Evidence for Distinct Verbal Memory Pathologies in Severely and Mildly Disturbed Schizophrenics

by Avraham Calev, Peter H. Venables, and Andrew F. Monk

Abstract

It is well known that schizophrenics have difficulty in effectively encoding verbal materials into their long-term memories and consequently show a deficit in recall. Recently, orienting tasks were introduced as a method for achieving equivalent to normal encoding and mnemonic organization in schizophrenics; consequently, their deficit in recall disappeared. A detailed review of the literature, however, showed that such effective orienting tasks had only been applied to mildly disturbed schizophrenics (nonchronic, in a good condition). This report presents three experiments which show that more severely disturbed (chronic, hospitalized) schizophrenics, unlike mildly disturbed patients, have memory deficits that cannot be located at the encoding stage. Severely disturbed schizophrenics show (1) a recall deficit, even after effective encoding and mnemonic organization are induced; (2) excessive forgetting over 24- and 48-hour periods; and (3) a recognition memory deficit. These deficits are in addition to their encoding deficit. The use of a matched-tasks check in experiments 2 and 3 suggests that this postencoding deficit is a differential deficit and does not simply reflect the schizophrenic generalized deficit. Theoretical implications, also supported by the use of various organizational indices (e.g., clustering, hierarchical clustering schemes, and hierarchical grouping analysis), are discussed.

Associative disturbance was traditionally conceived as a major symptom in schizophrenia (Bleuler 1950; Hull 1917). More recently such an associative (or organizational) ability has been regarded as of essential importance for the effective-
subject to establish a mnemonic representation or a retrieval plan of the to-be-remembered material at the encoding stage (Kintsch 1970), did not show memory deficits in schizophrenics (Bauman and Murray 1968; Nachmani and Cohen 1969; Bauman 1971; Koh, Kayton, and Berry 1973; Johnson, Klinger, and Williams 1977; Koh and Peterson 1978; Koh et al. 1981). Thirdly, when schizophrenics were induced to encode effectively and organize the to-be-remembered material, before the recall test, through an orienting task within an incidental learning paradigm, their recall deficit disappeared (Koh, Kayton, and Peterson 1976; Larsen and Fromholt 1976; Koh, Marusarz, and Peterson 1980; Koh et al. 1981).

However, a review of the literature revealed that all these reports of no memory deficit in schizophrenics, when encoding ability is not critical, are in fact limited to mildly disturbed patients (nonchonic based on a 2-year average hospitalization criterion, and in rather good condition). There are some reasons to believe that more severely disturbed schizophrenics have memory deficits that cannot be explained by such an encoding failure, that is, that they may show a postencoding deficit. For example, Traupmann (1975) reported a recognition memory deficit in process but not in reactive schizophrenics. Since it is unlikely that this deficit resulted from defective organization at encoding (e.g., Kintsch 1970) (as did other recognition deficit findings, e.g., Russell, Bannatyne, and Smith 1975), it can be taken to suggest a postencoding deficit specific to more severely disturbed schizophrenics.

This article reports three consecutive experiments that provide evidence for such a postencoding deficit in severely disturbed schizophrenics. Experiment 1 is a pilot study, which uses a matched-subjects, relatively artifact-prone methodology (e.g., Chapman and Chapman 1973, 1978) and is therefore very briefly summarized. Experiment 2 is another pilot study, which is a first attempted use of matched-task methodology, and again is very briefly reported. Experiment 3 uses experience from experiment 2 in constructing matched tasks. This experiment complements the findings of experiments 1 and 2, and is fully reported.

**Experiment 1**

This experiment (fully described by Calev 1981, experiment 1) had a general exploratory purpose. It was intended to establish whether severely disturbed schizophrenics can be induced to achieve a recall performance equivalent to that of normal subjects when the same method is used that induced more mildly disturbed patients to such a recall performance (Larsen and Fromhold 1976).

**Method**

**Subjects.** The psychiatric subjects comprised 15 severely disturbed schizophrenic men (chronic, i.e., with at least 2 years of cumulative hospitalization, and also hospitalized at the time of study) who were comparable to Larsen and Fromhold's (1976) subjects in their drug status, IQ, age, Schneiderian symptoms, and nonparanoid status. They had had no subnormality or electroconvulsive therapy within a year before testing. The normal controls were convalescent inpatients in a general hospital, with no psychiatric history. These subjects were closely matched to the schizophrenics on age and IQ.

**Orienting Tasks.** The Sorting Consistency Task (Larsen and Fromhold 1976; Calev, Monk, and Venables 1980) served as an orienting task, that is, a task designed to induce effective encoding of the to-be-remembered material, before recall was tested. In this task, the subject is given a list of words, usually unrelated nouns, and asked to sort them into categories of his or her own choosing. The original list is then removed and the same words are presented to the subject again, but in a different random order. The next requirement is to sort this second list, using the same categories. The list may be presented several times, in different random orders, until the subject achieves a criterion of two consecutive identical sorts. Larsen and Fromhold (1976) found that those schizophrenics who achieved this criterion also achieved recall levels of these word lists that were equivalent to those of normal controls. However, the problem with this task (version 1), as reflected in that study, was that not all patients completed the task in the 10 trials allowed. Therefore, in the present experiment an easier version of the Sorting Consistency Task (version 2) was also included. This list comprised five of the most frequently used nouns in six categories of Battig and Montague's (1969) Category Norms. The criterion of sorting consistency for this task was an identical sort, as in the norms.

**Procedure.** The experiment was carried out in three sessions. In session 1; a short intelligence test (Quick Test, Form 1; Ammons and Ammons 1962) was administered. This was followed by version 1 of the Sorting Consistency Task, using a list of frequently used unrelated nouns, chosen from Cucera and
Francis (1967), after which the subjects gave labels to their sorting categories. Then, following the interpolation of an irrelevant 5-second number recall task (buffer clearing task), free recall was tested. In session 2, the Sorting Consistency Task was administered, using another list of unrelated nouns, and up to 10 sorting trials were allowed. After the subject labeled the categories, an irrelevant 5-second number-recall task was interpolated, and then followed by three free recall trials and one cued recall trial, using the subject's category labels as retrieval cues (e.g., Tulving and Pearlstone 1966). In session 3, carried out about 24 hours later, free recall for the words of the list used for the sorting consistency task was retested and followed by one resorting trial of the same list. This was done to assess sorting similarity, and the extent to which categorical structure erasure (that is, the tendency of the subject not to leave the same words in the same categories) took place over time. In the later part of this session, version 2 of the Sorting Consistency Task was introduced. After sorting, an irrelevant 5-second number recall task was interpolated, and then followed by one free recall and one cued recall trial. See Table 1 for a summary of all tasks given in the experiment.

