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THE UNIVERSITY OF MANITOBA

MEMORY ATTRIBUTES IN SCHIZOPHRENIA

by

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE
OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF PSYCHOLOGY

WINNIPEG, MANITOBA

APRIL, 1978

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A dissertation submitted to the Faculty of Graduate Studies of
the University of Manitoba in partial fulfillment of the requirements
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ABSTRACT

The purpose of this research was to investigate the role of encoding processes in the schizophrenic memory deficit. The study employed a technique first devised by Wickens, Born, and Allen (1963) that has been used to study differential encoding dimensions for verbal materials. The technique was employed with schizophrenics to investigate the possibility that schizophrenics show a deficit at a higher level in the information processing system than at sensory or perceptual input levels as has traditionally been the focus.

The subjects were 48 schizophrenic patients and 48 normal individuals drawn from the staff of a general hospital. The schizophrenics were carefully selected according to several criteria so that a diagnosis of schizophrenia could be considered accurate. In addition, process-reactive and paranoid-nonparanoid scales were used. The schizophrenics were screened in an attempt to control for the interference of such extraneous factors as medication, ECT, and organicity. The normal subjects were matched with the schizophrenics for age, vocabulary level, sex, education, and socioeconomic status.

Wickens' (1970) release from proactive inhibition procedure was used in which each subject was tested on a short-term memory task with an experimental and control condition for each encoding dimension. There were four trials for each dimension. In the control

condition material from the same class was presented for the four trials, while in the experimental condition the material was the same until the fourth trial when there was a shift to a different class. The three encoding dimensions chosen were evaluation and taxonomic category (because normal subjects have been found to encode on these dimensions) and grammatical class (because normal subjects have been found not to encode on this dimension). Since each subject underwent all three encoding dimensions as well as the experimental and control conditions, a partial within-subjects design was employed.

The results suggested an overall schizophrenic impairment in recall. In addition, there was a decline in performance over trials from trials 1 to 3 for both groups. Both of these findings were as predicted and are consistent with the literature in this area. However, contrary to prediction, interference did not build-up to a greater extent for the schizophrenics than for the normals. In addition, the data did not suggest the occurrence of encoding differences. Both groups used taxonomic category for encoding and did not use grammatical class. The results for the evaluation dimension were difficult to assess because they were not consistent with Wickens' results. This was thought to be due to item selection problems. Since care was taken to ensure that the schizophrenics and normals perceived the information, and since they both seemed to be processing information in the same way, the present results were inter-

preted as showing interference at the retrieval stage. These results were viewed as suggesting a fairly widespread cognitive dysfunction for schizophrenics.

ACKNOWLEDGEMENTS

The author would like to thank the many individuals without whose help the present research could not have been completed. Firstly, she would like to thank her thesis advisor, Dr. T. P. Hogan, and the members of her committee, Drs. J. McIntyre, R. Bankier, and M. Brodsky for their help and encouragement. Thanks is also extended to Dr. J. Anker, chairman of the psychology department of the University of South Florida, for his valuable comments.

A special thanks is extended to the staff of Selkirk Mental Hospital and Mr. D. Pettit, their psychologist, for their assistance in running the pilot study. Additional gratitude is given to the staff of the Health Sciences Centre for their help in obtaining subjects.

My warmest appreciation is extended to my parents, my parents-in-law, my husband John, and our daughter Jennifer. Their encouragement throughout this task made the completion of it possible.

The present research was supported by a grant from the National Research Council of Canada (A0317), and by a grant from the University of Manitoba Research Board, both to Dr. J. McIntyre.

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CHAPTER 1

INTRODUCTION

"Schizophrenia" is a diagnostic category signifying a psychosis. Although most descriptions of schizophrenia indicate various behavioural abnormalities and inappropriate affect, these are often thought of as being secondary manifestations of a basic cognitive disturbance. This deficit on a wide variety of cognitive and intellectual tasks has been called the "psychological deficit" (Hunt and Cofer, 1944). This inadequacy has been reported many times in a wide variety of studies and is useful in differentiating schizophrenics both from other psychotic groups and from normal individuals (Koh and Kayton, 1974; Marshall, 1973).

Such a breakdown in cognitive functioning can occur at any one of several points in the memory process. There is some evidence that schizophrenics have difficulty at the level of attention or filtering (Buss and Lang, 1965; Huston, Cohen, and Senf, 1955; Maher, 1966). Thus, schizophrenics are considered to be more susceptible to the intrusions of irrelevant internal and/or external stimuli with interference being the result. A second level at which this breakdown in cognitive functioning could

occur is in encoding. Support for this has been obtained from results showing that difficulties in attention and perception are usually obtained with long-term (chronic, process) patients (Adams, 1970; Johannsen, Friedman, and Leccione, 1963; Ko, 1970; Payne, 1970; Venables, 1971). Consequently, there is a suggestion that some of the attention difficulties shown by schizophrenics may have been due to external factors such as hospitalization rather than the schizophrenic process. This has pointed to the possible involvement of higher levels of thought processes.

The possibility of encoding differences is suggested by several results reported in the literature. For example, Pavy (1968) has reviewed several studies of schizophrenia and noted free association differences between schizophrenics and normals. Hirsch (1971) suggested that schizophrenics are more susceptible to interference, and Smith (1969) reported a short-term memory deficit for schizophrenics as compared to normals. These differences have usually been attributed to schizophrenics having a general deficit in attention. However, they may also point to encoding difficulties.

Bower (1967), Underwood (1969), and Wickens (1972) have suggested that a memory trace is encoded along various dimensions. This encoding process aids in the discrimination of

words from each other and thus assists in the retrieval of material. It is this multiply-encoded memory trace which makes up the meaning of a word. Thus, many of the differences reported in the literature between schizophrenics and normals may be viewed in the light of possible schizophrenic/normal differences in encoding.

The major purpose of the present study was the investigation of encoding differences as one possible basis for the psychological deficit in schizophrenia. A secondary purpose was to assess the applicability of using a particular encoding technique (that of Wickens) with a schizophrenic population. This has been a primary technique in verbal learning research, but has not previously been used with schizophrenics. In the next section, we begin our review with a discussion of the literature on schizophrenia. This is followed by a discussion of recent innovations in the approach to memory. Finally, the possibility of encoding problems is reviewed and an experiment on differential schizophrenic/normal encoding is outlined.

SCHIZOPHRENIA AS A THOUGHT DISORDER

Recently, there has been considerable criticism of the use of the term "schizophrenic". It has been shown to have different

meanings to different mental health professionals (Fitzgibbons and Shearn, 1972; Shearn and Whitaker, 1969), some of whom do not even include a thought disorder in their definition of schizophrenia. Furthermore, subgroupings which are differentiated on the basis of psychological symptoms have been found to be quite unreliable for classification purposes (Maher, 1966; Zigler and Phillips, 1961). For example, paranoid schizophrenics were considered to have delusions as their primary feature and catatonic schizophrenics to have a motor disorder as their primary feature. Since these classifications have proven to be unreliable, most of the recent research on schizophrenia has indicated the importance of differentiating schizophrenics along various other dimensions in order to reduce the variance in results which has been obtained with this population.

One dimension which was found to be particularly important and useful was that of general adjustment (Buss and Lang, 1965; Johannsen, Friedman, Leitschuh, and Ammons, 1963; Maher, 1966; Ralph and McCarthy, 1967; and Silverman, 1964). This dimension dichotomizes patients according to process and reactive types. Process schizophrenia is associated with a heredity risk, insidious onset, and a poor prognosis, whereas reactive schizophrenia is associated with good heredity, sudden onset, and

a good prognosis (Kantor, Wallner, and Winder, 1953). A distinction between good and bad premorbid adjustment in schizophrenia is often made, but this seems to take into account the same factors of general adjustment as the process-reactive dimension. Thus the two dimensions are often used interchangeably (Johannsen, 1964). Another important dimension of schizophrenia is the acute-chronic dimension which in current usage defines groups according to length of hospitalization. This also seems to have a high correlation with the two dimensions mentioned previously (Johannsen, Friedman, Leitschuh, and Ammons, 1963).

