VISUAL INFORMATION PROCESSING DEFICITS IN CLINICALLY REMITTED OUTPATIENT SCHIZOPHRENICS
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SUMMARY
Twenty four remitted schizophrenics and twenty four neurotic depressives were studied on three measures of visual information processing, viz., simple reaction time, choice reaction time, and a forced choice span of apprehension test. The groups were matched for age, sex, and educational status. The remitted schizophrenics performed poorly on these measures compared to neurotic depressives. The findings suggest that information processing deficits are present in outpatient schizophrenics even during clinical remission.

INTRODUCTION
Impaired attention has long been held as a prominent feature of schizophrenia (Bleuler, 1950). Deficits of attention and information processing have also been reported in the children of schizophrenic patients as compared to the children of normal parents (Asarnow et al, 1977; Nuechterlein & Dawson, 1984). Further, some of the attentional deficits tend to persist in schizophrenic patients after clinical remission (Asarnow & MacCrimmon, 1978, 1981, 1982, Miller et al, 1979). This study examines the performance of outpatient schizophrenics who have clinically recovered as compared to a group of patients with depressive neurosis on three measures of information processing viz., simple reaction time (SRT), choice reaction time (CRT) and forced choice span of apprehension test (SAT).

METHOD
Experimental Group:
Twenty four schizophrenic patients who were attending the psychiatric out-patient department of NIMHANS, Bangalore participated in the study. They were of both sexes and were between the ages of 20 and 50. All the schizophrenics were on maintenance neuroleptics (phenothiazines and butyrophenones) at doses ranging between 50mg and 800mg (median = 300mg) in chlorpromazine equivalents, with or without anticholinergics. The remission status of the schizophrenic patients was determined by the following criteria:
1. A mental status examination for a minimum of 15 minutes (carried out independently and agreed by two psychiatric consultants NJ and BNG) which revealed no active psychopathology.
2. Cross checking with Brief Psychiatric Rating Scale (Overall & Gorham, 1962) for the absence of notable psychopathology (carried out by the first author) which may be regarded as specifically indicative of schizophrenia like emotional withdrawal, conceptual disorganization, mannerisms and posturing, grandiosity, suspiciousness, hallucinatory behavior, unusual thought content and blunted affect (Gur et al, 1989).
3. Patients should have attained usual or nearly usual level of functioning in occupational/educational spheres for a minimum of 3 months, as ascertained by interviewing close relatives.

Control Group
Twenty four currently ill neurotic depressives participated in this study. They were matched with the experimental group for age, sex and educational status. Eleven patients were on antidepressants and 13 were on anxiolytics, none receiving both.
Only patients with a minimum of 7 years of formal education were included. Their diagnosis was made on the basis of ICD-9 classification (WHO, 1978). The diagnosis of schizophrenia was cross checked and confirmed on the Diagnostic Criteria for Research of ICD-10 (WHO, 1990). Patients with a history of alcoholism, drug abuse or any associated organic mental condition were excluded. None of the patients had a history of epilepsy and none had received ECT in the past six months. All patients were right handed based on the following criteria: 1) absence of familial left handedness, 2) self reported use of right hand for activities viz., eating, writing, picking up things, brushing of teeth, combing the hair, and 3) physical verification of hand preference at the time of testing.

Apparatus
The apparatus used in the administration of the information processing tests consisted of an IBM personal computer with a monochrome (14") CGA monitor and a button console consisting of five keys - four active keys placed at the corners of an imaginary square (8.5cm x 8.5cm) at the center of the console and a dummy key in the center of this square serving as the resting place. The button console was interfaced with the computer with a 48 line digital input/output card. The custom made software developed by Techno-Nivilak, Bangalore was used for the delivery of the stimulus and recording of the response. Single Arabic numerals were used as stimuli for experiment one and two. English alphabets were used for experiment three.

Procedures
The patients were seated in a semi-dark room a meter away from the screen. The visual acuity of all the patients without glasses or corrected with glasses was normal. Adequate rest was given between the experiments.

EXPERIMENT 1: (Simple Reaction Time)
The Arabic numeral '2' was displayed on the screen for 80 milliseconds. This was preceded by a cross as the fixation point for 250 milliseconds for all the trials uniformly. The luminance of the fixation field and the target stimulus was kept constant throughout the experiment. The knob controlling the luminance of the visual monitor was kept in the same position throughout the experiment for all the patients. The patient was told that a cross would appear at the center of the screen followed by the numeral '2'. The patient was asked to keep the index finger on the dummy key and was instructed to press the right lower key as quickly as possible after seeing the numeral. After 20 practice trials a total of 64 trials were given. The inter-trial interval was 5 seconds. The mean response time (in milliseconds) of the 64 trials was taken as the score.

EXPERIMENT 2: (Choice Reaction Time)

Arabic numerals 2, 3, 5, and 6 were used as stimuli. Each of these numerals was allocated to each of the four active keys in the button console. The exposure time of each numeral was 80 milliseconds. A cross serving as the fixation field preceded the numerals by 250 milliseconds for all the trials uniformly. The luminance of the fixation field and the target stimulus was kept constant throughout the experiment. The knob controlling the luminance of the visual monitor was kept in the same position throughout the experiment for all the patients. The numerals were presented in a pseudo random order, that is, random but subject to the condition that the same numeral does not repeat in immediate succession.

The patient was informed about the keys corresponding to the four numerals and was asked to press the specified key as quickly as possible after seeing the numerals. He was instructed to keep the finger on the dummy key at all other times. After 20 practice trials a total number of 64 trials were given. The inter-trial interval was 5 seconds. The mean response time (in milliseconds) of the 64 trials was taken as the score.

