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Information Processing in Schizophrenics

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Abstract

15 subjects each falling in the 3 groups i.e., positive schizophrenics, negative schizophrenics and normal controls were assessed for post encoding information processing deficits using analogues of the CPT. Two parts of tasks (IA, IB and 2A, 2B) were administered under CPT of which one pair required abstraction. Two types of errors were scored - omission errors (OE) and commission errors (CE). On one of the tasks (task 2B), the OE was of two types - primacy error and recency error. Findings revealed that although the two groups of schizophrenics did not significantly differ from each other, they showed significantly more deficits relative to normals at the post encoding stage of information processing namely short term money. Further, schizophrenics made more errors when the tasks involved categorization and/or an increased processing load. They also made more primacy errors relative to normals.

Key words -
Information processing,
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Information Processing,
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The presence of information processing deficits in schizophrenics has been well established with the use of several paradigms such as reaction time, visual backwards masking, dichotic listening and the continuous performance test [1]. Studies employing these paradigms have indicated that deficits lie in the early stages of information processing i.e., at the sensory register. Often, poor motivation and reduced interest on the part of the subject can by themselves account for an absence of sensory registration. Perhaps with the exception of Wohlberg and Kornetsky [2], no other study has controlled for the effect of subjects' motivation and interest on their task performance. This raises the question of whether deficits among schizophrenics have also been reported at the post encoding phase of the information processing sequence as evidenced on tasks of recall and recognition [3]. In view of this, it was thought worthwhile to explore whether deficits continue to exist at the post-encoding phase (short term memory) of the information processing chain after ensuring

registration through adequate motivation and interest in the subject.

Following the work of Andreasen and Olsen [4] interest in the area of the positive-negative symptoms distinction has increased. With a view to add to the validity of this distinction several studies of cognitive functioning in the two types of schizophrenics have been carried out, the findings of which have been equivocal and at times contradictory. One set of studies found no difference between the positive and negative symptoms schizophrenics in terms of dichotic listening [5], language production [7] and conceptual processing [8], [9]. Another set of studies found significantly more deficits among the negative symptom schizophrenics, especially the early stages of the visual information processing [10], [11] and on recall of backwards digit span [12]. Weiner et al [13], also found the negative symptom group to show more information processing deficits than the positive and mixed symptoms group, which they explained in terms of reduced processing capacity. However, Green and Waler [11] found that the positive symptoms schizophrenics showed more deficits on a forward digit span task with distraction than did the negative symptom schizophrenics. Cornblatt et al [14] concluded that poor performance on cognitive tasks among the positive symptoms schizophrenics was due to their distractibility. Further, they concluded that the negative symptoms schizophrenics showed cognitive deficits predominantly due to their reduced processing capacity. These studies thus far assessed for differences among the positive and negative symptoms group only in the early part of the information processing, sequence, and deficits at the post-encoding stage are yet to be studied. Accordingly, this study aimed to determine whether

(i) schizophrenics continued to show deficits in information processing even after stimulus registration was ensured

(ii) there were differences between the positive and negative schizophrenics in their information processing

(iii) an increase in processing load resulted in an increase in deficits especially amongst schizophrenics.

Method

Subjects : The sample consisted of 45 subjects with 15 in each of the following groups - schizophrenics with predominantly positive symptoms (the PS group), schizophrenics with predominantly negative symptoms (NS) and normal controls (NC).

Males and females between the ages of 18-45 years with a minimum of 7 years of schooling, with sufficient familiarity with Kannada to be able to read simple words were included. The schizophrenic patients had to fulfill the DSM III [15] criteria before they were included in the study groups. Patients were selected from both outpatient and inpatient psychiatric departments of NIMHANS Bangalore. Patients who had multiple psychiatric diagnoses, disputed diagnoses associated with mental retardation and or other neurological disorders, and those who had undergone Electro Convulsive Therapy during the three weeks prior to testing were excluded.