These more severely disturbed patients found version 1 of the Sorting Consistency Task more difficult than Larsen and Fromholt's (1976) subjects did. Only a third of the schizophrenics, but 100 percent of the normals reached criterion within 10 trials (criterion achievers). Another third of the schizophrenics completed 10 trials, but did not reach two identical sorts (criterion non-achievers). The last third refused to continue the experiment after a few sorts and were excluded from the study. All 10 schizophrenics who achieved criterion reached criterion in version 2 of the task, in one or two trials.

### Table 1. The experimental tasks

<table>
<thead>
<tr>
<th>Task</th>
<th>Session 1</th>
<th>Session 2</th>
<th>Session 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sort list 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recall list 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buffer Clearing</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Recall list 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resort list 1</td>
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<td></td>
<td></td>
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<tr>
<td>Recall list 3</td>
<td></td>
<td></td>
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<tr>
<td>Determination test</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Recall list 2</td>
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<td></td>
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<tr>
<td>Resort list 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recall list 3</td>
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<td></td>
<td></td>
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<tr>
<td>Buffer clearing</td>
<td></td>
<td></td>
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<tr>
<td>Recall list 2</td>
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<tr>
<td>Resort list 2</td>
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<tr>
<td>Recall list 3</td>
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<tr>
<td>Determination test</td>
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<tr>
<td>Recall list 2</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Resort list 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recall list 3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The orienting tasks were effective in inducing subjects who achieved criterion (schizophrenics and normals) to improve their recall ($F = 4.10; df = 1.40; p < .05$, figure 1); those who did not achieve criterion (schizophrenics) also did not benefit from it (see points 1 and 2 on $x$ axis, figure 1). Also, both schizophrenics who achieved criterion and schizophrenics who did not reach criterion on task 1 performed alike once they achieved criterion on task 2 ($F = 1.239; df = 1.8; NS$).

### Results

Recall. The mean recall results for the words of versions 1 and 2 of the Sorting Consistency Task are presented in figures 1 and 2, respectively. Analyses of variance (ANOVAs) performed on the arcsin of the proportion of words recalled revealed the following: (1) Even after schizophrenics achieved criterion, they still recalled fewer words than did their normal controls. This difference was of 3.6 words on average for orienting task 1, and of 6.05 on average for orienting task 2 ($F = 23.221; df = 1.8; p < .002$). (2) Schizophrenics forgot more than their controls after 24 hours ($F = 5.49; df = 1.40; p < .025$; a planned comparison for the interaction), although some session forgetting was equivalent for all groups (see points 2,3,4 on $x$ axis, figure 1). (3) There were no differences between schizophrenics and normals for the effects of cues, and both groups benefited from retrieval cues ($F = 13.884; df = 1.8; p < .006$ for figure 2) to a similar extent (no interaction).

### Organization:

**Encoding deficit.** As in Larsen and Fromholt's (1976) experiment, here, too, schizophrenic criterion achievers needed significantly more sorting trials than normals to reach a criterion of sorting consistency. Moreover, most schizophrenics (two-thirds) failed to reach this criterion. These findings provide evidence for an encoding deficit in severely disturbed schizophrenics, which seems to have taken a more severe form than that of the more mildly disturbed schizophrenics in Larsen and Fromholt's experiment.

**Categorical structure erasure.** When resorting the unrelated words of version 1 of the Sorting Consistency Task, schizophrenic criterion achievers preserved only 87 percent...
of the same words in the original categories, while their normal controls preserved 97 percent. This statistically significant difference suggests that the schizophrenics' greater forgetting and lower recall could have been a result of structure erasure, i.e., destruction of the categorical associative structure, formed during the initial sorting stage. So, this may reflect an associative disturbance beyond the encoding stage.

Recall output. Schizophrenic criterion achievers used significantly less organization in their recall output, which was assessed independently of the amount recalled, using Pellegrino's (1971) ARC measure. In list 3, most subjects were at ceiling. Monk's (1976) Hierarchical Grouping Analysis and Johnson's (1967) Hierarchical Clustering Schemes repeated this finding, and provided no evidence for either peculiar lengths and orders of organizational sequences or for peculiar clusters in terms of meaning in the schizophrenic recall outputs. One can speculate that the low level of organization in the schizophrenic output was a result of the structure erasure they showed.

Control Variables. No evidence for confounding due to recall times, sorting times, number of categories used in sorting, number of intrusions, and hospitalization length was found.

Discussion

The results suggest that severely disturbed schizophrenics have a postencoding memory deficit. This deficit is apparent (1) in their poor recall even after being induced to equivalent to normal encoding, through orienting tasks, in incidental learning; and (2) in their greater than normal forgetting over 24 hours. The chronic schizophrenics' postencoding memory deficit can possibly be explained by categorical structure erasure, which was larger than that of normals. In

Figure 2. Experiment 1: Mean recall for schizophrenics and normals (list 3)
addition these patients show an encoding deficit, which resembles that of the more mildly disturbed patients used by Larsen and Fromholt (1976).

The findings of this study should be treated as tentative because of (1) the small number of subjects used and (2) the problems of the matched-subjects design (e.g., Chapman and Chapman 1973, 1978). The finding of greater than normal forgetting by schizophrenics can be criticized because of the possibly greater sensitivity of the more delayed test to forgetting (e.g., Gregg 1975), so that any low-functioning subjects, as well as schizophrenics, might have shown greater forgetting. The finding of an immediate long-term memory recall deficit can also be criticized because of regression to the mean resulting from selecting subjects for IQ for matching purposes. To demonstrate that these are differential rather than generalized deficits, a matched-tasks check was used in experiment 2.

Experiment 2

This pilot experiment (fully described by Calev 1981, experiment 2) was designed to discover: (1) whether version 2 of the Sorting Consistency Task is as capable as version 1 of ameliorating the recall deficits of mildly disturbed schizophrenics; and (2) whether the postencoding deficits of experiment 1 are present when a matched-tasks methodology is used.

