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Schizophrenia Research 41 (2000) 431–445

SCHIZOPHRENIA RESEARCH

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Memory and organizational strategies in chronic and acute schizophrenic patients

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Received 8 September 1998; accepted for publication 16 April 1999

Abstract

The memory profile of acute and chronic schizophrenic patients was examined according to the information processing model, with which encoding, retention and retrieval processes of these patients were compared. The effects of an external organizational strategy on their verbal learning and memory were also examined. Twenty chronic and 20 acute schizophrenic patients were tested with a list learning task consisting of a random (i.e., words presented randomly) and a blocked (i.e., words presented in clusters) word-list. The schizophrenic patients, as compared with age- and education-matched normal control subjects, demonstrated impaired learning, and the duration of their illness was not a significant factor in the severity of their learning impairment. However, the acute and chronic schizophrenic patients seem able to retain most of the newly acquired materials, regardless of the presentation format, after 30 min. In addition, the learning and subjective organizational strategy of the chronic patients, but not that of the acute patients, improved significantly by the blocked presentation. However, semantic organization could facilitate both the chronic and acute schizophrenic patients to retain more newly learned items

Keywords: List-learning; Schizophrenia; Semantic organization; Verbal memory

1. Introduction

The information processing model has been one of the most common theoretical frameworks applied to investigate the mechanisms underlying memory. According to this model, learning can be divided into three stages: acquisition, storage and retrieval. First, acquisition is commonly measured by using a learning measure, such as free recall of a word-list over one or multiple trials. Second, storage is typically measured by recall and/or recognition trials over various delayed intervals of, e.g., 10 and 30 min. Third, retrieval is typically evaluated by comparing the subjects' performance between free recall and recognition tasks.

While extensive studies have documented verbal memory impairments in schizophrenic patients (Clare et al., 1993; Kareken et al., 1996; Paulsen et al., 1995; Stirling et al., 1997), some studies were also conducted to examine the underlying nature of the verbal memory impairment. Nearly all empirical studies on memory in schizophrenic patients have demonstrated impaired acquisition of information (Brebion et al., 1997; Koh, 1978;

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0920-9964/00/$ - see front matter
PII: S0920-9964(99)00078-X

Levin et al., 1989; Traupmann, 1980). Similarly, the majority of the studies (but see Calev et al., 1983) found that patients with schizophrenia demonstrated impairment on various recognition tasks when compared with normal individuals, although their performance on the recognition tasks is usually better than on the recall tasks (Koh, 1978; Goldberg et al., 1989; Paulsen et al., 1995; Brebion et al., 1997; Gold et al., 1992). It should be noted that different performance between free recall and recognition was not unique to patients with schizoprehenia. Patients with other etiologies, such as frontal dysfunction (Janowsky et al., 1989) and subcortical lesion (Delis et al., 1991), also demonstrated a similar profile. However, results on retention in schizophrenic patients were somewhat inconsistent. While some studies reported intact retention in schizophrenic patients (Goldberg et al., 1989; Paulsen et al., 1995; Brebion et al., 1997; Wexler et al., 1997), others found their storage of information to be defective (Calev et al., 1983; Tamlyn et al., 1992; Clare et al., 1993).

The memory profile of schizophrenic patients with various durations of illness has remained unclear, given that the majority of studies on memory deficit in schizophrenia recruited either chronic (Gold et al., 1992; McKay et al., 1996; Nathaniel-James et al., 1996) or acute (Hoff et al., 1992; Kareken et al., 1996; Sweeney et al., 1991; Taylor and Abrams, 1984) patients. Although some studies recruited schizophrenic patients with various durations of illness (Heaton et al., 1994; Huron et al., 1995), the level of chronicity was not examined as a factor of their memory deficit. A study conducted by Tamlyn et al. (1992) showed that there was a tendency for chronic patients to perform less well than acute patients in the Rivermead Behavioural Memory Test (RBMT), and this result suggested that memory impairment may be significantly associated with chronicity of the illness. Hence, one purpose of the present study was to examine the memory profile of acute and chronic patients according to the information processing model in which encoding, retention and retrieval processes of these two groups of patients would be analyzed and compared.

Organizational strategies are important in learning and memory. The significance of organization and grouping was made obvious initially by Miller (1956). Miller has demonstrated that the capacity of humans to process information is limited to 7 items plus or minus 2. With this limitation, only increasing the amount of information each item contains can enrich memory capacity. In order to do so, information can be reorganized or recoded into new items or chunks (Miller, 1956). The ability to organize the to-be-learned information seems to be spontaneous. When subjects were presented with a word-list consisting of examples from four categories randomly for free recall, there was a tendency for subjects to recall items of the same categories together (Bousfield, 1953). Since Bousfield (1953) demonstrated the categorical clustering in free recall, many studies have shown that this organizational strategy can facilitate learning and memory (Bower, 1972; Mandler, 1967; Moely, 1977; Wood, 1972).

Some studies were conducted to examine the effectiveness of external organizational strategy (e.g., blocked presentation) to facilitate the learning and memory of individuals who have exhibited impaired spontaneous organizational abilities at encoding. It was reported that patients with frontal lobe dysfunction (Stuss et al., 1994), depression (Weingartner et al., 1981a), traumatic brain-injury (Levin and Goldstein, 1986) and Parkinson's disease (Hart et al., 1992) could recall more words that were presented in cluster than in random order. However, the recall of patients with progressive idiopathic dementia did not benefit by the blocked presentation (Weingartner et al., 1981b).

