.g. Moscovitch, 1989). In addition, in direct tests of encoding and retrieval variables carried out on patient RW (Delbecq-Derouesné et al., 1990) it was the retrieval variables that were relevant. Thus presenting short story information to RW in brief chunks led to better overall recall (as with normal subjects) but did not alter the tendency to confabulate in later recall. However making detailed probes of information *at retrieval* led to a large increase in confabulation rate.

Johnson (1991) argues that confabulators provide critical information regarding “reality monitoring” (i.e. deciding whether a memory is a trace of something that actually happened to you, or is a memory of an imagined event), by suggesting two kinds of judgment processes in making an attribution about the origin of a memory. The first is based on a nondeliberative evaluation of the characteristics of activated information (e.g. the type and amount of perceptual detail); the second is based on a more deliberate evaluation of the meaningful content of activated information in the light of other memories and knowledge. Both evaluative processes necessarily occur either post-recall or as part of the retrieval process itself.

It therefore seems appropriate to consider confabulation from within the perspective of theories of the normal retrieval process. Within cognitive psychology there are at present two major approaches to the study of memory. The more traditional approach uses standard human experimental psychology procedures, and theories are generally of an information-processing type, articulated in verbal or flow diagram form (e.g. Tulving, 1983; Tulving & Schacter, 1990) or mathematically (e.g. Raaijmakers & Shiffrin, 1981). They often contain a subdivision of memory into different types (e.g. episodic, semantic, procedural; e.g. Cohen & Squire, 1980; Tulving, 1983). The alternative approach has been concerned primarily with autobiographical memory, the domain where confabulations are most often seen (characteristic \(a_1\)). It places heavy reliance on verbal protocols of retrieval of prior
experiences. Theoretically it has been much influenced by artificial intelligence work such as that of Schank (1982) and Kolodner (1983). In the present paper the two approaches are treated as complementary and not as exclusive.

When a patient confabulates, retrieval has generally been initiated by some task that the clinician poses to the patient. From the perspective of traditional memory theory based on orthodox human experimental psychology procedures, what are seen as critical are the core retrieval processes. Any other processes involved in the carrying out of the specific task demands tend to be treated as secondary. For instance, in the theory of this type that relates in most detail to the neuropsychological evidence—that of Tulving (1983)—the core retrieval processes are those involved in producing memories. However, in addition other processes are needed. Retrieval requires that the subject be in a "retrieval mode", and retrieval does not just result in reproduction of part or all of a pre-existing trace; instead what is produced is "ecphoric information" a combination of information from the retrieval cue and the trace. Moreover, for ecphoric information to be reported a "conversion" process is required. However these two processes, which describe the way in which the core of the retrieval process, "encoding specificity", relates to the task demands, are not directly addressed other than by being labelled. Thus for practical purposes the core of the retrieval process operates in relative independence of its outer setting, which is treated as secondary. An alternative approach—that of Raaijmakers and Shiffrin (1981)—is to assume that in a given task the subject begins with a retrieval plan that produces probe cues which are used to search memory. However, in their approach a specific retrieval plan has to be assumed for each experimental paradigm, so again it is only the inner aspects of the model that are generalisable.

**Autobiographical Recollection as a Complex Retrieval Problem**

Are there any problems if the basic starting point for the memory process is characterised as a "retrieval cue"? Consider the simple experimental situation where a list of words is first presented, followed by a retrieval task in which one of the words is presented again. The word is clearly a retrieval cue. The task might however require the subject to say whether the word was in the list (recognition), to give words that were in the list (part-list cueing), the next word in the list (serial recall), or even to say which list contains the word given that more than one list has been presented. We will refer to the processes involved in using a retrieval cue in a specific task situation as retrieval task processing. If one considers the whole complex of traces that the experience of the experiment has produced, the retrieval task processing needs to specify which parts of the total complex that is related to the retrieval cue should be accessed. It needs to specify a relation between the retrieval cue and the target region of the trace-
complex. Memory task processing cannot be realised conceptually as just another retrieval cue. Nor does it correspond to "context cues" which are just associations between the context and item information as in Raaijmakers and Shiffrin's theory.

In a typical memory experiment the complexity of retrieval task processing is not apparent. Stimulus items are conveniently discrete (e.g. words, lists). They typically have no overall structure other than being simple lists, and they have only one or two relevant dimensions (e.g. sound, meaning). Moreover the relation between retrieval cue and the target region of the trace-complex required is fairly simple. For any natural series of events lasting the same order of time as an experimental list presentation, the retrieval situation will tend to be considerably more complex. Consider the situation of a colleague coming into one's office for a conversation. There are a very large number of questions that, sometime afterwards, you might potentially be asked or might ask yourself about what occurred. The query might refer temporally and spatially to anything from a small part to the whole of the conversation, to one domain of processing—cognitive, conative, affective, or perceptual (or to some combination of them)—might be highly specific or rather general, and potentially relate aspects of the event to those of many others. In such a situation, arriving at appropriate retrieval cues must be a very complex process and one not addressed in depth by traditional memory theory.

Prima facie, the theorists of the autobiographical memory school seem more likely candidates to use to explain confabulation. A central preoccupation for theorists of this school has been a stress on the complexity of the problems that need to be overcome in many memory situations for adequate retrieval to occur (e.g. Barsalou, 1988; Johnson, Foley, Suengas, & Raye, 1988; Kolodner, 1985; Neisser, 1981; Reiser, Black, & Kalamardides, 1987). One widely held position of the school was that the activities carried out were the indices by which memories were accessed (e.g. Kolodner, 1985; Reiser, Black, & Abelson, 1985). However, Barsalou (1988) has shown that retrieval cued by either information about the other people involved in an event, or the location, or even the period of time can be as effective as retrieval by activity (see also Conway & Bekerian, 1987). He therefore argues for a memory as being represented by exemplars in a number of different ontological domains—objects, people, actions, locations, periods of time, thoughts, and so on—with each exemplar being related to the most relevant concept in the hierarchically organised knowledge of that domain. This position fits well with the neuropsychological evidence for the existence of category-specific processing systems (see McCarthy & Warrington, 1990; Shallice, 1988, for review). Indeed Schacter (1989) has argued for the domain-specific organisation of the memory trace on neuropsychological grounds.

We have argued that memory task processing must encompass many possible relations between a memory and the cognitive needs to which it can be put, and that memories themselves are nested structures involving a number of
processing domains. Memory retrieval is therefore likely to be a computationally complex multi-stage process. Within the autobiographical memory school the principal suggestion of how it might operate is that of Norman and Bobrow (1979). They view memory retrieval as a three-stage process (see also Conway, 1992; Morton, Hammersley, & Bekerian, 1985; Williams & Hollan, 1981). In the first stage—retrieval specification—a description of the target memory is developed and verification criteria produced. The second stage involves a matching of the target description and all memory records. Finally any retrieval record that matches reasonably closely is evaluated by reference to the verification criteria set up during the retrieval-specification stage. In addition, the initial description can be modified as intermediate information becomes available during the retrieval cycle.

Norman and Bobrow’s theory has been used to explain confabulations by arguing that a disorder at the level of the retrieval-specification and/or the verification stages can account for them (Conway, 1992, Shallice, 1988; see also Baddeley & Wilson, 1988 for a related position). Excellent theoretical support for the existence of retrieval-specification and verification stages is provided by the analogy drawn by Anderson (1990) between memory retrieval and automated information retrieval in libraries. He points out that within that field, extensive theory exists on the trade-off between the depth of detail used in the specification of target information and the possibility of accessing false positive information (see also the effects of differing task demands on retrieval, e.g. Lindsay & Johnson, 1989). However, the Norman and Bobrow theory contrasts markedly with a theory such as Tulving’s, in that the evidence on which its central assumptions are based is extremely thin. For instance, although Norman and Bobrow say that the process of retrieval specification can take many forms, they conclude (1979, p.115) “Whatever the nature of the initial retrieval specification we believe that it is used to produce two types of information: a target description and verification criteria”, and no argument is presented to support their belief. Moreover the principal example they give of the forming of a description came from a protocol in Williams and Hollan’s (1981) study in which a subject is searching for a particular person’s name. It fits a retrieval cue characterisation as well as theirs. In any case neuropsychological evidence suggests that the retrieval of proper names may involve specialised processing as it is a dissociable function (see e.g. McKenna & Warrington, 1978; Semenza & Zettin, 1988; but also Shallice & Kartsounis, 1993). Examples from this domain may therefore not be typical of memory retrieval in general.

As far as verification is concerned, memory errors do occur (see Conway 1992; Neisser, 1981). Norman and Bobrow imply that they occur frequently but give only one example, that of the Williams and Hollan study which involved retrieval of childhood events. However, Linton (1986) in her study of free recall of her own memories where independent information was available on the accuracy of memories states (p.63) “... recall protocols for a just-past year were
tedious to obtain because of the richness of detail available for episodic after episode... During the first year following their occurrence virtually all events were recalled and dated with good accuracy”. The frequency of errors in naturalistic recall is far from being established. A similar conclusion could be drawn from findings of Brewer (1988) in a study where subjects had to write down what was happening whenever a randomly triggered alarm went off; they had to fill out, roughly three weeks later, the details of the event given certain cues. Incorrect details were recalled in only 3/654 events, where enough details were present to be sure that the subject had retrieved the appropriate event. Again recall appeared generally to be all-or-none. Moreover no empirical studies that examine the verification stage in detail are known to us, and where studies have examined errors in naturalistic memory they tend to use highly unfamiliar material (e.g. Bartlett, 1932).

A critical part of Norman and Bobrow’s theory, which is again only sparsely defended, is their most basic concept, that of “memory records”. They state (1979, p.115): “A defining property of a record is that at any time one has access to all of the memory record or none of it”. The idea that the engram involves a set of discrete units is a natural one given the design of most computer software, and indeed is common to many memory theories. In fact Norman and Bobrow provide no evidence that the memory trace is organised into discrete units.

At least as critical is the matter of how and when a record would be formed. It is apparent that generalisation occurs across events by so-called schematisation (Barclay, 1986) and some have argued that “summarisation” occurs after a single event (Barsalou, 1988). Such explanations however, do not say when such summarisation is formed, and on how many levels it occurs. A similar criticism can be made of the hypothetical mechanism (the encoder) that performs this function in Morton and Bekerian’s (1986) version of the Norman and Bobrow theory.

Finally, how Norman and Bobrow’s theory would deal with the phenomenon of confabulation, if it retains the notion of “record”, is unclear. They assume that a memory record is accessed in an all-or-none way. In this case, then, confabulations would seem to need to consist of complete incorrect events, which generally they do not. The Morton and Bekerian (1986) version of the theory seems little better in this respect. They suppose that memory records are discrete structures that have no direct relationship with each other (Assumption KA2, Morton & Bekerian, 1986, p.48), and that search with any one description will only lead to the retrieval of one record (Assumption KA6, p.49). It is difficult to see how, for instance, Talland’s characteristic (d), that confabulation is a misconstruction of memories, is to be explained.

In the present paper we articulate a position derived by combining aspects of the theories of Tulving and of Raaijmakers and Shiffrin with assumptions derived from Norman and Bobrow’s theory, and apply it to explain
neuropsychological phenomena, in particular the properties of confabulation. Certain of the assumptions we will make are theoretically motivated by the arguments presented in this section. The key aspects of the approach, as far as the explanation of confabulation is concerned, derive from Norman and Bobrow’s paper. However any theory derived from the ideas presented by them needs a more secure empirical basis in normal memory retrieval than they provided. In particular it needs to be shown that memory lapses are a standard part of the normal autobiographical memory retrieval process so that mechanisms that guard against them are required. This the following empirical investigation aims to provide.

