Serial Position and Mnemonic Organization in the Free Recall of Schizophrenics

Craig J Gonsalvez .

Reprints request
, Shobini L Rao,
- *Department of Clinical Psychology, National Institute of Mental Health & Neuro Sciences, Bangalore 560 029, India*

Abstract

Previous research has implicated two important factors in the recall deficit in schizophrenics: mnemonic organization and an inability to recall items occupying primacy positions in a list. The present study used ten schizophrenics and ten normals and studied the influence of both these factors in a task that required recall of lists of numbers. Lists were of three types based on the degree to which items of the list could be organized. Four different types of errors were delineated to determine whether schizophrenics were prone to a particular error-type. Results confirmed the finding that schizophrenics were deficient in recall and indicated that while decreased mnemonic organization was associated with poor performance in schizophrenia on lists that lacked organization, a serial position deficit in schizophrenia was more pervasive, and more adequately explained the results. Schizophrenics committed a greater proportion of errors in general, but were not found to be vulnerable to any particular error type.

Key words -
Information processing,
Memory,
Serial position,
Mnemonic organization,
Schizophrenia

Cognitive and language deficits in schizophrenia have always been an area of great interest, theorizing and research. Earlier theories implicated a wide variety of factors as responsible for the deficit: a disconnection of the threads of association [1], a loss of the abstract attitude [2]; over-inclusive thinking [3], and so forth. However, research support for the various positions has been equivocal, partly on account of the use of constructs too broad and ill-defined to be handled empirically.

More recently, the problem has been approached from an information processing perspective, with attempts being made to identify within the chain of information flow, the locus of the schizophrenic deficit. Consequently, memory capacities and functioning of schizophrenics have come under close scrutiny. One relatively consistent result that has emerged is that while schizophrenics are relatively adequate on tasks of recognition [4], [5], [6], [7], they evidence impaired recall of material both in a multi-trial free recall paradigm [8], [9], [10], [11], and also in an immediate recall paradigm [12], [13],

[14].

The impairment in recall has been attributed to deficient mnemonic organization, vulnerability to distraction, and a specific inability to remember the primacy items of a list. The argument for deficient mnemonic organization is based on the finding that improved organization of input material has been found to be associated with better recall in normals [5], [6], and schizophrenics have been shown to be less efficient than normals and nonschizophrenic patients in mnemonic organization [5], [8], [11], [15].

On the other hand, to support the distractability hypothesis Oltmanns and Neale [13] have shown that the deficit in schizophrenics is observed on tasks where immediate recall of digits is demanded under conditions of distraction, whereas the deficit is not evident under conditions of no distraction.

Further research, however, suggests that a specific inability to remember the first items (primacy items) in a list may be a more important factor than distractability. Oltmanns [12] found that while the recall of the last and the middle items in a word span task was adequate, schizophrenics as compared to manics and normals, showed a specific deficit in the recall of primacy items under distraction. Frame and Oltmanns [16] found similar results in a word-string recall paradigm, this time using depressive and normals as controls. Analysis revealed the impairment in recall to be the result of unrecalled primacy items and not to be the result of just distraction. Again, the deficit was specific to schizophrenics and a repeat testing of the same groups after clinical improvement showed the persistence of the deficit in schizophrenics, even though their general recall performance had improved significantly.

Further support for this position has come from research with children at risk for schizophrenia. Harvey et al [17] tested children of parents with schizophrenia, unipolar depression, bipolar disorders and no psychiatric illness. While vulnerability to distraction on a digit span task did not separate the children of schizophrenia from every other group, impaired recall of primacy items did so.

However, it is of interest to determine whether the serial position bias found in schizophrenics on tasks of immediate recall is also evident on multiple-trial recall tasks that have elicited deficits of organization. We are unaware of any such study and the present investigation is an attempt in this direction. Such a study may also throw light on other puzzling issues thrown up by the mnemonic organization data. For instance while it is true that Koh et al [5] have demonstrated schizophrenics to be impaired in subjective organization, the same study has also shown that for schizophrenics correct recall is poorly correlated with indices of subjective organization (r= .35 and .39 for categorizable and uncategorizable lists respectively) unlike that of normals (r= .63 and .69) and non-schizophrenic patients (r=.66 and .68). If it is not mnemonic organization that substantially accounts for the correct recall of schizophrenics is it the bias to remember only recent items - as the data of Oltmanns and his associates [12], [13], [14] would suggest, and as the immediacy hypothesis of Salzinger [18] would imply?

