What are confabulators’ memories made of? A study of subjective and objective measures of recollection in confabulation

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Received 7 October 2005; received in revised form 29 August 2006; accepted 20 November 2006

Abstract

Confabulating patients claim to remember events that had not actually happened, suggesting a vivid subjective experience of false memories. The present study was aimed at examining the nature of subjective experience of retrieval in confabulators and its relation to the objective ability to recollect qualitative aspects of the original episode. In Experiment 1, 5 confabulators, 7 non-confabulating patients, and 12 control subjects studied words under shallow and deep encoding conditions and underwent a Remember (R)/Know (K) recognition task [Tulving, E. (1985). Memory and consciousness. Canadian Psychology, 26, 1–12]. For recognized words, they additionally indicated two qualitative features of the encoding context. Whereas subjective (i.e. R responses) and objective (i.e. source) measures of recollection were associated in normal controls and non-confabulating patients, they were dissociated in confabulators. In Experiment 2, participants explained the content of their R responses. We found that confabulators’ recollections mainly included autobiographical information related to test items, but not to the study encounter. We conclude that remembering states in confabulators may be linked to a deficit in inhibiting irrelevant memories triggered by test items during retrieval attempts.

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Keywords: Confabulation; Source memory; Conscious awareness; Remember/know; Frontal lobe

1. Introduction

Confabulating patients have memories for events that have not been actually experienced. These false memories, termed confabulations (see Gilboa & Moscovitch, 2002 for a recent review), may include as many contextual and perceptual details as do memories of true events (Johnson, O’Connor, & Cantor, 1997). Confabulation is generally considered an impairment of retrieval rather than encoding processes (Burgess & Shallice, 1996; Moscovitch, 1989; Moscovitch & Melo, 1997; Schacter, Norman, & Koutstaal, 1998), consistent with the fact that it may affect memories acquired before the occurrence of brain damage (when encoding operations were well-functioning) as much as those acquired subsequent to brain damage.

Of great interest is confabulators’ subjective experience of retrieval: patients may claim they can re-live these confabulatory reports, suggestive of experiences of vivid recollection. For example, Dalla Barba (1993) described a patient, MB, who confabulated in response to questions tapping personal episodic memory (Dalla Barba, 1993). When asked to classify his memories according to the remember (R)/know (K) distinction (Tulving, 1985), that is, to indicate whether he recollected some aspects of the original episode (i.e., R response) or whether the memory was merely familiar (i.e. K response), MB frequently attributed R judgements to his confabulatory reports.

Not only confabulators claim to re-live their false memories, but they apparently do. That is, there is evidence that some confabulating patients act upon their confabulations as if they were true memories (e.g., looking for the phone number of a non-existing friend; see Schneider, 2003), or even show emotional responses congruent with the content of a confabulated event (e.g., crying for the alleged death of a work colleague). This complete adherence to confabulations may be related to the
way patients subjectively experience their memories, given that people base their decisions and actions upon their own experience (Bechara, Damasio, Tranel, & Damasio, 1997; Goel & Dolan, 2003; Koriat & Goldsmith, 1996). Thus, understanding the nature of the subjective experience associated to memory retrieval in confabulators may contribute to our understanding of the mechanisms responsible for confabulatory behaviour.

The goal of the present study was to characterize the subjective experience of remembering in confabulating compared to non-confabulating patients and control participants. We attempted to achieve this goal by investigating three issues. First, we investigated the extent to which subjective measures of recollection (i.e., R responses in the R/K paradigm) behave similarly to objective behavioural indicators of recollection (i.e., memory for details surrounding the encoding context). Second, we examined the extent to which subjective measures of recollection are affected by variables that are known to affect objective measures of recollection in these three groups of participants. Third, we sought to identify the type of information that triggers remembering states in confabulators compared to the other participant groups.

1.1. Subjective and objective measures of recollection

To date, there exists substantial agreement that recollection is the process responsible for the retrieval of contextual details surrounding the original episode (e.g., Atkinson & Juola, 1974; Jacoby, 1991; Mandler, 1980; Tulving, 1985; Yonelinas, 1994). Recollection is distinguished from familiarity, which is the process that reflects the global strength of the memory trace without additional qualitative information (Yonelinas, 1994). Individuals are thought to be able to report on their subjective experience of recollection and to differentiate it from the experience of familiarity (Gardiner, Ramponi, & Richardson-Klavehn, 1998; Tulving, 1985). These different subjective experiences of retrieval have been operationalized in the R/K paradigm (Tulving, 1985), in which participants are asked to indicate, for each recognized item, whether they recollect some aspects of its presentation (i.e. R response) or whether the item is merely familiar (i.e. K response). Numerous behavioural (Gardiner, 1988; Gardiner & Parkin, 1990; Rajaram, 1993) and neuroimaging studies (Eldridge, Knowlton, Furmanski, Bookheimer, & Engel, 2000; Wheeler & Buckner, 2004; Woodruff, Johnson, Uncapher, & Rugg, 2005) provided evidence consistent with the hypothesis that R and K responses reflect qualitatively distinct memory processes underlying recognition performance (Yonelinas, 1994; but see Wixted & Stretch, 2004).

If the R/K paradigm captures the distinction between recollection and familiarity, one should find that when R responses are provided individuals are more likely to correctly retrieve features of the encoding context than when K responses are provided. In other words, subjective and objective measures of recollection should be specifically associated. In line with this notion, Dudukovic and Knowlton (2006) have recently demonstrated that normal subjects were able to identify contextual details (i.e. the ink color) for remembered items, while their source accuracy for familiar items was at chance levels (but see Hicks, Marsh, & Ritchel, 2002). Similarly, Perfect and colleagues demonstrated that normal subjects were more likely to identify the temporal (i.e. the order of occurrence in the original list) and the spatial context (i.e. the quadrant of the screen in which the item had been presented) for remembered compared to familiar items (Perfect, Mayes, Downes, & Van Eijk, 1996). Moreover, ERP studies showed that the LPC, a late positive component that is typically associated to R responses (Duzel, Yonelinas, Mangun, Heinze, & Tulving, 1997), was detected only when both the source of an information and its content were retrieved (Rugg, Henson, & Robb, 2003; Senkfor & Van Petten, 1998).