Protocol Evidence

To what degree does the type of memory question that elicits confabulations in patients require memory control processes such as retrieval specification and verification in normal subjects? To what extent do errors in naturalistic recall occur? A conservative estimate can be obtained from patients’ self-report. Given the success of protocol analysis in developing a data-base for theories of the higher mental processes in general (see e.g. Ericsson & Simon, 1985; Newell & Simon, 1972) it seems appropriate to apply it to the interface between memory and thought. However where related procedures have been used by the autobiographical memory theorists, they are open to two criticisms. First the veridicality of the memory—a critical issue when considering a process like confabulation—has often not been assessed (but see Barclay & Wellman, 1986; Brewer, 1988; Linton, 1978; Russo, Johnson, & Stephens, 1989; Wagenaar, 1986). Second, the procedure generally used has been to ask subjects to write down the contents of their thoughts. Such a slow means of obtaining a record of the thought processes means that subjects must compromise between giving a brief account of any part of the thought process so as not to disrupt the overall flow, and giving an account adequate to the complexity of the part. The subtle parts of the thought process are likely to be lost.

We therefore combined two of the standard protocol procedures. We asked subjects first to produce a verbal protocol just giving brief labels for each element of their thought process. This was tape-recorded. The tape was immediately replayed to them and they were asked to provide a commentary on any label that had stood for a more elaborate thought. This method aims to combine optimum procedures for thinking-aloud and for retrospective recall (immediate cued recall) (see Ericsson & Simon, 1985). In addition, in the commentary subjects spontaneously commented on errors in the initial report giving us a lower bound for the actual number of errors in it (see Russo et al., 1989). In the analysis, the original report was divided into elements defined by seeing simple ideas expressed at most by simple main verbs in the protocol (or if less, by a phrase segmented by clear pauses from the rest of the response). Each
element of the original report was then categorised with the commentary used to facilitate categorisation. The categorisation was concerned primarily with the elements that were not memories.

As we were concerned with the types of situation in which patients typically confabulate, the subjects were asked to remember recent events that had occurred to them.

**PROCEDURE**

Each of the eight subjects (four male, four female), blind to the purpose of the experiment, was tested separately, in a quiet room on their own with the experimenter. All subjects were friends of one or other of the two authors, to allow rapid uninhibited communication. They were shown the two tape-recorders used and it was explained to them that one would run throughout the complete session, the other being used to record the initial recall string for playback. The subjects were given the following instructions, typewritten:

We are interested in the way people recall particular everyday events. We will be asking you about events that have happened to you recently. We want you to tell us as much as you can about what is passing through your mind as you are trying to remember—so you’ll be giving us a ‘‘running commentary’’ of your recall processes. Tell us what you can remember in the order that things come to mind, not necessarily in the order that they actually happened. As far as you can, say something about every distinct idea you have. However we don’t want you to sidetrack your thinking by extensive descriptions, so just give any sort of label or key-word you can for each thought. Immediately after the 1-minute attempt to recall we will go over what you said and you can expand each remark in order to describe better what you were thinking. We will not be asking you to explain why you thought what you did, but merely giving an opportunity for you to describe what you were thinking. You can think of the initial labelling as an *aide mémoire* for the later explanation. When you are later giving your explanation, only include things you are confident occurred to you during the initial presentation and do not include thoughts you believe you must have had, or might have thought but don’t actually remember. Sometimes, especially when you are trying to initially remember an event, other events will come to mind. Please mention these even though they may not be directly relevant to the question. However your main job is to try to remember the particular event asked of you.

So you have two tasks: 1. To try to remember what happened. 2. To say what goes through your mind while you are trying to remember. If by chance something happened on the occasion we ask you about which you would prefer not to discuss, please feel free not to answer. If you find difficulty in remembering please persevere and still try to carry out the task, even though it may mean that you have to think (and describe what you are thinking) for quite some time.

Subjects were also given a transcription of a protocol taken from pilot studies to demonstrate what they should be doing. The 14 questions put to the subjects
were designed to be similar to the type of questions the subjects might face in everyday life. Questions (see Appendix 1) were divided equally into two types—those where we expected the subjects to have previously described the experience, where (technically) explicit summarisation was likely to have occurred, and those where it seemed unlikely the subject would have previously thought about the experience. Subjects were told that they were permitted one minute for initial recall but that later expansion would not be restricted in time. However no effort was made to enforce the one-minute duration, as it was felt that such restrictions were not naturalistic, and might alter the structure of the recall protocols. In practice, there was considerable variation in the amount of time subjects took for initial recall (approximately 45 seconds to 3 minutes). If the subject became unsure of the original question, the question was not repeated to them, and the subject had to continue with the best information they had. Complete testing of each subject took approximately 1.5 hours. Each session was then transcribed word-for-word for analysis. This yielded 111 recall protocols, each with their consequent expansion (one question answer was lost due to technical failure).

RESULTS

The protocols produced a considerable variety of thought and memory elements. They have been used in two ways. First, it was clear from examination of the protocols that particular structures of thought and memory elements in the retrieval process tended to recur. A quantitative analysis of the protocols was carried out to assess both the generalisability of the presence of particular types of protocol elements and to obtain prototypic structures for the overall retrieval process. Second, it was apparent that examples of certain phenomena occurred which appeared highly relevant to confabulation, although they were only infrequently seen in the retrieval protocols of normal subjects. The protocols have therefore been used as a controlled data-base for the existence of such phenomena arising within the normal retrieval processes.

1. Basic Findings: Protocol Elements and Analysis

From pilot studies a method was developed for categorising memory protocols. First the protocols were divided into putative minimum elements, then each element was categorised into one of 25 different types. Both judgements were carried out independently by the two authors who had developed the set of categories in pilot studies. (The complexity of the categorisation process meant that it would have been inappropriate to use naive judges.)

As far as the process of dividing the protocols into elements was concerned, if the subject was using the labelling procedure then an element would correspond to a label. Where however the protocol contained continuous speech, an element was counted as the smallest number of clauses that both contained any
information different from that in the immediately preceding element and was separately interpretable (except in the case of elements clearly left incomplete; see Appendix 2 for an example).

The two judges’ element boundaries concurred on 2143 occasions. They both made a single boundary between an element with an agreed beginning and one with an agreed end, but placed it in a substantively different position on 30 occasions. On 232 occasions judge A made a division where judge B did not, and on 259 occasions judge B made a division where judge A did not. Overall there was 80.4% agreement between the two judges. The element-categorising process followed that of making the boundaries. For this purpose if one judge had made a boundary while the other did not, it was included. On those occasions where both judges had made a boundary but they differed in their position, one of the positions was selected at random. In either case the judges whose boundary was not accepted rated the changed elements again. Only when an agreed set of boundaries was obtained were the elements rated and then compared. An example of a categorised protocol is shown in Table 2.

The 25 categories used in the element rating procedure are shown in Appendix 2. An overall agreement rate of 76% in the assignment of categories by the two judges was obtained. The concordance between the judges is on the whole highly satisfactory, given that 25 categories were being used and that there are the following potential causes of disagreement:

i. Some dichotomies are in fact continua (e.g. that between Recall Specification \( \text{18} \) and Conscious Memory Search \( \text{4} \)) so the setting of a boundary must be to a certain extent arbitrary.

ii. Many elements have aspects that fit with more than one category. Consider the situation where the subject has just recalled a detail, but goes on to say “... but I’m just guessing, really...”. It is clear that this is notification that the subject is not confident that the detail is correct (and therefore would be classified as a “Correction Possibility” \( \text{6} \)). However it also has some of the characteristics of a “Hypothesis” \( \text{13} \) in that it may be a best estimate of what the answer might be, which may be used for further recall. Finally it may indicate that the subject has decided that the correct detail will never be recalled, and has given up trying (which would make it a “Failed Recall” \( \text{9} \)). These kinds of difficulties occur particularly often with “Explanations” \( \text{8} \) and “Problem Solving” \( \text{17} \).

iii. Even with the help of the commentaries, certain elements in the protocol are ambiguous.

Once the basic classification of each verbal protocol had been achieved, the combinations of protocol elements that commonly occurred together could be inferred from a table of the sequential dependencies between protocol elements. The aim was to determine common recall structures or typical recollection
sequences. Thus “my main course for dinner last night is very simple {7}/ because I got it approximately, um, half-past eleven {8}” would yield one example of a 7–8 combination. A memory followed by another memory would yield one example of a 14–14 combination, and so forth. As can be seen from the example given in Table 2, many recollection elements involve aspects of control that seem to lie outside the activation of the memories themselves. The following analysis aims to define the organisation of such processes involved in recollection.

The relation between the elements other than memories is clarified by any analysis of the sequential structure of the protocol elements. Table 3 gives the sequential dependencies between successive elements for the two raters. A close approximation to the frequency with which category B should directly follow category A if the relation between the two is a chance one is given by the binomial distribution \( (n, p) \) with \( n \) being the number of elements of category A overall and \( p \) being the overall probability of category B. (For calculations the normal approximation to the binomial was generally used with the critical \( z \) being 1.96.) Of the 625 cells representing all possible sequential relationships between two elements, for 26 the sequence occurred more frequently than would be expected by chance for the ratings of both judges, for 40 this was so for judge A but not judge B and 19 for judge B only. The only cells where significantly fewer observations occurred than would be expected by chance involved memories. Of the 49 cells involving memories, only one sequence—element 14 (Memory) relative to itself—occurred significantly more frequently than would

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**TABLE 2**

Example of an Analysed Protocol from Subject JS

**Q. WHEN WAS THE LAST TIME YOU WENT TO THE COAST?**

JS: “The last time I went to the coast {19}/—the last time I went to the coast would be the last time I went on holiday, I would think. {17}/ Which was last summer. {14}/ I went to the coast down to Plymouth to catch a ferr... [14; NB, incorrect] no! I didn’t go to Plymouth at all, did I? {6} Bloody hell no {6}/ I went to Dover {5}/ to Dunkirk {14; NB: incorrect} with you two bods {14}/ to Italy {14}/ so that would have been the last time {3}—I mean technically it would have been on the way back of course. {5}/ I can’t remember going to the coast since then {25}/ Um, on any trips of any variety {17}/ no rock climbing, {17}/er, I haven’t visited any relations on the coast. {17}/ Haven’t been to Blackpool. {17}/ No, I haven’t been anywhere there’s been any sea at all, {19}/ I don’t think... {6}/ Oh {6}/ well technically I suppose crossing the Forth Bridge up to Scotland at New Year... {5}/ I mean, that was a river estuary so that could technically be the coast. {24}/ But, er, other than that it was definitely last summer when I was on holiday in Italy {3}”.

Slashes are divisions made by the raters. Numbers refer to the subsequent classification of the element (see Appendix 2).