Patients with schizophrenia also demonstrated impaired categorical clustering in list-learning (Kareken et al., 1996; Paulsen et al., 1995). However, relatively little is known on the effect of experimenter-provided organizational strategy on verbal learning and memory in schizophrenic patients. Gold et al. (1992) studied a group of schizophrenic patients, with on average 12.67 years duration of illness, on learning three word-lists. One list consisted of semantically related words presented in random order (i.e., unblocked list), and another list was composed of concepts of the same category that were presented in clusters (i.e., blocked list). They reported that schizophrenic

patients recalled significantly fewer words than their age- and education-matched counterparts in all three conditions. However, the recalls of patients were significantly improved by the blocked categorized presentation, that is, they recalled significantly more words in the blocked than the random condition. Although Gold and his colleagues' findings suggested that schizophrenic patients benefit from external categorical organizational strategy, there are some issues remaining to be addressed. First, given that Gold and his colleagues studied schizophrenic patients at the relatively chronic stage, it is unclear as to whether the same results would be observed in acute patients. Second, though Gold and his colleagues reported a positive effect of blocked presentation on learning, it is unclear whether this effect can sustain a delay. Another purpose of the present experiment is to examine the effect of external organizational strategy on the learning, retention and recognition of schizophrenic patients at the acute and chronic stages.

2. Method

2.1. Participants

The demographic characteristics of the participants are given in Table 1. Forty patients meeting DSM-IV criteria for schizophrenia were recruited from the Prince of Wales Hospital and Shatin Hospital. There were 20 schizophrenic patients (11 men and 9 women) at the acute stage, and another 20 (11 men and 9 women) at the chronic stage. It should be noted that as unified definitions concerning the chronicity of schizophrenic illness are lacking, acute and chronic schizophrenic patients were defined according to both the nature of active symptoms and duration of illness. Subjects with acute schizophrenia were selected according to the following criteria. Firstly, the patients were admitted to the acute psychiatric unit with exacerbation of positive symptoms. Secondly, their duration of illness was less than 5 years. Subjects with chronic schizophrenia were selected with the following criteria. Firstly, the patients were admitted to the rehabilitation or long-stay inpatient facilities. Secondly, prominent negative symptoms were present. Thirdly, duration of illness was more than 5 years. Duration of illness for 5 years was taken as a reference in our study to make sure that patients belonging to the chronic schizophrenic group were the core patients with long-term illness.

All patients were assessed clinically for stability of mental condition before being subjected to memory assessment to minimize biases due to active psychotic symptoms. A Chinese version (Chan and Lai, 1993) of the Brief Psychiatric Rating Scale (Overall and Gorham, 1962) was used to measure the psychiatric symptoms of schizophrenic patients (Table 1). The total score

Table 1
Background information for young normal controls (YNC), middle-age normal controls (MNC), acute schizophrenic patients (ASP) and chronic schizophrenic patients (CSP)

Characteristic	Normal participants				Schizophrenic patients			
	YNC ($n=20$)		MNC ($n=20$)		ASP ($n=20$)		CSP ($n=20$)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age (years)	26.5	(8.1)	34.4	(9.7)	24.1	(6.4)	33.5	(7.7)
Education (years)	11.3	(2.1)	10.6	(2.2)	10.1	(1.8)	10.4	(1.1)
Age of onset of illness (years)					21.7	(6.9)	22.5	(7.8)
Duration of illness (years)					2.6	(1.5)	10.6	(6.1)
Total duration of hospitalization (months)					8.0	(10.1)	20.5	(26.2)
Brief Psychiatric Rating Scale (BPRS)					27.1	(11.1)	27.1	(10.5)
Positive Symptom Scale of the BPRS					14.6	(5.8)	16.0	(7.1)
Negative Symptom Scale of the BPRS					12.5	(6.4)	11.1	(4.0)

and five factor scores (Overall and Beller, 1984) suggested that the schizophrenic patients manifested relatively few psychiatric symptoms.

These patients represented a convenient sample recruited from both hospitals. They were consecutive admissions. As they constituted most of the patients who gave an informed consent, they were representative of the population of schizophrenic patients who are hospitalized. Exclusion criteria for recruiting the patients included age older than 65 years, personal or family history of major neurological disorders, significant history of head injury, known learning disabilities, recent electroconvulsive therapy during the past 6 months. The chlorpromazine equivalent dosages of the various types of neuroleptics taken by the patients at the acute (254.41 mg) and chronic (358.15 mg) stages were not significantly [$t(31)=1.90$, n.s.] different.

Given that the patients at the acute stage (ASP) were significantly younger than the patients at the chronic stage [CSP; $F(1, 39)=17.46$, $p<0.001$], a group of 20 young normal controls (YNC) and 20 middle-aged normal controls (MNC) were recruited. There was no significant difference in terms of age between ASP and YNC [$F(1, 39)=1.12$, n.s.] as well as between CSP and MNC [$F(1, 39)=0.09$, n.s.]. In addition, the four groups of participants were not significantly different in their years of education [$F(3, 79)=1.57$, n.s.]. The normal controls were selected from volunteers on the hospital staff and by advertising, and they reported no current or recent psychiatric history, alcohol abuse or drug addition. All participants were Chinese native speakers.