One dimension of schizophrenia apparently independent from these other dimensions is paranoid-nonparanoid (Johannsen et al., 1963). The classification of paranoid has usually been made on the basis of traits of suspiciousness, egocentricity, self-references, and projection of feelings of blame, as well as beliefs of persecution and grandiosity.

These dimensions have been useful in reducing some of the variance in results which have been obtained with the schizophrenic population. Whenever conflicting results were reported in the literature it often appeared to be a function of lack of control of these dimensions (Pearl, 1963). Several studies reported

different findings for these dimensions thus attesting to their usefulness. These studies have also produced data indicating the nature of these group differences. Sturm (1969) found differences between acute and chronic groups in their attention errors while DeWolfe (1971) and Moore (1971) found differences between reactive and process schizophrenics in cognitive style and structure. Maher (1966) and Payne (1970) concluded that it was mainly the reactive schizophrenics who exhibited the frequently reported phenomenon of overinclusion. Along these same lines, both Johnson (1966) and True (1966) found that reactive schizophrenics were superior to process schizophrenics in verbal abstracting ability and learning. Harrow, Adler, and Hanf (1974) reported that process schizophrenics were more concrete in their thinking than reactive schizophrenics. In general, except for one study which reported no difference between process and reactive groups on ability to shift set (Cancro, 1969), the overall pattern of the results was that reactive patients (or acute, or good premorbid) demonstrated a higher level of performance than process (or chronic, or poor premorbid) patients on cognitive tasks.

As previously mentioned, the paranoid-nonparanoid classification of schizophrenia has obtained a great deal of support as an

independent and useful dimension for categorizing schizophrenics. Paranoid schizophrenics have usually been found to show less evidence of psychological deficit and thought disorder than other groups. Kincaid (1964), Orgel (1956), and Rieger and Freedman (1970) reported a higher type of memory organization for paranoid schizophrenics as compared to nonparanoid schizophrenics. In addition, Bassos (1973) found that paranoids had different cognitive styles and Shaw (1961) found that paranoids scored higher on the Wechsler Memory Scale. The conclusion which seems to be warranted from these studies is that the thought processes of the paranoid schizophrenics are different from those of the non-paranoid schizophrenics. Thus, there has been considerable controversy for over a hundred years as to whether paranoids should be included as schizophrenics or whether they should be considered a separate class of psychosis (Buss, 1966). Studies such as these have suggested the importance of at least distinguishing these dimensions in research with schizophrenics.

Although groups of schizophrenics have been differentiated, they are still considered to have the underlying commonality of a thought disorder (Payne, 1970) with further distinctions within the schizophrenic category made on the basis of the different

forms this cognitive disturbance may take (Moore, 1971).

Thought disorder has long been considered to be the primary and essential characteristic of schizophrenia with other characteristics being secondary manifestations (Bleuler, 1950).

Today this view is still held even with the focus on clearly defined subgroups rather than the global term "schizophrenia".

Cancro (1968) and Schorer (1968) typify this view in advocating a thought disorder as a solid basis for a diagnosis of schizophrenia. Arieti (1965) felt that the schizophrenic primarily had disordered thinking and that this in turn prevented him from becoming socialized. The nature of these difficulties that schizophrenics seem to have in common have been specified in the following section.

Studies of the psychological deficit in schizophrenia

Schizophrenics have long been shown to experience difficulties on a wide variety of cognitive and intellectual tasks. Studies of the psychological deficit in schizophrenia have been carried out in an attempt to develop a theory of the deficit and therefore of schizophrenia. Since excellent reviews of these studies are available (Barker, 1974; Buss and Lang, 1965; Hemsley, 1975; Lang and Buss, 1965; and Maher, 1966), what is presented

here is a general review of some of the major findings as well as the research published since these reviews appeared. Using extremely broad overall categories, research on the psychological deficit in schizophrenia is divided into two groups of studies. The first group of studies focuses on social-motivational factors and drive (or arousal), while the second group examines such related concepts as association, set, and communication.

Studies which focus on social-motivational factors have hypothesized that schizophrenia is an increased (or decreased) drive state, or that schizophrenics are more sensitive to social stimuli than normals. Generally, the research based upon drive as being central to schizophrenia (e.g., Mednick, 1959) has had negative results (e.g., Streiner, 1969). However, there has been some support for the social sensitivity theory. Stilson, Walsmith, and Penn (1971) compared schizophrenics, nonschizophrenic psychiatric patients, and hospital employees on their ability to process information. The results indicated a differential task performance between the groups as the schizophrenics were less able to process the information when the content of the task was human as compared to when it was abstract. This suggested that the performance of schizophrenics may have been more impaired by

social stimuli than that of other groups. Laxer (1967) found that schizophrenics rated social stimuli such as "my mother" lower than nonschizophrenic psychiatric patients. Duke and Mullens (1973) showed that chronic schizophrenics preferred greater distance from others than either the normals or other psychiatric groups did. Although these studies suggested that social sensitivity may be implicated in schizophrenia, it is important to keep in mind that this may be a secondary effect due to the severe degree of psychopathology present in schizophrenia. Thus, these studies should not necessarily be interpreted as suggesting a social basis as a cause of schizophrenia. In addition, several studies have produced negative results in finding a social basis for schizophrenia (Sterne, 1967; Tolor, 1970).

The second major group of studies are those which focused on association, set, and communication difficulties as a possible basis for schizophrenia. This is an information processing approach to schizophrenia since the deficit is considered to be in this aspect of cognitive function. The results of these studies have been positive and most of this research has been linked to a general interference theory of the deficit. General interference effects have been shown in communication, association, and in the maintaining and shifting of set. These effects were confirmed

by several other studies. Schizophrenics were more distractible (Blum, Livingston, and Shader, 1969; Gellens, 1972; McGhie, Chapman, and Lawson, 1965), unable to maintain a set (Waldman, 1969), and had problems in communication (Suchotliff, 1970). Barker (1974) is in agreement with an information processing view of the schizophrenic psychological deficit. He suggested that some of this deficit can be accounted for by a dysfunctional retrieval process. His study is of particular interest because most information processing research in schizophrenia has focused only on input factors. Barker studied 48 schizophrenics and 48 controls under conditions of cued and non-cued recall. The schizophrenics were able to increase their recall to the level of the normals when provided with retrieval cues. This suggested a dysfunctional retrieval mechanism since the items were available in storage but they could not be retrieved. Generally, the nature of all the above difficulties seemed to indicate that the schizophrenics were particularly susceptible to interference. Thus it is important at this point to clarify what is meant by the term "interference".

Interference Theory of Schizophrenia

In the verbal learning literature the concept of interference has long been used and may refer to specific or general (not so speci-

liable) interference. Although most of the literature refers to specific interference, the nonspecific sources of extra-experimental interference (Keppel, 1968) also appear to play a large role. The interference theory of schizophrenia (Buss and Lang, 1965) posits fairly general interference effects for schizophrenics. This theory suggests that a schizophrenic's ongoing response tendencies suffer interference from external cues and from internal stimuli which consist of deviant thoughts and associations. These act as distractors and cause the schizophrenic's associations to deteriorate. If schizophrenics do have external and internal cues interfering, this could cause a deficit throughout the information processing system that might involve input, storage, and retrieval. Although most statements of interference theory have included the notion of schizophrenics having deviant associations which act as distractors, it may be the ability to reject associations (e.g., Smith, 1970) that is not functioning properly. It is difficult to determine which of these is the cause of interference particularly since there are some studies which have indicated that the associations of schizophrenics are deviant (Piercy, 1970; Shimkunas, 1972) and some studies which have indicated that they are not (Fuller and Kates, 1969; O'Brian and Weingartner, 1970; Smith, 1970).