Subjective estimates of recollection have also been compared to those obtained with the process dissociation procedure (Jacoby, 1991), in which recollection is measured as the ability to retrieve a specific aspect of the study event (e.g., when or where an item was presented) and to use this as a basis for controlled responding. The two procedures led to almost identical estimates of recollection, which were also similarly affected by encoding manipulations (Yonelinas, 2001). These results suggest that phenomenological experiences of recognition memory, that is R and K responses, function similarly to objective measures of recollection and familiarity in normal subjects.

Of importance, subjective and objective estimates of recollection also converge in some memory-impaired populations. Compared to normal controls, amnesic patients typically show a reduction of R responses in recognition tasks (Knowlton & Squire, 1995; Schacter, Verfaellie, & Pradere, 1996), and are also markedly impaired in objective measures of recollection, such as those derived from the process dissociation procedure (Verfaellie & Treadwell, 1993; Verfaellie, 1994), or the ROC analysis (Yonelinas, Kroll, Dobbins, Lazzara, & Knight, 1998; Yonelinas et al., 2002). Recently, however, dissociations between subjective and objective indicators of recollection have been observed. Duarte and colleagues found that patients with focal lesions in the dorsolateral prefrontal cortex (DLPFC) are impaired in recollecting the context in which items had been encountered, yet show seemingly unaltered remembering states (Duarte, Ranganath, & Knight, 2005).

The question of interest for the current research concerns the extent to which subjective and objective measures converge in confabulating patients. On the one hand, the frequent creation of false memories and attributions of true memories to wrong contexts are clear indicators of impaired (objective) recollection. On the other hand, the vividness with which these faulty memories appear to be experienced suggests that these patients may still have remembering states. It is possible, then, that the subjective experience of remembering and the objective ability to recollect qualitative features of the study context are not as tied in confabulating patients as they are in normal subjects. We have previously argued that whereas in normal subjects remembering states are thought to reflect the retrieval of contextual features of the learning episode, in confabulators remembering states may be triggered by vivid thoughts related to test items but independent of the context in which these items were originally encountered (Ciaramelli, Ghetti, Frattarelli, & Ládavas, 2006). If this is the case, the association between subjective and objective measures of recollection in confabulating patients...
should be lower than that observed in non-confabulating patients and normal controls. The question of whether or not subjective and objective measures of recollection converge in confabulating patients motivated Experiment 1.

1.2. Experimental manipulations affecting recollection

One additional way to gain insight on the behaviour of subjective measures of recollection in confabulators compared to other participant groups is the investigation of how subjective and objective measures are affected by experimental manipulations that typically result in changes in recollection. The literature is rich of examples of such conditions (see Yonelinas, 2002 for a review). For example, the study of experimental manipulations at time of encoding has demonstrated that processing the meaning of the stimulus versus its perceptual features increases recollection more than familiarity (e.g., Gregg & Gardiner, 1994; Yonelinas, 2002). Further, divided versus full attention reduces recollection more than familiarity (e.g., Jacoby & Kelley, 1991; Yonelinas, 2001). Similar dissociations are also found following retrieval manipulations (e.g., Dodson & Johnson, 1996; Yonelinas & Jacoby, 1994).

If subjective measures of recollection rely on different processes than objective measures of recollection in confabulating patients compared to other groups, then conditions that support recollection should differentially affect subjective and objective measures in confabulating patients, but not in other groups. This question was also addressed in Experiment 1.

1.3. The content of recollection in confabulation

As a final issue, we sought to begin to shed light into the cause of the dissociation between objective and subjective measures of recall in confabulation. As we described earlier, a dissociation between subjective and objective measures of recollection has been recently reported in DLPFC patients (Duarte et al., 2005). In this study, however, little emphasis was placed on the neuropsychological mechanism responsible for the dissociation. In this respect, a case-study by Curran and colleagues is quite revealing (Curran, Schacter, Norman, & Galluccio, 1997). They described a patient with a right DLPFC lesion, BG, whose R responses predominantly included associations made to the test words (e.g., for the word DISEASE: “I remember this word because one of the reasons I’m going to the dentist this afternoon is some gum disease”; Curran et al., 1997, p. 1041), rather than contextual aspects of the learning episode. These results suggest that BG’s subjective experience of retrieval did not necessarily reflect any re-access to the study phase. We note, however, that BG (Curran et al., 1997), as well as patients studied by Duarte and colleagues (Duarte et al., 2005), did not suffer from confabulation, thus the mechanism underlying the dissociation between objective and subjective recollection in these patients may differ from the one operating in confabulating patients.

Our hypothesis is that confabulating patients still experience remembering states in the face of clearly impaired retrieval processes because remembering states in these patients reflect something different from the accessibility of information about the encoding context. As we discussed earlier, the experience of remembering in confabulators might be triggered by an excessive processing of context-irrelevant information related to test items during retrieval (Ciaramelli, Ghetti, Frattarelli et al., 2006). To test this hypothesis, we conducted Experiment 2, in which we asked participants to describe the contents of their R responses. Whereas R responses would be associated with the description of contextual features of the learning episode in other participant groups, such responses would be likely associated with extra-list contexts in confabulating patients (Gardiner et al., 1998).

2. Experiment 1

In this experiment, we investigated the relation between subjective and objective measures of recollection in confabulators, non-confabulating patients, and normal controls. In addition, we manipulated a variable known to affect recollection to a greater degree than familiarity, i.e. depth of processing. Thus, we had participants study words both in a shallow- and in a deep-encoding condition. Participants were tested with a typical R/K paradigm and for each recognized word they were also asked to indicate two features associated with the encoding context, that is, the position of the item on the screen and the color ink with which it was presented.