In the commentary on this answer, JS admitted that not only was his first memory of Plymouth incorrect (corrected in protocol) but his subsequent recall of Dover was also incorrect. In fact he had travelled from Ramsgate on this occasion, but Dover was his more usual route.
|   | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1 | 2  |    |    | 1  | 3  |    | 1  |    |    |    |    |    |    |    |    |    | 1  |    |    |    |    |    |    |    |
| 2 | 2  | 10 | 3  | 1  | 2  | 1  | 5  | 1  | 2  |    |    | 4  |    | 4  |    | 2  |    | 8  | 13 | 4  |    | 1  |    | 4  | 14 |
| 3 | 1  | 2  | 2  | 1  | 1  |    | 1  |    |    |    |    |    |    |    |    |    |    | 3  |    | 1  |    |    | 2  |    | 1  | 1  |
| 4 | 2  |    |    |    |    |    | 1  | 1  |    |    |    |    | 9  | 1  |    |    | 1  |    | 9  |    |    | 1  |    | 1  |    |    |
| 5 | 1  |    |    |    |    |    | 1  | 1  |    |    |    |    |    |    |    |    |    |    |    | 2  |    |    |    |    |    | 2  |
| 6 | 2  |    |    |    | 14 | 3  |    | 3  | 3  | 1  |    |    |    |    | 1  |    | 1  |    | 16 | 1  |    |    | 1  |    |    | 1  |
| 7 |    |    |    |    |    | 1  | 3  | 4  |    |    |    |    | 2  |    |    |    | 2  |    | 2  |    |    | 6  |    |    |    | 3  |
| 8 | 1  | 5  | 3  | 1  |    | 1  | 16 | 2  |    |    |    |    |    |    |    |    |    | 2  |    |    | 7  |    |    |    | 2  |
| 9 |    | 1  |    |    | 1  | 1  | 1  |    |    |    | 2  |    |    |    |    |    |    |    |    |    |    |    |    | 1  | 1  |
| 10| 1  | 2  |    |    |    | 1  |    | 1  |    | 3  |    |    |    | 2  |    |    | 2  |    |    |    | 2  |    |    | 1  | 1  |
| 11| 1  |    |    |    | 1  |    | 1  | 2  |    |    | 6  |    |    |    | 3  |    |    |    |    |    |    | 1  |    |    |    |
| 12|    |    | 1  | 5  | 1  |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 8  |    | 2  |    |    | 1  |
| 13| 2  | 1  |    | 2  | 1  |    | 1  | 3  |    |    |    |    |    |    | 1  |    |    |    |    |    |    |    |    |    |    |
| 14|    | 6  |    | 14 | 6  |    | 8  | 23 | 2  |    |    |    |    |    |    |    |    |    |    | 16 | 105 |    |    |    |    |
| 15| 1  |    |    |    | 1  | 1  |    | 1  |    | 6  |    | 1  |    | 1  | 1  |    |    |    | 18 | 11 |    | 1  |    |    | 6  |
| 16|    |    | 1  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 2  |    |
| 17|    |    | 1  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 1  |    |
| 18|    |    |    | 6  |    | 3  |    | 4  | 2  |    | 1  |    | 2  |    |    |    | 3  |    | 31 | 4  |    |    |    | 3  |
| 19|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 20|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 21|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 22|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 23|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 24|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 25|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

*For example, the judges gave 41 examples of a 14 (row) element followed immediately by an 8 (column) element.
be expected by chance according to both judges ($z > 12, P < 0.001$ for both judges). For 23 cells, however, the sequence occurred significantly less often than would be expected by chance according to both judges, for 5 this was so for judge A but not judge B, and for 4 for judge B but not judge A.

Figure 1 is a diagrammatic representation of the findings just described. Two types of connection are represented. The solid lines join those pairs of elements where both judges had significantly more occurrences than would be expected by chance (other than $14 \rightarrow 14$) (see Table 3). So, for instance, the solid line connection from element 25 (Yet Unavailable) to 12 (Hypothesis) is derived from the finding that, in Table 3, a Yet Unavailable element was followed directly by a Hypothesis on significantly more occasions than would be expected by chance. An example of such a combination is shown in Table 4, where subject GM is answering the question “When did you last see one of your

<table>
<thead>
<tr>
<th>Element</th>
<th>Code</th>
<th>Protocol Segment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yet Unavailable</td>
<td>25D</td>
<td>“…I can’t actually think of a specific time—</td>
</tr>
<tr>
<td>Hypothesis</td>
<td>12(C)</td>
<td>I think the last person I must have seen would’ve probably been dad,</td>
</tr>
<tr>
<td>Correction Poss.</td>
<td>6(B)</td>
<td>but I could be wrong—</td>
</tr>
<tr>
<td>Correction</td>
<td>5(B)</td>
<td>no—it must’ve been mum</td>
</tr>
<tr>
<td>Memory</td>
<td>14(A)</td>
<td>at Jane’s birthday.’’</td>
</tr>
<tr>
<td>Family Imp.</td>
<td>10(B)</td>
<td>‘‘{at the}…beginning of this week</td>
</tr>
<tr>
<td>Memory</td>
<td>14(A)</td>
<td>I bought her some flowers</td>
</tr>
<tr>
<td>Verification</td>
<td>24(B)</td>
<td>I suppose that’s, that’s giving her a present</td>
</tr>
<tr>
<td>Memory</td>
<td>14(A)</td>
<td>just on the way back from work.’’</td>
</tr>
<tr>
<td>Familiarity Imp.</td>
<td>10(B)</td>
<td>‘‘But I think I have an impression</td>
</tr>
<tr>
<td>Memory (incorrect)</td>
<td>14E(A)</td>
<td>of the weather being stormy.</td>
</tr>
<tr>
<td>Correction Poss.</td>
<td>6(B)</td>
<td>But somehow that doesn’t ring true.’’</td>
</tr>
<tr>
<td>Recall Spec.</td>
<td>18(C)</td>
<td>‘‘…aah, let me think away here…um…</td>
</tr>
<tr>
<td>Success Point</td>
<td>21(B)</td>
<td>yes, I think I’ve got it.</td>
</tr>
<tr>
<td>Memory</td>
<td>14(A)</td>
<td>It Barclay’s Bank down in Poole.’’</td>
</tr>
</tbody>
</table>

*A list of the questions is given in Appendix 1.

*See Appendix 1 for a full characterisation.

*This refers to the numerical code assigned to a given protocol element, as used illustratively in Fig. 1.*
relatives you don’t live with?’’. The dotted lines represent those pairs involving an element 14 (Memory) which were not significantly less than chance on both judges ratings\(^1\). For instance, this applied to element 5 (Correction) preceding element 14. In addition all elements directly linked to the act of producing a protocol rather than the act of remembering have been removed. These are Answers \(\{1\}\), Comments \(\{2\}\), Conclusions \(\{3\}\), Explanations \(\{8\}\), Furtherances \(\{11\}\), and Repetitions \(\{19\}\).

It can be seen from Fig. 1 that the elements can be grouped into four main classes according to their relation to Memories \(\{14\}\):

**Group A. Memories**

**Group B.** Elements with a direct link to Memories.

**Group D.** Elements that do not have a direct link to elements in groups A and B.

**Group C.** Elements that have a link to one or more elements of group B and to two or more elements of group D.

(For two elements—Demand Setters \(\{7\}\) and Hypotheses \(\{12\}\)—other aspects of their connectionivity have led to their being placed in a different group than that obtained by strict application of the procedure given earlier.)\(^2\)

Beginning with elements furthest from Memories (element 14, group A: 14A) one can subdivide the group as follows:

**Group D.** These fall into two subgroups (i) General cognitive processes: Problem Solving \(\{17\}\), and Task Demand Analysis \(\{22\}\) and (ii) Voluntary Metamemory Processes: those that perform a function in the memory domain similar to that of the evaluation aspects of the first phase of position investigation in normal problem-solving (see De Groot, 1965) Demand Setters \(\{7\}\), Metamemory Insights \(\{15\}\), and Yet Unavailable \(\{25\}\).

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\(^1\) The difference in criteria between memory elements and other elements is made on the grounds that, as a considerable number of elements were related to memories, the more interesting finding was which control elements were “farthest away” from memories in recollection strings; this is best represented by omission of pathways only when their incidence was statistically less than chance.

\(^2\) There are two items whose grouping position is somewhat ambiguous. Hypotheses \(\{12\}\) have a direct connection with Memories \(\{14\}\) and so could qualify for group B as well as group C. It is placed in group C because the overall pattern of connections is quite different from any other group B element and is similar to Recall Specifications \(\{18\}\). Second, Demand Setters \(\{7\}\) have connections with both a group B element (Familiarity Impressions \(\{10\}\)) as well as a group C one (Hypotheses \(\{12\}\)). It is placed in group D because its pattern of connections is very different from that of the two elements in group C. For ease of communication all elements are labelled with a letter as well as a number.
FIG. 1. Diagrammatic representation of protocol element sequential dependencies.

*Group D (Mediator Processes)*: 22: Task Demand Analysis 15: Metamemory Insights 25: (as) Yet Unavailable 7: Demand Setters 17: Problem-Solving.

*Group C (Descriptions of Recall Requirements)*: 18: Recall Specifications 12: Hypotheses.

**Group C.** Descriptions of what is required in recall, which can take the form of an *Hypothesis* {12} or a *Recall Specification* {18}.

**Group B.** These are elements related to the on-line editing of memories, which includes verification, corrections, and certain aspects of controlled "scanning" of memories. These may be subdivided according to whether they basically precede or follow *Memories* {14} and whether they have a direct or an assessment function. Together they perform an on-line "editing" function: (i) **Direct Preceding:** These include *Conscious Memory Search* {4} and *Recall Specification* {18}, indicating that different levels of description of the required memory may have different distances from the eventual memory in the layering of memory control (also includes *Correction* {5}). (ii) **Direct Following:** These are elements that are part of a Verification Process; *Correction Possibility* {6}, *Familiarity Impression* {10}, and *Verification Analysis* {24}. (iii) **Assessments of the success or otherwise of stages A, B, C, or D:** *Correction Possibility* {6} *Familiarity Impression* {10}, *Statement* {20}, and *Success Point* {21}.

**Group A.** *Memories* {14}. The overall incidence of element types across all subjects' protocols is shown in Fig. 2. This demonstrates the high level of agreement between the raters, and the relative incidence of each category type: memory elements {14} were far more common in the protocols than any other kind.

![Mean](image)

**FIG. 2.** Frequency of element type across subjects' protocols.
The total number of protocol elements by subject and question is shown in Table 5. In general, slightly larger differences existed between subjects, across questions (a number of comparisons between subjects’ total number of elements produced were statistically significant) than between questions, across subjects (where no comparisons were significant), although the differences are not considered remarkable. Two further analyses of the element sequences show that the groups of elements have different characteristics. First, one can examine where in the protocols the different types of element occur. In particular each protocol was divided into three equal parts with any final one or two remainder items being ignored. Figure 3 shows the retrieval incidence of group A, B, C, and D elements in the three sections for both raters. For A, C, and D items there is a significant change in their frequency between section 1 and sections 2 and 3. For A incidence increases (1v2 Wilcoxon T=1, n=8, P<0.01; 1v3 Wilcoxon T=0, n=8, P<0.005) where the analysis is carried out over each subject using the average of the ratings of the two judges. For B and C the incidence declines (C1v2 Wilcoxon T=1, n=8, P<0.01; 1v3 T=3, n=8, P<0.05; Dlv2 T=0, n=7, P<0.01; Dlv3 T=1.5, n=8, P<0.01).

Second, inspection suggested that strings of A and B elements and of C and D elements were common. Consider sequences that contain at least three elements which belong to either category A or B, and at least three which belong to C or D, and where neither one of each pair comprises more than 75% of the overall sequence. (This restriction is made so as not to boost the incidence of strings by including sequences that are almost entirely composed of one of the two pairs of element types.) For each element one can calculate the length of the sequence in

<table>
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<tr>
<th>Q/S</th>
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<th>3</th>
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</table>
which it is placed. Then the mean length (assessed over elements) for A/B sequences is 7.56 and for C/D is 3.55 (average over judges). If each element appeared randomly in these sequences then the mean length of an A/B string would be 2.8 and of a C/D one 1.55 (calculated from the overall probabilities of the different types of element). Clearly the tendency to have sequences composed of similar types of elements is much stronger. Moreover these strings were not exclusively of one or other element. They shifted (mainly) either between A and B elements or between C and D elements. Thus the five longest A and B strings contained 8A and 5B, 12A and 2B (twice), 13A and 3B, and 15A and 6B. Moreover only one of the longest 15 sequences was composed of one element only (for judge B 1/9). For C/D ratings the longest six were 3C and 3D, 2C and 4D (twice), 1C and 5D, 5C and 3D, and 5C and 6D, and again none of the longest 11 was of one element only (for judge B also 0/11). Thus Fig. 1 should not be taken to imply that DCBA is a typical sequence of elements. The move from D to A is more gradual, and frequent strings of D/C elements and of B/A elements occur.

