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BRIEF COMMUNICATION

Memory and dating of past events in schizophrenia

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Abstract

Memory deficits are frequently observed in schizophrenia but their intrinsic characteristics have not been clarified. We studied remote memory in a group of 20 schizophrenics and 20 healthy age and education matched controls using a newly devised public event questionnaire (PEQ) that employs a free recall, progressive cueing and recognition protocol and requires dating of events. Results indicate that patients with chronic schizophrenia perform significantly more poorly on the PEQ than a group of age and education matched controls both in terms of content and dating of events. The number of events recalled does not improve with progressive cuing or recognition. No distinctive pattern was observed in their temporal gradient. There was no significant difference in content scores for pre- and post-onset events in the schizophrenics. These findings indicate that remote memory deficits in chronic schizophrenics arise from deficient encoding rather than from a retrieval deficit secondary to executive dysfunction. (*JINS*, 2002, *8*, 861–866.)

Keywords: Remote memory, Dating, Schizophrenia, Temporal context

INTRODUCTION

In the last two decades, studies have highlighted the presence of cognitive deficits, especially of some aspects of memory, in a vast proportion of schizophrenics and suggested that they represent an intrinsic characteristic of the disorder (Aleman et al., 1999; Brebion et al., 1997; Dolan et al., 1997; Feinstein et al., 1998; Gilbertson & vanKammen, 1997; Hawkins, 1999; Landro, 1994; Nathaniel James et al., 1996; Owens & Johnstone, 1980; Park et al., 1999; Rushe et al., 1999).

Some authors see the memory impairment as a primary trait abnormality independent of mental state at the time of testing and treatment (Nelson et al., 1998; Park et al., 1999; Stone et al., 1998). Others claim that it is dependent on treatment or secondary to executive dysfunction and/or attention deficits (Gilbertson & vanKammen, 1997; Nathaniel James et al., 1996).

A few studies have attempted to characterize what causes memory deficits in schizophrenia. Rushe et al. (1999) found normal temporal order abilities in their sample of 58 chronic schizophrenics, but significant deficit on conditional associative learning tasks. The authors suggested that the memory deficits observed in schizophrenia are more similar in nature to those found following mediotemporal lesions (i.e., deficit in learning and retaining new information), rather than frontal lesions (i.e., deficit in strategic retrieval of information or memory for temporal of order). This hypothesis is also supported by anatomical data showing bilateral volumetric reduction of the hippocampus in schizophrenics (Nelson et al., 1998). A different view is offered by Schwarts et al. (1991), who found deficits in a recency discrimination task and suggested that memory deficits in schizophrenia derive from prefrontal dysfunction. Rizzo et al. (1996) also used a recency discrimination task and found that patients performed as well as controls in the recall and recognition tasks, but very poorly on recency discrimination, a task associated with the frontal lobes.

As for remote memory studies, Feinstein et al. (1998) studied remote memory for autobiographical events and found a *U*-shaped temporal gradient in schizophrenics, which they judged to be "unique in the neuropsychiatric literature" (p. 155). The phenomenon was not observed in patients with affective disorders and in controls. No differential

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performance or amnesic gradient across the periods was found by Calev et al. (1987) who tested remote memory for public events.

We have designed a public event questionnaire, resembling the one used by Venneri et al. (1997), aiming to ascertain whether schizophrenics display a dissociation between remembering the content of events (unimpaired) and remembering their temporal context (impaired). The differential recall stages adopted in the questionnaire should also allow us to differentiate deficits at encoding from problems retrieving memories of past events.