We expected confabulators to show a similar proportion of R responses compared to normal subjects, but a lower proportion of correct source judgements. If this discrepancy between subjective and objective measures of recollection were a specific feature of confabulation, and not a common consequence of a frontal pathology superimposed on amnesia, a different pattern of results should be found in amnesic patients with frontal lesions who do not suffer from confabulation. Specifically, we predicted that non-confabulating patients would show a lower proportion of R responses together with a lower proportion of correct source judgements compared to normal controls (see also Yonelinas et al., 1998).

Deep compared to shallow encoding was expected to increase both R responses and source identifications in non-confabulating patients and normal controls (Yonelinas, 2002). This result would indicate an association between subjective and objective measures in these groups. In contrast, deep compared to shallow encoding was not expected to equally increase R responses and source identifications in confabulating patients. If R responses in these patients are crucially dependent on the retrieval of context-irrelevant information, and this retrieval occurs independently of encoding operations or strength of the memory for studied items, or even during test, R responses should not be affected by the encoding manipulation included in this study, whereas source identifications might in principle increase.

2.1. Method

2.1.1. Participants

Table 1 shows demographic data, and the etiology and the site of brain damage as determined by CT/MRI scans or medical files for each subject. The participants in this study included 12 people with brain damage. Five were patients who suffered from AcoA aneurysm, and exhibited confabula-
...Patients were classified as confabulators depending on (1) their behaviour in real life and on (2) their performance on the Confabulation Battery (Dalla Barba, 1993; see below). With regard to (1), examples of spontaneous confabulation were recorded from all patients (e.g., without any verbal probe, patient M1 narrated that the examiner had participated to her daughter’s wedding). Patients appeared to be quite convinced about the truthfulness of their claims and typically give the impression of vividly remembering their false memories. Confabulators had a mean age of 55 years (range 45–65) and a mean of 9 years of education (range 8–13).

The other seven patients were non-confabulating patients with frontal lobe lesions due to various aetiologies. These patients were selected because they exhibited memory and executive impairment comparable to that of confabulators, without showing any evidence of confabulation. The absence of confabulation was corroborated by patients’ relatives and assessed by the confabulation battery. Non-confabulating amnesics had a mean age of 51.7 years (range 40–59) and a mean of 8.5 years of education (range 5–13). Patients gave their informed consent to participate in the study according to the Declaration of Helsinki (BMJ 1991; 302:1194), that was approved by the local Ethical Committee.

Table 1 shows performance on the psychometric tests for confabulating and non-confabulating patients. All patients showed well-preserved intellectual skills, as indicated by the scores obtained on the Mini Mental State Examination (Folstein, Folstein, & McHugh, 1975), the Verbal Judgement Task (see Spinnler & Tognoni, 1987 for normative data) and the Raven Standard Progressive Matrices.

With respect to long-term memory, on the Wechsler Memory Scale (Wechslers, 1987), both groups of patients obtained a mean general memory index (MQ) that was one standard deviation below average performance. In the Buschke–Fuld test (Buschke & Fuld, 1974), that is a standardized selective-reminding list learning task involving free recall, both groups of patients showed a highly pathological Consistent Long Term Retrieval score (CLTR, i.e. the number of recalled words without further reminding until the last trial), with a mean performance below the fifth percentile (Spinnler & Tognoni, 1987). Patients were also administered a prose-passage recall task that has been standardized for the Italian population by Spinnler and Tognoni (1987). Specifically, patients were read a short story and required to immediately recall as many details as they could. Immediately after the recall task, the passage was newly read to patients and, after 10 min of distracting activities, patients were asked to recall the passage again. A recall score, accounting for both the immediate and the delayed performance, was calculated based on Spinnler and Tognoni (1987). Both groups of patients showed below-average performance.

As far as executive functioning is concerned, both confabulators and non-confabulating patients presented a pathological “Total Move Score” (TMS; i.e.,...
2.1.3. Assessment of confabulation

In order to assess the nature of patients’ confabulations systematically, the confabulation battery by Dalla Barba (1993) was administered both to confabulating and non-confabulating amnesics. Unfortunately, it was not possible to test two non-confabulating patients, CC and GN, because they were no longer available for testing. This battery consists of six subsections of questions concerning personal semantic memory (PS), personal episodic memory (PE), orientation in time and space (O), general semantic memory (GS), “I don’t know” semantic (DKS) and “I don’t know” episodic (DKE) memory. The DKS and DKE sections contain questions for which “I don’t know” is an appropriate response. In order to corroborate patients’ memory statements, interviews were conducted with their relatives, and Dalla Barba’s criteria (1993) for classifying answers as confabulations were applied.

Confabulating and non-confabulating patients obtained a similar percentage of correct responses in all the sections investigated (PS: 89% versus 81%; PE: 29% versus 34%; O: 64% versus 69%; GS: 60% versus 56%; DKS: 76% versus 92%; DKE: 94% versus 98%; p > 0.3 in all comparisons). However, compared to non-confabulating patients, confabulators produced a higher number of confabulations in the PE (50% versus 2%; p < 0.05), O (24% versus 4%; p < 0.05), and GS (13% versus 3%; p < 0.05) sections. In contrast, confabulators did not produce more confabulations than other amnesics in the PS (2% versus 1%), DKS (10% versus 1%; p = 0.053); and DKE (4% versus 1%) sections. This performance pattern resembles that of the confabulating patients described by Dalla Barba (1993) and Box and colleagues (Box, Laing, & Kopelman, 1999). Not all confabulating patients exhibit this pattern. For example, some patients freely confabulate in the “I don’t know” sections (Dalla Barba, 1995; Fotopoulou, Solms, & Turnbull, 2004).