The observed pattern provides clear general support for the Norman and Bobrow theory. The most distant elements preceding a memory are primarily cognitive or problem-solving ones. Intermediate ones are broad memory control elements related to Norman and Bobrow’s descriptions. Closest to memories are specific memory control elements and elements related to an editing and verification process. In addition the primarily cognitive and problem-solving elements (group D) and the broad memory control elements (group C) occur

**FIG. 3.** Proportion of element types within protocol subsections.
early in the protocols with specific memory control and editing ones (group B) occurring throughout. Thus the movement from level D to level A indicated in Fig. 1 is more frequently over the whole protocol rather than as rapidly as indicated in the first example in Table 4.

Third, the relations between elements indicates a more complex layering of control. Thus Recall Specifications \{18C\}, Hypothesis \{12C\}, and Conscious Memory Search \{4B\} would all be included under Descriptions but they differ considerably in the elements by which they are preceded or followed. Thus although a Correction Possibility \{6B\} is the most common element to follow a Hypothesis \{12C\} according to one judge (and after Memories \{14A\} for the other) it virtually never follows Recall Specification \{18C\}. By contrast Recall Specifications \{18C\} are relatively frequently preceded by a Verification Analysis \{24B\} but neither a Hypothesis \{12C\} nor a Conscious Memory Search \{4B\} ever is.

In addition, although the idea of verification is generally supported, it is clear that overall assessment applies at all levels of the retrieval process running in parallel with the different types of retrieval specification.

2. Basic findings: Errors

The most basic finding concerning errors is that they are a frequent part of the retrieval process, when this is viewed on a moment-to-moment basis, given that one accepts the subject’s commentary as an accurate record. Moreover, the subjects were making (self-corrected) errors in the commentary. Assuming the commentary is accurate, then the total number of errors in the protocols plus their commentaries must be even greater. Subjects commonly make errors while in the process of recalling, but relatively few errors are normally reported because these are often subsequently corrected. In total, 41 admitted errors were made in the protocols. Some were very minor (e.g. two small pictures, instead of three), and 17 were the giving of an event that did not fit the specification of the question.

3. Qualitative Findings: Errors

Certain error types were of particular interest. These will be examined, with the number of separate protocols in which they occurred in brackets (out of 111) (where a “protocol” refers to one answer by one subject). Of course these figures are likely to be an underestimate of their real incidence, as they can only refer to instances where the subject has actually reported them, and even then only when they may be recognised for what they are.

i. (2 protocols) Incorrect insertion of information from personal semantic memory—or at least more generic memory—occurs. Thus in answer to Q3 concerning his latest visit to the coast, JS said “I went to the coast down to
Plymouth to catch a ferry... No...’’ and in the commentary said he went to Spain most summers and therefore presumed that he would have gone last summer. In fact he had gone elsewhere (see Table 2).

ii. (3 protocols) In certain protocols it is apparent that rival candidate memories are being assessed as to which is the most appropriate answer to the question, and that these can become conflated. Thus in answer to Q5, DG had four different memories of similar incidents involving reporting to the police break-ins or vandalism to her car and to a friend’s. She tried to disentangle them but they became conflated. Thus she said ‘‘which is the last visit to the Police Station which was when John’s car got broken into’’. According to her commentary, the car in question was vandalised but not broken into. It was her car that had been broken into.

iii. (3 protocols) There are memories that are in fact incomplete but are claimed to be complete. Thus IB, in answer to Q4, said that for dinner the previous night he had ‘‘soup ... er, spicy soup’’ and later ‘‘{That is} in fact all I had’’. However, later he remembered also having both pitta bread and an orange. It is noteworthy that a large percentage of errors (44%) were corrected in the protocols, often after doubt was expressed first and sometimes after more detailed cross-checking was carried out\(^3\).

iv. (5 protocols) Error correction sometimes occurs when a memory element is retrieved which conflicts with earlier ones. For instance, JS, when asked to describe the first thing that came to mind that happened to him in the month before last, recalled the following: ‘‘... Something that happened in January? Er, I comp ... completed a major sale. No! I didn’t complete a major sale in January at all. I didn’t sell anything at all in January because I remember looking at the board and that was blank {i.e. the sales figures board}’’. This process does not need to be initiated by any awareness of the possible inadequacy of the previously retrieved memory. For instance, JS recalled that the last time he had cleaned his car was at a carwash near to his place of work. He continued: ‘‘... I seem to remember it costing ridiculous amounts of money as well. Oh no, hang on a second! {NB: Correction Possibility} Maybe I might have a wa ... might have, er, might have been on Upper Brook Street, there’s a good car wash on there ... In fact it was because I was handing it over to one of the directors for a week or two so I thought I had better clean it first...’’.

4. **Qualitative Findings: Memories**

A number of aspects of the retrieval process as it relates to memories are of interest.

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\(^3\) This calculation is based on the assumption that the commentary is correct.
i. (5 protocols) Relevant aspects of an event are often produced in an unbroken stream of labels or discourse as the high rate of immediate succession of one memory by another in Table 3 indicates. However, it also frequently occurs that only part of an episode may be accessible, with other parts being recalled at a later time in the protocol. Thus IB, in answer to Q2 about when he had last cleaned his car, was able to say that it was cold, night was drawing in, and it was about 3.30 (and therefore November) but did not recall that two people were present until later. All-or-none access is not a property of many of the scenes retrieved in the study.

ii. (10 protocols) Personal semantic information is used in retrieval. Thus when asked what the weather was like yesterday morning, JS initially remembered seeing grey clouds over Salford on his way to work. However, later in the commentary he admitted that he didn’t actually remember seeing grey clouds over Salford specifically on the previous morning, but that it was a scene he had witnessed “countless times”, and was in fact just a general image he had of the town—see also finding 3(i).

iii. (4 protocols) At times a strong well-situated memory keeps recurring even when it has been explicitly rejected. Thus DG, when trying to remember when she had last been in a certain area of London, said later in the protocol “what keeps coming to mind was the Guy Fawkes night” (a night of bonfires and fireworks) which she had retrieved first and rejected. She commented “it just can’t be the last time . . . about 23 years ago”. In the commentary she said she kept remembering it because it was “memorable” with “everyone going crazy”.

iv. (12 protocols) On many occasions subjects give a list of memories associated with the question but do not directly answer the question even though they can recall the question when asked. For instance, when asked “When was the last time you had dealings with the police”, GM gave an extensive description of an argument she had had with a policeman who had pulled her over for questioning. However she did not say when this had occurred, and in the commentary, she admitted that she had not actually answered the question itself (see also Rubin & Baddeley, 1989).

v. (5 protocols) At times a memory occurs which appears to be unrelated to the question but is in fact linked to it by an inferential process. For instance, when asked what the weather was like yesterday morning, GM said that although she couldn’t immediately remember what it was like, she could remember putting her sunglasses in the car “. . . so it must have been sunny”.

vi. (9 protocols) The order in which memories are retrieved frequently differs from the temporal sequence of the actual events. For example, GM recalled the
details of a visit to the seaside before she recalled the travelling involved in getting there. In the commentary, she said that ‘‘I couldn’t do it the other way round’’. (See Conway, 1988; also Anderson & Conway, 1993 for related phenomena over a longer timescale).

vii. (9 protocols) Typically, when a subject finds an episode easy to remember, they begin their response with a general statement and then go on to describe the details. For example, subject DHB, when asked when she had last cleaned her car, responded ‘‘... I have only cleaned it once in about a year because normally some children from school come and clean it . . .’’ and then went on to describe the details of the last time it was cleaned. Similarly, later when asked to describe the last case conference she had been to, she began ‘‘um, I go to case conferences quite regularly at school . . .’’ before describing the last one in detail.

5. Additional Findings: Conscious Memory Search [B4]

i. (4 protocols) Precise specification of what is required occasionally occurs. Thus subject IB, when asked to describe a present he had recently given or received, conjured up the image of the Christmas Tree he had had in his front room, and then went on to ‘‘search’’ the image for the presents that had been placed at the foot of the tree, for one that fitted the recall criteria.

ii. (7 protocols) Restricting the area of memory search occurs frequently. For instance, when asked for the last time he had cleaned his car, IB based his memory search on the personal semantic knowledge that he generally only cleans his car when he is at a particular location. He then went on to search recent memories associated with that location in order to recall instances of car-cleaning.

6. Qualitative Findings: Verification

Verification can take various forms:

i. (15 protocols) Assessing whether the solution fits the question requirements. For instance, when asked for his last dealings with the police, NA recalled first an episode when he had been waved over to the side of the road by the police who were conducting a roadside poll. However he went on to say that: ‘‘there was no specific interaction between me and the police and I don’t know whether you would include that’’. He then went on to recall another incident in which he had actually talked to a policeman.

ii. (6 protocols) Considering whether a putative solution is better than one previously obtained. In describing the last meeting etc. that he had been to, NA
immediately recalled two events, one the day before, and one that morning. He went on to say ‘‘I’m not sure whether that {i.e. the second event} falls in your criteria . . .’’.

iii. (2 protocols) Checking to see whether an additional element retrieved fits with previous elements. Thus in trying to describe what the weather was like yesterday morning NA said: ‘‘. . . I think I have an impression of the weather being stormy. But somehow that doesn’t ring true. What I do remember is driving to Aylesbury yesterday and driving back, and on both occasions the windows of the car were down because it was hot and sunny. So why I think it was stormy in the morning I don’t know. I think that it’s probably because I have a better recollection of the weather being stormy the day before when it definitely was stormy’’.

iv. (3 protocols) Reaccessing a candidate solution to check explicitly if more information is available which fits with other elements of the memory. Subject DG, for instance, when trying to remember the last time she had had dealings with the police, remembered being in the local police station reporting an incident where someone had broken one of her car windows. However she also remembered being in the same police station on another occasion when her partner’s car had been vandalised. In trying to decide which was the more recent of the two, she activated the memories she had in turn, in order to try to discover a key piece of evidence that would help her. This key evidence was which part of the car was damaged. In the commentary, she reported:

... I had an image of standing in Kilburn police station, um ... and I went there two, two periods quite close together, once to report the broken window in—the second broken window in my car and once either before it or after it to report that John’s aerial had been damaged and the car had been scratched and at the time that, that I had that image, um, I, I, initially remembered it as being going down for John’s car and then I was trying to think was that the case or was it when I went down for my car?

v. (3 protocols) Checking if there are any other memories that might compete as a candidate, e.g. (KN) ‘‘. . . I’m just checking back to see if there are any other dealings with police . . . er . . . um . . . no that’s probably it’’.

DISCUSSION AND THEORETICAL ASSUMPTIONS

The analysis of the memory protocols supports a number of initial conclusions. Errors are a frequent part of the normal retrieval process when it is viewed on a microscopic level. Linton’s (1986) account of the accuracy of long-term memory for key events does not correspond to the moment-to-moment retrieval of the humdrum happenings of daily life. Moreover errors take a number of
different forms. The analysis of the protocols in this study suggests that it is possible to identify a variety of different types of elements in the retrieval of a memory episode. Moreover the broad structure of the prototypical retrieval process corresponds to Norman and Bobrow’s (1979) account, with description and verification stages indeed being parts of the retrieval process. However the analysis of the sequential dependencies between successive elements (i.e. which element tends to follow which) indicates that the organisation of the episodic retrieval process is that of layers of control lying between general problem-solving and specific memory retrieval, with assessment running in parallel with the different stages of the process (see also Johnson et al., 1993). This study therefore broadly supports Williams and Hollan’s (1981) view of remembering as a problem-solving process, where cycles of retrieval stages are used iteratively to reconstruct a memory. However the result here suggests that the recollection process is more adaptive than suggested by Williams and Hollan, and that many different possible processing cycles may exist.