Method

Subjects. Eleven severely disturbed and 10 mildly disturbed male schizophrenics took part in the experiment. The severely disturbed patients closely resembled the patients studied in experiment 1. The mildly disturbed patients differed from them in having in their past records at least three instead of at least four of Schneider's first-rank symptoms, in having partial or no hospitalization, and in having an average of total hospitalization shorter than 2 years (1.1 years). In the last aspect they were very similar to Larsen and Fromholt's (1976) patients. A larger group of 45 normal men (firemen and subject panel members) was used for the task-matching check. This working-class, middle-aged group (20-50 years of age) closely resembled the schizophrenic groups in age and intelligence.

Materials. Version 2 of the Sorting Consistency Task was used.

Procedure. In session 1 this orienting task was followed by an interpolated 5-second number-recall task, to ensure long-term processing; and then by free recall and cued recall trials, in the same way as in experiment 1. In session 2, about 24 hours later, a free recall retest was given. In addition, an intelligence measure (Quick Test, Form 1) was given to all subjects in a preliminary session, and a short form of the Wechsler Adult Intelligence Scale (1955) was given to schizophrenics at the end of session 2, to estimate the agreement of these two measures for schizophrenics. (This comparison, reported in Calev 1981, showed high agreement.)

Results

Effectiveness of Version 2 of the Orienting Task in Ameliorating the Recall Deficit in Mildly Disturbed Schizophrenics. The mean recall scores for all groups are presented in figure 3. Two separate analyses of variance comparing mildly disturbed schizophrenics with both (1) a randomly sampled normal subsample of the same size, and (2) the entire normal sample, using arcsin of proportion recalled scores, showed neither lower recall ($F = .528; df = 1.18; NS$) nor greater forgetting in mildly disturbed schizophrenics than found for normals ($F = .422; df = 2.36; NS$). So, it seems that version 2 of the orienting task was as effective as version 1 (e.g., in Larsen and Fromholt's study) in ameliorating the mildly disturbed schizophrenics' memory deficit.

Postencoding Recall Deficits in Severely Disturbed Schizophrenics. A matched-tasks check, which preceded analysis (see tables 2 and 3), showed that the last trial of session 1 (cued recall) and the first retested recall trial of session 2 (free recall) represent fairly well-matched tasks, as assessed by their reliabilities (alpha coefficients), means, shapes of
distributions, and mean item difficulty. However, there are two difficulties: (1) the retest variance is twice as large as that of the earlier test (table 3); and (2) the retest items have larger and slightly more skewed distributions than the earlier test items (table 2). It seems that these variations can indeed explain the schizophrenic greater forgetting observed in experiment 1. However, when z-scores are used, these problems are virtually eliminated for the following reasons: (1) The z-transformation equates the discrepant variances of the two tasks. (2) The reliability and the true score variance of the 11 lowest scoring normals as a group become smaller rather than larger in the retest than in the earlier test (see table 4); this suggests that the two tests are also comparable for lower scoring subjects, with which the schizophrenic performance is compared, as well as for other subjects. Thus, the data of severely disturbed schizophrenics can be analyzed using z-scores in terms of the larger normal sample mean and variance.

This ANOVA showed that severely disturbed schizophrenics (1) recalled significantly less than normals \(F = 19.052; df = 1,20; p < .0003\), and (2) forgot significantly more than normals over 24 hours \(F = 4.327; df = 1,20; p < .049; interaction\). These results (see figure 4) again suggest that severely disturbed schizophrenics have a postencoding deficit. It should be noted that an additional analysis of the data in terms of the number-of-categories and items-per-category-recalled revealed similar trends, and that in this analysis forgetting was largely due to item-per-category forgetting. It therefore seems unlikely that the lack of retrieval cues was solely responsible for the finding of excessive forgetting by schizophrenics, since these cues enhance mainly category recall. However, an additional confirmation of this point is presented in experiment 3.

**Table 2. Properties of items for the normal sample \((n = 45)\)**

<table>
<thead>
<tr>
<th>Items</th>
<th>Cued recall</th>
<th>Cued variance</th>
<th>Retest</th>
<th>Retest variance</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Animals</td>
<td>3.733</td>
<td>.973</td>
<td>3.578</td>
<td>1.522</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Insects</td>
<td>3.511</td>
<td>.937</td>
<td>3.511</td>
<td>1.876</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Furniture</td>
<td>3.444</td>
<td>.707</td>
<td>3.022</td>
<td>1.477</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Parts</td>
<td>2.844</td>
<td>1.543</td>
<td>2.133</td>
<td>2.709</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Fruits</td>
<td>3.711</td>
<td>.756</td>
<td>3.889</td>
<td>1.010</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Distributions unimodal.

2 Departures from normality \((p < .05)\).

**Table 3. Properties of tests for the normal sample \((n = 45)\)**

<table>
<thead>
<tr>
<th>Test</th>
<th>Cued recall</th>
<th>Cued variance</th>
<th>Alpha coefficient reliability</th>
<th>Estimated true-score variance</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>Item difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retest</td>
<td>20.000</td>
<td>26.273</td>
<td>.724</td>
<td>19.035</td>
<td>-.603</td>
<td>.997</td>
<td>3.333</td>
</tr>
</tbody>
</table>

1 Means and variances of numbers of words recalled.

2 Distributions unimodal.
Figure 4. Experiment 2: Mean recall for schizophrenics and normal subsample

![Image](https://example.com/image.png)

Normals.  Severely disturbed schizophrenics.

Table 4. Properties of tests for the low-normal subsample (n = 11)

<table>
<thead>
<tr>
<th>Test</th>
<th>Mean</th>
<th>Variance</th>
<th>Alpha coefficient</th>
<th>Estimated true-score variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cued recall</td>
<td>17.27</td>
<td>9.62</td>
<td>.49</td>
<td>4.71</td>
</tr>
<tr>
<td>Retest</td>
<td>17.90</td>
<td>13.29</td>
<td>.40</td>
<td>5.34</td>
</tr>
</tbody>
</table>

* Based on number of words recalled.

**Discussion**

Experiment 2 confirms the previous results that severely disturbed but not mildly disturbed schizophrenics have a postencoding deficit, even when the retest variance is decreased and matched tasks are thus obtained. However, experiment 2 also suggests that nonorganizational factors, in addition to organizational postencoding factors (e.g., structure erasure in experiment 1), may be responsible for the postencoding deficit. The following experiment had a purpose of investigating this latter question, in addition to substantiating further the above results.