It is interesting to note here that low levels of confabulations in the “I don’t know” sections are indicative of some meta-memorial skills (see also Mercer, Wapner, Gardner, & Benson 1977): like non-confabulating patients, the confabulators involved in the present research did not respond to questions for which they did not believe an answer was warranted, thereby showing some awareness of the conditions under which answers may or may not be expected (see also Moscovitch, 1995).

We also include the scores patients obtained in the continuous recognition test developed by Schneider and colleagues (Schneider & Phak, 1999). This test consists of two runs of a continuous recognition task. Critically, some of the targets appearing on the first run re-appeared as distractors in the second run. A temporal context confusion (TCC) index is then calculated as 

\[
\text{TCC} = \frac{\text{Number of R responses} - \text{Number of K responses}}{\text{Total number of R responses}}
\]

within-subject factors, revealed a significant effect of group (CP, NCP, NC) as between-subject factor, and recognition condition, participants were told to read each word aloud and to tell whether or not it contained the letter “A”. In the deep-encoding condition, participants were told to read each word aloud and to tell whether they liked it or not. For each encoding condition, the recognition test immediately followed the study session. Participants were requested to indicate, for each word, whether they had seen it at study, by saying “old” or “new”.

For each word they judged “old”, they were asked to indicate whether they remembered or rather they knew the word (Tulving, 1985). Participants were instructed to give an R response if they could mentally travel back to the moment of seeing the word and remember something about that encounter. Participants were instructed to give a K response if they believed that the word was presented earlier, but they could not recollect anything specific about the moment of its occurrence (see also Perfect et al., 1996). To ensure that participants understood the distinction between R and K responses, numerous examples were provided. Moreover, participants were asked to describe the R/K distinction back to the experimenter and the instructions were repeated if the participant appeared to have misinterpreted the distinction. Participants were occasionally reminded of the difference between R and K responses during the test itself. Finally, for each recognized item, participants were asked to indicate on which half of the screen the word was presented and the ink color in which it was printed.

2.2. Results and discussion

2.2.1. Recognition performance

Table 3 shows overall hit and false-alarm rates, as well as the proportion of R and K responses to targets and distractors in confabulators (CP), non-confabulating patients (NCP), and normal controls (NC), in the shallow and in the deep-encoding condition. Recognition scores were computed by applying the standard correction procedure (Gardiner & Java, 1991), in which the proportion of “old” responses for distractors (false-alarm rate) is subtracted from the proportion of “old” responses for targets (hit rate).

An ANOVA performed on recognition scores with group (CP, NCP, NC) as between-subject factor, and recognition response (R, K) and encoding condition (Deep, Shallow) as within-subject factors, revealed a significant effect of group 

\[F(2, 21) = 4; p < 0.05\]

which was qualified by a significant group x recognition response interaction 

\[F(2, 21) = 12; p < 0.05\]

Specifically, recognition accuracy did not differ between confabulators and normal controls either in R (0.48 versus 0.51) or K responses (0.18 versus 0.29; p = 0.08). In contrast, compared to normal controls, non-confabulating patients showed a reduced accuracy for R responses (0.29 versus 0.51; p < 0.05), and a comparable accuracy for K responses (0.38 versus 0.29; p = 0.22). This result is consistent with our hypothesis that recollection, as assessed by subjective estimates, is not apparently impaired in confabulators, whereas it is impaired in non-confabulating patients (see also Dalla Barba, 1997; Schacter et al., 1996).

Further, a significant effect of Encoding condition emerged 

\[F(1, 21) = 30; p < 0.05\]

which was qualified by a significant encoding condition x recognition response interaction 

\[F(1, 21) = 12; p < 0.005\]

recognition accuracy for R responses was significantly higher in the deep compared to the shallow-

the number of moves executed by the subject minus the minimum number of solution moves) in the Tower of London Test (Culbertson & Zillmer, 2001). The two groups of patients were also equally impaired on the Letter Fluency Task (Lezak, 1995).
encoding condition (0.53 versus 0.32; \( p < 0.05 \)), whereas no difference between the two conditions was observed in accuracy for K responses (0.29 versus 0.28; \( p = 0.9 \)). Previous literature documented that deep compared to shallow encoding disproportionately increases recollection more than familiarity (Gardiner, 1988; Jacoby, 1991; Rajaram, 1993; Yonelinas, 2002). The finding that deep encoding increased subjective estimates of recollection in all groups of participants is of great interest. Previous research has suggested that confabulators may overestimate R responses because these judgements derive from the retrieval of a variety of memories only a small part of which would be actually connected with the learning episode (Ciaramelli, Frattarelli et al., 2006). Increased R responses in the task (color, position) as factors yielded a significantly difference between the two conditions was observed in accuracy for K responses (0.29 versus 0.28; \( p = 0.9 \)), whereas no

Deep-encoding condition

- **Targets**
  - CP: 0.63, NCP: 0.64, NC: 0.78
  - CP: 0.40, NCP: 0.22, NC: 0.44
  - CP: 0.23, NCP: 0.42, NC: 0.34

- **Distractors**
  - CP: 0.12, NCP: 0.09, NC: 0.03
  - CP: 0.05, NCP: 0.02, NC: 0.02
  - CP: 0.07, NCP: 0.07, NC: 0.01

- **Targets – distractors**
  - CP: 0.51, NCP: 0.55, NC: 0.75
  - CP: 0.35, NCP: 0.20, NC: 0.42
  - CP: 0.16, NCP: 0.35, NC: 0.33

Shallow-encoding condition

- **Targets**
  - CP: 0.88, NCP: 0.82, NC: 0.87
  - CP: 0.64, NCP: 0.38, NC: 0.61
  - CP: 0.24, NCP: 0.44, NC: 0.26

- **Distractors**
  - CP: 0.07, NCP: 0.03, NC: 0.02
  - CP: 0.03, NCP: 0.01, NC: 0.01
  - CP: 0.04, NCP: 0.02, NC: 0.01