2.2. Materials

The Hong Kong List Learning Test (Chan and Kwok, 1999), a newly developed neuropsychological assessment in Hong Kong, was used for the assessment. The list for the random presentation condition consisted of 16 two-character Chinese words, with four items from each of four categories: *furniture*, *vegetable* (both are concrete objects); *relative* and *country* (relatively abstract nouns). The words were arranged randomly with the condition that no two items from the same category were presented consecutively. For the blocked condition, there were another 16 two-character Chinese words from four categories: *clothing*, *flower* (concrete objects); *music* (e.g., folk songs and opera) and *occupation* (relatively abstract nouns). These items were organized into clusters based upon the categories. It should be noted that the words of the lists were not randomized in the two conditions, that is, list A was always used in the random condition and list B was always used in the blocked condition. This design was less than ideal as an experimental test, as the word lists are confounded with condition. However, as we intended to develop the Hong Kong List Learning Test as a clinical assessment, fixing the order of the word-lists will help to maintain standardization of this clinical assessment.

Attempts were made to match the level of typicality, frequency, and difficulty of the word-lists. All items were within the frequency rank of 10–35 in the norms provided by Jeng et al. (1973), suggesting that the items were of mid-level frequency in the category. In a pilot study, the two lists were presented, both in random order, to 10 college students. As no significant difference was found between the number of items recalled from the two lists, the lists were likely to be matched in terms of their level of difficulty for comprehension and learning.

For each word-list, there was a 32-item list for recognition that consisted of the 16 target words interspersed among 16 distracter items. Distracters were either from the same category as the target items (e.g., *carpet* belongs to the category *furniture* in the list) or were semantically unrelated to the targets (e.g., swimming).

2.3. Procedure

Written consent was obtained from each participant prior to the testing. In the random condition, each participant was told that a list of words was going to be read. He/she should try to remember the words. Immediately after the presentation, the participant was told to recall all the words he/she could remember in any order. The examiner marked down the responses, and did not give any feedback to the participant. The same list was

presented two more times, and the participant was reminded at every presentation to recall the words he/she could remember, including the words that he/she had already told the experimenter in the preceding trials. After the learning task, the subject was asked what method(s) he/she used to remember the words.

Without notification in advance, the participant was then required to recall the list again after 10 min (short delay) and then after another 20 min (long delay). A recognition task followed immediately after the 30 min delay trial. The 32 words were read aloud for the participant one at a time, and he/she was asked to decide if the word had been presented in the learning trials. The blocked condition followed a procedure similar to that of the random condition, except that the participant was informed, before the word-list was read, about the number of items in the list, the names of the four categories, and their order of presentation. The fixed order of presentation is necessary because if the blocked condition was presented before the random one, the subject may learn the organizational techniques prior to doing the random one. Thus, the measurement of the subjects' spontaneous organizational strategy would then be confounded with the learning effect.

3. Results

3.1. Memory profile of acute and chronic schizophrenic patients

3.1.1. Acquisition

A Group (YNC, MNC, ASP, CSP) × Trial (1–3) × Condition (random, blocked) repeated measures ANOVA was conducted to examine the total number of recalls (Fig. 1). The interaction effects of Group × Condition [$F(3, 76) = 5.9$, $p < 0.001$], Group × Trial [$F(6, 152) = 2.99$, $p < 0.01$], and Condition × Trial [$F(2, 152) = 6.87$, $p < 0.01$] were significant. The main effects of group [$F(3, 76) = 26.88$, $p < 0.01$], condition [$F(1, 76) = 46.62$, $p < 0.01$] and trial [$F(2, 152) = 271.98$, $p < 0.01$] were also significant. However, the Group × Trial × Condition interaction effect was non-significant [$F(6, 152) = 1.10$, n.s.] (Fig. 1a and b). Since the Group × Condition interaction effect was significant, the effects of group and trial on the two conditions were analyzed separately.

3.1.1.1. Random condition. Given that the Mauchly sphericity test was significant [$W = 0.88$, $p < 0.01$], the degrees of freedom on all significant results were adjusted by a Greenhouse–Geisser Epsilon of 0.89. The results showed that the Group × Trial interaction effect [$F(6, 152) = 2.39$, $p < 0.05$], and the main effects of group [$F(3, 76) = 18.87$, $p < 0.01$], and trial [$F(2, 152) = 105.41$, $p < 0.01$] were significant. The simple effect of group was then analyzed by a post hoc *t*-test with the significance level at 0.05, and the results showed that the two groups of normal participants learned significantly more words than the acute and chronic schizophrenic patients in all three trials (Fig. 1a). In addition, all four groups learned significantly more words in the second than the first trials; however, only CSP [$t(19) = 2.59$, $p < 0.05$] and YNC [$t(19) = 3.49$, $p < 0.01$], but not ASP [$t(19) = 0.92$, n.s.] and MNC [$t(19) = 1.42$, n.s.], learned more words on the third than the second trial (Fig. 1a). When comparing the performance on the third and first trials, both MNC [$t(19) = 10.31$, $p < 0.01$], YNC [$t(19) = 6.53$, $p < 0.01$], CSP [$t(19) = 5.06$, $p < 0.01$] and ASP [$t(19) = 4.54$, $p < 0.01$] learned significantly more words on the third trial than the first one.

3.1.1.2. Blocked condition. The repeated measures ANOVA on the organized list yielded similar results as that of the random list. The main effects of group [$F(3, 76) = 26.93$, $p < 0.01$] and trial [$F(2, 152) = 221.2$, $p < 0.01$] were significant. Consistent with the results of the random condition, post hoc *t*-tests revealed that both YNC and MNC learned significantly more words than ASP and CSP (Fig. 1b). However, unlike the result in the random condition, the Group × Trial interaction was not significant [$F(6, 152) = 1.91$, n.s]. All four groups learned significantly more words on the second than the first trials, and all participants performed best on the third trial.