EXPERIMENT 3: (Forced Choice Span of Apprehension Test)

The stimulus display screen (CGA monitor) was divided into four quadrants. Arrays of 12 English alphabets (11 non-target and one target) and four blanks were randomly constructed by using an imaginary 4x4 matrix. Each of these arrays appeared in one of the four quadrants. The location of the target alphabet (T or F) in the matrix was assigned to one of the predetermined two places near the center of the matrix. Each set in this experiment called the arrays on four occasions. In two of the trials the target alphabet was T; in the other two the target alphabet was F. The quadrant in which the array appeared and the presence of T or F was random; each set had an array in each quadrant and the target alphabet F or T occurred with equal probability. Sixteen such sets were used. Hence, the target alphabets T and F appeared 32 times each. The non-target alphabets differed in each set. The exposure time of each array was 70 milliseconds. The patient was asked to fix his eyes on the screen and scan the entire array and report verbally whether it was T or F; if in doubt, he was asked to guess. The experimenter sat by the side of the patient and noted down the response. The correct number of target detections was the score of the patient. The inter-trial interval was 5 seconds.

RESULTS

Twenty four patients in each group completed all the three tests. Table 1 shows the age, sex, and educational status of the two groups. The two groups were comparable on these variables.

Table 2 shows the mean reaction time in milliseconds for the two groups on SRT and CRT. The remitted schizophrenic group had significantly longer reaction times on both these measures. (SRT: t=3.04, p=0.004; CRT: t=2.14, p=0.04). The two groups also differed significantly on the number of correct detections in SAT (t=2.5, p=0.02). The remitted schizophrenic group performed poorly on all tests.

| Variable          | Schizophrenics (n=24) | Depressive Neurotics (n=24) | Significance |
|-------------------|-----------------------|----------------------------|--------------|
| Gender            | M:F                   | 16:8                       | Chi square=0.08 p=0.77 |
| Age (Years)       | Mean(SD)              | 29.8(7.7)                  | t=0.79       |
| Education         | 12th Std & 10         | 31.9(10.5)                 | p=0.44       |
| Below 12th std    | 14                    | 13                         | Chi square=0 p=1 |

Table 2. Results of the Information Processing tests

| Tests              | Remitted Schizophrenics (n=24) | Depressive Neurotics (n=24) | Significance |
|-------------------|--------------------------------|----------------------------|--------------|
| i) Simple Reaction Time Mean (SD) | 752.4(274.1) | 535.7(217) | t = 3.04 p = 0.004 |
| ii) Choice Reaction Time Mean (SD) | 1219.4(374.8) | 1035.4(192.8) | t = 2.14 p = 0.04 |
| iii) Span of Apprehension Mean (SD) | 45.9(11.5) | 53.3(9.1) | t = 2.5 p = 0.02 |

Within the remitted schizophrenic group, the performance of the paranoid schizophrenics (n=14) was not significantly different from the non-paranoid schizophrenics (n=11) on SRT (t=1.7, p=0.18), CRT
VISUAL INFORMATION PROCESSING IN SCHIZOPHRENIA

(t=1.5, p=0.14) and SAT (t=1.8, p=0.97). Third quartile value of the performance of neurotics was computed for all the three tests. The number of schizophrenic patients who had performed poorly on the three tests was calculated keeping these values as standards.

This value was 605.7 msecs for SRT, 1164.04 msecs for CRT and 49 correct detections for SAT. The two groups differed significantly on SRT ($X^2=5.4$, $p=0.019$) and on SAT ($X^2=5.4$, $p=0.019$) but not on CRT. Nearly two out of every three remitted schizophrenics performed poorly.

The schizophrenics ($n=13$) who were on neuroleptic dose equal to or greater than 300 mg chlorpromazine equivalents and the rest ($n=11$) did not differ significantly on SRT ($t=0.58$, $p=0.56$), CRT ($t=1.14$, $p=0.27$) and SAT ($t=0.33$, $p=0.73$).

### DISCUSSION

These data indicate that deficits in information processing are detectable in schizophrenic patients in clinical remission. This is in agreement with the findings of Asarnow and MacCrimmon (1978) and Miller et al. (1979).

All the schizophrenic patients were on neuroleptics. Drug regimen is a potentially confounding variable as simple and choice reaction time tests involve motor responses; it may be argued that neuroleptics could have slowed down the performance. Available evidence suggests that chronic administration of neuroleptics does not affect the motor response (Kornetsky et al., 1959; Fredericks & Finkel, 1978). Further, neuroleptics induce no changes on simple and choice reaction time (Pearl, 1982). These studies and our own data suggest that the observed deficits are not attributable to the influence of drugs. Also, the deficits of information processing appear common to schizophrenics irrespective of the paranoid-nonparanoid distinction.

It has been reported that perceptual span is reduced both in schizophrenics and manic depressives (Strauss et al., 1984). Since we have not included a non-schizophrenic psychotic group in our study, we do not know whether the performance deficits are specific to schizophrenia or applicable to psychosis in general. This issue can be resolved by including a control group of remitted manic patients on a comparable drug regimen. Likewise, a control group of normal subjects may better reveal the deviations in remitted schizophrenics. Patients were assessed only once and there is a need to establish the stability of the measures; repeat measurements over time are desirable. Subject to these limitations, it may be concluded that deficits of information processing are present even during clinical remission in outpatients who had performed poorly on the three tests was calculated keeping these values as standards.

### Table 3. Number of patients performing below the third quartile (Q3) of the depressive neurotics.

| Tests                          | Remitted Schizophrenics | Depressive Neurotics | Significance |
|-------------------------------|-------------------------|----------------------|--------------|
| ii)Choice Reaction Time Q3=1164 Msecs | 8                       | 6                    | $X^2=0.1$    |
| iii)Span of Apprehension Q3=49 | 15                      | 6                    | $X^2=5.4$    |

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