- **Targets – distractors**
  - CP: 0.81, NCP: 0.79, NC: 0.85
  - CP: 0.61, NCP: 0.37, NC: 0.60
  - CP: 0.20, NCP: 0.42, NC: 0.25

Table 3

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2.2.2. Subjective experience and source memory

Fig. 1 shows the proportion of correct source judgements for R responses (i.e., number of source identifications for targets receiving a R response divided by the number of R responses to targets) and K responses (i.e., number of source identifications for targets receiving a K response divided by the number of K responses to targets), separately for the color and the position of the targets, by participant group and encoding condition. An ANOVA on the proportion of correct source judgements with group, recognition response, encoding condition (Deep, Shallow), and task (color, position) as factors yielded a significant effect of group \( F(2, 21) = 8; p < 0.05 \), which was qualified by a significant group \( \times \) recognition response interaction \( F(2, 21) = 4; p < 0.05 \), confabulating (0.53) and non-confabulating patients (0.61) made fewer correct source judgements for R responses than did controls (0.77; \( p < 0.05 \) in all comparisons), whereas the proportion of correct source judgements for K responses was similar across groups (CP: 0.50; NCP: 0.48; NC: 0.52). Of importance, R responses were associated with better levels of source judgements than K responses in control subjects (0.77 versus 0.52; \( p < 0.01 \)) and non-confabulating patients (0.61 versus 0.47; \( p < 0.05 \)), but not in confabulators (0.53 versus 0.50; \( p = 0.5 \)). This result suggests that recollection of qualitative details of the encoding context may contribute to determining R responses for normal controls and non-confabulating patients, but not for confabulators.

Encoding condition was also significant \( F(1, 21) = 17; p < 0.01 \), such that correct source judgements were more likely to be made in the deep than in the shallow-encoding condition (0.61 versus 0.52; \( p < 0.05 \)). That is, deep-encoding led to some increase in source identification in all groups of participants. Note however that the effect of encoding condition did not elevate confabulators’ correct source judgements (collapsed across ink color and position on the screen) above chance level: their proportion of source identifications for R responses was not above chance either in the shallow (0.50), or in the deep-encoding condition (0.57 versus 0.5; \( p = 0.15 \)), similar to that for K responses (shallow: 0.47; deep: 0.52). In contrast, in normal controls the proportion of correct source judgements for R responses was significantly above chance in both encoding conditions (shallow: 0.66 versus 0.5; \( t(11) = 6.6; p < 0.05 \); deep: 0.87 versus 0.5; \( t(11) = 10.5; p < 0.05 \)), whereas that for K responses was not (shallow: 0.49; deep: 0.55; \( p > 0.07 \) in both cases). Finally, in non-confabulating patients the proportion of
correct source judgements for R responses was significantly above chance in the deep (0.67 versus 0.5; t(6) = 5.9; p < 0.01) but not in the shallow-encoding condition (0.55 versus 0.5; p = 0.28), whereas that for K responses was always proximal to chance level (shallow: 0.46; deep: 0.50).

Taken together, the results of Experiment 1 indicated that recollection, as measured by objective indicators, is impaired both in confabulating and in non-confabulating patients. In contrast, recollection as assessed by subjective indicators is impaired in non-confabulating patients, but appears to be preserved in confabulators. Note, however, that whereas non-confabulating patients and normal subjects produced more correct source judgements for items they had labelled as R rather than for those they had labelled as K, confabulators were not able to identify the contextual details of remembered items to a greater extent than those of items judged as familiar. This evidence suggests that for control subjects and non-confabulating patients R responses actually mark recollection of distinctive features of the encoding context, whereas this is not true for confabulators. Thus, the question is: what do confabulators’ R responses reflect if they are not associated with enhanced accessibility of information about the encoding context?

One hypothesis is that confabulators’ R responses mainly rely on the retrieval of memories related to test items, which do not involve contextual features of the study episode (Ciaramelli, Ghetti, Frattarelli et al., 2006). The pleasantness judgments made in the deep-encoding condition may have enhanced the availability of general, context-irrelevant, information about test items at retrieval, leading to an effect of encoding condition on R responses, even without a (or with a neglectable) corresponding increase in retrieval of context-relevant information (i.e., source information). If confabulators disproportionately rely on the availability of such irrelevant information to provide R responses, one should be able to detect different characterizations of R responses in confabulators compared to non-confabulating patients and normal controls. In Experiment 2 we explored this possibility, by asking participants to describe the contents of their recollections.

3. Experiment 2

Participants were tested on a R/K recognition task and asked to characterize their R and K responses. In other words, they were not only asked to provide a R/K judgment, but also describe the content of their memories motivating R and K judgments (see also Norman & Schacter, 1997; Piolino et al., 2003). Based on the results of Experiment 1, we predicted that normal subjects and non-confabulating amnesics’ reports for R responses would involve contextual details pertaining to the presentation of the word at study. In contrast, such responses would be likely associated with extra-list contexts in confabulating patients.

3.1. Methods

3.1.1. Participants

The patient groups in this experiment were the same as in Experiment 1 (see Tables 1 and 2). A new group of 12 healthy individuals, matched to patients on the basis of age (mean age = 53.4, range 47–53) and education (mean age = 9.2, range 8–13), was recruited for the present experiment. Participants were excluded if they exhibited clinically significant depression, alcohol or drug abuse, epilepsy, or other known neurological condition.

3.1.2. Materials

A new set of 80 medium frequency words (mean frequency =87 per 1.5 million occurrences; range: 25–180; Barca et al., 2001), between four and eight letters long, were selected and divided randomly into two sets of 40 words each, matched for frequency, length, concreteness and imageability (p > 0.62 in all analyses). Items belonging to one set were studied, and items from the other set were not studied but were included as distractors in the recognition tests. Study and non-studied lists were counterbalanced across participants. The recognition test included 80 words, 40 studied and 40 nonstudied words, which were presented visually, one at time, mixed in a random order.