**Experiment 3**

Experiments 1 and 2 are pilot studies which suggest that severely disturbed schizophrenics have a memory pathology distinct from that of mildly disturbed schizophrenics. The purpose of experiment 3 is to elucidate the nature of this deficit. It aims at repeating the above finding using another matched-task check. This replication is essential because the earlier results were obtained without the use of a very large standardization and cross-validation sample, as recommended by Chapman and Chapman (1973, 1978).

Moreover, it aims at obtaining these results with increased accuracy. Three modifications are introduced for this purpose: (1) In experiments 1 and 2 the earlier recall test and the retest differed in both (a) time of testing and (b) retrieval cues. The present experiment uses cued tests only, so that the two tests differ only in time of testing. This manipulation was also expected to reduce retest variance, so that test and retest would become more comparable. (2) In the pilot studies (experiments 1 and 2) the level of significance of the interaction showing excessive forgetting by severely disturbed schizophrenics was low after the matched-tasks manipulation (p < .049). In the present experiment, the delay between test and retest is increased from 24 to 48 hours, in an attempt to obtain more excessive forgetting. (3) The concept that severity of disturbance explains these deficits consists of (a) full time hospitalization and (b) chronicity. Chronicity can be partitioned into (a) long-term effects of institutionalization, (b) the way of reacting to this institutionalization, (c) long-term effects of physical treatment (e.g., drugs, electroconvulsive therapy), and (d) level of schizophrenic disturbance per se. Since the last component is the one of interest, components a, b, and c must be excluded as contributors to the effect. Usually investigators test the correlation between hospitalization and recall for this purpose. However, a lack of correlation between length of hospitalization and memory functioning does not prove that these factors have no effect because of (a) the small samples usually used, (b) the fact that a nonsignificant correlation does not necessarily mean no correlation, (c) the fact that the institu-
tionalization length includes a disturbance component as well as other nuisance variables, and (d) the possibility that the relationship between institutionalization and recall may be nonlinear, e.g., after 2 years of hospitalization the postencoding deficit emerges but does not increase further as length of hospitalization increases. So, it seems essential to find a control group of non schizophrenics who have a similar length of institutionalization as schizophrenics. However, no other psychiatric group except epileptics and brain-damaged patients tends to stay in hospital that long, and also nonschizophrenic patients who remain hospitalized for such long periods can be suspected of being schizophrenics. Furthermore, if a patient group that fulfills these requirements were found, it would probably have a memory pathology of its own (e.g., Breslaw, Kocks, and Belkin 1980). Thus it seems that finding a proper control group of patients is a very difficult task. Since it also appears unlikely that a control group with a similarly prolonged treatment history can be found, an attempt is made in experiment 3 to control for the institutionalization components only. A group of single combat soldiers, all privates, with little out-of-camp life, and comparable length of institutionalization to that of severely disturbed male schizophrenics, is judged to fulfill this purpose.

The final aim of experiment 3 is to determine whether the postencoding deficit of severely disturbed schizophrenics can be explained by other than organizational factors, such as structure erasure, that is, by nonorganizational factors. Recognition memory has been suggested to be such a test (e.g., Kintsch 1970; Anderson and Bower 1972). Although objections to this contention have been raised (e.g., Tulving and Thompson 1973; Mandler 1972; Watkins and Tulving 1975) and the argument is still going on, it seems that these objections are most valid when contextual variables are maximized (Koh 1978). The literature review with which this report began demonstrates that in recognition tests in which contextual variables are not maximized, mildly disturbed schizophrenics show no deficit (e.g., Koh, Kayton, and Berry 1973; for review, see Koh 1978). Only one study (Traupmann 1975) used more severely disturbed patients, and showed a recognition memory deficit in process but not in reactive schizophrenics. In the present experiment it is hypothesized that severely disturbed schizophrenics (chronic, hospitalized) are characterized by such a recognition memory deficit.

Method

Subjects. Twelve severely disturbed schizophrenic men (six of whom participated in neither of the two pilot experiments), 12 soldiers, and a larger sample of 44 firemen, all unpaid, between 20 and 50 years of age, and right-handed, took part in the experiment. The schizophrenics were inpatients in York hospitals; from a wide population of schizophrenics only those patients who fulfilled the experimental criteria were included. The patients were selected on the basis of having no observable brain damage, no hearing impairment, no psychosurgery, no mental deficiency (IQ 85 or above), no alcoholism, and no electroconvulsive therapy within a year before testing. They were all on phenothiazines and anti-parkinson medication. The first drugs are reported not to have an appreciable effect on most memory tasks (Gardiner et al. 1955; Mason-Brown and Borthwick 1957; Datson 1959; Vestre 1961; Pearl 1962; Helper, Wilcott, and Sol 1963; Koh, Kayton, and Berry 1973; Koh and Kayton 1974). However, because there are some reports showing that such medications may affect complex learning (e.g., Gillis 1975; Gillis and Parkinson 1977) or forgetting (Vestre 1961), their effect on the experimental tasks was assessed in experiment 3. All schizophrenics showed at least four of Schneider's (1959) first-rank symptoms, and met the research diagnostic criteria of Feighner et al. (1972). All were poor-pemorbid, process (age of first hospitalization did not exceed 27 years), and chronic (at least 2 years of full hospitalization), but none had a psychiatrist's diagnosis of paranoid; thus they fulfilled the criterion of genetic predisposition, unlike some acute groups (Rosenthal and Kety 1968). The combat soldiers were privates, single, had at least 3 years of service with little out-of-camp life, and were of the same age range as the schizophrenics. No subjects in the larger firemen sample or in the soldier sample were taking any drugs or had any psychiatric treatment. In the firemen sample, subjects who had higher education or an IQ above 110 (Quick Test, Form 1) were excluded. A subsample of the firemen, which most closely matched the schizophrenics' intelligence and age, was used for ANOVA to avoid the problem of unequal n. (See table 5.)

Materials. Two new word lists (nos. 4 and 5) were constructed. List 4, like list 3 (experiments 1 and 2), was constructed from Battig and Monte-gue's category norms, but it consisted of another 36 nouns, of three to seven letters each. This longer list of six categories of six words each was used to reduce bias due to slightly
lower difficulty than 50 percent accuracy which characterized list 3. List 5 was adopted from Koh and Peterson (1978). It consisted of four types of 10 target and distractor words, for a recognition task, thus having 80 words. It was chosen because it had formerly shown the traditional finding of no deficit in recognition memory in mildly disturbed schizophrenics who had a deficit in recall (Koh and Peterson 1978). Thus, it was relatively immune to criticisms that both recall and recognition are similar in nature (e.g., Tulving and Thompson 1973) and that schizophrenics may therefore show deficits in both these tasks.