In sum, the results suggest that whether the information is presented in a random format or an organized way, acute and chronic schizophrenic

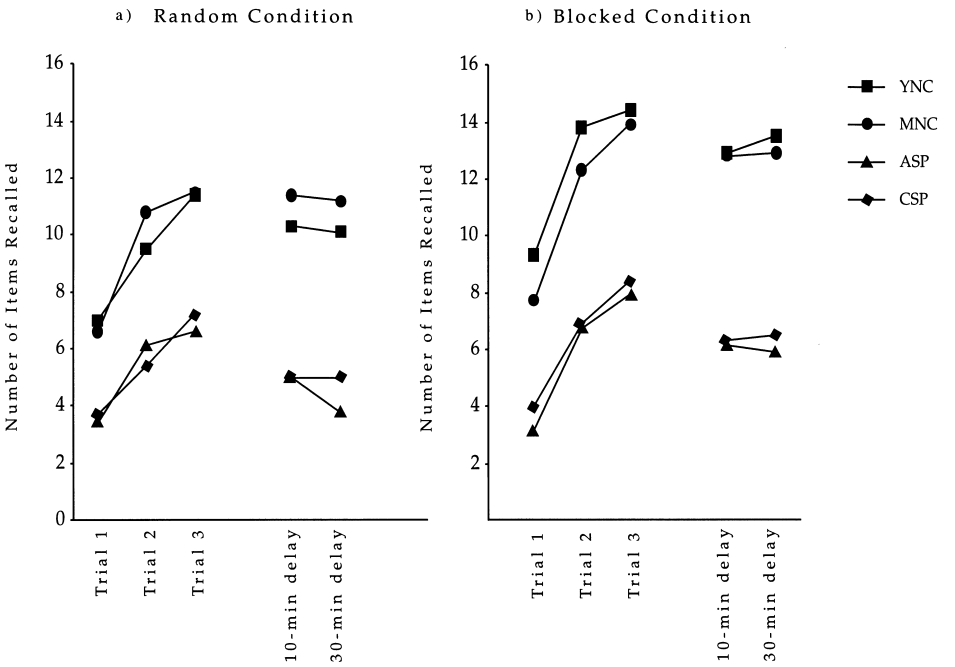

Fig. 1. (a) The number of items recalled on trials 1–3, 10 min and 30 min delay conditions for YNC, MNC, ASP and CSP in the random condition. (b) The number of items recalled on trials 1–3, 10 min and 30 min delay conditions for YNC, MNC, ASP and CSP in the blocked condition.

patients learn significantly fewer words than do normal control participants. In addition, schizophrenic patients at the chronic stage do not seem to have poorer learning and memory than those at the acute stage.

3.1.2. Retention

A repeated measures ANOVA was conducted on the number of words recalled with group as the between-subject factor, and delay (10 min, 30 min) and condition (random, blocked) as within-subject factors (Fig. 1). The results indicated significant interaction effects of Group × Delay [$F(3, 76)=2.91$, $p<0.05$] and Condition × Delay [$F(1, 76)=8.34$, $p<0.01$], but the Group × Delay × Condition [$F(3, 76)=0.77$, n.s.] and Group × Condition [$F(3, 76)=1.22$, n.s.] interaction effects were not significant. The main effects of group [$F(3, 76)=29.71$, $p<0.001$] and condition [$F(1, 76)=31.42$, $p<0.001$] were also significant but the main effect of delay [$F(1, 76)=0.88$. n.s.] was not. Given that the Condition × Delay interaction effect was significant, the performances of participants in the two conditions were analyzed separately.

3.1.2.1. Random condition. A Group × Delay repeated measures ANOVA on the number of words recalled after the 10 min and 30 min delay trials (Fig. 1a) showed a significant Group × Delay interaction effect [$F(3, 76)=2.74$, $p<0.05$]. The main effects of group [$F(3, 76)=24.28$, $p<0.01$] and delay [$F(1, 76)=6.29$, $p<0.01$] were also significant. Post hoc *t*-tests on the simple effect of group showed that the normal participants recalled significantly more words than did schizophrenic patients in the 10 min and 30 min recall trials.

Next, the number of items recalled after a short delay was examined by comparing the difference of items recalled on the learning trial 3 and 10 min delay (Table 2). The results of a one-way ANOVA suggested that schizophrenic patients could retain as much acquired information as normal control subjects after the 10 min delay [$F(3, 79)=2.09$, n.s.]. The one-way ANOVA on the long delay condition (i.e., the difference of items recalled on

Table 2
Mean (standard deviation) of the short and long delays in the random and blocked conditions[a]

	Normal participants				Schizophrenic patients			
	YNC ($n=20$)		MNC ($n=20$)		ASP ($n=20$)		CSP ($n=20$)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Short delay:								
Random condition	1.1	(2.4)	0.2	(2.3)	1.6	(2.7)	2.2	(3.1)
Blocked condition	1.5	(1.5)	1.1	(1.8)	1.8	(2.1)	2.1	(2.1)
Long delay:								
Random condition	1.3	(2.4)	0.3	(2.5)	2.8	(2.1)	2.2	(3.1)
Blocked condition	1.0	(1.5)	1.0	(1.6)	2.0	(2.4)	1.9	(1.9)

[a] YNC = young normal controls; MNC = middle-age normal controls; ASP = acute schizophrenic patients; CSP = chronic schizophrenic patients.

the third and 30 min delay trials) showed a marginally significant difference among groups [$F(3, 79)=3.51$, $p<0.05$], but a post hoc t-test revealed no significant difference between patients and their age-matched normal control subjects. Thus both acute and chronic schizophrenic patients demonstrated a normal rate of forgetting in remembering randomly presented verbal materials.