There is literature to suggest that schizophrenics also show greater specific interference effects than normals. Hirsch (1971) and Kausler, Lair, and Malsumoto (1964) used A-Br and A-C interference paradigms compared to a C-D control paradigm and found that the schizophrenics showed more performance decrement due to interference than the normals. Kates (1971) compared the performance of schizophrenics and normals on the Stroop Colour-Word Test. This is a test of interference proneness in which the names of colours are printed in ink which is incongruent with the name. Several measures of interference proneness are possible such as errors due to dominant word-reading intrusions or the time required to complete the colour-word card. The results indicated that the schizophrenics were more prone to interference than the normals. Peixotto and Rowe (1969) found greater interference proneness for schizophrenics on the Stroop Test than for either normals or psychoneurotics. Similar findings were reported by Smith and Nyman (1959) whose data indicated that the more disorganized a patient was, the more disorganized were his responses on this test.

Nachmani and Cohen (1969) used a different test which detected greater interference effects for schizophrenics than for anxiety neurotics. They found that on both recognition and recall in a free recall task, the schizophrenics made more intrusion errors.

Hawks and Robinson (1971) compared chronic schizophrenics with psychiatric nurses matched for age and intelligence. They were presented with both relevant and irrelevant digits. The results indicated that the schizophrenics were more affected by distraction from the irrelevant material. Thus the evidence is quite conclusive in showing that schizophrenics are particularly susceptible to interference.

This greater interference proneness has not always shown up on all tests. For example, Kapche (1969) used a paired-associate task and varied the amount of response competition in different lists. The results indicated that the performance of the schizophrenics was inferior to that of the normals, but that normals and schizophrenics were equally affected by the response competition. It is possible, however, that Kapche's test was not sufficiently sensitive to schizophrenic cognitive interference. The importance of this has been stressed by Taylor (1971) who studied the effects of interference upon the performance of process and reactive schizophrenics. Taylor used the digit span test which is a test of short-term memory. Initially he was unable to obtain results supportive of greater interference proneness for schizophrenics. But, by varying the time interval between digit presentation and recall, Taylor obtained support for the interference notion. This may

assist us in shedding light on negative results in this area.

Taylor's research also suggested possible interference differences between process and reactive schizophrenics. His results indicated that it was mainly the process patients who experienced interference.

Shimkunas (1970, 1972) and Watson (1973) have provided a link between the interference notion and other schizophrenic phenomena such as loss of abstracting ability. They have suggested that this occurs in the early stages of schizophrenia and that it gives way to idiosyncratic thought processes which lead to associative interference. Since overinclusion is basically an inability to maintain conceptual boundaries, it would also seem possible that there may be some relationship between overinclusion and interference. Yet, overinclusion is generally found to occur in acute/reactive schizophrenics (Maher, 1966; Weinberger and Cermak, 1973) and paranoid schizophrenics (Craig, 1971). Thus, acute/reactive patients and paranoid patients tend to include irrelevant material when responding to a stimulus. However, these are the groups which have generally shown fewer interference effects. Andreasen (1974) suggested that overinclusion is associated with illnesses which have a good prognosis. Thus, it is interesting to speculate about possible differences in types or causes

of interference in the different subgroups of schizophrenia.

While there is good evidence for increased interference of a variety of kinds in schizophrenia, the underlying interference mechanism is not entirely clear. Since the emphasis of the present research is on encoding, in the following section a model of memory is first presented, then research that has studied encoding in the schizophrenic is dealt with more specifically.

THE INFORMATION PROCESSING SYSTEM

It is important at this point to adopt a model of memory which can be referred to in our discussion of encoding. In general, the model that the present author finds the most clear-cut is that of Atkinson and Shiffrin (1968). This model differentiates various stages in the memory system and therefore makes the flow of information fairly easy to follow. Although there have been some new ideas about memory since this model was developed, the basic model was adopted and then some of these changes were considered.

Atkinson and Shiffrin hypothesized that material is received into a sensory register in which it stays for a very short period of time. If the material is not processed in some way it then

decays and is lost. Attention is necessary at this stage and many theories of the schizophrenic deficit focus on this primary level. In the sensory register the incoming material is represented in its original form. The next stage of the memory system is the short-term store in which the incoming information may be transferred to a different form. This is generally what is referred to when one talks about the encoding of material. Material from the sensory register is encoded into any one (or possibly even several) of a number of codes such as auditory or linguistic. This short-term store has a limited capacity, but the amount of material held in this store may be increased by chunking (Miller, 1956). Chunking refers to the grouping of material into a meaningful unit so that more information can be retained. In the short-term store the material is held for approximately 15 to 30 seconds but can be held longer if the subject rehearses it. Material which is not lost is then transferred to the long-term store (functionally). The capacity of this store is apparently limitless and retrieval mechanisms become important here. Interference can occur at any point in the system and is usually greatest when interfering material is most similar (Kintsch, 1970).

Most of the variations on this model assume a distinction between short-term memory and long-term memory. For example, Tulving and Thomson (1973) have formulated the encoding speci-

ficity hypothesis to account for much of the available data from research on retrieval mechanisms. This hypothesis states that specific encoding operations are performed on what is perceived and these determine what is stored. Subsequently, that which is stored determines which retrieval cues are effective. Basically, this suggests that organization must occur at input in order to be effective. Craik and Lockhart (1972) suggested a variation of the model which does not assume a distinction between short-term memory and long-term memory. They proposed that the concept of memory is tied to the depth of encoding. They have postulated that there are different levels of encoding and that deeper encoding establishes a higher ceiling on potential memory performance. The extent to which this potential is realized depends upon the degree to which retrieval conditions recreate the encoding context that uniquely specifies the target item.

There are also some new ideas about the way encoding is viewed. Wickens (1970) talks about encoding as a fairly automatic process of which people are often unaware. However, other investigators are cognizant of the varied encoding schemes that people often use in encoding (Paivio, 1969). What is obvious is that learning and memory are very complex, rich, active processes.

With this overview of the information processing system the intake, storage, and output aspects of the system can be distinguished.

The former stages are involved in the learning of material, whereas retrieval processes are involved in memory.

Encoding

It is apparent that encoding is an important process which is related to word meaning, increased discrimination, and better recall of material. Funkhouser (1968) showed subjects pictures of familiar objects and assisted them by providing categories such as shape, colour, class, and locus. The results indicated that the subjects who recalled objects with reference to the same categories by which they encoded them were superior in recall to subjects who recalled inconsistently with encoding, and to control subjects who had not been given categories.

Both Bower (1967) and Underwood (1969) have argued that words are encoded along several dimensions rather than as a single unitary trace. While each has specified some encoding dimensions, it has been the work of Wickens (Wickens, Born, and Allen, 1963) which has been most influential in suggesting a number of dimensions of encoding. Wickens utilizes a release from proactive inhibition (PI) paradigm in his study of encoding. The method involves presenting several Peterson and Peterson (1959) short-term memory trials in succession. Typically it has been found that PI builds up over successive items on such short-term memory

trials (Keppel and Underwood, 1962; Paul, 1969; Peterson and James, 1967). Presumably the build-up of PI over trials is due to the overlap in encoding of successive items; the more the items overlap in encoding dimensions, the more they may interfere with one another. PI builds up very rapidly and reaches a maximum after as few as four or five trials. Wickens has shown that a release from PI will occur when a change is made in the pre-dominant encoding dimension. In fact, he has argued that a shift along a given word dimension which produces PI release indicates a fundamental dimension along which words are encoded. Wickens has suggested that the procedure he has developed around this phenomenon is similar to a "projective technique of cognitive organization; a way of asking a person what classes are being employed without requiring him to identify and label them" (1970, p. 3.). He has stated further that individuals may not even be aware of the use of these classes.