It is also unclear whether the schizophrenic deficiency in mnemonic organization is particular to verbal material, or whether it extends to the encoding of other types of material like numbers. For this reason and also to avoid the varying affective and associative values of words that is difficult to control experimentally, we used numbers as recall material.

Furthermore, the nature of errors in memory data has been insufficiently researched, though the extension of several theories would indicate the vulnerability of schizophrenics to a particular error-type. The hypothesis that schizophrenics are hypersensitive to distraction, for instance, would predict that they incorrectly reproduce a greater degree of distractors or intrusion errors (presuming the source of distraction is external), or that they evidence a greater degree of idiosyncratic errors (presuming the source of distraction is internal and self-generated). Similarly, a continued presistence of the same error would be in consonance with the perseverative-chaining model of schizophrenic speech [19].

Hence the present investigation delineated four different types of errors: errors of approximation (closely resembling the correct item), errors of intrusion, errors of perseveration, and idiosyncratic errors. It was hypothesized that errors in normals would fall predominantly in the first category while those of schizophrenics would fall in any or a combination of categories.

Materials and Method

Subjects

The sample consisted of 10 male schizophrenics and 10 male normals. Outpatients whose case-records bore a diagnosis of schizophrenia and attending the psychiatric clinic at the National Institute of Mental Health & Neuro Sciences, Bangalore, were selected. Cases that bore multiple diagnoses, and cases that bore a subtype classification of paranoid, latent, residual or schizoaffective sub-typing, or where uncertainty about the diagnosis were mentioned were excluded. Patients with a history of epilepsy, regular alcohol or drug use were also excluded. The sample therefore included only non-paranoid and non-chronic (for the purposes of the study defined as patients who were never continually ill for two or more years) schizophrenics. They had duration of illness ranging from 2 to 22 months (Mdn=9 months) and all but one patient were on maintenance doses of neuroleptic medication (in terms of chlorpromazine equivalents: range =0 to 900 mg; median=350 mg). Two patients had a history of single courses of ECT in the past but not during the six months prior to testing. The normals were clerical and technical staff from the institute who voluntarily participated in the study without payment. They had no previous psychiatric consultation and secured below the cut-off score "five" on the General Health Questionairre [21]. The two groups were comparable in terms of age (Schizophrenics: M=26.70, SD=4.12; Normals: M=26.50, SD=5.10) and education, in terms of years of formal education, (Schizophrenics: M=11.80, SD=2.31; Normals M=12.10, SD=2.10). Analysis showed no significant difference between the two groups for either age, $t(18)=0.09$, $p > .05$; or for education, $t(18)=0.29$, $p > .05$.

The stimulus material consisted of 12 lists, four lists in each of the three types of organization: Random (No organization), Complex organization, and Simple organization. Each list consisted of 12 three-digit numbers. The items in the Random lists were selected through a random procedure from all possible three digit numbers. In the lists of Complex organization, the 12 items could be categorised into three experimenter-induced clusters, four items to a cluster. For instance, the numbers 222, 555, 666, and 999 formed one cluster, while 525, 636, 747, 858 formed another. In the lists of Simple organization, items in each list were in the form of an arithmetical progression, for example, in serial threes as follows: 778, 781, 784 ---------- 811.

Procedure

The stimuli were printed in indian ink and presented on white cards (10 cm × 15 cm), one item per card by means of an electronically operated tachistoscope (Gebrands, Model G1125, with a G1146/ 1150 automatic card changer). Stimulus exposure was fixed at two seconds with a one-and-a-half second inter stimulus interval. The subject was required to call out the numbers as they appeared on the screen. The experiment was conducted in three separate sessions (each session took about 35 minutes) for the Random, Complex and Simple organisation conditions respectively. Individual sessions were conducted on successive days, and occasionally when conducted on the same day, sessions were separated by a 15-minute rest period.

Each list was presented five times (trials) in a repeated learning-and-recall paradigm. The sequence of items on each trial was randomised, but was held constant across subjects. Recall was assessed after each trial by requiring the subject to write down the remembered items in any sequence desired.

Results

The number of correct responses (see Table 1) was analysed using a 2 (groups) × 3 (types of organization) × 5 (trials) analysis of variance. All main effects were significant: for groups F $(1,270)=145.54$, p <0.001; for types of organization, $F(2,270)=100.20$, p < 0.001; for trials, $F(4,270)=24.50$, p <0.001. The results indicate that schizophrenics were poorer in recall (M=4.38, SD =2.25) than normals (M=6.99, SD=2.40). Organization of stimuli served to increase recall across groups, and as expected, repeated trials served to enhance recall performance across groups. All interaction effects fell well short of significance indicating that organization of stimulus material and repeated trials enhanced schizophrenic recall in much the same way as it did in normals.