3.1.2.2. Blocked condition. The results obtained from the blocked condition (Table 2) are consistent with those obtained in the random condition, that is, they revealed a significant main effect of group [$F(3,76)=23.83$, $p<0.01$]. The Group × Delay interaction effect [$F(3, 76)=1.14$, n.s.] and the main effect of delay [$F(1, 76)=1.48$, n.s.] were not significant (Fig. 1b). A post hoc t-test showed that YNC and MNC recalled significantly more words than ASP and CSP. Furthermore, the one-way ANOVA on the short delay [$F(3, 79)=1.03$, n.s.] and long delay [$F(3, 79)=1.87$, n.s.] conditions revealed no significant difference. In sum, acute and chronic schizophrenic patients seemed able to retain most of the newly acquired materials, regardless of the presentation formats, after 30 min.

3.1.3. Retrieval

3.1.3.1. Correct hits on the recognition task. In order to examine if the relatively poorer performance of ASP and CSP in the recall trials can be attributed to a retrieval deficit, a Group × Condition repeated measures ANOVA was applied to analyze the number of correct responses in the recognition task (Table 3). The results showed a significant group effect [$F(3 ,76)=14.68$, $p<0.01$]. The main effect of condition [$F(1, 76)=2.08$, n.s.], and the Group × Condition effect were not significant [$F(3, 76)=0.51$, n.s.]. Post hoc t-tests on the main effects of Group showed that both the YNC and MNC identified significantly more correct responses than the ASP and CSP in both the random and blocked conditions.

3.1.3.2. False-alarm errors on the recognition task. A Group × Condition repeated measures ANOVA was used to examine the false-alarm errors in the recognition task of both conditions (Table 3). The main effect of group [$F(3, 76)=2.88$, $p<0.05$] was marginally significant, and the interaction effect of Group × Condition [$F(3, 76)=1.74$, n.s.], and the main effect of condition [$F(1, 76)=0.53$, n.s.] were not significant. Schizophrenic patients have a tendency to commit more false-alarm errors than normal controls, though the difference was not significant.

3.1.3.3. Discrimination score on the recognition task. Given that the number of correct hits in the recognition task may overestimate the participant's ability to discriminate target and foil items if the participant committed many false-alarm errors (e.g., identified all items as 'target' ones), a discrim-

Table 3
Mean (standard deviation) of correct hits, false alarm and discrimination scores in the recognition task in the random and blocked conditions[a]

	Normal participants				Schizophrenic patients			
	YNC ($n=20$)		MNC ($n=20$)		ASP ($n=20$)		CSP ($n=20$)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Random condition:								
Correct hits	15.3	(0.9)	15.1	(1.2)	11.8	(3.3)	12.0	(2.8)
False alarm	0.5	(1.0)	0.5	(1.2)	1.4	(1.9)	2.3	(3.6)
Discrimination score	99.8	(0.3)	99.7	(0.4)	98.9	(0.8)	98.8	(0.9)
Blocked condition:								
Correct hits	15.3	(1.1)	15.2	(1.0)	12.6	(3.0)	12.5	(3.3)
False alarm	0.3	(0.6)	0.5	(0.9)	1.4	(2.0)	1.8	(3.8)
Discrimination score	99.8	(0.3)	99.8	(0.3)	99.1	(0.7)	99.0	(0.9)

[a] YNC = young normal controls; MNC = middle-age normal controls; ASP = acute schizophrenic patients; CSP = chronic schizophrenic patients.

ination score [(Correct hits − False alarms)/ 16×100], was calculated to correct for the possible bias due to the false-alarm errors. The results of a Group × Condition repeated measures ANOVA on the discrimination score were consistent with those for the correct hits with a significant group effect [$F(3, 76) = 14.74$, $p < 0.01$]. The main effect of condition was marginally significant [$F(1, 76) = 3.91$, $p = 0.05$], and the Group × Condition effect was not significant [$F(3, 76) = 0.57$, n.s.] (Tables 2 and 3). Given that the performances on the free recall and recognition tasks were significantly correlated ($p < 0.05$) for YNC (−0.93), MNC (−0.98), ASP (−0.40) and CSP (−0.54), the subjects' performance on the recognition task was analyzed with the long delay recall score as a co-variance variable. The group effect was almost significant [$F(3, 75) = 2.3$, $p = 0.08$].

3.1.3.4. Free recall vs recognition. Furthermore, a repeated measures ANOVA was applied to examine the number of words generated in the 30 min delayed recall trial and the number of correct hits in the recognition task. The difference scores (i.e., the number of correct hits − the number of words recalled) for YNC, MNC, ASP and CSP were 5.25 (SD = 3.8), 3.85 (SD = 2.6), 8.0 (SD = 3.3), and 7.1 (SD = 2.9), respectively. A post hoc *t*-test on the difference scores, with a higher score representing a greater improvement, showed that the improvement observed in the acute and chronic schizophrenic patients was significantly greater than that of the normal controls ($p < 0.01$).

It should be noted that the normal controls showed less improvement than the schizophrenic patients, probably due to a ceiling effect in which they had already recalled over 80% of the items. These results suggest that the relatively poorer learning and/or retention of schizophrenic patients can be improved to some extent if the task requires less effort in retrieval (i.e., recognition). Nevertheless, the performance of acute and chronic schizophrenic patients is still significantly poorer than that of normal participants in the recognition task. Thus, their memory impairment cannot be totally attributed to a retrieval deficit.