3.1.3. Procedure

All subjects were visually presented with a list of 40 words, at a rate of one word every 3 s, with an ISI of 1 s. Subjects were told to do the best they could to memorize the words for a later memory test. Confabulators and non-confabulating amnesics were tested immediately after study. Normal controls were tested after a 10 min interval during which they were engaged in other activities. This interval was included to reduce the risk of obtaining ceiling effects in normal subjects’ false alarms, which would prevent the analysis of the subjective experience associated with such responses.1

Participants were requested to indicate for each word whether they had seen it at study, by saying “old” or “new”. In addition, for each word they judged “old”, they were asked to indicate whether they remembered or rather knew the word (Tulving, 1985). Participants were also requested to characterize R and K responses (Norman & Schacter, 1997; Piolino et al., 2003). Specifically they were asked to report what they actually remembered about the item presentation at study, and participants’ reports were recorded.

Two raters, blind to participant group, and item type (i.e., whether a given explanation corresponded to a hit or a false alarm) evaluated the content of the transcripts. Based on an extensive study by Gardiner and colleagues (Gardiner et al., 1998), we required raters to classify subjects’ reports as (1) intra-list (IL), if the explanation included specific sensory or contextual details regarding the presentation of the word, such as the list context (e.g., “This word was in the initial part of the list”/“This word came immediately before FROG”), some sensory characteristics of the word (e.g., “I remember the shape of the word CANDY”), or even item-specific images generated at study (e.g., “When I saw it I immediately had an image of a shining KNIFE”); (2) extra-list (EL), if the explanation included associations made to the word which, although not explicitly referring to contextual features of the learning episode, reflected thoughts and encoding operations made at study (e.g., “I thought of a woman with a red DRESS”; “I thought that WINTER makes people sad”); (3) self-referent (SE), if...
the explanation included some personal memory from everyday life triggered by the presentation of the word at study (e.g., “I remember SUN very well because today it is raining a lot”; “I thought about the red CUP I had bought in London”); (4) F, if the explanation included a sense of familiarity for the recognized word, but no qualitative feature (e.g., “I had a strong feeling that it was there, but that’s it”). This category was added to verify that participants used the R and K distinction accurately. Inter-rater agreement ranged between 93 percent and 98 percent across subjects.

3.2. Results and discussion

3.2.1. Recognition performance

Table 4 shows overall hit and false-alarm rates, as well as the proportion of R and K responses to targets and distractors in confabulators, non-confabulating patients, and normal controls. Recognition scores were computed by applying the standard correction procedure (Gardiner & Java, 1991), in which false-alarm rate is subtracted from hit rate.

An ANOVA performed on recognition scores with group and recognition response (R, K) as factors revealed a significant effect of recognition response \( F(1, 21) = 17; p < 0.05 \) and a significant group \( \times \) recognition response interaction \( F(2, 21) = 5; p < 0.05 \). Post hoc tests showed that recognition accuracy did not differ between confabulators and normal controls either in R (0.38 versus 0.46; \( p = 0.2 \)) or K responses (0.19 versus 0.21; \( p = 0.6 \)). In contrast, compared to normal controls, non-confabulating patients showed a reduced accuracy for R responses (0.25 versus 0.46; \( p < 0.01 \), and a comparable accuracy for K responses (0.25 versus 0.21; \( p = 0.6 \)). Thus, as in Experiment 1, confabulators show subjective estimates of recollection comparable to those of normal controls, whereas non-confabulating patients show lower levels of recollection than do normal controls.

3.2.2. Recollective experience of true and false memories

Fig. 2 shows the proportion of intra-list (IL), extra-list (EL), and self-referent (SE) R responses following endorsement of targets (e.g., number of EL responses to hits divided by the number of hits) and distractors (e.g., number of EL responses to false alarms divided by the number of false alarms) produced by confabulators, non-confabulating patients and normal controls. The content of R responses was never rated as an F category, consistent with the idea that all participants used the R and K instructions appropriately. The category F was consequently not included in these analyses.

An ANOVA on R responses with group, item (target, distractor) and R-type (IL, EL, SE) as factors yielded a significant effect of group \( F(2, 21) = 20; p < 0.05 \), and item \( F(1, 21) = 28; p < 0.05 \), which were qualified by a significant group \( \times \) item interaction \( F(2, 21) = 4.4; p < 0.05 \). Post hoc comparisons showed that rates of R responses were higher for targets than for lures in normal controls and non-confabulating (NC: 0.64 versus 0.16; \( p < 0.05 \); NCP: 0.41 versus 0.13; \( p < 0.05 \)), whereas similar rates of R responses were observed for targets and lures in confabulators (0.68 versus 0.59; \( p = 0.55 \)). This result indicates a similar, vivid subjective experience for true and false memories in confabulators, which is in line with results on patient MB (Dalla Barba, 1993).

The group \( \times \) R-type interaction was significant \( F(4, 42) = 8; p < 0.05 \): the rates of SE responses were higher in confabulating (0.30) than in non-confabulating patients (0.07) and normal controls (0.09; \( p < 0.01 \) in all cases), whereas the rates of IL (CP: 0.14; NCP: 0.09; NC: 0.19; \( p > 0.2 \) in all comparisons) and EL responses (CP: 0.18; NCP: 0.10; NC: 0.11; \( p > 0.5 \) in all comparisons) were similar across groups. Thus, confabulators, compared to other participants, showed an increased tendency to give R responses when they retrieved autobiographical memories related to the test items (SE responses; e.g., “I remember this word because last year I suffered terrible pain to my left KNEE”).