The use of this technique has shed light on the dimensions that people use to encode words. Most of the research that has been done has used college students as subjects. There are a few studies which have focused on other groups and have discovered that these groups employed the same encoding dimensions as college students. Ingle (1973) used educable mentally retarded people as subjects and tested the dimensions of evaluation, potency, and activity with

Wickens' procedure. The results indicated that the percentage release was generally less for the retarded subjects than for the normal subjects, but that it was still significant. Thus the retarded subjects seemed to be using the same dimensions. Flowers (1973) used Wickens' procedure with groups of aphasic, brain-damaged nonaphasic, and normal subjects. He found that PI and release from PI operated to the same degree in aphasic subjects as in normal subjects.

Recently, a fair bit of research has been done using children as subjects to study the development of their encoding ability. Most studies have reported that the procedure can be used even with fairly young children. Cann, Liberty, Shafton, and Ornstein (1973) used children eight years of age and got release when switching between digits and consonants. Cermak, Sagotsky, and Mosher (1972) found that sixth graders used the evaluative dimension for encoding whereas second and fourth graders did not. Kail and Schroll (1973) found that older children used evaluation and taxonomic category whereas younger children used taxonomic category but did not yet use evaluation. Zinober, Cermak, Cermak, and Dickerson (1975) found that the more obscure dimensions such as phonemic class and sense impressions produced release only for college students but that less obscure dimensions such as

taxonomic category produced release for third graders, fourth graders, and college students.

Smothergill (1973) questioned whether Wickens' procedure is valid for young children. He suggested that this technique has not been demonstrated with second graders, and that the conclusion of Cermak, Sagotsky, and Mosher (1972) is not valid. In the Cermak et al. study the sixth graders showed both the build-up of PI and release, but the second graders showed neither. Thus their results cannot be interpreted as a failure to encode. However, this does not necessarily mean that the procedure is not valid for young children. For example, Hoemann, DeRosa, and Andrews (1974) used this procedure for children as young as four and found qualitatively similar performances to the older children.

Considerable data are available suggesting which dimensions produce release from PI for adult subjects and which do not. Wickens (1970) reported particularly high release from PI for semantic properties such as taxonomic category and the semantic differential dimensions. Grammatical class and the physical properties of words seemed to be relatively ineffective in reducing PI. These results have been confirmed by other research. Wickens and Clark (1968) conducted three separate experiments using the semantic differential dimensions. Switches from high to low or low to high were studied for evaluation, potency, and activity. The results

indicated that all three dimensions were used in encoding. Turvey (1968), Turvey and Fertig (1970), and Turvey, Fertig, and Kravetz (1969) also reported a release in PI for the three dimensions of the semantic differential. In addition, their research suggested the importance of polarity in the build-up and reduction of PI. A word's polarity or distance from neutrality in semantic space, is obtained by squaring and adding the evaluation, potency, and activity scores and taking the square root of the sum (Heise, 1965). Wickens (1972) stated that the highest release was obtained with word-number switches while taxonomic category also produced very high release. Bird and Goodwin (1974), Goggin and Riley (1974), Goggin and Wickens (1971), Loess (1968), Turvey, Cremins, and Lombardo (1969) all suggested the importance of the dimension of taxonomic category in encoding. McIntyre, Stojak, and Mostoway (1973) provided further evidence for the powerfulness of taxonomic category in both short-term memory and free recall. These authors asked subjects in a free recall situation to sort words into conceptual categories. These categories were then used in the release from PI procedure to see if release would occur for them. Release did occur and this provided some evidence for the same encoding dimensions being used in short-term memory as in free recall. Kroes and Libby (1971) have also lent support to the notion that dimensions which have been found to be important

using Wickens' procedure are also important in a free recall procedure. In comparing two taxonomic, two semantic, and two sense impression word classes, the results indicated that the semantic differential categories were as powerful in producing release as the taxonomic categories.

Many other encoding dimensions have been identified through the use of Wickens' procedure. Bird and Goodwin (1974) switched from nouns to verbs and verbs to nouns and got release from PI. This was contrary to several studies in which Wickens was unable to get release from PI along this dimension. However, Bird and Goodwin increased the salience of this dimension by announcing the content of each triad prior to its presentation and thus obtained release from PI. Turvey and Egan (1970) found release from PI with a shift in visual structure (horizontal to vertical arrangement of consonants) and also a release with a shift from one phoneme class to another. The physical size of a stimulus was changed in a release from PI procedure by Elliott (1974) and a significant result was obtained. However, Baldwin and Wickens (1974) suggested that the physical characteristics of words are of some, but generally of minor importance. They found no significant release effects for number of syllables, number of phonemes, and only a small effect for locus of pronunciation. Goggin (1974) found a small release for gender change of Spanish

nouns but she stated that the high number of intrusions for both the experimental and control groups reflects the ineffectiveness of this as a dimension. A switch from Spanish to English and vice versa was found to produce release in bilingual subjects (Goggin and Wickens, 1971). Other dimensions which have been found to produce release are: a switch between a male and a female voice (Gardiner and Cameron, 1974), sense impressions (Wickens, Reutener, and Eggemeier, 1972), syntax (Heisey and Duncan, 1971), pleasant as compared to unpleasant words (Kincaid and Cooper, 1972), frequency of occurrence (Swanson and Wickens, 1970), and symbolic representation (Reutener, 1972). Eggemeier (1972) produced some interesting research which showed multi-dimensional encoding. This was demonstrated by giving one group a double shift and one group a single shift. The results indicated that the double-shift group excelled the single-shift group. Turvey (1968) and Turvey and Fertig (1970) have suggested that a switch in polarity even across dimensions can produce release. Wickens (1970) reported that physical properties of words were only moderately effective in releasing PI, while Lachar and Goggin (1969) did obtain release from PI with this dimension. A good review of the literature on the various encoding dimensions is provided in Wickens (1973).

Some controversy has arisen about the extent of the use of imagery in encoding. Wickens and Engle (1970) stated that high

imagery words when compared to low imagery words produced little or no release from PI. They therefore suggested that the use of imagery as an encoding dimension has been overestimated. This seems to contradict some of Paivio's (1969) work which has shown imagery to be an important factor in learning and memory. As Wickens has pointed out, the discrepancy is likely due to the fact that it takes about 2.5 seconds to generate an image, and in Wickens' procedure the subjects are not given that much time with each word. Two recent studies supported this explanation. Release from PI was obtained when subjects were shifted from words to actual pictures (Wells, 1973) or when subjects were shown drawn objects and then shifted (Yuille and Fox, 1973). Since this should have reduced the time required to form an image, obtaining release from PI in these studies suggests that imagery may be used in encoding.

Another dimension which has produced some apparently discrepant results with the release from PI procedure is that of acoustic similarity. Wickens has long maintained that acoustic factors are not an important source of interference in short-term memory. Wickens and Eckler (1968) and Wickens and Simpson (1968) provided data supporting this view. However, Henriksen, Fleming, and Pilichowski (1974) suggested that acoustic encoding is important. Using the release from PI procedure, they found that PI built up for words that sound the same, and that release was obtained on the shift trial.

It is possible that these different results may have been due to differences in presentation and/or distractor modality. For example, Hopkins, Edwards, and Gavelek (1971) found that they got release from PI when they shifted from visual to auditory presentation, but no release when shifting from auditory to visual. A subsequent study (Hopkins, Edwards, and Cook, 1973) revealed that release was obtained when shifting from auditory to visual if the interpolated task was in the auditory mode rather than the visual. Differences such as these may account for some of the discrepancies in this area.

It can be seen that considerable data has been accumulated on encoding but most of this has been with normal subjects. While Wickens' procedure has not been used with schizophrenics, there are data available which allude to the possibility of encoding differences between schizophrenics and normals.