Those patients who qualified for a diagnosis of schizophrenia according to the DSM-III were then rated on the Scale for the Assessment of Positive Symptoms (SAPS) [16] and the Scale of Assessment of Negative Symptoms (SANS) [17], following which they were divided into two groups - schizophrenics with predominantly positive symptoms (PS) and schizophrenics with predominantly negative symptoms (NS). Care was taken to include only those patients who showed no switch in their clinical status from positive symptoms to negative, and from negative symptoms to positive in the past six months.

A control group comprising of 15 normal subjects were also included in the study. Only those subjects without psychiatric consultation and those who scored below the cut-off on the General Health

Questionnaire [18] were included. Subjects with a history of regular alcohol intake, neurological disorders and family history of schizophrenia were excluded.

Some of the variables that could influence performance on cognitive tests were controlled for. The three groups were matched in terms of age ($F[2,42]=1.35$, NS) and education ($F[2,42]=1.05$, NS). Further, the two schizophrenic groups did not differ from each other significantly in terms of the age of onset of illness ($t=0.66$, NS), duration of illness ($t=1.76$, NS), the dosage of antipsychotic ($t=0.48$, NS) and anticholinergic medication ($t=1.95$, NS) received.

Design and Measures

Two pairs of tasks (1A, 1B and 2A, 2B) were used which were all analogues of the Continuous Performance Test (CPT), but items were presented at a slower rate. The items were words that were short, neutral (non-emotional) and common in Kannada (the local language). All the tasks had 100 items of which the initial 10 items were used as trial items. In all the tasks, the subjects read aloud the stimulus word(s) as and when presented and thereafter responded appropriately with a 'yes' (targets 28%) or a 'no' (non target 72%). The percentage of targets in all the tasks were constant. The sequence in which the targets appeared was determined by random. Only those items which the subjects read aloud correctly before responding as per instructions were considered in scoring. Further, subjects were dropped who were so distractible that they failed to read out the words on more than 20% of the stimuli.

Task 1A:

This task involved a fixed target. The subjects were instructed that they would be presented with one word at a time belonging to three categories namely colours, names of boys and names of places. After the presentation of each word, they were required to read it aloud as soon as they could, without fail. They were also required to say 'yes' when two words from the colour category immediately followed one another and say 'no' when this did not occur.

Task 1B:

This task involved targets that varied from trial to trial. The subjects were instructed that they would be presented with one word at a time belonging to three categories namely birds, vehicles and numbers (written in alphabets eg: 'one'). They were required to read out the words aloud and respond with a 'yes' if words from the same category followed one another (eg: 2 birds, 2 vehicles, 2 numbers occurring consecutively); and with a 'no' if this did not occur.

Task 2A:

This task involved a variable target from trial to trial. The subjects were instructed that they would be presented with pairs of words at a time which they had to read aloud, and respond with a 'yes' if any word occurred on two consecutive slides, and with a 'no' if this did not occur.

Task 2B:

On this task the subjects were presented with one word at a time. They were required to respond with a 'yes' if the same word appeared on two consecutive slides (task y) or on an alternate slide, (task z) and with a 'no' if this did not occur.

Apparatus : Kinderman telefocus automatic slide projector was used. The slides were projected on to a white screen. The slides had a black background with white lettering. The dimensions of the projection were 2 feet by 1 and ½ feet within which the projected word was of four inches in height. The length of the words varied, although all of them were 10-12 inches in length. All the subjects were seated at a distance of six feet away from the screen, with the experimenter sitting behind the subject. A Nihon Kohen Auditory Stimulator (SMP-4100) was used to generate low tone bursts with a interstimulus interval of 5 seconds. This was recorded on a Bush cassette tape recorder. The tones were used as signals to alert the experimenter to initiate the slide, which the experimenter did by a remote control switch.

Procedure

Instructions were given to the subject after seating them comfortably. A trial of 10 items was presented to them before the start of each task. To control for fatigue effect, the sequence of the presentation of the tasks was determined by a latin square format in all the three groups. Between the tasks of the CPT, a five minute rest period was given for all the subjects. The entire testing session lasted a maximum of sixty minutes.