Crucially, the evidence that confabulating patients motivated their remembering states with qualitative information about items (i.e., IL, EL, and SE responses; see Gardiner et al., 1998) indicates they were using the R/K distinction appropriately.\(^3\) No such

\(^{3}\) To further support the evidence that confabulating patients may have sufficient meta-memory abilities to distinguish between \( R \) and \( K \) responses, we had a confabulating patient evaluate a sample of transcripts of \( R \) and \( K \) responses. The patient, AB, has been recently referred to the CSRNC, Cesena, due to severe confabulation following an ACoA aneurysm, occurred one year ago. The patient is 56 years old, has 12 years of formal education, and shows memory and exec-
3.2.3. R responses: relation to temporal context confusion

The previous set of analyses demonstrated that confabulators, unlike non-confabulating patients, gave a similar proportion of R responses following endorsement of studied and unstudied material, suggesting that these responses may actually represent associations made at the time of test, rather than genuine recollections from the study phase. We then asked whether these associations to test items are related to confabulators’ failure to adapt their behaviour to the on-going reality (Schneider, 2003). Such a problem would lead patients to fail to filter out irrelevant information, such as associations made at the time of test, thereby delivering it to consciousness.

Thus, we first calculated Pearson correlations between TCC scores and proportion of IL, EL, and SE responses across confabulating and non-confabulating amnesics. TCC scores marginally correlated with the proportion of SE responses to targets (r_Pearson = 0.66; p = 0.06) and distractors (r_Pearson = 0.58; p = 0.09), but not with IL and EL responses (p > 0.4 in all cases).

Then we re-explored the difference in R responses between confabulating and non-confabulating patients after controlling for TCC scores. The original ANOVA on R responses with group (CP, NCP), item, and R-type (IL, EL, SE) as factors yielded a significant main effects of Item [F(1, 10) = 12; p < 0.05] and group [F(1, 10) = 30; p < 0.05], and a significant group × R-type interaction [F(2, 20) = 6; p < 0.05]. The interaction was due to confabulators’ propensity to give more SE responses (0.30 versus 0.05; p < 0.05) than non-confabulating patients, but a similar amount of EL (0.18 versus 0.10; p = 0.07) and IL responses (0.14 versus 0.09; p = 0.22). When we performed an ANCOVA including patients’ TCC score as a covariate a similar pattern of results was found. The effects of item [F(1, 10) = 12; p < 0.05] and group [F(1, 10) = 30; p < 0.05] were significant, as it was the group × R-type interaction [F(2, 20) = 6; p < 0.05]. The effect of TCC score was not significant (β = −0.22; p = 0.6).

Taken together, the results of Experiment 2 indicate that although confabulators provided a similar number of R responses to normal subjects, the kind of information feeding into R responses differed across participant groups. Specifically, confabulators’ R responses were not triggered by contextual features of the learning episode. Rather, they were mainly triggered by autobiographical information related to test items, possibly emerging during the test itself. Temporal context confusion seems to contribute to this dysfunctional retrieval of irrelevant information during test, but this construct alone does not adequately account for our pattern of results.

4. General discussion

Confabulators often claim to vividly remember events that did not actually happen (Dalla Barba, 1993; Moscovitch, 1989). In the present study, we were interested in characterizing the subjective experience of retrieval in these patients and its relation to the objective ability to recollect accurately qualitative aspects of the original episode. To do so, we investigated the extent to which subjective and objective measures of recollection behave similarly, and are affected by variables that are known to affect recollection. In addition, we examined the content of retrieved information that is associated with R responses across confabulators, non-confabulating amnesics and normal controls.

In Experiment 1 we found that normal controls were better able to provide contextual information (i.e. the position and the color ink) for items they claimed to recollect than for items they reported as finding only familiar (see also Dudukovic & Knowlton, 2006; Perfect et al., 1996), consistent with the view that R and K responses correspond to two separable memory processes (Duzel et al., 1997; Rugg et al., 2003), and, specifically, that R responses are associated to accurate source identifications (Yonelinas, 2001).4

4 We acknowledge that the R/K distinction has also been described in terms of a trace-strength, or signal-detection model (e.g., Donaldson, 1996; Dunn, 2004; Wixted & Stretch, 2004). According to this model, R and K responses reflect different degrees of memory strength, instead of qualitatively different memory processes (Dunn, 2004). We note that the dual-model view would imply source-memory accuracy being at chance for K responses, whereas our results show that in normal controls K responses were associated to some recollective details (e.g., items’ position; see Fig. 1), even though to a lesser extent than were R responses (see also Perfect et al., 1996; Hicks et al., 2002). It falls beyond the aim of the present study to adjudicate between different models of the R/K distinction, thus we will not discuss this issue further. We emphasize, however, that the significance of our results would not substantially change if they were interpreted from the signal-detection model perspective: whereas for normal controls and non-confabulating patients memories perceived as strong enough to pass the R criterion were the richest in contextual details, this was not the case for confabulating patients. In these patients, other (non-contextual) information appears to influence the perceived strength of memories, resulting in a relatively lenient R criterion.
We also documented that non-confabulating patients, who provided fewer R responses compared to normal controls, also produced fewer correct source identifications than controls did. Converging evidence has suggested that both the subjective sense of remembering (Dalla Barba, 1997; Eldridge et al., 2000; Knowlton & Squire, 1995; Piolino et al., 2003; Schacter et al., 1996; Wheeler & Buckner, 2004) and source memory (Kopelman, Stanhope, & Kingsley, 1997; Thaiss & Petrides, 2003) depend on temporal and frontal lobe regions, which are damaged in our non-confabulating patients. The convergence of remembering and source memory deficits in non-confabulating patients lends further support to the association between subjective and objective estimates of recollection (Yonelinas et al., 1998).

In contrast, we found that in confabulators subjective and objective measures of recollection are discrepant. Indeed, compared to normal controls, confabulating patients produced a similar amount of R responses, but fewer source identifications (see also Dalla Barba, Cappelletti, Signorini, & Denes, 1997; Johnson et al., 1997; Schnider & Ptak, 1999; Schnider, Gutbrod, Hess, & Schroth, 1996). In other words, these patients appeared to experience remembering states as frequently as normal controls do in the face of a severe impairment in re-accessing contextual aspects of the original episode. This finding suggests that in confabulators remembering states are not tied to objective memory for source information. Indeed, unlike normal controls and non-confabulating patients, confabulators did not produce more correct source judgements for items they claimed to recall than they did for only familiar ones. Moreover, whereas in normal controls and non-confabulating patients deep compared to shallown encoding led to an increase of both R responses and source accuracy, in confabulators R responses increased independent of source accuracy, which remained at chance levels.