3.2. Organizational strategy and memory

3.2.1. Semantic clustering

To examine the participants' ability to utilize semantic knowledge in organizing new information, a semantic clustering score was calculated for each participant. The score was obtained by calculating the number of times two items that belong to the same category were recalled consecutively in trial 3. The maximum score was 12, with four categories and four items per category. To account

for the different number of recalls among groups, the mean scores were divided by the number of recalls in trial 3. In order to understand their ability to utilize semantic clustering spontaneously and with external cues, their semantic clustering scores in the random and blocked conditions were analyzed.

3.2.1.1. Spontaneous semantic clustering. A one-way ANOVA on the semantic clustering scores of the random condition revealed a significant group difference [$F(3, 79) = 5.05$, $p < 0.01$], and ASP have a significantly lower mean score than YMC. However, although the mean score of CSP was lower than that of MNC, the difference was not significant. The self-reports of the subjects were consistent with results of the quantitative analyses. That is, 5% of the acute and 15% of the chronic schizophrenic patients reported that they used the organizational strategy to help them learn the word-list. On the other hand, about half of the normal participants (52.5% YNC and 50% MNC) used this strategy.

Thus, acute schizophrenic patients demonstrate a significant deficit in utilizing semantic clustering spontaneously when compared with their age- and education-matched counterparts (Fig. 2).

3.2.1.2. Guided semantic clustering. In the blocked condition, the semantic clustering scores of ASP and CSP were significantly lower than that of YNC and MNC [$F(3, 76) = 8.29$, $p < 0.01$]. The chronic patients demonstrated significantly lower semantic clustering scores than MNC. In this condition probably the semantic clustering scores of the middle-aged normal control subjects increased more (31.9) than those of the chronic patients (25.9) with the external organization cues. It should be noted that *t*-tests revealed that all participants demonstrated significantly higher semantic clustering scores in the blocked condition than in the random condition.

3.2.2. Subjective organization

Individuals may prefer to organize the to-be-learned information by a subjective method (Sternberg and Tulving, 1977) rather than by the semantic organizational strategy. In order to examine the subjective organization in schizophrenic patients, the pair frequency score calculated according to the method proposed by Sternberg and Tulving (1977) was used. The score was obtained by calculating the number of word pairs recalled together in one trial that were again recalled contiguously (regardless of order) in the

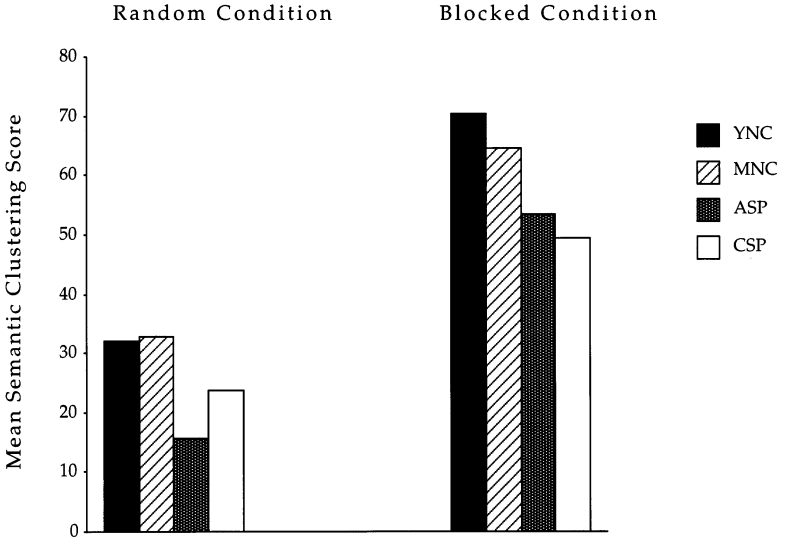

Fig. 2. The mean semantic clustering scores of YNC, MNC ASP and CSP in the random condition.

next trial. Thus, if items A, B, C, and D were recalled in trial 1, and E, A, B, D, C were recalled in trial 2, then the pair frequency score would be 2 (AB and CD). The mean pair frequency score was the average of the first (trials 1 and 2) and second (trials 2 and 3) scores.

A Group × Condition repeated measures ANOVA revealed significant effects of Group × Condition [$F(3, 76) = 13.32$, $p < 0.01$], group [$F(3, 76) = 18.45$, $p < 0.01$] and condition [$F(1, 76) = 93.81$, $p < 0.01$]. In both the random and blocked conditions, the scores of the two groups of patients were significantly lower than their age- and education-matched counterparts (Fig. 3). However, the normal control subjects and the chronic patients, but not the acute patients, had a significantly better subjective organization score in the blocked condition than in the random condition.

3.2.3. Primacy and recency effects

Primary and recency effects were considered as relatively more passive learning strategies. To evaluate whether schizophrenic patients rely more on this learning strategy, two repeated measures ANOVA were conducted. First, a score of the primacy effect (Table 4) was calculated for each participant by counting the number of the first four items in the word-list that were recalled in the third trial. This number was divided by the number of total recalls in trial 3, and then multiplied by 100. A Group × Condition repeated measures ANOVA revealed a marginally significant effect of group [$F(3, 76) = 2.84$, $p = 0.04$], but the effects of condition [$F(1,76) = 2.62$, n.s.] and of Group × Condition [$F(3, 76) = 0.78$, n.s.] were not significant. A post hoc *t*-test on the main effect of group revealed no significant difference among groups.