Results

Two types of a errors were scored i.e., omission errors (OE) and commission errors (CE), with reference to target and non target items on all the tasks. In order to test whether there were differences between the three groups across these tasks, a one-way analysis of variance (ANOVA) was performed for OEs and CEs separately. It was found that there were significant group differences on the types of errors across all the tasks (Table II). A further Tukey's Honestly Significantly Different (HSD) [20] test was carried out to determine the significance of difference between pairs of groups (Table III). Findings indicate that on all the tasks, the two schizophrenic groups did not differ from each other significantly; the positive schizophrenics group differed significantly from the normal controls on all tasks; and the negative schizophrenics differed from the normal controls on most of the tasks.

Table I - Sample characteristics of 30 schizophrenic and 15 Normal Control Subjects

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Table II - Omission and commission errors for the 3 study groups on the 4 tasks

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Table III - Findings of Tukey's Honestly Significantly Different Test for the 3 groups across 4 tasks

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NS = Not significant

For the purposes of determining whether the performance of the subjects deteriorated with an increase in the processing load, analysis was carried out separately for the two pairs of tasks. Thus a 2 tasks (1A, 1B) × 3 groups (NS, PS, NC) ANOVA was carried out separately for OE and CE. Results indicated that the three groups made more OEs on task 1A ($F[1,42]=5.82$, $p<0.05$). than on task 1B. The groups did not however significantly differ with reference to CEs across the two tasks. The interaction between groups and tasks did not prove significant.

A similar analyses was also carried out with reference to tasks 2A and 2B. Task 2B compared of 2 subtasks; task y and task z involving 50% of the target items each. For the purpose of analyses, they were considered as two separate tasks by multiplying the errors scores by 2. Thus, a 3 tasks (2A, 2By, 2Bz) × 3 groups ANOVA was performed. The findings indicated that all the three groups made significantly more OEs on task 2By than on tasks 2Bz and 2A ($F[2,126]=6.15$, $p<0.01$).Since no CEs were possible specifically on the subtasks y and z, an overall CE score for task 2B was obtained. A 3 groups × 2 tasks (2A, 2B) ANOVA did not reveal any significant differences. The groups × tasks interaction once again did not prove significant.

Discussion

Nature of the deficit

A striking feature of the finding is the presence of a significantly large number of both OEs and CEs on all the four tasks among schizophrenics relative to normals. This indicates that schizophrenics are less efficient information processors. The consistency of the results obtained across the four tasks reflects the robustness of this finding. Despite this being a finding which had been well established [1], [13], [14] the present finding is a significant one as the paradigm used and the processes assessed have been different. Researchers in the past have provided varied interpretations to the schizophrenics' information processing deficits. While a few investigators have pointed to a basic attentional deficit [21], a few others regard it as a short term money deficit [3]. Wohlberg and Kornetsky [2] on the other hand have accounted for the short-term memory deficit in terms of a primary attentional deficit. In our study, this was looked into. Attempts were made to ensure stimulus registration (and identification) on all the 4 tasks, and therefore required the subjects to retain in short term memory stimulus words ranging from 5 to 10 seconds. That deficits in schizophrenics on these tasks have been elicited in spite of ensuring attention, points towards a short term memory deficit, or deficits in processing capacity influencing short term memory retrieval.

Wohlberg and Kornetsky [2] have also implicated poor motivation of the schizophrenic subject as a possible explanation for the information processing deficits that they show. Poor motivation is also evidenced clinically among schizophrenics, and is often reflected during psychological testing through their "I don't know" responses, especially when the task demands are high. In our study, subjects were required to respond with only a 'yes' or a 'no' to targets and non-targets respectively, both of which involved minimal effort, thereby ensuring that the motivational factor was to a significant degree controlled. The results therefore seem to clearly suggest a post-encoding deficit, i.e., a short term memory deficit in schizophrenics.