METHODS

Research Participants

Twenty schizophrenics, mean age 45 ($SD = 9.4$) years, mean education 12.2 ($SD = 2.5$) were recruited through the outpatient and community resident population at Royal Cornhill Hospital in Aberdeen, UK. All were receiving neuroleptics either in oral or depot form (average 800 mg chlorpromazine equivalent per day, range 250–2000 mg). Six patients were also receiving anticholinergic treatment. None were acutely ill at time of testing. All fulfilled DSM–IV criteria for schizophrenia and had a mean duration of illness of 7.66 ($SD = 3.5$) years (range 0.5–13.3 years) with 5 hospital admissions on average ($SD = 3.7$; range 1–12). Disease onset was defined as the time of first admission. All patients had been previously diagnosed schizophrenics by a consultant psychiatrist on ICD–10 criteria. Only patients fulfilling DSM–IV criteria for schizophrenia on the basis of psychiatric case note examination by one of the authors (D.StC.) were enrolled. No formal measure of their positive and negative symptoms was available nor was administered at time of testing. All patients were in remission, and none had cognitive or behavioral defects that prevented them from giving informed consent and cooperating in the tests. None of the patients had other overlapping psychiatric disorders. Additional inclusion criteria were as follows: good physical health, premorbid IQ more than 85 as estimated by the National Adult Reading Test (NART), normal hearing, normal vision, more than 30 years of age.

Twenty controls were matched for age, sex and education to the schizophrenics, mean age 44.8 ($SD = 10.2$) years and mean education 12 ($SD = 2.7$). They were selected from the Department of Psychology panel of volunteers from the general public and were all in good physical health, with normal or correct to normal vision and normal hearing. None had history of psychiatric disorders, nor presented with psychiatric disturbances at the time of the study. All had previously undergone IQ testing for other studies and had an IQ above 90. Informed written consent was obtained from all participants. This study received ethical approval by the joint Grampian Research Ethics Committee of Grampian Health Board and University of Aberdeen.

Materials and Procedure

Public Event Questionnaire

This instrument was designed with the same structure as, but different content from, the Italian Public Event Questionnaire (Venneri et al., 1997). The new questionnaire tested participants' knowledge of public events that occurred between 1978 and 1997. The period was chosen to cover adolescence and adulthood of patients and normal participants. One event only for each year was selected amongst those that had received large media coverage for a short period of time. The choice was restricted to events that were likely to be familiar to a high percentage of the British population. Events were selected from the news headlines of local and national newspapers and could be answered correctly, in free recall, by at least 80% of the participants in a pilot study. Sixty participants (age range 30–79; 30 male and 30 female) took part in this pilot. For each event, a question asking for information related to it was prepared.

The questionnaire was structured to test recollection of the content of remote events at different stages: *free recall*, *cued recall*, and *recognition*. In addition to recalling the content of the event, ability to recall the temporal location of the event was also tested. If the participants could not answer the question in free recall, the cued recall stage included progressive cueing, for example, "A British princess died in a fatal accident. What was her name?" If a participant could not give the correct answer (Diana), they were helped by providing the following cues progressively: "The accident took the form of a tragic car crash"; "The car was being chased by the paparazzi through an underpass in Paris"; "The driver and another passenger, Dodi Fayed, also died in the crash."

If none of these cues elicited the correct answer, participants were offered four choices among which they had to select the correct answer—in the example above, "Sarah, Anne, Diana, Margaret."

In the case of a wrong answer also at the recognition stage, participants were asked if they had any recollection of the event at all. In case of an affirmative answer, as well as when a correct answer had been provided in previous stages, participants were asked to recall the year in which they thought the event had occurred. Both content and temporal dating scores were evaluated separately for each question.

Content Information Score

Content information score depended on the stage at which the correct answer was provided. Participants recalling the target event in free recall obtained a score of 5. In cued recall, participants obtained a different score (from 4 to 2) depending on the number of cues needed to reach the correct answer. If the correct answer was provided only at the recognition stage, then a score of 1 was given. Total score ranged from zero to 100. In addition to the total score, the questionnaire was sectioned in four 5-year periods (1978–

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1982, 1983–1987, 1988–1992, 1993–1997) and the total scores for these periods were calculated.