Second, the score of recency effect (Table 4) was obtained by counting the number of the last four items in the word-list that were recalled, divided by the number of total recalls in trial 3, and then multiplied by 100. A Group × Condition repeated measures ANOVA showed that the effect of condition [$F(1, 76) = 5.68$, $p < 0.05$] was significant, but the effects of group [$F(3, 76) = 2.17$, n.s.] and of Group × Condition interaction [$F(3, 76) = 0.64$, n.s.] were not. A paired simple *t*-test on the main effect of condition indicated that all participants recalled significantly more words at the end of the lists in the blocked than in the random conditions.

3.2.3.1. Learning and external organizational cues. The effect of the experimenter-provided

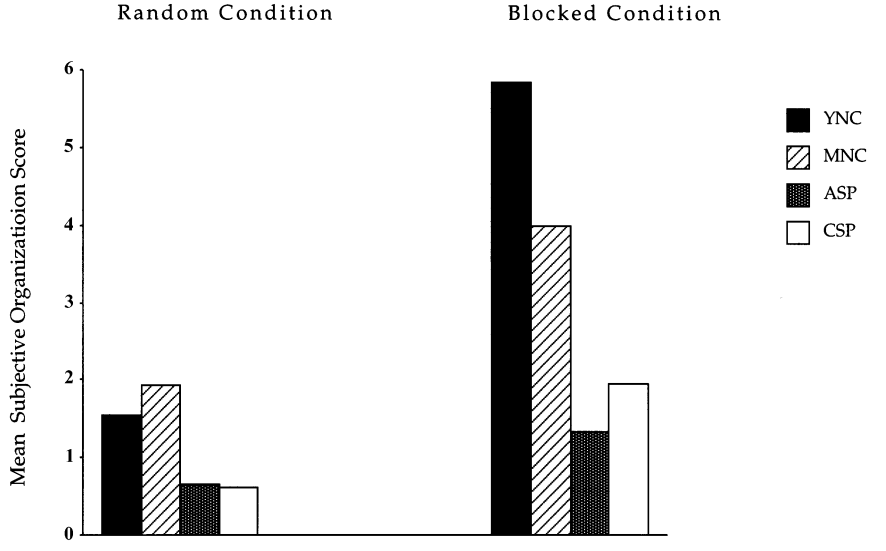

Fig. 3. The mean subjective organization scores on the learning trials of YNC, MNC, ASP and CSP in the random and blocked conditions.

Table 4
Mean (standard deviation) percentage of primacy and recency effects in random and blocked conditions[a]

	Normal participants				Schizophrenic patients			
	YNC ($n=20$)		MNC ($n=20$)		ASP ($n=20$)		CSP ($n=20$)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Primacy effect:								
Random condition	25.9	(10.5)	28.7	(9.1)	36.7	(21.6)	31.1	(15.7)
Blocked condition	25.5	(6.1)	28.7	(5.0)	30.4	(13.2)	24.7	(10.9)
Recency effect:								
Random condition	23.8	(9.9)	23.4	(11.7)	30.7	(19.3)	25.6	(15.1)
Blocked condition	27.2	(5.0)	26.5	(4.0)	34.0	(20.6)	35.4	(18.8)

[a] YNC = young normal controls; MNC = middle-age normal controls; ASP = acute schizophrenic patients; CSP = chronic schizophrenic patients.

organizational strategy on the participants' learning (total number of items recalled on trials 1, 2 and 3) was analyzed by Group × Condition repeated measures ANOVA (Table 5). The results indicated that the interaction effect of Group × Condition [$F(3, 76)=5.9$, $p<0.01$], and the main effects of group [$F(3, 76)=26.88$, $p<0.01$] and condition [$F(1, 76)=46.62$, $p<0.01$] were significant. The paired sample *t*-tests on the simple effect of condition showed that all participants, except acute schizophrenic patients, recalled significantly more words in the blocked than in the random conditions. The results suggest that the external organizational strategy helps the chronic schizophrenic, but not the acute schizophrenic patients, to learn significantly more to-be-remembered items.

3.2.3.2. Retention and external organizational cues. The effect of the external organizational strategy on retention (total number of items recalled on trials 4 and 5) was examined by a Group × Condition repeated measures ANOVA (Table 5). The results showed that the main effects of group [$F(3, 76)=29.71$, $p<0.01$] and condition [$F(1, 76)=31.42$, $p<0.01$] were significant, but the interaction effects of Group × Condition [$F(3, 76)=1.22$, n.s.] were not. A paired sample *t*-test showed that all participants retained more items

Table 5
Mean (standard deviation) of learning and retention in random and blocked conditions[a]

	Normal participants				Schizophrenic patients			
	YNC ($n=20$)		MNC ($n=20$)		ASP ($n=20$)		CSP ($n=20$)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Learning:								
Random condition	27.9	(9.6)	28.9	(7.6)	16.1	(5.3)	16.2	(5.8)
Blocked condition	37.5	(7.5)	33.8	(10.0)	17.8	(7.5)	19.3	(9.2)
Retention:								
Random condition	20.3	(8.1)	22.6	(5.8)	8.8	(5.3)	10.0	(5.9)
Blocked condition	26.4	(5.1)	25.7	(6.5)	12.0	(8.2)	12.8	(8.5)

[a] YNC = young normal controls; MNC = middle-age normal controls; ASP = acute schizophrenic patients; CSP = chronic schizophrenic patients.

in the blocked than in the random conditions, suggesting that the organizational strategy seemed to facilitate, for both acute and chronic schizophrenic patients, retention of the newly learned information for at least 30 min.