Table 1 - Means and SDs (within parentheses) of correct responses per trial, error proportions, ITR and SCR scores for schizophrenics and normals on lists of random, complex and simple organization

Table 1 - Means and SDs (within parentheses) of correct responses per trial, error proportions, ITR and SCR scores for schizophrenics and normals on lists of random, complex and simple organization

Mnemonic organization

Mnemonic organization was indexed by the inter-trial-repetition score, ITR (2), used by Mandler and Dean [22], Koh et al. [5] and the stimulus category repetition score (SCR), used by Bousefield and Bousefield [23]. The ITR(2) indexes the degree of organization that the subject imposes upon the items of a list, and increases to the extent that the same sequence is preserved between two consecutive recall reports. The SCR indexes the degree to which the subject uses the inherent (experimenter-induced) categories in the list to cluster recall output. Consequently, while the ITR(2) is applicable to all three list types, the SCR applies to only the list of the complex organization and simple organization. Subjective organization (see Fig 2) as measured by the ITR(2) was subjected to a 2 (Groups) × 3 (Types of organization) analysis of variance. The main effect for types of organization was significant. F $(2,54)=6.49$, p<0.01. Further analysis revealed that across groups, the ITR(2) was reduced in the random lists as compared to both the lists of complex organization (Duncan's test, p<0.01) and the lists of simple organization (Ducan's test, p<0.05), but did not differ between complex and simple organization.

Mean ITR and SCR scores for schizophrenics (bold lines) and Normals (dashed line) as a function of degree of list organization
Relative proportions of the types of errors (EA=approximation errors, IN=intrusion errors, ID=idiosyncratic errors) in schizophrenics and normals

The main effect for groups fell short of significance, F $(1,54).=2.05$, p>0.05. and so did the effect for interaction, $F(2,54)=1.43$, p>0.05. However, the data (see Figure 2) suggested the possibility of a decline of the ITR score for schizophrenics specifically on the random lists. This was tested independently and the results indicated poorer subjective organization for the schizophrenic group (M=0.13, SD= 0.15) as compared to normals (M=0.32, SD=0.12), F(1,18)= 10.05, p<0.01. This specific effect has obviously been suppressed by the close similarity in performance of the two groups on the lists of complex organization and simple organization (see Table 1). The SCR measure was very similar for the two groups for both the lists of complex organization and simple organization. None of the main or interaction effects were significant: for groups, F(1,36)=0.49, p<0.05; for types of

organization, $F(1,36)=2.34$, $p<0.05$: for groups X types of organization, $F(1.36)=0.07$, $p>0.05$. Both ITR and SCR measures, corrected for effects of chance and amount recalled were also determined, but are not quoted because statistical analysis of corrected measure yielded the same significant and nonsignificant effects as the uncorrected measures.

Serial position effects

The effect on recall of items in the primacy, or recency positions of the list was analysed in the following way. In the 12-item list (the sequence of items was randomised from trial to trial), the first three items were denoted as the primacy items, and the last three as the recency items. The trial wise recall performance of each subject was examined and the following measures were computed:

(a) primacy and recency rawscores, referring to the total number of primacy and recency items correctly recalled:

(b) primacy and recency proportions, referring to that proportion of the individual's correct recall that was constituted by primacy and recency items;

(c) primacy-early and recency-early scores, referring to the number of primacy and recency (with reference to order at presentation) items that appeared among the first three items in the order of recall;

(d) primacy-late and recency-late scores, referring to the number of primacy and recency (with reference to order at presentation) items that appeared later than the third position in the recall sequence.

Primacy measures

A 2 (groups) × 3 (types of organization) analysis of variance was performed for each of the four primacy measures; primacy raw scores, primacy proportions, primacy-early impaired on each of these measures (see Table 2). They recalled less primacy items as compared to normals, $F(1,59)=6.65$, $p<0.05$. Besides, of the total correct recall primacy items constituted a smaller proportion in schizophrenics than that in normals, $F(1.59)=8.34$ $p<0.01$. Further, irrespective of whether schizophrenics sequenced the primacy items early in their recall order, or later, they still manifested the deficit; for primacy-early scores, $F(1,59)=6.56$, $p<0.05$; for primacy-late scores, $F(1.59)=29.81$, $p<0.001$. In each of the four analyses, the main effects for types of organization were also signfiicant. The direction of the results was consistent in that it indicated that organization of the stimulus items served to help both normals and schizophrenices to enhance the recall of each of the primary measures. None of the interaction effects were significant.