Encoding in Schizophrenics

Difficulties in encoding along the various dimensions would be expected to result in interference and a performance deficit on a wide variety of tasks. Greenberg (1970), Oltmanns and Neale (1975), Smith (1969), and Truscott (1967), all reported that schizophrenics had difficulty on tasks of short-term

memory. Furthermore, they seem to have trouble in the detection of meaning in material. Acres (1969) compared the role of semantic and syntactic components in the language ability of schizophrenics. He found no differences in recall between normals and schizophrenics when the learning task was strings of unrelated words. However, as the strings became more meaningful the normals were able to increase their performance but the schizophrenics were unable to make use of the increased meaningfulness. Although Shaw (1961) did not find differences between schizophrenics and normals on a memory task, he did find qualitative differences between them in meaning since the schizophrenics used major distortion more frequently. Johnson and Billiauskas (1971) showed that some schizophrenics used extensive overinclusion. In addition, Richman (1964) found disturbances in meaning such as condensation of multiple meanings, and attempts to reconcile irreconcilable opposites. Hogben and Jacobs (1972) showed that schizophrenics often used antonyms and homonyms instead of synonyms. These results could also be indicative of inefficient encoding with resulting difficulty in discrimination. Inadequate encoding could also cause schizophrenics to use the strongest meaning response and there is evidence that they do this (Klorman and Chapman, 1969; Mourer, 1971, 1973). However, there is also some evidence to the contrary (Neuringer, Fiske, Schmidt, and

Goldstein, 1972), so this obviously needs further investigation.

Frith (1970), Lerner (1969), Midorf (1964), O'Connor and Hermelin (1967), and Truscott (1970) all reported results similar to those of Acres (1969) in that making material meaningful was less helpful to schizophrenics than to normals. These studies indicated that the performance of schizophrenics and normals was similar on material on which there would seem to be less encoding (i.e., random and unrelated material), but that the performance of schizophrenics was inferior on material on which there would seem to be more encoding (meaningful material). This is strongly suggestive of encoding differences between schizophrenics and normals. Such differences could also account for some of the positive results from the social sensitivity theories of schizophrenia. Research testing these theories has shown that the performance of schizophrenics is not as high with stimuli that are affective or human in content as compared with neutral stimuli. However, this difference did not exist for normal subjects. Since there is likely to be much more encoding for affective and human stimuli than for neutral stimuli, these results may point to encoding differences between schizophrenics and normals.

Although some of these studies on meaning refer to an in-

ability to perceive meaning in context, this is nevertheless relevant to a difficulty in the meaning of words to which the basic encoding process refers. Raeburn and Tong (1968) reported one of the few studies which did not find that schizophrenics were less able to benefit from increasing contextual constraint than normals were. However, there was considerable variance within the schizophrenic group and under closer scrutiny it was found that the six schizophrenics who failed to improve with increasing degree of contextual constraint were those with low verbal ability and a slower writing response. Thus it is possible that verbal ability has not been adequately controlled in some of the other studies. However, Levy and Maxwell (1968) compared schizophrenics with other psychiatric groups which were matched for age and intelligence. They found that both the schizophrenic and depressive groups showed impairment in their ability to make use of contextual cues. This finding with the depressive group is an isolated one and will need further research support before speculation can be made about the results.

Although many of the studies cited here are suggestive of encoding difficulties, only a few studies have looked specifically at encoding problems in schizophrenia. Smith (1969) compared chronic schizophrenics with chronic nonschizophrenic

psychiatric patients. Material was presented both visually and verbally and was then probed for by either visual or verbal cues. Since the controls and schizophrenics did not differ with respect to which type of cue retrieved more information, the author concluded this indicated that the information was stored in the same modality for both groups. However, this conclusion is not necessarily justified. Tyler (1971) compared normals and chronic schizophrenics in the encoding of sentences which occurred in connected discourse. He suggested that previous research indicated that normal subjects encode sentences according to their semantic and syntactic aspects. Tyler's results showed that schizophrenics performed in a manner generally similar to the normals. Although this study was not supportive of differential encoding between schizophrenics and normals, the dimensions investigated in it were very global and it would seem worthwhile to investigate more specific dimensions. Hermelin and O'Connor (1967) provided evidence for encoding difficulties in psychotic children as compared to subnormal children. These psychotic children had better recall scores than the subnormal children, but they were less able to make use of the patterning and coding of words according to conceptual categories. This suggests one of the dimensions on which schizophrenics may differ from normals.

Truscott (1967) compared normals, schizophrenics, and brain-damaged subjects on Peterson and Peterson's (1959) short-term memory task. Truscott plotted the recall functions for the three groups and the results showed that the schizophrenic group was more susceptible to interference than the brain-damaged or normal group. However, Truscott concluded that this was due to interference at recall and not due to encoding difficulties. This conclusion was based primarily on the finding that it was the brain-damaged group who suffered most under the timed procedure. Truscott was assuming that a reduction in time led to a reduction in performance for subjects who were using encoding. However, this was not necessarily true because the type of encoding discussed here is the basic process of encoding words along various dimensions. This is a fairly automatic process (Wickens, 1970) which is not always done consciously and therefore is different from the use of complicated memory schemes which do require considerable time. Thus, Truscott's results cannot be said to negate the involvement of encoding difficulties in schizophrenics. In addition, there is some evidence from other sources that schizophrenics do have difficulty with regard to timed procedures (Adams, 1970; Davidson and Neale, 1974; Ortof, 1969; Phelan, Levy, and Thorpe, 1967; Yates, 1966). However, this is not always a consistent finding (Hawks and Robinson, 1971; Presly, 1969).

One other point needed mentioning before this discussion of encoding in schizophrenia is complete. There are several studies available which reported that normals encoded material according to the three dimensions of the semantic differential. Although this has not been tested with schizophrenics, there are a large number of studies available which reported the use of the semantic differential with this group. The primary purpose of these studies was to investigate the meaning of the Rorschach Test to schizophrenics (Loiselle, Fisher, and Parrish, 1968; Zax, Loiselle, and Karras, 1960) or to investigate the meaning of various concepts to schizophrenics (Crumpton and Groot, 1966; Freed, 1956; Klein and Fontana, 1969; Laxer, 1967; Nathanson, 1967). Most of these studies reported differences between schizophrenics and normals on the various measures which were studied by means of the semantic differential scale. However, it is important to keep in mind that the semantic differential is a technique used to rate concepts, and that research showing that schizophrenics are able to use this technique does not mean that they automatically encode words according to these three basic dimensions. Nor does the fact that these three factors have been found when the semantic differential data of schizophrenics have been

factor analyzed (Snider and Osgood, 1969) mean that schizophrenics encode material along these dimensions.

SUMMARY AND STATEMENT OF HYPOTHESES

It is apparent that the literature on schizophrenia is full of contradictory results, poorly defined terms, and inadequate controls (Cash, 1973). However, out of the mass of data have emerged some consistencies and conclusions. In general, schizophrenics have been shown to have a deficit on a wide variety of tasks. This deficit seems to suggest the occurrence of interference. As a result, Buss and Lang (1965) postulated interference theory as an explanation of the schizophrenic deficit. This theory seems to be the only theory broad enough to account for most of the data. Basically, the theory states that a schizophrenic's ongoing response tendencies suffer interference from irrelevant external cues and from internal stimuli which consist of deviant thoughts and associations. These act as distractors and cause the schizophrenic's associations to deteriorate. Although this theory is promising, we know little about how the interference actually operates, nor about its involvement at different stages in the information processing system. Most studies of schizophrenia have focused only on the stage of input (attention, set); however, it seems that an important contribution can be made by studying the role of interference in

the storage stage as well. The present investigation focused on this stage, in particular the process of encoding.