Overall Structure of the Model

In order to discuss confabulations we need a more adequately articulated account of the retrieval process. We therefore put forward a set of theoretical assumptions, based on the model illustrated in Fig. 4. They are motivated primarily by the need to account for the characteristics of the different layers of control shown in the analysis of the retrieval protocols, and by the considerations raised in the Introduction. The main such consideration is that a subject’s behaviour is held to be determined, implicitly and explicitly, by a Task. In a typical memory experiment this will be a particular type of retrieval task (free recall, serial recall etc), but in naturalistic situations it will frequently be a task that does not involve memory, as in Schank’s (1982) ‘‘reminding’’ scenarios (see also Ross 1984)4. In addition the storage systems involved are assumed to be the same as those used in semantic memory. It is held that the distinction between episodic and semantic memory, which is well motivated neuropsychologically (see e.g. Warrington & McCarthy, 1988) does not lie in their utilising different stores but in the form of the trace, the nature of the retrieval process (e.g. Mandler, 1980), and possibly in the indexing procedure used (see Schank, 1982).

Four types of process are held to be involved in episodic memory retrieval. They operate on the system in which the relevant memory traces are stored, which to be theoretically neutral, we will call the Long-Term (LT) Storage System.

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4 Comprehension of the retrieval task obviously requires activation of representations at the semantic level in the long-term stores. It is proposed that the ‘‘Input Template’’ is an instantiation of generic memory (or memories) combined with the semantic activation. In this sense it is a ‘‘template’’ for the following recollection, and is rather more than just a retrieval cue (which may be event-independent).
All but the first are memory control processes and are assumed to be part of the Supervisory System. This has methodological consequences. It will be assumed that information transmitted between the Supervisory System and the systems on which it acts corresponds to the content of awareness (see Shallice, 1988, 1991 for a defence of this position). Such information should therefore correspond to elements of the protocol, but any process operating within the LT storage system would not be consciously accessible (for related views see...

1. **Input Template.** An “Input Template” for recollection is actually the pared-down representation of a particular pattern of activation within the Long-Term (LT) store, but is shown as a separate module in Fig. 4 for ease of understanding. It is wholly, or more usually part of, a “generic memory”, i.e. an amalgam of representations of similar events. For example, often Londoners can conjure up an image of Trafalgar Square in their mind. This image is an amalgam of many occasions when they have been there, or seen pictures of the square on postcards, films etc. This type of representation is distinguished from purely semantic ones by the fact that it is, at some level, a representation of events. In this context, purely semantic representations are seen as event-independent knowledge.

   Thus “Input Templates” are templates in the sense that they are “starting value” for recall. Implicit in the model is the notion that details in autobiographical events become more “semantic” (i.e. less tied to any one event) with repetition. So the person who has only visited Trafalgar Square once in their life will have a memory of the square that is tightly bound up with the details specific to that event. The person who is a regular visitor will have representations (a “template”) of the square that are independent of any one event, but may be common to many. We propose, then, that when our subjects were asked when they were last in Trafalgar Square, the initial step of recollection was the activation of this template, followed by the processes of narrowing down and respecification which are the domain of the modulatory (descriptor, editor, mediator) system. This contention is given broad support by findings 3(i), 3(ii), 3(iii), 3(iv) and 4(ii), which provide evidence of the influence of personal semantic/generic memories on recall of specific episodes. Further evidence is provided by the analysis of the order of stages A–D in the protocols, where elements least related to memories of specific events tend to come first (see findings 1). The Input Template processes are assumed to be part of “routine” cognitive systems.\(^5\)

2. **Descriptor Processes.**\(^6\) The function of these is to produce a specification of the type of trace that would satisfy the demands of the retrieval task. As discussed in the Introduction, the retrieval task can be specified in ways that do

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\(^5\) In the sense of those not part of the Supervisory Systems.

\(^6\) This position differs from that of Norman and Bobrow in that retrieval is not determined solely by the Description system and other controlling inputs (e.g. motivational ones). Transiently active inputs from the Input Templates are also present. Hence memory protocols can illustrate a failure to follow what would be the most appropriate development from a problem-solving perspective—see findings 4(iii) and (iv).
not have direct correspondences in the organisation of the memory trace. Thus processes must exist to translate the cognitive requirements of the retrieval task into a form that can satisfactorily address the LT storage systems. The resulting Descriptors will in part specify particular Input Templates. However more critically they code the relation between these contents and the type of trace required. They are equivalent in the domain of episodic memory to the determining tendencies (Ach, 1905; see also the Aufgabe of Selz, 1913) that operate in the domain of thought. It is presupposed that in retrieval, multiple levels of Descriptors can activate to different extents regions nested within the LT Storage systems. The main types of phenomenological correspondence seen in the protocols would be the Recall Specification {18C} and Hypotheses {12B} elements.

In the protocols there are two different types of element that relate to editing and verification: Correction Possibility {B6} and Verification Analysis {C24}. These, we argue, relate to two types of process. The first is:

3. Memory Editor Processes. These are assumed to be continuously involved in checking that the outputs of the LT storage systems fit with previously retrieved memory elements in the episode being retrieved and also with the overall task requirements. We assume that the setting up of a Description triggers an Editor process which checks that the memory element(s) retrieved do not contradict other elements of the event previously retrieved, and that they are compatible with the overall Descriptor requirements. Using the framework of the Norman–Shallice model of action and thought control, awareness is held to relate to the transmission of information between the Supervisory System (SS) and the structures it supervises (see Shallice, 1988, 1991). Thus the operation of the descriptor and mediator processes, and especially the way an episodic memory output is checked by the Editor processes (SS), would result in its being experienced as a particular form of awareness, which would correspond to the autonoetic consciousness of Tulving (1989). Mismatches would correspond phenomenologically to Correction Possibilities {6B} and the types of example given in findings 3(iv), 6(i), and 6(ii). As indicated by finding 3(iv) the detection of a contradiction can be automatic if a Description has been set up. If a possible contradiction is detected, then the Editor will initiate cognitive operations concerning whether the current output option (a) fits the relevant specification, and (b) fits the overall task requirements. Reconciliation of the impasse created by detection of an incompatibility proceeds through the action of the mediator processes outlined next.

4. Mediator Processes. These processes control cognitive (strategic and problem-solving) operations concerning the adequacy or plausibility of retrieved memory elements, following their initiation by the Editor. They differ from
Editor processes in being under strategic control, and in not being dedicated solely to the mnestic domain. The mediator processes are a complex set of problem-solving routines involving frank reasoning about the plausibility or probability of a particular conjunction of memories, or whether the recollection process is following a course that is likely to lead to a conclusion which fits the initial specification (they “mediate” between conflicting representations). Phenomenologically, we have all experienced the type of situation where, for instance, we recall that a certain person was with us on some particular occasion (e.g. a party), only to subsequently realise that this cannot have been the case; this realisation often follows from the recall of other details which make the first “memory” implausible (e.g. we’ve remembered that the person was abroad at the time of the party). What follows this realisation is a deliberate problem-solving routine followed by memory respecification (i.e. re-inputting of new Descriptions, activating new Input Templates) to resolve the contradictions. In the protocols, these processes are evidenced by elements Problem-Solving \{17 type D\}, Verification Analysis \{24B\}, often leading to a Hypothesis \{element 12C\} which is input to see if it aids recollection of details that will resolve the impasse.

In addition, before memory retrieval, related processes are required to determine the tightness of the required specification for the retrieval task(s) and to specify descriptions for the overall cognitive task—a process analogous to that termed the *evaluative moment* by De Groot (1965, p.192) in normal problem-solving; these corresponded to *Metamemory Insight* \{element 15, Appendix 2\} and *Demand Setters* \{D7\} elements.

5. The LT Storage Systems. The assumption made in the previous section—that awareness corresponds to transmission between supervisory and non-supervisory processes—means that the protocols can provide no direct evidence on the nature of the retrieval processes within the LT storage systems. The limited indirect evidence that is available is not easily compatible with discrete records—see findings 3(ii), 3(iii), 4(i)—so where necessary an associative net type of approach (e.g. Raaijmakers & Shiffrin, 1981) will be adopted. The contents of episodic memory, involving as they do a large variety of types of sensory and conceptual content (e.g. Barsalou, 1988; Conway, 1990), presumably involve traces of the results of processing in a wide variety of separable cortical systems (e.g. Damasio & Damasio, 1989; Schacter, 1989). Memory is thus held to involve a set of domains, each of which is realised by a system containing representations of a particular type. Co-occurrence of activated elements in different domains leads to the formation of associative links between the representations. These can be strong, if the co-occurrence occurs frequently as in semantic memory operations. In episodic memory functions we assume the associations to be individually weak but numerous and potentially mutually reinforcing if multiple concurrently activated representa-
tions are reactivated.\textsuperscript{7} The representation of a typical event will, as Neisser (1986) has pointed out, form a complex nested structure. It will contain many links of differing strengths between different types of element. The production of an element in the retrieval process corresponds to its being activated above threshold within the LT Storage Systems. The element can then be output direct, but is also, we assume, automatically operated on by the Editor process. The overall consequence of these assumptions is that retrieval of a small part of an event would require the reinstituting of some of the co-occurring elements (as in encoding specificity) together with the appropriate description. Retrieval of different parts of the event will proceed by the recovery of a series of the substructures, the order of retrieval being dependent on the relative strength of connections and the specific descriptions generated. As Moscovitch has pointed out, the order would not be identical to that occurring in the event itself—finding 4(vi). Thus one can have the temporal gaps observed between retrieval of different parts of an overall event—finding 4(i).

6. Schematisation: An Assumption Relevant to Particular Aspects of Confabulation. Retrieval of a subset of the elements of the complex structure that represents a complete event corresponds to “summarisation” of the memory trace. On a traditional account the reactivation of some of the elements in a memory representation will strengthen the links between those elements at the expense of other links which are not reactivated. Retrieval will therefore produce the summarisation described in normal recall (Barsalou, 1988; Kahneman & Miller, 1986). If the process occurs sufficiently often, and in particular if it occurs for many similar events, then what the autobiographical memory theorist Barclay (1986) called schematisation will occur, namely generalisation across events. Eventually when such schematic representations are sufficiently activated they would be accessible without the need for Descriptions to be created on-line (see Mandler, 1979, for a similar perspective). They would then correspond to “generic” memories (Watkins & Kerkar, 1985) or “personal semantic memories”. Thus, when specific events are asked for, generic representations can be retrieved (Pillemer, Goldsmith, Panter, & White, 1988; Reiser et al., 1987; Watkins & Kerkar, 1985; Williams & Dritschel, 1988)—see also findings 3(i), 4(ii). These generic representations are the basis for Input Templates.