Table 2 - Means and SDs (within parantheses) per trial on primacy and recency measures in schizophrenics and normals

Table 2 - Means and SDs (within parantheses) per trial on primacy and recency measures in schizophrenics and normals

1: Maximum possible score is 3.00

Recency measures

The four recency measures were analysed in the same way as the primacy measures. A 2 (groups) × 3 (types of organization) analysis of variance was done separately for each measure. Schizophrenics were found to be impaired on recall of recency items as indicated when the recency-raw scores was considered, $F(1,59)= 25.17$, $p<0.001$. but further analysis showed the deficit to be accountable to poor

performance on the recnecy-late measures, $F(1,59)=22.78$, $p<0.001$, but not to poor performance on the recency-early measures, $F(11,59)=1.79$, $p>0.05$. Analysis of the recency proportion index indicated that the correct recall of schizophrenics was actually constituted by a greater proportion of recency items than that of normals, $F(1,59)=16.10$, $p<0.001$.

The main effect for types of organization was significant on all except the recency-early measure. The results indicated in general that inbuilt organization enhanced the recall of recency items (as indicated by increased recency-raw scores) and also enhanced the number of recency items reproduced later in the recall order, $F(1,59)=22.78$, $p<0.001$. However inbuilt organization failed to affect the performance of the recency-early measure, $F(1,59)=1.79$, $p>0.05$, and actually served to decrease the proportion of recency items recalled, $F(1,59)=16.10$, $p<0.001$. The interaction effects of all four measures fell well short of significance, indicating that types of organization did not differentially influence schizophrenics as it did nomals.

Errors

Because the correct recall performance of the two groups differed widely (see Table 1) the number of errors in each case was converted to a proportion, namely, number of errors to recall output (correct recall + errors). This measure was subjected to a 2 (group) × 3 (types of organization) × 3 (types of errors) analysis of variance. Again, all main effects were significant: for groups, $F(1,62)=7.19$, $p,0.001$; for types of organization, $F(2,162)=22.51$, $p<0.001$; and for types of errors, $F(2,162)=49/19$, $p<0.001$. All interaction effects were not significant.

Analysis revealed schizophrenics to have made a higher proportion of errors than normals (see Figure 1). Errors were most frequent on the random lists intermediate on lists of complex organization and least frequent on lists of simple organization. All the above comparisons between types of organization were significant as the five percent level or better (Duncan's test).

With reference to error-types, the four following categories were defined:

(a) The EA- error referred to an approximation. Here, two digits were recalled accurately, while the third was erroneous (631, 832 or 821, instead of the correct number 831);

(b) The IN-error referred to an intrusion error. Here an item actually belonging to a prior list intruded into the recall of a subsequent list;

(c) The ID-error referred to an idiosyncratic error and was scored when an error was neither scorable as EA or IN;

(d) The PER-error referred to the preservation of any of the above errors (e.g., the repetition of the EA-error 821 on two or more occasions for the correct number 831) and was scored in addition to one of the above three types.

Both schizophrenics and normals committed a greater degree of EA-errors, an intermediate number of ID-errors and the smallest proportion of IN-errors (see Figure 2). Again, all comparisons between EA, ID, and IN-error types were significant at the five percent levels or better (Duncan's test).

The errors of preservation, again converted to proportions were analysed separately because the same responses that merited a PER-error also secured one of the other three error types. Consequently, pooling it with the other three error-types would have raised the total error proportions, to a value higher than actually observed. A 2 (group) × 3 (types of organization) analysis of variance yielded no significant main or interaction effect: for groups, $F(1,54)=0.29$, $p>0.05$; for types of organization, $F(2,54)=2.14$ $p>0.05$; and for groups × types of organization, $F(2,54)=0.55$, $p>0.05$.

Discussion

The finding in the present study that schizophrenics are deficient in recall supports the findings of other studies [5], [8], [9], [11], and also indicates that the deficits is not restricted to recall of verbal material, but also extends to the memory of numbers.