Encoding is an important operation in the information processing system (Funkhouser, 1968). Recently a new technique was devised which has given us a great deal of information on how normal subjects encode material. This is the release from PI procedure which was developed by Wickens (1970). In general, two dimensions on which release has been found fairly consistently are taxonomic category and the semantic differential dimensions. Grammatical class has produced little release (Wickens, 1972). Although this procedure has not been used previously with schizophrenics, it seemed like a reasonable procedure for the investigation of encoding difficulties in schizophrenia.

In general, there has been very little direct research on the possibility of encoding difficulties in schizophrenia. What is available is research on differences in word meanings and differences in ability to make use of contextual constraint between schizophrenics and normals. These allude to the possibility of encoding differences between the two populations.

The present study was designed to investigate the hypothesis that part of the memory deficit associated with schizophrenia could be accounted for in terms of encoding difficulties.

Previous research generally focused only on the input stage of the information processing system rather than postulating a deficit throughout the entire system. The present research thus attempted to analyze the locus of the interference effects in schizophrenia through an analysis of the encoding processes of schizophrenics. Our understanding of the deficit obviously has implications for a theory of schizophrenia.

The present investigation employed the release from PI procedure (Wickens, 1970) to test whether release would be obtained on the shift trial for the dimension of taxonomic category, and the evaluation dimension of the semantic differential. These two dimensions were chosen because fairly strong and consistent results have been obtained with them for normal subjects. In addition, it was deemed advisable to include at least one dimension which normals do not seem to use for encoding (grammatical class). This would have allowed for a schizophrenic/normal difference to be demonstrated in either way.

Four hypotheses were evaluated:

Hypothesis 1— Across all conditions, the recall performance of the schizophrenic group was predicted to be lower than that of the normal group.

Thus, the schizophrenics were expected to show general interference effects in terms of a short-term memory deficit as has been

previously shown in the literature (Smith, 1969). This would be shown by the schizophrenic group having an overall poorer recall score.

Hypothesis 2-- PI was expected to be obtained with schizophrenics.

Thus, since these specific interference effects have been obtained with normal subjects, and since schizophrenics are also susceptible to interference, PI effects would also be obtained with the schizophrenics. This was based on previous research as well as the results of a pilot study (Appendix 1). This would be shown by a decrement in performance over trials.

Hypothesis 3-- PI was predicted to build up more for the schizophrenic group than for the normal group.

Thus, while both groups would show the PI effect, the schizophrenic group was considered to be more susceptible to interference (e.g., Neale, 1971) and would show greater PI effects. This would be indicated by a greater decrement in performance over trials for schizophrenics than for normals.

Hypothesis 4-- The schizophrenic group was predicted to encode material differently from the normal group.

This was based on deductions drawn from verbal learning research and from research on schizophrenia. Obtaining release on the shift trial was considered to be evidence that subjects were

using that particular dimension to encode material. If release was not obtained this was considered to be evidence to indicate that subjects were not using that particular dimension for encoding.

CHAPTER II

METHOD

Experimental Design

A pilot study (See Appendix 1) was conducted to ensure that Wickens' procedure could be used with schizophrenics. This pilot study made it clear that there would be difficulty in obtaining enough schizophrenics who met the fairly stringent criteria that were used in order to label a patient "schizophrenic". Therefore a partial within-subjects design was used in which each subject was presented with all of the conditions. Since there were three dimensions (taxonomic category, grammatical class, evaluation scale of the semantic differential) and an experimental (shift) and control (nonshift) condition for each of these, this resulted in six different conditions. With each condition requiring four trials, there was a total of 24 trials for each subject. To prevent subjects from becoming fatigued and because the schizophrenic population seems to have considerable difficulty concentrating for any length of time, they received three conditions on one day and the second three another day. The six conditions were presented in six different orders across subjects so that results could not be attributed to an order effect. The original design of this study

was to have equal numbers of process paranoid, process nonparanoid, reactive paranoid and reactive nonparanoid. However, the pilot study made it clear that it was difficult to obtain adequate numbers of some of the subgroups. Nevertheless, the total number of subjects planned was kept the same.

The order of the testing of the various conditions is given in Table 1. The design was a $2 \times 2 \times 3 \times 4$ design with number correct (0-4) on a given triad as the dependent variable. Variables Trial (1-4), Item Type (grammatical class, taxonomic category, evaluation), and Release Condition (experimental or control) were within-subjects variables while Subject Type (schizophrenic versus normal) was a between-subjects variable. The scoring of 0-4 on the dependent variable allowed for one point for each word correctly recalled and an extra point for recalling all three words in the correct order.

Word Lists

As has been mentioned, the three encoding dimensions that were studied in the present research were the evaluation dimension of the semantic differential, taxonomic class, and grammatical class. Osgood, Suci, and Tannenbaum (1957) devised a procedure to measure words in a three-dimensional verbal space. These dimensions were evaluation, potency, and activity. Only evaluation

TABLE 1

Order of Groups

<u>Number of Subjects</u>	<u>Day 1</u>			<u>Day 2</u>		
8*	Ec	GCe	TCc	TCe	Ee	GCc
8	TCe	Ee	GCc	Ec	TCc	GCe
8	GCc	TCe	Ec	TCc	GCe	Ee
8	Ee	TCc	GCe	GCc	TCe	Ec
8	TCc	GCc	Ee	GCe	Ec	TCe
<u>8</u>	GCe	Ec	TCe	Ee	GCc	TCc
48						

E = evaluation dimension

TC = taxonomic category dimension

GC = grammatical class dimension

e = experimental condition

c = control condition

* four subjects out of each 8 were shifted in one direction
and the other four in the other direction

words were used in the present experiment. They were chosen from Heise (1965) which gives the semantic differential profiles for the 1,000 most frequent English words. The 21 positive evaluation words which were used had a mean of 1.35 on the evaluation dimension (all were above a score of 1.10) and an average of .47 on the potency and activity dimensions (all were below a score of 1.00). The 21 negative evaluation words had a mean of 1.78 on the evaluation dimension (all were above a score of 1.20) and an average of .47 on the potency and activity dimensions (all were below a score of 1.00). These are standardized factor scores describing a word's distance from neutral out of three points in either a negative or positive direction. An effort was made to include only words with different initial sounds so that acoustic factors could not be introduced as a source of interference (Wickelgren, 1965). No synonyms or antonyms of any words were used. Basically these are the same controls used by Wickens and Clark (1968). The words used for the evaluation dimension are presented in Appendix 2a.

For the grammatical class dimension of verbs and adjectives, 21 verbs and 21 adjectives were chosen from the Thorndike-Lorge Word Book (1944). The words used were of high frequency and any words which were both verbs and adjectives were eliminated. Care was



taken to avoid semantic and/or acoustic similarity in each subset of words as is done by Wickens, Clark, Hill, and Wittlinger (1968). The words used for the grammatical class dimension are presented in Appendix 2b.

For the taxonomic category dimension, four different categories were used with 12 words from each of the first two categories and nine words from each of the second two making a total of 42 words. These words were chosen from Battig and Montague (1969) which has the word frequencies for different taxonomic categories. The words used for taxonomic category are presented in Appendix 2c.

Subjects never received the same triad twice and all triads were counterbalanced in so far as was possible. Prior to actual experimentation a practice slide was used (with the letters D A K) to give subjects an idea of the procedure and timing to be used.

Subjects

Schizophrenic Subjects

The schizophrenic subjects (N=48) were patients at the Health Sciences Centre, Winnipeg, Manitoba, Canada. Each had a psychiatric diagnosis of schizophrenia, with no evidence of mental retardation, organic impairment, alcoholism, or drug abuse. Patients who had ECT in the last year were not used. Patients

were initially selected on the basis of a psychiatrist's diagnosis of schizophrenia and were evaluated against various criteria so that there would be a solid basis for considering them to be schizophrenic. Subjects' medication and amount of medication were noted. The standards that were used in the selection of subjects involved a step by step application of the following criteria:

1. Had received a psychiatric diagnosis of schizophrenia.

This had to be the patient's primary and current diagnosis.