Temporal Dating Score

Dating was evaluated by looking at three different variables:

1. Dating error was defined as the absolute value, in years, of the difference between the estimated and the real date of the event. This dating error was calculated for the entire questionnaire as well as for the four 5-year periods.
2. Dating bias represented participants' tendency to report a date more recent than the real one and was defined as the slope of the linear regression of estimated *versus* real date, computed to have a measure of the "forward telescopic effect" (Venneri et al., 1997).
3. Dating precision was obtained by subtracting from 1 the ratio between the residual and the total variance present in the linear regression of estimated *versus* real dates using the following formula: 1 − (residual variance/total variance). This score was used to indicate the closeness with which dates provided agreed with one another and gave a measure of how consistent they were with any specific bias.

RESULTS

Content Information Score Analysis

Analysis of variance on the total content information scores showed that schizophrenics scored lower than controls, achieving a mean of 59.9 ($SD = 17.18$) and 79.6 ($SD = 8.9$) respectively. This difference was statistically significant [$F(1,38) = 20.38$, $p < .001$]. Further analyses were carried out to determine whether the difference between the two groups was maximized by the graded scoring system that rewards a correct response given in free recall compared with that achieved only at the recognition stage. For this analysis, the difference in score between recalling at the free recall stage and that at the recognition stage was voided by giving one point to event recalled independently of stage of recollection. The patients' total content score corresponded to the number of event recalled. First, an analysis on scores achieved for events recalled by the two groups in free recall was compared. Results showed a highly significant difference between the number of events recalled in this condition by the two groups [$F(1,38) = 20.81$, $p < .0001$]. Schizophrenics recalled an average of 9.6 events ($SD = 3.27$) in free recall whereas controls recalled an average of 13.5 events ($SD = 1.99$). A further analysis was run on the total score for events recalled, independently of stage of recollection. The mean number of events recalled was 16.9 ($SD = 2.9$) and 19.4 ($SD = 0.75$) for schizophrenics and controls respectively. The difference between the two groups remained highly significant [$F(1,38) = 13.92$, $p < .0006$].

Analysis of variance with repeated measures was run to evaluate group scores (using the original graded scoring system) across the four different 5-year periods. The main effect of group was significant [$F(1,38) = 20.90$, $p < .0001$], as well as the main effect of period [$F(3,114) = 41.83$, $p < .0001$]. There was also a significant interaction between the above two factors [$F(3,114) = 3.05$, $p < .03$; see Figure 1]. Sheffé *post-hoc* tests revealed that schizophrenics had significantly lower scores for the periods 1983–1987 and 1993–1997 ($p < .0001$ in all comparisons), whereas in the controls a significant difference was present only for the period 1993–1997 when compared with scores with the other three periods ($p < .01$ in all comparisons). No other comparison was significant.

A further analysis of variance with repeated measures compared content scores for pre- *versus* post-onset events in the schizophrenics only. For this analysis content scores were normalized into percentages to eliminate differences amongst and within patients in number of pre- and post-onset events. Results showed no significant differences between content scores for pre- and post-onset events [$F(1,19) = 1.707$, $p > .2$; see Figure 2].

Temporal Dating Score Analysis

A one-way analysis of variance was run on the total dating error score. Results showed a mean total dating error of 4.43 ($SD = 1.51$) and 3.55 ($SD = 1.7$) for schizophrenics and controls respectively. The difference between the two groups was significant [$F(1,38) = 4.6$, $p < .04$]. An analysis was also carried out for the dating error in the four 5-year periods. Results showed a main effect of group [$F(1,38) = 5.74$, $p < .02$], a main effect of period [$F(3,114) = 6.63$, $p < .0004$] but there was no significant interaction [$F(3,114) = 0.22$, n.s.]. Dating error was greater for more distant events compared with the most recent ones (Figure 3). This was equally true for both groups.

Analysis of variance was also run on the dating bias values. No significant difference between the two groups was detected with the mean dating bias being 0.76 ($SD = 0.29$) and 0.86 ($SD = 0.14$) for schizophrenics and controls respectively [$F(1,38) = 1.92$, $p > .17$].