An important implication of the study is that poor subjective organization alone fails to account for the poor recall performance in schizophrenics. Impaired subjective organization (ITR) in schizophrenics was specific to the random lists and while this may explain poor recall performance on these lists the poor recall that extended to lists of complex and simple organization must be due to factors other than mnemonic organization-since both subjective and category organization were unimpaired on these lists. In this context, the results of Culver et al [9] who found that semantic orienting tasks could not eliminate the recall deficit in schizophrenics, also suggests a factor other than organization influencing memory in shcizophrenics.

Consequently, our results that indicate a schizophrenic deficit on items in the primacy positions gains importance, especially since this deficit and poor recall are both present on all three list-types. Besides, the deficit is consistently observed on each of the primacy measures. The results reinforce the findings of Oltmanns [12] and Frame and Oltmanns [16] who found similar deficits in schizophrenics and that of Harvey et al [17] who elicited the deficit in children of schizophrenics parents.

The results with regard to the recency items may appear irreconcilable at first sight. On the one hand, when the recency raw scores are considered, schizophrenics show a deficit compared to normals. On the other hand, when the recency proportion index is considered, the recall of schizophrenics is found to be constituted by a greater proportion of recency items than that in normals. However, it must be noted that an efficient recency raw score may be influenced by at least two strategies. One strategy can involve giving receny (in order of presentation) items early (among the first three) positions in the recall order This would imply that between the presentation of the recency items and the recall of the same, there is both a close proximity in time and also an absence of intervening items. On the other hand, the recency raw score will also include those occasions in which recency (in order of presentation) items were reproduced later in the recall order.

Results showed that schizophrenics were not impaired in the memory of recency items when they recalled them immediately, but they were unable to delay the reproduction of these items to a later time. Thus, the deficit in the recency-late measure and all the primacy measures appear to be due to a common mechanism: an inability to transfer data from immediate memory to more enduring storage levels.

The observed deficit related to serial position may also be explained by assuming a deficient capacity in schizophrenics for controlled information processing as Nuechterlein and Dawson [24] have suggested. This would imply that the immediate recall of items just presented would require minimum processing, while the recall of primacy or recency items after some interference would entail a processing load greater than that which the schizophrenics are capable of. Poor subjective organization on only the random lists in schizophrenics may also be explained, since it may be reasonably, assumed that the development of subjective organization on random items would require greater and more sustained processing abilities than the passive adoption of experimentally induced categorization.

The bias of schizophrenics towards recency items, brings to mind the stimulus immediately hypothesis [18] that holds that the ongoing speech and behavior of schizophrenics is unduly influenced by only the immediately preceding stimulus and thereby becomes progressively unrelated to the words uttered/theme set upon much earlier. The studies on serial position preferences in the recall of schizophrenics, suggest poor memory of earlier stimuli as the possible reason for such a bias. Interestingly, it also explains an unexpected finding of Pishkina and Bourne [25]. In an experiment that was intended to study abstraction in schizophrenics, the authors observed that unlike normals, "Schizophrenics profit when only a single past stimulus available as a memory aid but show a significant performance loss when two or more stimuli are available from previous trials."(p.201). The inability to profit from earlier instances may simply be in consonance with the clinical experience of some thought disordered schizophrenics who, in the course of responding to a question, go progressively away from the topic and then are able to recollect neither the exact question, nor the initial part of their response.

Further, schizophrenics produce a greater proportion of errors in general, but are not specifically vulnerable to any of the four error-types delineated. Thus we did not find evidence that schizophrenics suffered from a greater degree of intrusion errors. Pishkin and Bourne [25] have suggested that distraction in schizophrenia may be self-generated, however, we did not find in schizophrenics a particular vulnerability to idiosyncratic errors. In fact, like normals, the most common error in schizophrenics was the EA- an approximation of a stimulus actually presented.

The theory of distractability in schizophrenia also involves interference effects, but it must be noted that the intervening items in the present study were not irrelevant, but relevant items. Distractability may also just serve to increase processing load on a task that, by itself, would not have sufficiently taxed the limited capacity in schizophrenics.

An inadequacy in the present study is the absence of a non-schizophrenic patient group as controls. However, the emphasis in the present study was not to address the issue of the specificity of memory deficits to schizophrenia as much as to study together the deficits of mnemonic organization and serial position, both of which have been implicated in schizophrenic recall. It was also intended to emphasize the need of devising experiments that attempt to relate different information processing deficits already identified. Finally, since the present study used a homogeneous sample of acute, non-paranoid schizophrenics, it will be useful, to determine whether the same results are also found in other types of schizophrenics.