Procedure. The subjects participated in two sessions. In session 1, after the administration of the Quick Test, Form 1, each subject was shown each of list 5's target words, printed on a 10.2 × 15.3 cm card, for 4 seconds, and was asked to remember it, and say it after the removal of the card. A recognition test followed. It consisted of all target and distractor words given in a random order, printed on a sheet of paper; the subject had to rate each word on a 1- to 5-point scale, to indicate how certain he was that it was or was not presented in the list. After the completion of this test, list 4 was presented. Each word was printed on a 13.8 × 7.5 cm card and the subject was instructed to sort the cards on the table into six piles of six words each, according to their meaning. The criterion of sorting consistency was a perfect match of the subject's categories with Battig and Montegue's categories. All subjects reached this criterion in one or two trials. Only two schizophrenics and one fireman needed two trials. Next, each subject was asked to give the labels of his categories, and then another eight-digit number was given to be remembered immediately after its presentation in the same way as after list 5. A recall test followed. Each subject was given an instruction sheet and asked to write down as many words as he could remember out of the words he had sorted, in any order he liked. The cues were the category labels printed on the left-hand side of the sheet with large spaces between them, in which the

Table 5. Characteristics of subjects

<table>
<thead>
<tr>
<th>Variable 1</th>
<th>Schizophrenics</th>
<th>Soldiers</th>
<th>Whole sample</th>
<th>Sub-sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>36.077</td>
<td>26.667</td>
<td>31.818</td>
<td>33.833</td>
</tr>
<tr>
<td>Mean</td>
<td>7.815</td>
<td>6.083</td>
<td>7.686</td>
<td>6.933</td>
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<tr>
<td>SD</td>
<td>23-45</td>
<td>20-41</td>
<td>20-50</td>
<td>24-44</td>
</tr>
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<td>Education (years)</td>
<td>10.500</td>
<td>10.583</td>
<td>10.636</td>
<td>10.500</td>
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<tr>
<td>Mean</td>
<td>1.527</td>
<td>1.645</td>
<td>.809</td>
<td>.522</td>
</tr>
<tr>
<td>SD</td>
<td>8-13</td>
<td>7-11</td>
<td>9-13</td>
<td>10-11</td>
</tr>
<tr>
<td>Quick Test score</td>
<td>99.615</td>
<td>99.417</td>
<td>104.909</td>
<td>100.000</td>
</tr>
<tr>
<td>Mean</td>
<td>9.858</td>
<td>9.150</td>
<td>5.713</td>
<td>6.550</td>
</tr>
<tr>
<td>SD</td>
<td>87-116</td>
<td>87-116</td>
<td>90-112</td>
<td>90-110</td>
</tr>
<tr>
<td>Range</td>
<td>8-13</td>
<td>7-11</td>
<td>9-13</td>
<td>10-11</td>
</tr>
<tr>
<td>First hospitalization 2</td>
<td>20.667</td>
<td>4.250</td>
<td>15-27</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>8.917</td>
<td>8.167</td>
<td>8.167</td>
<td>8.167</td>
</tr>
<tr>
<td>SD</td>
<td>7.394</td>
<td>5.109</td>
<td>5.109</td>
<td>5.109</td>
</tr>
<tr>
<td>Range</td>
<td>2-22</td>
<td>3-21</td>
<td>3-21</td>
<td>3-21</td>
</tr>
<tr>
<td>Hospitalization (including remission) 3</td>
<td>14.917</td>
<td>8.028</td>
<td>3-30</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>8.028</td>
<td>6.028</td>
<td>6.028</td>
<td>6.028</td>
</tr>
<tr>
<td>SD</td>
<td>3-30</td>
<td>3-30</td>
<td>3-30</td>
<td>3-30</td>
</tr>
<tr>
<td>No. of 1st rank symptoms</td>
<td>5.333</td>
<td>1.231</td>
<td>4-7</td>
<td></td>
</tr>
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</table>

1 SD is used even though no normality of distribution of variables is assumed.
2 Age in years at first hospitalization.
3 Length in years of hospitalization or service.
4 Length in years of hospitalization, including remission.
subject wrote the word he remembered for each category. Session 2 took place about 48 hours later; in this session, each subject was given exactly the same recall test as in session 1.

Results

Recall Performance:
The tests' discriminating power. To avoid possible artifacts due to unmatched tasks, the discriminating power of the test and retest recall trials was assessed. Using each category as an item and the larger normal firemen sample scores (n = 44), it was found that as predicted the tasks were indeed better matched than in experiment 2 (see tables 6 and 7). The estimated true-score variance, which differed slightly, was made very similar after transforming the arcsin of proportion scores into z-scores (.693 and .690 for test and retest, respectively; Variance Ratio: $F = 1.10$, NS).

The two tests cannot be matched in the same way for schizophrenics, since schizophrenics are expected to find the retest's items more difficult than the test's items. However, for schizophrenics, too, the variance of item difficulty is not very different for test and retest (table 7, columns 5, 6). Also, the two tests show non-discrepant reliabilities, and when their scores are expressed in the same way that the scores for the soldiers sample are, the true-score variances of test and retest differ appreciably, but not significantly (Variance Ratio Test: $F = 3.051$, NS). This suggests that schizophrenics and normals can be statistically compared on parametric tests in the same way as normals.

Schizophrenics' recall performance. The mean recall scores of these groups (44 firemen, 12 soldiers, and 12 schizophrenics) are presented in figure 5. This figure demonstrates that none of the normal groups forgot a substantial amount over 48 hours as did schizophrenics. However, the group average for the soldiers was slightly lower than that for the larger normal group. If this difference is real, it could possibly be explained by the slightly lower general level of functioning of soldiers (table 5). However, it should be noted that the performances of these two normal groups are very similar. Both groups show virtually no forgetting.

To test the significance of the differences between schizophrenics and normals, while minimizing the effects of discriminating power, all statistical comparisons used transformed z-scores. According to prior planning, all groups should have been compared. However, the soldiers group happened to have an abnormal and nonunimodal dispersion of scores, resulting in an abnormally large variance that would violate the assumption of homogeneity of variance (table 7). Therefore it was decided to compare schizophrenics with firemen only.