4. Discussion

A purpose of this study was to examine the learning and memory profile of both acute and chronic schizophrenic patients. Our findings suggest that both acute and chronic patients exhibited an encoding problem as measured by their performance on the immediate learning trials. These findings are consistent with a number of previous studies that examined schizophrenic patients (Brebion et al., 1997; Koh, 1978; Levin et al., 1989; Paulsen et al., 1995; Traupmann, 1980) in which prominent encoding or acquisition deficit characterized by impaired total recall across learning trials was observed in both acute and chronic patients. In addition, the schizophrenic patients in the present study demonstrated relatively intact retention ability, as measured by the 10 min and 30 min delay trials, consistent with many findings in Western countries (Goldberg et al., 1989; Paulsen et al., 1995; Brebion et al., 1997; Wexler et al., 1997). Thus, comparison of the present results with those reported in the Western countries suggests a cross-cultural similarity in memory profiles of patients with schizophrenia.

The relatively poorer performance of the schizophrenic patients when compared with their age- and education-matched counterparts in the recognition task seems to suggest that the patients may also have a retrieval deficit. However, given that the performance of the patients on the recognition task was significantly correlated with that of the recall tasks, no strong conclusion can be drawn regarding the retrieval ability of the patients with these data. In order to better understand the retrieval ability of the schizophrenic patients, further studies with longer word-lists and different numbers of learning trials for patients with schizophrenia and normal control subjects to equate the level of learning before the delay are recommended.

The association between duration of illness and neuropsychological impairment in patients with schizophrenia has been reported inconsistently. Several investigators have suggested that the progressive neuropsychological dysfunction in schizophrenia is associated with severity and chronicity of the illness (Mitrushina et al., 1996; Sweeney et al., 1991; Taylor and Abrams, 1984). Other investigators, however, have suggested that neuropsychological impairment in schizophrenia does not relate to duration of illness (Goldberg et al., 1993; Heaton and Drexler, 1987; Heaton et al., 1994; Hoff et al., 1992). Given that the acute and chronic schizophrenic patients in the present study demonstrated a similar learning and retention profile, the present results seem to suggest that memory deficit is a characteristic of schizophrenia, but this deficit does seem to progress with the illness.

Another purpose of this study was to evaluate the effect of semantic organization on verbal learning and storage function in acute and chronic patients. The learning strategies, which were measured by semantic clustering, subjective organization, primacy and recency effects, were different between acute and chronic schizophrenic patients. That is, the chronic schizophrenic patients seem to utilize semantic knowledge as much as their age- and education-matched counterparts spontaneously in learning new information (i.e., in the random condition). However, the acute schizophrenic patients were less able than the normal controls to utilize the semantic properties of the words-list to encode the to be learned information. This discrepancy is less likely due to a difference of learning strategies (e.g., not to rely on semantic organization) between chronic and acute schizophrenic patients since measures of their subjective organization, primacy and recency effects were not significantly different.

Furthermore, some researchers have suggested that an underlying semantic system remains available in chronic schizophrenic patients (Gold et al., 1992). These authors proposed that since latent semantic structure (random presentation) is not sufficient to facilitate word recall in patients with schizophrenia, semantic characteristics must be highly salient (blocked presentation) in order to

facilitate recall significantly (Gold et al., 1992). Inasmuch as schizophrenic patients do impose semantic organization on material that they encode and recall, the degree of semantic organization predicts their performance, as it does in normal controls (Harvey et al., 1986). Our findings add to our understanding that the chronic patients recalled significantly more items in the blocked condition, suggesting that they can benefit from the semantic organization strategy. However, patients at the acute stage, unlike the chronic schizophrenic patients, did not recall significantly more words with the aid of the external organizational cues. Although acute patients did not seem to benefit as much as chronic patients by the experimenter-provided learning strategy in learning new information (i.e., immediate recalls), they demonstrated better retention (i.e., a 30 min delay recall) with the organizational cues.

One possible explanation for the acute schizophrenic patients not benefiting immediately from the semantic organization may be related to the difference in the dosage of medication that is taken by the two groups of patients. It has been reported that anticholinergic medication, depending on the course of the intake, can affect cognitive processing differently (Frith, 1984; Spohn and Strauss, 1989; Paulsen et al., 1995). That is, it has been reported that long-term neuroleptic medication can improve cognitive performance, particularly on measures of attention and information processing (Spohn et al., 1977; Spohn and Strauss, 1989), whereas acute neuroleptic treatment can impair cognitive performance, especially on tests of attention and motor function (Bilder et al., 1992). In the present study, the acute and chronic patients were taking comparable doses of medication (both neuroleptic and anticholinergic medications), the only difference being that the chronic patients had been taking medication for more than 5 years. Thus, it is possible that the acute schizophrenic patients, receiving relatively shorter term treatment with neuroleptic medication, may experience slower information processing speed. Thus, they demonstrated benefit from the organizational cues when sufficient time was given for them to process the information.

In conclusion, the results of a relatively newly developed list learning test (Hong Kong List Learning Test) revealed a similar pattern of learning and memory deficits in acute and chronic patients with schizophrenia. Semantic organization seemed to be helpful for the both chronic and acute schizophrenic patients to retain the to-be-recalled items. Poor manipulation of the organizational strategy is observed in acute schizophrenic patients, and this may be explained on the basis of the duration of their medication intake.

Acknowledgements

This study was funded in part by a Chinese University of Hong Kong Direct Grant and a United College Grant. We would like to thank Q.L. Chen, Maggie Ng, Baffin Chan, Angel Choi, Anita Lee, Carol Liu, Fion Ho, Tracy Ma, Johnny Ng, Gabrielle Wong, Angela Wong, John Yip, F. H. Wong and Beeto Leung for their assistance with data collection and management.

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