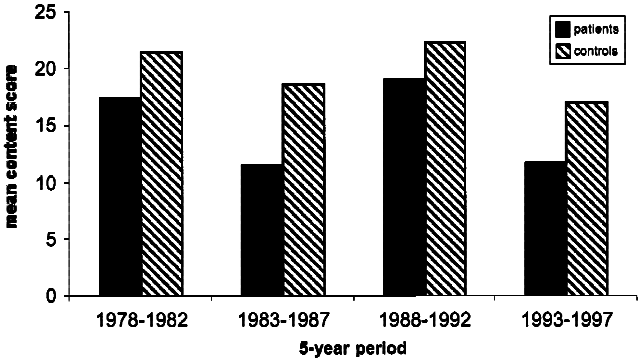

Fig. 1. Mean content information scores in each 5-year period.

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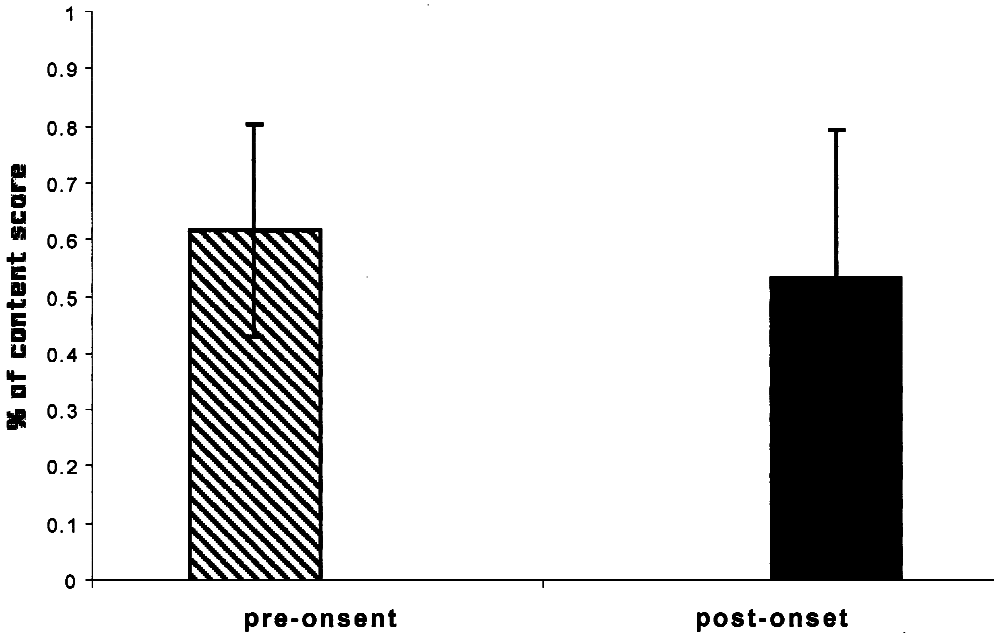

Fig. 2. Content score (expressed as a percentage of the total possible score achievable in pre- and post-onset periods) achieved by schizophrenics on pre- and post-onset public events.

Finally, analysis of variance was run on dating precision scores. The results showed a statistically significant difference between the two groups [$F(1,38) = 4.36$, $p < .05$], with the schizophrenics showing lower precision scores ($M = 0.58$, $SD = 0.25$) than controls ($M = 0.71$, $SD = 0.13$).

Correlation Analyses

Correlation analyses were run to assess the relationship between content and dating scores and between these latter scores and other variables including age, age of onset and duration of illness. A negative correlation was present between content and dating scores ($r = -.39$). This correlation however, did not reach significance level ($p = .09$). All other correlations between these variables and either content or dating scores were very low (r range .06–.32) and not significant.

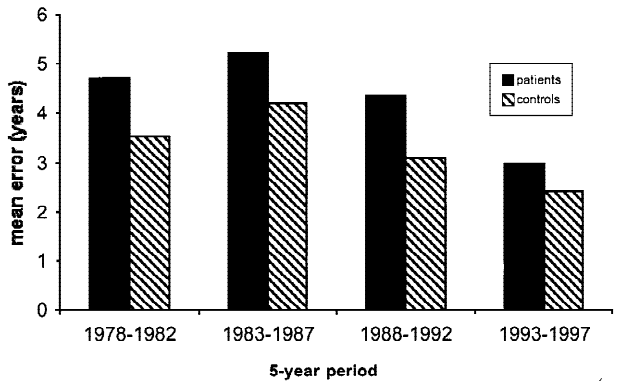

Fig. 3. Mean dating errors in each 5-year period.