Of two such possible comparisons, the one using a smaller normal subsample (see Method) seemed more precise since it did not violate the equal-n principle of analysis of variance. The corresponding means for this comparison for test and retest were $-1.10$ and $-2.65$, and $-0.10$ and $0.00$, for schizophrenics and normals, respectively. The ANOVA on these scores showed that schizophrenics forgot substantially more than normals, when retested (for the interaction $F = 21.115$; $df = 1,22$; $p < .0002$). A planned comparison showed that schizophrenics recalled fewer words than normals, even when tested in the same session.
(F = 7.294; df = 1.22; p < .013). Just to confirm that these effects were not due to the specific normal subsample used (which showed a slightly better retest performance than the larger firemen sample), an alternative overlapping unequal-n ANOVA using the unweighted means solution was also performed, comparing schizophrenics to the entire firemen sample. The results of this comparison were virtually the same. They again showed greater forgetting (F = 39.268; df = 1.54; p < .0001; interaction) and lower same session recall (F = 15.976; df = 1.54; p < .0002; main effect) for schizophrenics.

As stated above, the alternative comparison between schizophrenics and soldiers violated the assumption of homogeneity of variance. However, since this is a robust assumption, and the results of the analysis were of interest, the analysis was performed as a check, using z-scores. The results of this analysis were very similar for forgetting (F = 27.088; df = 1.22; p < .008). However, the planned comparison for same session recall did not reach significance (F = 2.958; df = 1.22; p < .0995), probably due to the larger variance of the soldiers group.

Recognition Performance. To avoid the possibility of a response bias, all subjects' recognition scores were calculated using Brown and Routh's (1970) R-measure of discrimination. The mean performance of the 12 schizophrenics, the 12 soldiers, and the 32 remaining normals for the four distractor types is presented in figure 6. This figure shows that schizophrenics failed to reach the level of performance of the normal groups in any of distractor type conditions.

Before analysis, the arcsin transformation was performed on these scores. This was done because these scores reflected proportions (approximately related to ROC areas). Since soldiers did not differ appreciably from schizophrenics and their 12 normal controls in their variances, the ANOVA included these three groups. It showed that the groups differed significantly in recognition performance (F = 5.168; df = 2.33; p < .012), and that there was no effect of distractor type (F = .466; df = 1.99; NS) and no interaction (F = .611; df = 3.99; NS). Orthogonal planned comparisons indicated that this significant effect was largely due to schizophrenics performing less well than the two normal control groups (F = 7.120; df = 1.33; p < .0117), and that soldiers did not significantly differ from firemen (F = 3.253; df = 1, 33, NS).

**Figure 6. Experiment 3: Mean recognition performance for normals, normal subsample, soldiers, and schizophrenics**

Control Variables:

Performance time. Table 8 shows that sorting time, recall time, and recognition time did not confound memory performance, even though sorting time in this experiment was significantly correlated with recall performance for firemen (p < .01). However, sorting time was not treated as a confounding variable because it showed no significant differences between the groups (F = 1.869; df = 2.33, NS; ANOVA using log-transformed scores for skewed distributions).

Intrusions. Intrusions were not treated as a confounding variable because (1) the number of intrusions did not correlate with recall (r = .304, NS; and r = -.006, NS; for test and retest, respectively, for the larger firemen sample), and (2) all groups had negligible amounts of intrusions, firemen showing on average slightly more intrusions than schizophrenics (1.667 and 3.833 for test and retest versus 1.5 and 2.0, respectively).

Drugs. To check the effect of phenothiazines on the patients' memory, the drug dosages given were converted into chlorpromazine equivalents, using Davis' (1976) conversion table. The correlations between these equivalents and memory were r = .053 for the first recall test, r = -.053 for retested recall, r = .110 for the difference scores of forgetting, and r = .140 for recognition (r was used because of the distribution's deviations from normality). Thus, it seems that amount of phenothiazines does not show an appreciable effect on the memory tasks used, repeating previous findings. These results give no support for Vestre's (1961) suggested finding that forgetting can be selectively affected by phenothiazines, namely by Thorazine. Firstly, no significant correlations between memory function-
ing and drug dosages emerged. Secondly, the mildly disturbed schizophrenics of experiment 2 showed no excessive forgetting, even though they were on phenothiazine medication. Thus, it does not seem likely that even the forgetting component of the postencoding deficit of severely disturbed schizophrenics could be explained by their medication.

To check the effect of anti-parkinson drugs, the subjects were divided into those who took the drugs and those who did not. The mean recall performances for drug takers and nontakers, respectively, were 17.57 (SD = 3.552) and 16.40 (SD = 2.881) for the first test, and 10.14 (SD = 4.434) and 10.00 (SD = 4.899) for the second. The mean recognition scores were .763 (SD = .071) and .808 (SD = 0.32), respectively. Drug takers (n = 6) were compared with nontakers (n = 6) using t tests on the arcsin of the proportion recall scores. None of the differences were significant. These findings suggest that the drugs taken by patients did not appreciably affect their memory performance. However, this does not mean that there are no short-term effects of such drugs on some memory tasks, or that there are no long-term effects of drug usage on any task. The analysis only suggests that current dosages were not a confounding variable.

Length of hospitalization. If hospitalization per se has an effect on memory, even beyond the 2-year chronicity criterion used, then a significant correlation between the total length of hospitalization and memory performance would be expected. This prediction was not confirmed. For the recall tests these correlations were r = -.320 (NS) and r = -.047 (NS), respectively. For recognition they were r = -.125 (NS).