It has been proposed that one crucial function of recollective states is to signal that one is experiencing a memory of a past event as opposed to another type of mental representation such as imagination or fantasy (Conway, 2001). This being the case, events as opposed to another type of mental representation such as that of non-confabulating patients when assessed by objective and objective measures of recollection (Yonelinas et al., 2003) depend on temporal and frontal lobe regions, which are damaged in our non-confabulating patients. The convergence of remembering and source memory deficits in non-confabulating patients lends further support to the association between subjective and objective estimates of recollection (Yonelinas et al., 1998).

The results from Experiment 2 showed that confabulators produced higher rates of SE responses than did other participants (e.g. for the word CAR: “I remember this word, because I thought that my car is still broken”). If a participant labelled a recognition judgement as an R response because he remembered having imagined his car during the presentation of the word CAR, subjective estimates of recollection should have increased, but not necessarily objective source memory. Note that the R/K paradigm relies on the participants’ own assessment of what counts as recollection, thus one could have determined that that recognition judgements merited an R response because of the retrieval of that personally relevant qualitative detail. In contrast, in source-memory tasks such as the one used in the present research, the experimenter determines what counts as recollection (i.e. the position and the color ink). Thus, one might argue that subjective compared to objective estimates of recollection in confabulators are inflated due to a massive presence of such “noncriterial” recollections (Yonelinas & Jacoby, 1996).

We are, however, not inclined to interpret confabulators’ R responses as noncriterial recollections. Indeed, whereas normal controls and non-confabulating patients were more likely to “remember” studied than new material (see also Lampinen, Neuschatz, & Payne, 1999; Neuschatz, Payne, Lampinen, & Toglia, 2001), confabulators gave a similar proportion of R responses to studied and new items, and, somewhat paradoxically, provided relatively more SE responses for new items than they did for studied ones. This finding suggests that confabulators’ R responses, rather than genuine recollections of the study episode, reflect associations to test items, which may be the byproduct of retrieval attempts (Ciaramelli, Ghetti, Frattarelli et al., 2006; Koriat, 1993).

In general, the retrieval of associative information in itself is not sufficient for remembering, that is, an association may be retrieved, but assessed as not pertaining to the specific encounter tested in recognition memory tasks, and thus filtered out. However, given that confabulators have problems in adapting their behaviour to the ongoing reality (Schnider, 2003), they may fail to inhibit information that is irrelevant to the current task, such as associations triggered by test items, which did not originate in the study phase. In line with this interpretation, the propensity to give SE responses in our study was marginally related to temporal context confusion (Schnider & Ptak, 1999). We note that the emergence of context-irrelevant information at retrieval could be in part the result of a general difficulty at creating effective retrieval cues (i.e. retrieval focusing; Moscovitch & Melo, 1997; Schacter et al., 1998). To the extent that retrieval cues are not useful to access the target material, they may result in access of irrelevant information. Nevertheless, differences in R responses between confabulating and non-confabulating patients were not fully explained by confabulators’ temporal context confusion, suggesting other factors might contribute to our results.

In this respect, it is worth noting that the type of information motivating R responses for false alarms (which can be assumed to be context-irrelevant) was mainly related to the self (i.e. SE responses). Other research has found “self-serving” biases in memory reports of confabulators (i.e., confabulators tend to remember self-relevant information as more positive than it actually is; Conway & Tacchi, 1996; Fotopoulou et al., 2004), which raises the possibility that these patients exhibit deficits concerning processing of self-related information. In line with this, several fMRI evidence implicates the ventromedial prefrontal cortex (VMPFC), which is often damaged in confabulating patients (Gilboa & Moscovitch, 2002), in processing of information related to the self (see Amodio & Frith, 2006; Gilboa, 2004 for reviews). Note, however, that patient M2, who
has lesions involving in part the VMPFC but does not suffer from confabulation, produced few SE responses, suggesting that our results on recollective experience are specific to confabulation, rather than a common consequence of VMPFC damage (see also Gilboa, Alain, Stuss, Melo, Miller, & Moscovitch, 2006).

To conclude, we found that recollective states are inflated in confabulating patients, possibly due to a failure to inhibit irrelevant associations about test items. The excessive processing of context-irrelevant information seems to be responsible for the dissociation between subjective and objective measures of recollection in confabulators, and for their vivid remembering of false memories (see also Dalla Barba, 1993). Recently, it has been demonstrated that perceptual decisions made in cluttered environments, whether correct or incorrect, are typically made with high confidence (Baldassi, Megna, & Burr, 2006). One could argue that we may be observing an analogous phenomenon in the memory domain: confabulating patients appear to be confident in their (false) memories because their memories are cluttered by irrelevant information available at retrieval.

Moreover, given that the amount of information resulting from retrieval attempts influences feeling of knowing (Kelley & Lindsay, 1993; Kioriat & Goldsmith, 1996), irrelevant information triggered by new items might promote false recognition in confabulators. Thus, conditions that limit patients’ access to irrelevant information by preventing, for example, retrieval attempts, should exert beneficial effects on their memory performance (Ciaramelli, Ghetti, & Borsotti, 2006). Future research should examine this possibility. For the time being, we demonstrated that confabulators can be interrogated about their subjective memory states, and that their descriptions offered new insight on the nature of their deficits.

Acknowledgements

We thank Cristina Di Stefano, Giulia Giovagnoli, and Moreno Barbiani for rating participants’ transcripts, and Patrick Davidson and the reviewers for their comments on earlier versions of this manuscript.

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