\textsuperscript{7} For speculation on how this latter process, which relates to the phenomena of encoding specificity (Tulving & Thomson, 1973) might occur see Crick (1984); Hinton and Plaut (1987); Damasio (1989). The existence of output that is easily represented as a combination of discrete entities is a natural consequence of the operation of certain types of connectionist architecture—those with attractor structures (Hinton & Anderson, 1981; see also Hinton & Shallice, 1991; Plaut & Shallice, 1993, for the direct application of the concept to empirical neuropsychological evidence). Thus the existence of reproducible units within memory output is not good evidence for the presence of discrete units corresponding to them within a storage system.
Collectively on the contention scheduling and Supervisory System framework of Norman and Shallice (1980, 1986) and Shallice and Burgess (1991a,b), the Descriptor processes, the Editor processes, and the Mediator processes are considered part of the Supervisory System, and should therefore be controlled anteriorly in the cortex. The LT storage systems are presumed to be located elsewhere in the cortex. Episodic memory processes appear anatomically to involve the interaction of posterior cortical systems and anterior cortical ones (see e.g. Hodges & McCarthy, 1993; Nichelli, Bahmanian-Behbahani, Gentilini, & Vecchi, 1988; Mair, Warrington & Weiskrantz, 1979; Rudge & Warrington, 1991; Warrington & Weiskrantz, 1982). That critical parts of the memory control system are assumed to be anterior fits with the generally agreed location of lesions that give rise to confabulatory disorders (see Burgess et al., in press, for a review), and of the activation of the right frontal lobe in episodic memory retrieval in PET studies (Shallice, Fletcher, Frith, & Grasby, 1994; Tulving et al., 1994). On the basis of these PET studies it has been hypothesised that certain of the editor processes (those related to verification) are specifically right frontal in localisation (see Shallice et al., 1994), with description processes more likely to be left frontal (see Incisa della Rocchetta & Milner, 1993), and the mediator processes would be bilateral. No doubt, however, the localisation issue will in time come to relate to how the processes interact together (see Burgess & Shallice, 1994).

**THE EXPLANATION OF CONFABULATION**

How does the theory of retrieval presented here explain confabulations? What, first, requires explanation? A large number of clinical accounts of patients who confabulate and of their confabulations exist in the neuropsychological literature. However, in most of these, quantitative results are limited to clinical psychometric tests. In addition there are a very small number of group studies where experimental manipulations have been carried out (Mercer et al., 1977; Shapiro, Alexander, Gardner, & Mercer, 1981) and an almost equally small number of single case studies where this is done (e.g. Moscovitch, 1989; Dalla Barba, in press). We will use all three types of evidence in an explanation of how the model we have just proposed might explain the characteristics of confabulation. To start with, we will make the simplifying assumption—which will be partly revised later—that the same type of process is occurring in all confabulating patients described in the literature. We will also use all three types of available evidence.

**Impaired Editor Process**

Turning to the theory, three of the hypothetical components of the model appear relevant—the Editor, Descriptor, and Mediator processes. Consider first the Editor process. Mercer et al. (1977) investigated 11 patients, 5 with Korsakoff's
Syndrome, 3 with encephalopathy, 1 with normal pressure hydrocephalus, and 2 with dementia. Four of these patients were “‘nonconfabulators’”, but had been “‘identified by the attending physicians as possible confabulators’” (Mercer et al., 1977, p.429), two showed a severe confabulatory disorder, and four showed mild confabulation. The degree of confabulation shown by the remaining patient changed during the study period.

These patients were asked a series of questions on recent and remote memory. They deliberately included questions that frequently drew an appropriate “‘I don’t know’” response from a non-neurological control group (e.g. the winner of the Superbowl last year). Mercer et al. found that their confabulators paused before responding to a question on only 10% of trials, compared with 59% for a nonconfabulating neurological group. In addition, “‘verbal checking’” (where patients voice aloud the fact that they are correcting the answer they have just given) occurred on only four occasions in the case of their severe confabulators, whereas their mild confabulators corrected themselves 21 times. Additionally, they found that nonconfabulators’ answers were more likely to be correct when they showed a significant response latency, whereas the confabulators not only showed smaller latencies, but their answers were no more accurate when they had paused before answering. Mercer et al. concluded that their findings were consistent with the hypothesis that the latency of responding represented “‘an internalisation of a self-correction process’”, and that confabulators tended not to show this self-correction. It therefore seems plausible that many confabulators have an impaired Editor process. It could be argued that decreased response latencies may reflect impulsivity of responding rather than actual inability to verify and edit memories. However, if the conflict is pointed out to confabulators this typically provides a new cue for further (erroneous) recall, rather than the changing of their original recall in the light of the new information (as a normal subject would do). (For striking examples see Barbizet, 1970, and Baddeley & Wilson, 1986.)

**Damaged Description Process**

An additional question is, however, raised by the findings of Mercer et al. Why do confabulators come up with so many erroneous memories in the first place, when there were so few errors, relatively, in the protocols of our normal subjects? On the present theory this difference cannot be explained by assuming that the normal subjects have a better internal monitoring process: We have already made the assumption that the LT store outputs of the memory systems are available to awareness and report, which means that we cannot fall back on an explanation of the difference in terms of “‘unconscious editing’”. One must therefore propose that there needs to be an additional source of error in the operation of the confabulator’s memory.
Consider the effect of the breakdown in the descriptor process, which is involved in specifying the requirements to be made by the to-be-recalled memory. If this specification is too noisy, too wide an area of the store would be activated by the memory control process and, at least as critically, inhibition of inappropriate parts of the space would be less strong. Thus, there should be a greater chance of an inappropriate representation exceeding threshold and so being produced as a candidate memory.

A number of more specific predictions can be made, which we will now outline. In each case related phenomena occur in normal subjects (see findings). For the last prediction quantitative evidence is available from the performance of confabulators. Moreover, where other forms of evidence are weak, the predictors are given general support by clinical observation.

1. Dependence on Precise Specification of Recall Requests. Considerable parts of our normal subjects’ protocols were devoted to recursive recall specification (element C18, see also element B4) and hypothesis formation. With pathological damage at this level, the patient would not be able to initiate a self-restricted memory search adequately and so would not be able to ‘‘home in’’ on a particular detail if it is not central to that event. This success of recall would depend crucially on the match between the precision of the request—because the patient’s Descriptors would at best reflect that—and the relevant representation of the event(s). If the request has been too broad then externally improving the recall specification should increase the likelihood of successful recall much more than in classical amnesic or even normal subjects, who are also affected by such variables (see e.g. Tulving & Osler, 1968). A dramatic example that fits this prediction is provided the Korsakoff patient, Helen, described by Talland (1965). Talland reports that on some 40 occasions, spanning 6 years, Helen had been asked how long she had been in hospital. She always replied that she had been admitted ‘‘yesterday’’. Talland continues (1965, p.24) ‘‘Still, if questioned how she spent her days in the hospital, she would often describe her work in the sewing room, some of which manifestly spread over several days. If asked to talk about her daily routine, without specific reference to the hospital, her answer would be drawn from an earlier setting of her life’’. (See also Damasio et al., 1985, for another example.) It is difficult to see how a Editor impairment alone would produce this phenomenon.

2. Conflation of Different Memory Experiences. Too broad a description would lead to too wide a part of the memory store being activated. Elements of various different memories are therefore liable to be retrieved together. On occasion, normal subjects also incorrectly conflate details—see finding 3(ii). However, in our protocols these conflated ‘‘memories’’ occurred only infrequently. There were not a large number that had to be edited out by a conscious verification process. However, conflated memories are often
described in confabulators (e.g. Baddeley & Wilson, 1986; Berlyne, 1972; Damasio et al., 1985; Delbecq-Derouesné et al., 1990; Kapur & Coughlan, 1980; Moscovitch, 1989; Shapiro et al., 1981; Stuss et al., 1978). In addition, Delbecq-Derouesné et al. (1990) found that in recall of one of a number of short stories their confabulatory patient made many errors which involved the replacement of a piece of information (e.g. Sunday morning) by a related piece (e.g. dusk) that occurred in another story (personal communication).

3. **Intrusions from Input Templates.** More catastrophic damage to the descriptor processes would lead to recall being stimulus-driven. Intrusions would be particularly expected to arise from representations recently activated by Input Templates. This influence can be seen at work in confabulations. For instance, patient LE previously described by our group (Shallice et al., 1989) was given the Famous Faces test (Sanders & Warrington, 1971) which contains a number of former Prime Ministers of Britain. At the end of this test LE described how he had met Harold Wilson (a former Prime Minister) the day before while walking down the High Street, and had discussed with him a building job {LE was a construction worker} on which they were working (see also examples from Brodmann, 1902, and Ross, 1890, quoted in Talland, 1968, pp.149–150). Intrusion from “primed” cues or memories unrelated to the task demands are very rare in our protocols. So an impaired editor explanation would be insufficient.

4. **Relative Sparing of Cued Recall.** In cued recall a description is explicitly provided and so under these conditions confabulatory responses would be expected to be fewer than in free recall tasks, given that the impairment is in producing an appropriate initial description. This has been shown in a group study of such patients by Shapiro et al. (1981). They showed their confabulators 20 black and white drawings, each of which contained three major components (e.g. a man in a boat with a fishing rod). After a period of distraction with an unrelated task, the patient was asked to describe the picture. If the patient could not give a complete description, they were given a “cue” of one of the items from the picture (either verbally or visually), and then a second cue if this failed to work. Shapiro et al. note (1981, p.1073) that the number of confabulatory responses “showed a marked decrease from the initial condition . . . to cue conditions”.

The account given so far is that confabulators have damage to two processes—in description formation and in editing. We will now argue that the mediator processes are damaged in many patients too. Then before considering more specific issues, we will assess whether the present account explains the clinical properties of confabulation derived from Talland (1965) and Moscovitch (1989) as discussed in the Introduction.
As already outlined, in the protocols of the normal subjects, when the memory required was not immediately available, correct autobiographical recollection required some hypothesis testing and frank reasoning (see also Baddeley, 1990; Baddeley & Wilson, 1986). For instance, where two competing memories are recalled, or where some aspect of the recall structure is incompatible with other elements or the original description, some problem-solving may have to occur in order to resolve the impasse (see element 17D, *Problem Solving*, in Fig. 1). The products of this problem-solving approach would then be used to set up new descriptors for recall.

Consider the implications for memory performance of a patient who has problems on, say, the Shallice and Evans (1978) Cognitive Estimates test. This test requires patients to produce estimated answers to a set of questions which they are unlikely to be able to answer purely from knowledge alone, but where reasonable estimates of what the answers might be can be given after some reasoning. This study used a measure of the bizarreness of response (i.e. the degree to which the answer differed from that given by normals), and demonstrated that patients with anteriorly located lesions were significantly poorer at performing this test than patients with posterior lesions (see also Kartsounis, Poynton, Bridges, & Bartlett, 1991; Smith & Milner, 1984). In the memory context such reasoning errors could lead to the acceptance of confabulations or even help to produce them.

Of course, patients with anteriorly located damage are generally considered to be the most likely to confabulate (Burgess et al., in press; McCarthy & Warrington, 1990; Shallice, 1988), and it has frequently been suggested that the presence of confabulation might be related to the degree of frontal lobe dysfunction (e.g. Berlyne, 1972; Kapur & Coughlan, 1980). Given that accurate recall under certain circumstances requires some problem-solving ability, then one would expect that a patient who has such a dysexecutive syndrome would be inaccurate (on occasion) in recall, and that this inaccuracy might be related to the severity of the deficit. Many investigators have suggested that the presence of confabulation in a patient may be related to the degree of dysexecutive-style problem-solving deficits that the patient shows, probably more so than the degree of memory dysfunction *per se* (Baddeley & Wilson, 1988; Della Sala et al., 1993; Kapur & Coughlan, 1980; McCarthy & Warrington, 1990; Mercer et al., 1977).

Although there is little definitive evidence for the case that problem-solving or “supervisory” deficits necessarily play a part in confabulation, there is some evidence that this might be the case, at least for confabulators who display “spontaneous” confabulation (Kopelman, 1987). Thus Kapur and Coughlan’s (1980) patient who, at least in the early stages of his illness, showed spontaneous confabulation, also performed below the first percentile on the Cognitive
Estimates test. Hodges and McCarthy’s (1993) patient who produced internally contradictory confabulations also performed poorly on the test, and a patient reported by Burgess and Wood (1990) who showed marked confabulation estimated that the length of the average man’s spine was 5ft 5in (1.65m). Other cases with severe confabulation are also reported who were markedly ‘‘dysexecutive’’ in their presentation (e.g. Baddeley & Wilson, 1986) whereas others, where the content of their confabulations was qualitatively less bizarre, performed better on tests considered sensitive to frontal lobe lesions (e.g. Dalla Barba et al., 1990; Delbecq-Derouesné et al., 1990; Moscovitch, 1989). Thus on this account, bizarre or ‘‘fantastic’’ confabulations should be related to the degree of damage to the mediator processes. The locus of impairment in those whose confabulations are more sensible would lie in the other memory control processes. A distinction between fantastic and non-fantastic confabulators therefore supports the distinction made between Verifier and Mediator processes.