DISCUSSION

Our results demonstrate evidence of deficits in memory of remote events in chronic schizophrenics. There were large group differences in content score and in the number of recalled events, with schizophrenics performing worse on each of these measures. There was no special pattern in the types of events not recalled by either group. Our results suggest that the deficits reflect defective encoding rather than failure at retrieval. This argument is supported by a highly significant difference in total number of events recalled. If poor performance were the result of defective retrieval, the facilitation provided by progressive cueing and recognition should have generated a significant improvement. This was not observed. In addition, the analysis of scores achieved in the four 5-year periods showed a significant difference and presence of an interaction, which indicates that performance was affected by some kind of temporal gradient disrupting mainly recollection of the events in two time periods.

These results contrast with earlier findings by Calev et al. (1987) who found no large differences in performance between schizophrenics and controls on a remote memory task. A possible explanation for these conflicting findings may be in the relatively short time span assessed (12 years in Calev et al.'s study *vs.* 20 years in the present study), which could have reduced the chance of detecting differences in recollection of events in different time periods. The present study does not support Feinstein et al.'s (1998)

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claim that remote memory deficits in schizophrenia are restricted to the time period coinciding with the onset of the disease. For most patients, the onset of the disease coincided with the 1988–1992 period, a period for which they achieved scores similar to those of the earliest period. Furthermore, no correlation was found between scores and age of onset or duration of illness and no difference in content score for pre- *versus* post-onset events was present in the schizophrenics, supporting the notion that the learning deficits are premorbid in nature.

Schizophrenics also showed significantly greater impairment in dating accuracy and precision compared with controls. No group difference in dating bias was observed. Schizophrenics therefore, encoded and retained a significantly smaller amount of information, presented with some temporal gradient and the deficit affected both memory for content and memory for temporal context of events, although failure in dating could also arise from poor recall. Our results contrast with studies of recency that suggested that the memory deficits of schizophrenics might be confined to temporal context (Rizzo et al., 1996). Our results highlight the presence of both a content and temporal context memory deficit in schizophrenics, but they are not strictly comparable with Rizzo et al., since they refer to a different aspect of memory. Six patients in our sample were receiving anticholinergic treatment and it is recognized that these drugs can have effects on learning and memory. However, the patients in this subgroup were among those with the highest scores in the schizophrenic group.

Remote memory tests assume that high level media coverage of certain events results in near universal awareness. This may not always apply. We had no means of assessing the true level of exposure or interest for news prior to disease onset in the patients. Neither was a measure of level of exposure or interest in public affairs available for controls. There were only a few instances (1.2%) when participants from either group admitted to no recollection of the event when explicitly asked. All patients had good exposure to everyday events through television and newspapers coverage available in day centers and in hospital wards. All appeared to be aware of contemporary events at time of testing.

Taken together, our results seem to point to a primary deficit at memory encoding. This would result in poor recollection of both content and temporal context of past events. While deficits for content and context are well recognized in other types of memory in schizophrenia (Bazin et al., 2000; Saykin et al., 1991), this is the first study to demonstrate an impairment in temporal context for remote memory.

Finally, although the results of this study point to a deficit at memory encoding which appears to be premorbid in schizophrenics, some degree of caution is necessary in the interpretation of these findings. Testing of remote memory provides a good source of information on how individuals remember events that occurred at a specific point in time and place. This particular procedure, however, suffers from the limitation of lack of experimental control on the relative influence that occasional repeated exposure to certain events might exert and so influence individuals' memory of events. Future studies may take advantage of available functional imaging techniques (e.g., by comparing the activation patterns in encoding and retrieval of material in schizophrenics and controls) to better clarify the nature of memory deficits in schizophrenia.

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