Table 6. Item characteristics 1—Normals (n = 44)

<table>
<thead>
<tr>
<th>Item no.</th>
<th>Means</th>
<th>Observed variance</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test</td>
<td>Retest</td>
<td>Test</td>
<td>Retest</td>
</tr>
<tr>
<td>1.</td>
<td>3.477</td>
<td>3.523</td>
<td>1.372</td>
<td>2.023</td>
</tr>
<tr>
<td>2.</td>
<td>3.591</td>
<td>3.432</td>
<td>1.038</td>
<td>1.228</td>
</tr>
<tr>
<td>3.</td>
<td>3.409</td>
<td>3.568</td>
<td>.712</td>
<td>1.228</td>
</tr>
<tr>
<td>4.</td>
<td>4.045</td>
<td>4.273</td>
<td>1.347</td>
<td>1.500</td>
</tr>
<tr>
<td>5.</td>
<td>3.614</td>
<td>3.773</td>
<td>1.033</td>
<td>1.668</td>
</tr>
<tr>
<td>6.</td>
<td>3.795</td>
<td>3.955</td>
<td>1.608</td>
<td>1.393</td>
</tr>
</tbody>
</table>

1 All distributions unimodal.
2 Deviation from normality (p < .05).

Table 7. Test characteristics

<table>
<thead>
<tr>
<th></th>
<th>Firemen (n = 44)</th>
<th>Soldiers (n = 12)</th>
<th>Schizophrenics (n = 12)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test</td>
<td>Retest</td>
<td>Test</td>
</tr>
<tr>
<td>Mean</td>
<td>22.227</td>
<td>22.591</td>
<td>20.500</td>
</tr>
<tr>
<td>Alpha coefficient (reliability)</td>
<td>.693</td>
<td>.690</td>
<td>.898</td>
</tr>
<tr>
<td>Estimated true-score variance</td>
<td>11.665</td>
<td>14.671</td>
<td>38.786</td>
</tr>
<tr>
<td>Estimated true-score variance (after z-score transformation)</td>
<td>.693</td>
<td>.690</td>
<td>2.304</td>
</tr>
<tr>
<td>Mean item difficulty</td>
<td>3.643</td>
<td>3.752</td>
<td>3.403</td>
</tr>
<tr>
<td>Variance of item difficulty</td>
<td>.054</td>
<td>.099</td>
<td>.212</td>
</tr>
<tr>
<td>Skewness</td>
<td>-.169</td>
<td>.226</td>
<td>.604</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>.416</td>
<td>.750</td>
<td>-.472</td>
</tr>
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</table>
Thus, it seems that length of hospitalization is not a confounding variable for these chronic patients, even though it affects memory through the factor of severity of disturbance (e.g., more chronic patients performed less well than more acute patients in experiment 2).

Age of first hospitalization. The age of first hospitalization of patients, though regarded as an index of severity of disturbance, did not correlate significantly with the amount remembered. The Spearman rank order correlations were .107, and -.196 for the two consecutive recall tests, respectively; and -.030 for recognition. This result, though based on few subjects, suggests again that the relative severity of disturbance within a chronic group does not affect memory appreciably.

Age. The age variations within the limited range of ages used did not correlate significantly with memory. The correlations for the two consecutive recall tests were $r_s = -.253$ and $r_s = -.127$, respectively, for the entire firemen sample, $r_s = -.030$ and $r_s = .087$ for soldiers, and $r_s = -.232$ and $r_s = .117$ for schizophrenics. Also, age did not correlate significantly with recognition performance. The correlations for these three groups were $r_s = .143$, $r_s = .184$, and $r_s = .057$, respectively.

Intelligence. Similarly, IQ variations did not correlate significantly with recall. The correlations were: for the 44 firemen, $r_s = .115$ and $r_s = -.199$ for the two recall tests, respectively; for soldiers, $r_s = -.312$ and $r_s = .067$; and for schizophrenics, $r_s = .005$ and $r_s = .232$, respectively. For total recognition performance, the correlations with IQ were $r_s = .144$, $r_s = .065$, and $r_s = .251$ for these three groups, respectively.

General Discussion

The results of experiment 3 confirm the suggestive evidence from experiments 1 and 2 for a postencoding memory deficit in severely disturbed schizophrenics. Like mildly disturbed schizophrenics, severely disturbed patients show an encoding deficit in establishing an adequate mnemonic organization (experiment 1); but unlike mildly disturbed patients, they are also characterized by the following: (1) a lower recall performance, even after an adequate mnemonic organization has been established at the encoding stage (experiments 1, 2, and 3); (2) after a long period of time (24 or 48 hours) a lesser likelihood of retrieving well-encoded information (experiments 1, 2, and 3); and (3) a recognition memory deficit, which could be indicative of a nonorganizational cause for their postencoding recall deficit. Thus it seems clear that severely disturbed patients have a memory pathology distinct from mildly disturbed schizophrenics.

The postencoding deficit is not likely to reflect a generalized deficit (e.g., Chapman and Chapman 1973, 1978; Blaney 1978); the matched-tasks checks exclude the possibility that the observed excessive forgetting resulted from differences in the tasks' discriminating power, and reduce considerably the chance that the patients' lower recall was a result of regression to the mean.

Experiment 3 leaves no doubt that it is the passage of time per se, and not the lack of retrieval cues at the retest, that accounts for the schizophrenic excessive forgetting. When the time delay was increased from 24 to 48 hours, that level of forgetting, which was not due to task sensitivity, was no longer marginally significant ($p < .049$ in experiment 2 vs. $p < .0002$ in experiment 3). Similarly, institutionalization per se does not seem to cause these deficits. A correlation between institutionalization and recall performance was not observed in any of the three studies, and "institutionalized" soldiers failed to show a postencoding deficit.

Although the finding of a postencoding deficit seems novel, several other studies support it. Firstly, Traupmann (1975) reported such a recognition memory deficit in process but not in reactive schizophrenics.

Table 8. Spearman's rank-order correlations between time variables and memory test performance

<table>
<thead>
<tr>
<th>Times</th>
<th>Tests</th>
<th>Firemen ($n = 44$)</th>
<th>Soldiers ($n = 12$)</th>
<th>Schizophrenics ($n = 12$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sorting time</td>
<td>Recall test</td>
<td>.626$^*$</td>
<td>.115</td>
<td>-.246</td>
</tr>
<tr>
<td>Sorting time</td>
<td>Recall retest</td>
<td>.451$^*$</td>
<td>.005</td>
<td>-.306</td>
</tr>
<tr>
<td>Recall time</td>
<td>Recall test</td>
<td>-.016</td>
<td>.310</td>
<td>-.144</td>
</tr>
<tr>
<td>Recall time</td>
<td>Recall retest</td>
<td>-.094</td>
<td>.500</td>
<td>-.425</td>
</tr>
<tr>
<td>Recognition time</td>
<td>Recognition test</td>
<td>-.186</td>
<td>.400</td>
<td>.431</td>
</tr>
</tbody>
</table>

$^*$ Significant ($p < .01$).
Secondly, the results of Koh and Murphy (1980; described by Koh et al. 1981) can suggest a lower than normal recall, even after effective encoding, by more severely disturbed schizophrenics. Thirdly, Gladis' (1967) results showing excessive forgetting by schizophrenics, and Hull's (1917) and Shaw's (1961) contradictory results could perhaps be explained by the types of subjects used in each of these studies. However, since these studies did not give details about their selection of subjects, it is difficult to reach such a conclusion. Yet, it seems that the distinct memory pathology of more severely disturbed schizophrenics has been recognized in the past.