This line of argument can be extended to explain why a confabulation might become fixed as in case 1 from Damasio et al. (1985), who believed that he was a spaceship commander or a ‘‘space pirate’’. Fixing of confabulation is also likely to be one of the mechanisms underlying the genesis of delusional paramnesias; Patient PD (Burgess et al., in press) developed a delusional misidentification around confused details he misremembered from a time early in his brain injury recovery when he was confabulatory. The obvious mechanism suggested by the present model is schematisation through which memory retrieval is held to become possible without use of a Description. When the confabulator retrieves memory elements from the long-term memory stores, it can be presumed that the relevant links will be strengthened as retrieval from episodic memory leads to stronger traces (Tulving, 1967). If these consist of a conflation of existing memories, or are inappropriately biased by Input Template activation, then reactivation of the erroneous combination can easily occur. Indeed Damasio et al. (1985, p.260) point out that the visually based descriptions their patient provided appeared to come out of Star Wars or some other film or television science-fiction programme.\(^8\)

**Talland’s Properties of Confabulations**

In the Introduction we listed a number of properties of confabulations essentially derived from Talland (1965) (see Table 1)—termed \((a_1)\), \((b)\), \((c_1)\), \((c_2)\), \((d_2)\), and \((i)\)—of which \((b)\) is basically a characterisation of what a confabulation is, and

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\(^8\) Patients whose confabulations are fixed in one period of their life (e.g. Hodges & McCarthy, 1993) could potentially be explained in an analogous fashion, as it tends to be the most striking part of their life that is the relevant period. The most easily retrievable memory elements would become the seeds of the schematisation process (but for alternative suggestions see Hodges & McCarthy, 1993).
(d2) is that the disorder is explicable in terms of damage to existing memory processes, a premise we share with most commentators. All the others, except possibly (i), follow from the model. Thus confabulations would be expected to occur in whatever types of situation where Description–Editor–Mediator retrieval control processes come into operation. As they would not normally be involved in semantic memory processes, this leaves their primary involvement as in autobiographical recollection (see also Hodges & McCarthy, 1993). From this, properties (a) and (c1) would follow.9

Property (c2), that confabulations can involve semantic memory, is to be expected as the store accessed by the Description is held to contain both episodic and semantic information. Property (d2) is essentially the same as the prediction from the Descriptor Failure set. Characteristic (h), that patients should at times act on the basis of their confabulations, follows from the memory control systems being linked to problem-solving and would therefore come into play when novel situations occur.

This leaves (i)—the lack of awareness of the deficit. The domain of the model includes the awareness of memories, but does not relate to the more abstract issue of anosognosia. As no generally accepted theory of anosognosia exists in neuropsychology to which the model can be related or with which it might be in conflict, this seems an acceptable lacuna for the model at present. Indeed if verification processes (a subtype of the editing ones) are impaired, the patient would not seem to have the raw material available on which an awareness of the deficit could be based (see also Dalla Barba, 1993).

**GENERAL DISCUSSION**

The present paper has had two main aims. The first is to present a model of the processes involved in autobiographical recollection which, when damaged, give rise to the clinical neuropsychological phenomena of confabulation. The second is to show that these phenomena are in general mirrored, if to a much more minor degree, in the retrieval protocols of normal subjects, as one would expect if the same processes underlie normal and abnormal retrieval.

There are many similarities between our account and other neuropsychological accounts of confabulation. For instance, it is in many ways a development of Moscovitch’s (1989) notions of strategic and associative recall; it shares with Schacter (1989) a concern for how autobiographical instances are made

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9 It should, however, be noted that Norman & Bobrow (1979) give an example of the use of Descriptions and Verifications (part of Editing) from the attempt of a subject to retrieve the meanings of imperfectly learned commands in programming languages, which would imply that certain specific tasks might also use these processes, acting on material that is transitional between episodic and semantic memory in type. The phenomenon of a seemingly irrelevant memory being produced at the same time as an inferential process that links it to the solution to the question—finding 4(v)—corresponds in this domain to the insightful flashes that occur in normal problem-solving.
discriminable and set in their proper context; it emphasises, as do Baddeley and Wilson (1986, 1988) the role of recollection (see also McCarthy & Warrington, 1990), and acknowledges the role of judgement processes in it, as does Johnson (1991, Johnson et al., 1993).

We have, however, tried to argue that impairments to three types of memory control process can occur in confabulation. Description deficits are required in addition to Editor ones because of the frequency of certain phenomena in confabulators by comparison with the protocols of recall in normal subjects. Mediator deficits are required in addition to Editor ones to explain the contrast between fantastic and non-fantastic confabulation. In addition we have reported elements corresponding to all three processes in the autobiographical recollection protocols of normal subjects.

We do not see confabulation or corresponding phenomena in normal subjects as posing any strong constraints on a theory of the basic ephoric processes. Instead we see confabulation as providing raw material for the development of a theory of the control processes involved in memory, which builds on the initial position of Norman and Bobrow. The model we have put forward can provide an account not only of the main aspects of the memory protocols produced by normal subjects but also of a variety of phenomena related to confabulation, namely the confabulator’s speed of response, of their failure to check, of their variability in recall, of their conflation of memories, of their incorporating recent input into old memories, of the sparing of certain types of cued recall, of fantastic confabulations, and the genesis of other forms of paramnesia. The account given of confabulation within the context of the model is close to clinical accounts given by other investigators. However by expressing them within the confines of a model of normal functioning and by using the analogy with memory lapses in normal subjects, we aim to stimulate the cross-talk between studies of normal subjects and neurological patients that has been so fruitful in other areas of cognitive neuropsychology.

REFERENCES


APPENDIX 1

Autobiographical Memory Questions

1. Describe the first thing that comes to mind that has happened to you in the month before last.
2. When did you last clean your car?
3. When was the last time you went to the coast?
4. Describe your main course for dinner last night.
5. Describe the last time you had dealings with the police.
6. What was the weather like yesterday morning?
7. When was the last time you saw one of your relatives you don’t live with?
8. Describe what you were doing during the two hours before lunch last Sunday.
9. Describe what you did the last evening you went out to a party, the theatre, cinema, restaurant, or similar.
10. When was the last time you were in Trafalgar Square?
11. Describe a present you have recently given or received.
12. Describe the last meeting, seminar, or case conference you went to.
13. Describe the state of your house/flat/room when you moved into it.
14. Describe the last time you were introduced to someone you had not previously met.

APPENDIX 2

Element Analysis of Autobiographical Memory Protocols

<table>
<thead>
<tr>
<th>ELEMENTS</th>
<th>TYPE</th>
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</thead>
<tbody>
<tr>
<td>1. Answers</td>
<td>Other</td>
</tr>
<tr>
<td>2. Comments</td>
<td>Other</td>
</tr>
<tr>
<td>3. Conclusions</td>
<td>Other</td>
</tr>
<tr>
<td>4. Conscious Memory Search</td>
<td>Editing</td>
</tr>
<tr>
<td>5. Corrections</td>
<td>Editing</td>
</tr>
<tr>
<td>6. Correction Possibility</td>
<td>Editing</td>
</tr>
<tr>
<td>7. Demand Setters</td>
<td>Mediation</td>
</tr>
<tr>
<td>8. Explanations</td>
<td>Other</td>
</tr>
<tr>
<td>9. Failed Recall</td>
<td>Editing</td>
</tr>
<tr>
<td>10. Familiarity Impression</td>
<td>Editing</td>
</tr>
<tr>
<td>11. Furtherances</td>
<td>Other</td>
</tr>
<tr>
<td>12. Hypotheses</td>
<td>Description</td>
</tr>
<tr>
<td>13. Incomplete</td>
<td>Other</td>
</tr>
<tr>
<td>14. Memory (incorrect memories = 14E)</td>
<td>Memory</td>
</tr>
<tr>
<td>15. Metamemory Insights</td>
<td>Mediation</td>
</tr>
<tr>
<td>16. Multiple Memories</td>
<td>Mediation</td>
</tr>
<tr>
<td>17. Problem Solving (3 Types):</td>
<td>Mediation</td>
</tr>
<tr>
<td>A: uses semantic knowledge</td>
<td></td>
</tr>
<tr>
<td>B: uses autobiographical knowledge</td>
<td></td>
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<tr>
<td>C: uses contextual personal semantics</td>
<td></td>
</tr>
<tr>
<td>18. Recall specifications</td>
<td>Description</td>
</tr>
<tr>
<td>19. Repetitions</td>
<td>Other</td>
</tr>
<tr>
<td>20. Statements</td>
<td>Editing</td>
</tr>
<tr>
<td>21. Success Points</td>
<td>Editing</td>
</tr>
<tr>
<td>22. Task Demand Analysis</td>
<td>Mediation</td>
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</tbody>
</table>
‘Other’ category refers to those elements putatively resulting from the protocol procedures and not informative about recall structure (see text).

These are defined as the following (numbers in brackets refer to elements above):

1. **Answer**

Responses that contain no suggestion of any additional memory content, are not part of a reasoning process, and directly answer the set (stimulus) question are known as answers. Answers can be positive when based on a memory. Answers are not the product of a reasoning process—it appears that the S has the answer to the question readily to hand without having to think about it.

Example: When responding to the question ‘‘What did you have for dinner last night?’’—‘‘Fried squid and mustard’’. Another example might be where the S was asked when they had last seen a relative and merely responded ‘‘Last Tuesday’’. An answer can also be in the negative as in responding to the above question with ‘‘I didn’t have dinner last night’’.

2. **Comments**

Rhetorical remarks, comments or statements, aimed at the listener, that do not convey a memory, are not part of problem solving, or anything specifically to do with the recall process, but which summarise a state for the subject (or are a throwaway comment not intended to be germane to the task, but conveying some comment on something recalled), for instance ‘‘... which was fascinating...’’ or ‘‘That was that’’, etc. Parts of discourse that could be removed without altering the significance or message from the point of view of understanding the recall processes. Speaking ‘‘to camera’’ is generally also a comment.

Examples: ‘‘... if you can call it that’’; ‘‘... not that I’d have wanted to anyway...’’; ‘‘all pretty meaningless to me really’’; ‘‘... what an idiot...’’.

3. **Conclusions**

Summaries of what has already been said. They add no new memory elements and their purpose seems to be a sum up for the listener all the different strands of memories and reasoning so as to make a sensible ‘‘answer’’.

Example: ‘‘So, yes, as I’ve already said the visit to Towcester must have come before the last ditch attempt in Maidenhead and that is where I was introduced to someone ... and that’s the answer {3}’’.

4. **Conscious Memory Search**

Where the subject has identified a topic and claims to be trying to recall detail/s pertinent to it, but not in a problem-solving way, e.g. ‘‘... thinking about the dummy again, in Brixton, trying to think when that was...’’. This does not include the situation where a S merely identifies a topic they are thinking about (e.g. ‘‘thinking about the shop window...’’ {a MEMORY}). Distinct from a RECALL SPECIFICATION in that aspects of the event/episode/situation have already been recalled. CONSCIOUS MEMORY SEARCH is searching a memory whereas RECALL SPECIFICATION is getting there in the first place. Only {4} if it can be demonstrated that the S is thinking about one thing only—no competing possibilities (a period of time is unlikely to be a {4} because many things may have happened during that time).
Examples: “There was something I was reading this morning {14} … now what on earth was it? … {4} … oh yes! {21}, it was about the peculiar professor…”.