1.Bleuler E, *Dementia-Praecox or the Group of Schizophrenias. International Universities Press, New York*1950/1911
2.Goldstein K, Methodological approach to the study of schizophrenic throught disorder
*In J S Kasanin (Ed). Language and Thought in Schizophrenia, Norton, New York*1944
3.Cameron N, *The psychology of the Behaviour Disorders. Houghton and Mifflin, Boston*1947
4.Bauman E & Murray D J, Recognition vs recall in schizophrenica
Canadian Journal of Psychology Page: 22: 18-25, 1968
5.Koh S D, Kayton L & Berry R, Mnemonic organization in young nonpsychotic schizophrenic young adults
Journal of Abnormal Psychology Page: 81: 299-319, 1973
6.Koh S D & Peterson R A, Encoding orientation and the remembering of schizophrenic young adults
Journal of Abnormal Psychology Page: 87: 303-313, 1978

7.Nachmani G & Cohen B D,   Recall and recognition in free learning in schizophrenics
Journal of Abnormal Psychology   Page: 74: 511-516, 1969
8.Bauman E,   Schizophrenic short term memory: A deficit in subjective organization
Canadian Journal of Behaviour Science   Page: 3: 55-65, 1971
9.Culver L C, Kunen S & Zinkgraf S A,   Patterns of recall in schizophrenic and normal subject
Journal of Nervous & Mental Diseases   Page: 174: 620-623, 1986
10.Koh S D, Kayton L & Schwartz C,   The structure of word storage in the permanent memory of nonpsychotic schizophrenics
Journal of Consulting & Clinical Psychology   Page: 42: 879-887, 1972
11.Larsen S F & Fromholt P,   Organization and recall in schizophrenica
Journal of Abnormal Psychology   Page: 85: 61-65, 1976
12.Oltmanns T F,   Selective attention in schizophrenic and manic psychosis: The effect of distraction on information processing
Journal of Abnormal Psychology   Page: 87: 212-225, 1978
13.Oltmanns T F & Neale J M,   Distractibility in schizophrenia
In S. Schwartz (Ed). Language and Cognition in Schizophrenia, Erlabuam, Hillsdale, New Jersey
         Page: pp 117-143, 1978
14.Oltmanns T F, Ohayon J & Neil J M,   The effects of antipsychotic medication and diagnostic criteria on distractibility in schizophrenia
Journal of Psychiatric Research   Page: 14: 81-91, 1978
15.Traupmann K L,   The effects of categorization and imagery on recognition and recall by process and reactive schizophrenics
Journal of Abnormal Psychology   Page: 84: 307-314, 1982
16.Frame C L & Oltamanns T F,   Serial recally by schizophrenic and affective patients during and after psychotic episodes
Journal of Abnormal Psychology   Page: 91: 311-318, 1982
17.Harvey P H, Winters K, Weintraub S & Neale J M,   Distractibility in children vulnerable to psychopathology
Journal of Abnormal Psychology   Page: 90: 298-304, 1981
18.Salzinger K, Portnoy S & Feldman R S,   Communicability deficit in schizophrenics resulting from a more general deficit
*In S Schwartz (Ed) Language and Cognition in Schizophrenia. Erlabaum, Hillsdale, New Jersey*1978
19.Cohen B D,   Referent communication disturbances in schizophrenia
In S Schwartz (Ed.,). Language and Cognition in Schizophrenia. Erlabaum, Hillsdale, New Jersey
          Page: pp 1-34, 1978
20.World Health Organisation, *International Classification of Disease, 9th revision, WHO, Generva*1977
21.Goldberg D P & Hiller V F,   A scaled version of the General Health Questionnaire
Psychological Medicine   Page: 9: 139-145, 1979
22.Mandler F & Dean P J,   Seriation: The development of serial order in free recall
Journal of Experimental Psychology   Page: 81: 207-215, 1969
23.Bousefield A K & Bousefield W A,   Measurement of clustering and sequential constancies in repeated free recall
Psychol. Reports   Page: 19: 935-942, 1966
24.Nuechterlein K H & Dawson M E,   Information processing and attentional functioning in the development course of schizophrenic disorders
Schizophrenia Bulletin   Page: 10: 160-203, 1984

25.Pishkin V & Bourne L E. Jr,   Abstraction and the use of available information by shcizophrenic and normal individuals
Journal of Abnormal Psychology   Page: 90: 197-203, 1981