Explaining the Postencoding Deficit

It has long been considered that factors not necessarily of the encoding stage, such as lack of motivation (e.g., Sullivan 1928; Cameron 1938; Haley 1959; Johnson 1974), a generalized lowering in performance (e.g., Kraepelin 1919; Chapman and Chapman 1973; Crow and Mitchell 1975), or a retrieval failure (e.g., Koh and Kayton 1974; Barker 1977), may affect schizophrenic memory performance. However, these factors cannot explain a deficit in severely but not in mildly disturbed schizophrenics. Instead one has to look for explanations based on qualitative differences between these two patient groups.

Severely disturbed schizophrenics differ from mildly disturbed patients in being chronic. Chronic patients are expected to be more aroused and have narrowed attention (e.g., Venables and Wing 1963; Venables 1964). In these circumstances larger interference from internal sources, such as hallucinations and delusions, and greater susceptibility to output interference (e.g., Bauman and Kolynsk 1976), response interference (e.g., Broen and Storms 1977), or retroactive interference (e.g., Menon, Mazundar, and Menon 1976) seem more likely explanations. Such excessive interference may prevent the retrieval of well-encoded and organized information, and may even result in an excessive erasure of formerly established categorical structures (experiment 1). The abnormally narrowed attention of chronic schizophrenics may cause disattending or attending away from the recall task demands, and so they are likely to recall less information, and organize their recall output less well than normals (as in posthypnotic amnesia; e.g., Spanos and D'Eon 1980). Also chronic patients tend to be more withdrawn, mute, and to show little florid symptomatology. As such, chronic schizophrenia may even be taken to represent a distinct disease (e.g., Crow 1980). The symptomatology of chronic patients makes them less cooperative and less motivated (e.g., Sullivan 1928) than mildly ill patients. This may result in lowered recall performance, at any information processing stage, including postencoding stages, in chronic patients. Despite the plausibility of these hypotheses for explaining the verbal memory deficits of severely disturbed patients, they cannot be treated with great certainty. Firstly, Venables and Wing's (1963) findings were not always replicated. Secondly, the concept of arousal, which is essential to these hypotheses, has been criticized as oversimplified; there are different types of arousal (e.g., Lacey 1967), which occur in different brain structures (Routtenberg 1968; Broadbent 1971). Although this criticism of the arousal concept does not exclude other possible explanations for chronic schizophrenics' deficits (e.g., excessive susceptibility to interference), it leaves other speculations as plausible alternatives.

For example, it is important to note that these memory deficits can be regarded as amnestic symptoms. Whereas the encoding deficit, observed in both mildly and severely disturbed schizophrenics, can be characterized as a learning deficit like anterograde amnesia, the postencoding, possibly nonorganizational deficit observed only in severely dis-
turbed schizophrenics can be described as a deficit in recalling encoded information, more like retrograde amnesia (e.g., Horel 1978; Wickelgren 1979). The principle "no retrograde amnesia without anterograde amnesia" (e.g., Wickelgren 1979), when applied here, means that severely disturbed schizophrenics who have a postencoding deficit will also show difficulty in encoding; and that mildly disturbed schizophrenics who have an encoding deficit do not have to show a postencoding deficit.

This characterization of these deficits leads to speculations about their causation in schizophrenia. One possibility is that they are associated with dysfunctions at certain brain structures that are also involved in amnesia. For example, a dysfunction in the hippocampus has been suggested both in schizophrenia (e.g., Mednick 1970; Kessler and Neale 1974; Venables 1981) and in human amnesia (e.g., Isaacson and Pribram 1975; Olton, Becker, and Handelmann 1979). Moreover, it has been suggested by Wickelgren (1979) that a mild hippocampal dysfunction may result in a "chunking" or encoding deficit, while severe hippocampal dysfunction may be concomitant with an inability to recall previously encoded or chunked material. Thus, if severely disturbed schizophrenics have a more severe hippocampal dysfunction than mildly disturbed schizophrenics, it could explain their specific memory pathology. However, data to support the latter assumption are lacking, so that any suggestion that a hippocampal dysfunction accounts for the different memory pathologies of these two schizophrenic groups must be purely speculative.

A second possible explanation for these deficits involves the effects of drugs. The negative findings as to the effects of drugs on current memory performance do not exclude the possibility that there is an accumulative effect of excessive and prolonged treatment (e.g., drugs, electroconvulsive therapy) on memory. Since severely disturbed patients spend more time in hospitals than mildly disturbed patients, the former patients are more likely to suffer from such a disability than the latter. Therefore, a permanent brain dysfunction or damage—not necessarily in the hippocampus—such as enlarged ventricles (e.g., Crow 1981) could explain these verbal memory postencoding deficits. This possibility seems tenable in view of physiological and dementia oriented studies on schizophrenic memory (e.g., Crow and Mitchell 1975; Crow and Stevens 1978; Crow 1981) and the possible long-term effects of electroconvulsive therapy on memory (e.g., Freeman, Weeks, and Kendell 1980). However, further research is needed to establish the specific links between dysfunctions at specific brain structures and these memory deficits in schizophrenia.

In conclusion, the present article presents evidence for distinct memory pathologies in severely and mildly disturbed schizophrenics. Because these distinct pathologies resemble amnesias, a neurological cause for these deficits seems possible. There is a need for research into memory processes which may be common to amnesics and schizophrenics. Such research could be revealing if the investigators who have suggested that some schizophrenic behavioral abnormalities may be secondary to memory problems (e.g., Koh 1978) or to an associative disturbance (e.g., Bleuler 1950) are correct.

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The Authors

Avraham Calev, D.Phil., is Senior Clinical Psychologist and Honorary Research Fellow, Department of Psychiatry, The University of Manchester, West Didsbury, Manchester, England. Peter H. Venables, Ph.D., D.Sc., Professor, and Andrew F. Monk, Ph.D., Lecturer, are in the Department of Psychology, University of York, York, England.