“Ah yes, I’ve got it {21} … it was the meeting last Thursday {14} … now who was there? {4}…”

5. Corrections

These are where the S has realised that some elements of what they are saying are not correct. Corrections start with a statement announcing the fact that the S has realised what it is that is inaccurate (not the realisation that something is not right but not knowing what—that is a CORRECTION POSSIBILITY) and end when the S starts to produce memories again (i.e. once the correction has been made).

Example: “… removed odd scraps from the floor {14}, took out …—wait a minute {6}, it wasn’t before I took it in, it was the night before {5}, and it was dark {14}—about 8 o’clock at night {14}…”.

6. Correction Possibility

Comments that indicate that the S has just become aware that what they’ve just said may not be correct. This can result either from the S realising that two memories, or details within a particular memory, are incompatible, or from a reasoning routine {17}. Thus they can result from conflicting episodic or semantic material. Also refer to recalled material that the subject is saying may well not be correct e.g.

“Nick Sales … or was it Nick Sainsbury?—something like that {6},”

Examples: “Hang on a minute, that’s not right, let’s see…”; “No, that can’t be right…”; “Actually, I don’t know that I’m right there…”; “Oh there’s an element of doubt in my mind now…”.

7. Demand Setters

Comments that refer (directly or indirectly) to the ease with which the person expects to be able to recall the required material. They contain no memories in themselves and are usually self-contained.

Examples: “Ah! Straightforward!”; “… really difficulty to remember now…”; “I immediately thought I hadn’t had a meeting with my bank manager for ages!”.

8. Explanations

Explanations of hypotheses or other protocol elements that have already been formed. They are usually self-contained. Explanations can appear in relation to many other protocol elements—see for instance {17}. They clearly follow an element in time: “I know that because…” (if not a METAMEMORY INSIGHT) and do not convey episodic memories. Background information about state of situations used to situate/explain why the events in mind occurred are also EXPLANATIONS.

Explanations of a memory can exist as well—for instance “I remember asking for a red one {14} because red is my favourite colour you see {8}”.

Examples: “There were two papers that needed doing {14} and I’m trying to remember which one of them was the more important {4}… Presumably the one closest to the submission deadline would be the most crucial {17} so it must have been the African Toads project, I would have thought {12} … That’s how I’d reason it, anyway {8}”.

“Thinking about talking to my niece about it afterwards {14}—because she was there the same night {8}”.

Comments on explanations that extended the understanding but are not actually new explanations in themselves are called FURTHERANCES {11}.
9. **Failed Recall**

The point where a S notifies the listener that the attempted recall has been unsuccessful and will not be continued any further.

Examples: “I can’t remember the number {9}, but I can remember it was light in colour {14}”; “I’ll have to give up on that one . . . no, I can’t remember what it was, let’s go on”; “I forget. So anyway . . .”.

10. **Familiarity Impression**

A feeling of familiarity without specified detail and precise content. It is a rough idea of a time, area, or detail that has no attached reasoning, and is based on a trace that is so weak that no details can be accurately recalled. Just a vague impression of something.

Examples: “somewhere round here . . .”; “some time ago, now . . .”; “pretty recent I think . . .”; “something vaguely to do with work, I think . . .” (without any attached reason why it should be to do with work).

11. **Furtherances**

These are extensions to EXPLANATIONS (see above) which extend one’s understanding of what it is that is being explained, but which are not new explanations in themselves.

Example: “because I always go there because they serve enormous burgers {8} . . . other places’ burgers just don’t fill me up, you see {11}”.

12. **Hypotheses**

Often the product of a reasoning process, these are hypotheses about what the answer might be which are fed into the memory system to facilitate recall.

Example: S is asked when he last cleaned his car and responds: “… Must have been in November I would have thought . . . in Towcester . . . {17} . . . this is difficult . . . yes, probably early November {12} . . . now let’s see, what happened in November? {4} . . .”.

13. **Incomplete**

Where an element of a protocol is so incomplete that it is impossible to decide what it is intended to be. Also includes isolated and non-directed expletives and uninterpretable utterances.

Examples: “… because . . .” followed immediately by a new line of thought: “but turned out to be {13}—I was still half an hour late {14}”.

14. **Memories**

Must refer to a specific event in which the subject was personally involved and apparently to an evoked image or other autonoetic memory experience (Tulving, 1989). They refer only to autobiographical material. Memories that are factually “incorrect” (this being discovered either later in the protocol or in the commentary) are designated with an “E”, whether they are later corrected or not.

*What are memories?*

NOT memories:
1. Knowledge of facts.
2. Knowledge of events in which the S was not personally involved.
3. Knowledge of one's personal characteristics, behaviours, or abilities (personal semantics) expressed independently from the events in which they might have been learned.
4. Knowledge of any information about other people outside the activities that the S has personally witnessed.

Memories are:
1. Autonoetic experience of any form as expressed by the S that are representations of particular episodes in which the S was personally involved.
2. In most part included in definition above recollections of states of mind, reasoning processes, and other mental activity which existed at a particular time, linked with a personal episode to which the S currently has access.
3. Generic memories: These are images evoked by an S that are specific to that S but which are event-independent. They are images derived from repeated exposure to a stimulus—the repeated exposure that ensured that the S cannot tell from which episode that image derives. Hypothetically we assume that it is a culmination of different images of the same thing taken from all the episodes and represents a memory "half-way" in the transition from autobiographical memory to semantic memory. Imagining a situation is also classified as a generic memory.

15. Metamemory Insights

When a S tells you why it was that they thought of what they did. They describe, post-recall, which memory led to which and why.

Example: "... and I remember thinking I about the trees outside and that sparked the memory of the state of the garden..."; "... one could elaborate ... {then another element} ..." {ie. noting that there would be more to recall if one had the time}; "now that association has triggered off...".

16. Multiple Memories

Where the subject gives notification of the recall of more than one memory in response to one stimulus. These memories are recalled either simultaneously or in such quick succession that recall appears simultaneous.

Examples: "Well, initially thought of two things..."; "Ah, well, two things come through very strongly...".

17. Problem Solving

There are three types of problem solving (which occurs because memories are unavailable). There must be evidence of reasoning. Problem Solving can include many different types of elements, but does not include hypotheses. It can be in brief or extended form:

A. Problem-solving based on non-autobiographical semantic knowledge (but includes common semantic event knowledge).

B. Problem solving based on autobiographical knowledge (or personal semantics). They are the elements of one's knowledge about oneself which can be independent of any specific event (i.e. I went to Churcher's College) or specific to an event (i.e. I was born on...) but do not rely on knowledge of the details of events themselves. They are the elements of one's knowledge about oneself that do not change over time.

C. Problem solving based on contextual personal semantic knowledge. Contextual semantic information is knowledge of what one personally does in a given situation, one's preferences, prejudices, and the like; i.e. it is information that one has about oneself, independent of events themselves, but necessarily bound up with one's situation. One's current age would therefore fall into this category.
Example: ‘‘... Well it was 8.30 when I left because I can remember looking at the clock as I went out of the door {14} and I remember arriving at the station with only 2 mins to spare before the train left {14}. So if I left home at 8.30 and the train left at 11.30, the journey to the station must have taken me 3 hours {17}’’

‘‘... I know that the standard price for the kind of text is £40 and that discount is usually 25% {17} so it must have cost me about £30 {12}... Yes I remember now {21} making out the cheque {14}...’’

‘‘... I can’t quite remember what kind of restaurant it was ... er ... um ... {4} ... well it wouldn’t have been an Indonesian because I hate peanut butter and it’s unlikely to have been the chicken place because my company was vegetarian {17} so it must have been either the Pizza place or the Indian {12} ... yes! {21} It was in fact the Indian {14}...’’

18. Recall Specifications

Where the S is giving notice of the fact that they are trying to recall something. It should indicate that the S, already having an idea in mind about that they want to recall, is trying to home in on the particular example they require, using ever more precise descriptions of what is required. It is not the same as a {4} because the S has not yet arrived at the memory which they then want to go on and explore—S is in the process of getting there. An {18} has to show evidence of actively trying to get a handle on one particular exemplar of a number of possible candidates. The conscious attempt to deactivate a memory may also be an {18} e.g. ‘‘I keep thinking of that incident ... trying to think of another time I’ve had dealing with the police...’’.

Examples: ‘‘thinking now along the lines of work {14} ... trying to trace back to that week...{18}’’; ‘‘Thinking now about meetings I have been to recently {18} ... yes {21}, I can remember the one now where that was discussed {14}—now who was there? {4}.’’

19. Repetitions

Repetition can be either of a memory or a non-memory. If the repetition includes all of the old elements but also introduces some, then these new elements are categorised as independent from the repetition.

20. Statements

General statements about a remembering process or a particular memory element which provide information (after retrieval has occurred) about how well the process has gone or the element has been remembered such as ‘‘so that’s quite memorable’’ or ‘‘so that’s about all I can remember really’’. They do not add any new memory elements or other content information. The fact that they convey information about states/patterns of retrieval differentiates them from {2}.

Example: ‘‘Yes {21} ... I can now remember {20}...’’.

21. Success Point

Clear expression of the sudden accessing of either a sought-after memory or memory element or an associated but not sought-after memory strand. To be distinguished from a {6} as no suggestion of any need to correct error. These criteria distinguish between {21} and {6} because a SUCCESS POINT occurs before any manipulation is performed on a memory that comes to mind. A {6} that results from the realisation that two memories are not compatible is obviously not the same as the point at which the incompatible memory itself is recalled. However the S may not express both stages of the process and at these times the {6} has priority.
For instance: "Um, now when was it... Ah yes! {21} I remember now. {20} It was at Hereford at the car wash {14}... Oh, {21} there’s another car wash at Windsor {14}... hang on, what is that one then? {6}... Yes it was {5}...".

As opposed to: "Um, now when was it?... Ah yes! {21} I remember now {20}. It was at Hereford at the car wash {14}... er, I’m not sure about that actually {6}, there’s another car-wash at Windsor {14}... In fact it was that one, not Hereford {5}...".

Examples: Oh I know, yes that’s it..."; "Oh, there’s something else..."; "Ah!..."

22. Task Demand Analysis

Where the stimulus question is being analysed in order to try to think what is required. Pre-recall. Example: "The month before last... so you don’t want last month then do you..."

23. Unlinked Image

When the S recalls some image, which does not appear to be related to the subject of the recall, and notifies the E that they do not consider it relevant to the main purpose of their efforts.

Examples: "... I just got an image of my house at home... don’t know where that came from" [followed by unconnected recall]. "For a moment I thought of Croyde Bay, but I can’t think why..."

24. Verification Analysis

This has two forms:

A. Where a retrieved memory is being compared with the criteria established by analysis of the task, e.g. "... that was my initial thought—thinking well, could you call him a relative I don’t live with?"

B. Where potential incompatibility of two memories is assessed (see also {6}, {5} and {17}).

Example: "... Oh, hang on, I don’t know whether that would constitute a ‘main meal’ let’s see..."

25. (as) Yet Unavailable

This has two forms:

A. Where the S gives notice that, for the moment at least, they cannot recall a particular detail, although they do believe that they will be able to recall it soon.

B. Where the S, after having "checked" for a particular detail, has come to the conclusion that they do not know (and have never known) the sought-after detail.

Distinguished from {9}, in the case of A in that with {25} the S has given notice of the end of an attempt to recall, and B in that an inability to recall something that one has never known cannot be considered a failure in the recall process.

Examples: "... can’t think of it for the moment..." "I’ve never been able to remember that".
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