2. Were between the ages of 20 and 50.

3. Included only patients whose antipsychotic medication was of the phenothiazine group. The medication of any patients who were on a drug other than chlorpromazine (which was found to be the most common drug) was translated into an equivalent dose of chlorpromazine. For example, 10 milligrams of trifluoperazine was considered to be 100 milligrams of chlorpromazine. Only patients who were on moderate doses of medication were used in the study. A survey of five psychiatrists at the Health Sciences Centre, revealed that they considered a moderate dose to be in the range of 200-800 milligrams per day. Thus, this was the range accepted in this study. The mean amount of medication was 380.73 milligrams daily, and the standard deviation was 156.44. It should be noted

that only two patients were on 800 milligrams of medication a day and these two were fairly obese.

4. Used approximately half males and half females. The schizophrenic group was comprised of 28 males and 20 females, whereas the normal group was made up of 27 males and 21 females.

All of the schizophrenic subjects who met the above criteria then underwent further testing. To assist in the diagnosis of schizophrenia two scales were used: 1. the Schizophrenic Checklist (Whitman, 1967) which is presented in Appendix 3, and 2. the Sc', a 30 item shortened form of the MMPI Sc Scale (Hobbs and Fowler, 1974; Welsh, 1952) which is presented in Appendix 4. On the Sc' subjects had to achieve a score of at least 10. On the Schizophrenic Checklist subjects had to achieve a score of at least 3. These cut-offs were used since patients scoring at this level were considered to show enough signs of schizophrenia that the diagnosis could be considered accurate. The Sc' Scale was filled out by the patients themselves while the Schizophrenic Checklist was filled out by a psychiatric nurse who knew the patient well. Subjects who met these criteria then filled out the Vocabulary Test of the Shipley-Hartford Scale (Shipley, 1940, shown in Appendix 5). Subjects who received a score of below 21 were discarded from the study. This score is roughly equivalent to the lower end of the

average intelligence range as measured by the Wechsler Adult Intelligence Scale (Wright, 1946).

Two other factors which have been found to be important in research with schizophrenics are symptom pattern (paranoid-nonparanoid) and premorbid adjustment (process-reactive). Subjects were assigned ratings on the process-reactive dimension by filling out the Ullmann-Giovannoni Self-Report Scale (Ullmann and Giovannoni, 1964). This scale is comprised of 24 questions (See Appendix 6) relating to premorbid adjustment, marital status, work history, etc., which are answered either true or false. A score of 12 or below is considered process and 13 or above is reactive. This has been validated by Held and Cromwell (1968) and Watson and Logue (1968).

The paranoid dimension generally refers to the presence of delusions of grandeur or persecution, ideas of reference, suspiciousness, and hypersensitivity to moralistic issues. Two scales were used to classify subjects on the paranoid-nonparanoid dimension. The first measure was Whitman's (1967) Paranoid Checklist (See Appendix 7) on which items are answered either true or false. This was rated by a psychiatric nurse who knew the patient well. The second measure was a shortened form of the MMPI Paranoid Scale (Pa' Scale, Hobbs and Fowler, 1974; Welsh, 1952). This is a true-false Scale (See Appendix 8) which was filled out by the patient himself.

Since the paranoid-nonparanoid dimension can be conceived of as a continuum depending on the degree of symptoms exhibited, it was considered appropriate to use a median split to classify the schizophrenic sample on this dimension. For the Pa' Scale the median was 5 and for the Whitman Paranoid Checklist the median was 3. Subjects above the median were considered paranoid and below the median were considered nonparanoid. Only those schizophrenics who attained a score of paranoid on both scales were finally classified as paranoid. Nonparanoids were those whose scores on both scales were in the nonparanoid category. Those subjects who were at the median or who scored paranoid on one scale and nonparanoid on the other were considered to be nonclassifiable. Thus, those classified as paranoid or nonparanoid can be considered to be the extremes of the sample.

Following the usage of Johannsen (1964) chronicity was defined in terms of the length of hospitalization. An acute patient was defined as one who had been hospitalized for less than a year. A process patient was defined as one who had been hospitalized for more than a year.

When subjects were given the pre-experimental tests they were told that certain specific scores were needed for participation in the experiment. This made it possible to reject subjects who did

not meet the required criteria. The characteristics of the schizophrenic group are shown in Table 2.

Normal Subjects

The normal subjects (N=48) were obtained from the staff of the Health Sciences Centre, Winnipeg, Manitoba, Canada. The criteria for normal subjects were:

1. Had no psychiatric history and were not on phenothiazines nor any other psychiatric medication.
2. Attained a Shipley-Hartford Vocabulary score of 21 or above.
3. Had a score of 8 or below on the Sc' Scale of the MMPI.

This was done to reduce the possibility of undiagnosed schizophrenia among the control group since this would minimize normal/schizophrenic differences.

In addition, each normal subject had to resemble one of the schizophrenic subjects in terms of age, sex, education, vocabulary score, and socioeconomic status, so that he/she could be matched with that subject and undergo exactly the same lists, conditions, and word orders as his/her mate. Socioeconomic status was judged by the experimenter prior to the experiment according to five criteria:

1. marital status
 2. occupation
 3. interests
 4. where subjects lives
 5. occupation of parents.
- On this basis a subject was considered to be of low, middle, or upper socioeconomic class. The distribution for the normal group was as follows: 23 low, 25 middle,

TABLE 2

Characteristics of the Schizophrenic Group

<u>Characteristic</u>	<u>Number in each group</u>
Paranoid	9
Nonparanoid	11
Nonclassifiable	28
Acute	41
Chronic	7
Reactive	15
Process	33
Low S-E class	25
Middle S-E class	22
Upper S-E class	1

and none in the upper socioeconomic class. The distribution for the schizophrenics is presented in Table 2. Table 3 gives the schizophrenic/normal comparisons on the important relevant dimensions. As with the schizophrenic group, each normal subject who was used in the experiment and completed both sessions was paid \$10.00.

Medication

The medication factor was an important one in this study. Since the schizophrenic group was on medication and the normal group was not, this introduced a possible confounding effect. However, taking patients off medication prior to testing was not acceptable because patients would be difficult to handle. Also, it was not considered humane to keep patients from receiving their treatment. In addition, there would have been a bias in selecting patients who were well enough to be taken off medication (Chapman, 1963). Another possibility was to try to test patients as soon as they came into the hospital (as done by Cancro, 1969) but some of these patients were on maintenance medication or were admitted to the hospital because they were undergoing a crisis. Thus, this was not the best time to test them.

The effects of phenothiazines on performance have been the subject of much research. However, few of these have investigated

TABLE 3

Means, Standard Deviations, and t Values of the Pre-
Test and Subject Characteristic Data for the Normal and
Schizophrenic Group

	Schizophrenics		Normals		t Value
	Means	Stand. Dev.	Means	Stand. Dev.	
Age (yrs.)	28.44	8.06	28.92	9.04	.27
<u>Sc'</u>	12.10	2.86	3.92	2.43	*
Vocab.	26.71	4.13	27.63	4.99	1.04
Educ.	10.52	2.61	10.40	2.07	.26
Medication	380.73	156.44	—	—	—

* t test not done here because there was no overlap in scores
between the two groups

the effects of these drugs on memory. Barker (1974) and Bauman (1971b) both concluded that the effects of phenothiazines on memory tests are minimal. Among the researches which warranted such a conclusion are Daston, 1959; Donahoe, Curtin, and Lipton, 1961; Gardiner, Hawkins, Judah, and Morphie, 1955; Helper, Wilcott, and Sol, 1963; Mason-Brown and Borthwick, 1957; Vestre, 1961; Whitehead and Thune, 1958. Where consistent effects were shown they seemed to be primarily detrimental motor effects (Goodman and Gilman, 1965; Latz, 1963; McKinnon and Singer, 1969) or impaired attention (Chapman and Knowles, 1964).