Positive vs negative symptoms schizophrenics

The findings of studies on information processing in positive and negative syndrome schizophrenics have varied widely [5], [6], [7], [8], [9], [10], [11], [12], [13], [14]. These disparate findings could perhaps be attributed to the selection criteria employed in these studies. One drawback in these studies has been that sufficient care was not taken to select schizophrenics with positive and negative symptoms who showed no switch in their clinical status from time to time. In our study however, great care was taken to select only those patients who showed no fluctuations in their symptoms from positive to negative and vice versa, as gathered from the file data. In addition, care was taken to eliminate patients who were distractible, and attention and motivation was ensured on all the tasks. If it were true that deficits in the positive symptoms group were due to distractibility [14], then in our study they should have shown no deficits since distractibility had been controlled for. Instead, our results indicate that both the groups of schizophrenics have short term memory deficits and they did not differ from each other significantly in terms of the number of errrors. These findings are more in line with those of Allen [5], [7] and Bilder et al [6]. Indicating that schizophrenics as a group show a similar pattern of information processing deficits.

Processing load vs deficits

It was hypothesized that schizophrenics will show greater deficits on tasks involving a greater processing load. Accordingly, it was expected that schizophrenics relative to nomals will commit significantly more omission and commission errors on task 1B relative to task 1A. On the task 1A, the subjects were required to respond with a 'yes' only when two words from a predetermined category followed one another. Hence, the subjects' task was to remember instances only from one category. Further, this task involved only minimal abstraction as the subjects had to only determine whether the words fell in the predetermined category or not before responding appropriately. On the other hand, task 1B required the subjects to respond with a 'yes' when any two words from any category followed one another. Here the subjects' task was to remember all the words as any word was a potential target. Further, this task also required a more demanding degree of abstraction since the subject was required to place every word in its respective category before responding appropriately.

As was expected, both the positive and negative symptoms schizophrenics made significantly more omission errors on task 1B than on task 1A compared to the normals. Earlier workers have also demonstrated that an increase in the processing load resulted in a poorer performance on cognitive tasks among schizophrenics [8], [9], [14]. More specifically, Cornblatt et al [14] reported that increase in performance demands elicited deficits among negative symptoms schizophrenics, but not among the positive symptoms group. The findings of this study however have demonstrated that the two types of schizophrenics tend to perform uniformly poorly under conditions involving increased task demand, and even at the post encoding stage of the information processing chain.

The two groups of schizophrenics also showed a greater amount of primacy errors (on task 2Bz) relative to the number of recency errors (on task 2BA and 2By) as compared to normals. That recall deficits in schizophrenics is more often due to primacy errors has been amply demonstrated by prior research [22], [23]. In keeping with this finding, both the schizophrenic groups in this study showed more primacy errors. Tasks 2A, 2By, and 2By differed from each other clearly in terms of the inherent processing load. Of the three tasks, task 2Bz involved the maximum processing load as each item had to be retained in memory for a period of 10 seconds. Task 2A required that 2 words be retained in memory every 5 seconds, while task 2By involved the retention of one word in memory every 5 seconds. In other words, errors on task 2Bz represented primacy erors and those on tasks 2A and 2By

represented recency errors. Viewed from the processing load frame work, primacy items require more processing relative to recency items as they need to be actively rehearsed to be remembered over longer periods of time. That both the positive and negative symptoms schizophrenics made significantly more primacy than recency errors once again supports the view that schizophrenics as a whole perform poorly under conditions involving a greater processing load.

Conclusion

The findings of this study have reinforced the view that schizophrenics are less efficeint information processors. Further, by ensuring stimulus registration it was possible to localize the deficits to the post encoding phase of the information processing sequence i.e., the short term memory stage, with a use of tasks analogous to the CPT. Contrary to most research findings of the past, our results seem to suggest that the nature of information processing deficits regardless of the type of schizophrenia (positive or negative) is uniform. It was also possible to demonstrate that schizophrenics' performance deteriorates significantly under conditions of increased task demands, thereby lending support to the reduced processing capacity hypothesis in schizophrenics as a whole [13].

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