In his extensive review, Hartlage (1965) concluded that chlorpromazine produces general learning impairment in many areas such as attention, cognition, and psychomotor tasks. However, the effects on memory seem to be minimal. But, it should be mentioned that recent articles (e.g., Goldstein, 1973; Mosher and Feinsilver, 1973; Rappaport, Silverman, Hopkins, and Hall, 1971) have suggested that phenothiazines have different effects according to premorbid adjustment and paranoid status.

Obviously there is no completely acceptable way of dealing with the problem of one group being on phenothiazines and the other group not being on these drugs. However, since the literature suggests that the effects of phenothiazines on memory are minimal,

the approach taken in the present study was to use only patients who were on moderate amounts of medication. In addition, the patients were carefully categorized on as many variables and dimensions as possible so that a drug effect would be more likely to be detected.

Comparison of the Schizophrenic and Normal Group

In Table 3 the means of the descriptive and pre-test data are presented for the normal group and the schizophrenic group. In addition, the standard deviations and t values relevant to each of these comparisons are also presented. The raw data for both groups is given in Appendix 9. Because the normal and schizophrenic groups' performances were being compared, it was important that the two groups be comparable on several factors. From Table 3 it can be seen that the means and standard deviations of the normals and schizophrenics for age, education, and vocabulary were highly comparable reflecting the similarity of the two groups on these variables. In addition, all three t values were not significant reflecting the comparability of these means. The means for the Sc' Scale were of course different by design since the normals had to achieve a score of less than 8 and the schizophrenics had to achieve a score of above 10. No t test was done here because there was no overlap in scores.

Attrition Rates

The number of subjects who could not complete the experiment or could not be used is shown in Table 4. As can be seen from this Table, many schizophrenic subjects (N=114) were excluded because they failed to meet pre-test criteria. Only one schizophrenic dropped out during the experiment. No schizophrenics were lost due to apparatus breakdown.

Many normals (N=65) were excluded because they did not meet pre-test criteria. No normals dropped out during the experiment and none were lost due to apparatus breakdown.

Procedure

Schizophrenic Subjects

Patients who were on the psychiatric wards at the Health Sciences Centre with a diagnosis of schizophrenia and who met the initial criteria for participation were asked whether they were interested in being involved in the experiment. This was done individually. They were also told that the study was completely independent from the hospital. They were promised \$10.00 if their scores were those needed for the experiment and if they then completed the whole experiment. The Sc' Scale was given to those patients who indicated an interest in participating. Those who

TABLE 4

Attrition Rates of Schizophrenics and
Normals at Various Stages of Experimentation

<u>Stage</u>	<u>Number Excluded</u>	
	<u>Schizophrenics</u>	<u>Normals</u>
Pre-test		
<u>Sc'</u>	33	25
Shipley-Hartford	70	40
Whitman Sc Checklist	10	—
Experimental Task	1	0
Apparatus Breakdown	0	0
	—	—
Total	114	65

had scores in the schizophrenic range were then administered the Shipley-Hartford Vocabulary Test. Subjects who met the Shipley-Hartford criterion and who also had a diagnosis of schizophrenia on the Whitman Schizophrenic Checklist, were told they would be in the experiment. Patients who were rejected because of failure to meet any of these criteria were told that certain scores were needed for participation in the experiment (some high and some low) and not to feel badly if their scores did not happen to match those needed.

Subjects were then run in the experiment in whichever order they had been pre-tested. Following the experiment, the Pa' Scale and the Ullmann-Giovannoni were administered and a psychiatric nurse filled out the Paranoid Checklist.

Normal Subjects

Each normal subject who was a match for a schizophrenic subject in terms of age, education, sex, vocabulary score, and socioeconomic status, was given the Sc' Scale. Those scoring as nonschizophrenic were then administered the Shipley-Hartford. Subjects who met these criteria were used in the experiment. Both schizophrenic and normal subjects underwent the same experimental procedure.

Experimental Procedure

Subjects were run individually. Upon entry into the experiment-

al room, subjects were told that they would be tested according to their ability to recall words and to name colours. The instructions that were read to the subjects are given in Appendix 10. It should be stressed that some of the schizophrenic subjects required more repetition of parts of the instructions plus considerable reassurance.

Material was presented by means of a slide projector, timer, and screen. A trial consisted of a 2 second presentation of the signal "ready" followed by a 3 second presentation of a word triad. This was followed by the Stroop Colour-Word Test for 14 seconds. This is a distractor task which is designed to keep subjects from rehearsing the word triad. Finally, there was a recall period indicated by the word "recall" for 12 seconds. Item order was different across subjects. Four trials of this procedure made up one condition. To ensure attention and registration of the triads, each subject was required to read the three words aloud when they appeared.

This sequence is slightly modified from Wickens' procedure. Generally, Wickens uses a 2 second presentation of the word triad. However, the pilot study for the present research indicated that the schizophrenics had difficulty keeping pace with this. Another change is that Wickens' procedure generally uses five trials per condition. However, some of Wickens more recent research shows the same results with only four trials used. Obviously, this was preferable for use

with schizophrenics since they have trouble concentrating for any period of time.

Each subject received three conditions on day 1 with a 5 minute time interval in between each to allow interference to dissipate (Kincaid and Wickens, 1970). Another three conditions were given on the second day. There was a time lapse of approximately 1 day between day 1 and day 2. At the conclusion, each subject was thanked, received payment, signed a receipt book, and left.

CHAPTER III

RESULTS

One point which should be mentioned at the outset is that encoding was assessed by recall in the present data. The author realized the difficulties inherent in evaluating storage in this manner; however, there does not appear to be any direct way to assess storage (Hall, 1971; Wood, 1972). Another factor which is worthy of mention is that the range of possible recall scores was not as great as would be desired. Since the range for each subject's recall score was only from 0 to 4, large group differences would be necessary for even the most powerful statistical tests to detect such mean differences in relationship to expected high within group variability. This is the principle reason why Wickens (1970) and subsequent investigators have used relatively large sample sizes. The raw data as well as the means and standard deviations are given in Appendix 9.

Since the present research posed specific hypotheses, it was possible to use planned comparisons. These were preferred over an omnibus test since they afford the researcher more statistical power (Kirk, 1968). Thus, the four hypotheses in the present experiment were analyzed by means of t tests and a trend analysis. In addition, the dimensions of process-reactive and paranoid-nonparanoid were evaluated for possible differences.

Before proceeding to the specific discussion of each hypothesis, it should be mentioned at this point that the error terms and degrees of freedom needed for each planned comparison were generated from the appropriate analysis of variance model without referring to the overall F values and their probabilities. These analysis of variance summary tables are presented in Appendix 11a for all the data with the fourth trial included and in Appendix 11b for all the data with the fourth trial excluded. Since the fourth trial was a mixture of both shift and nonshift data, there were certain planned comparisons in which this trial needed to be included (for hypotheses 1 and 4), and certain planned comparisons in which it should not have been included (for hypotheses 2 and 3). Thus, both analyses were needed. The error mean square values were obtained by pooling appropriate error terms generated from the analysis of variance models. Appendix 11c lists the appropriate error terms for each planned comparison with the number of the comparison appearing in the text as a superscript.

Some general trends can be seen in the data. From Figure 1 it is apparent that there was an overall schizophrenic impairment in recall. In addition, there was a decline in performance over trials, from trials 1 to 3. Both of these trends were consistent with the literature in this area. However, contrary to expectation, interference did not build up over trials to a greater extent for the schizophrenics than for the normals. From Figure 2 it can be seen

FIGURE 1
RECALL DATA FOR SCHIZOPHRENICS
AND NORMALS

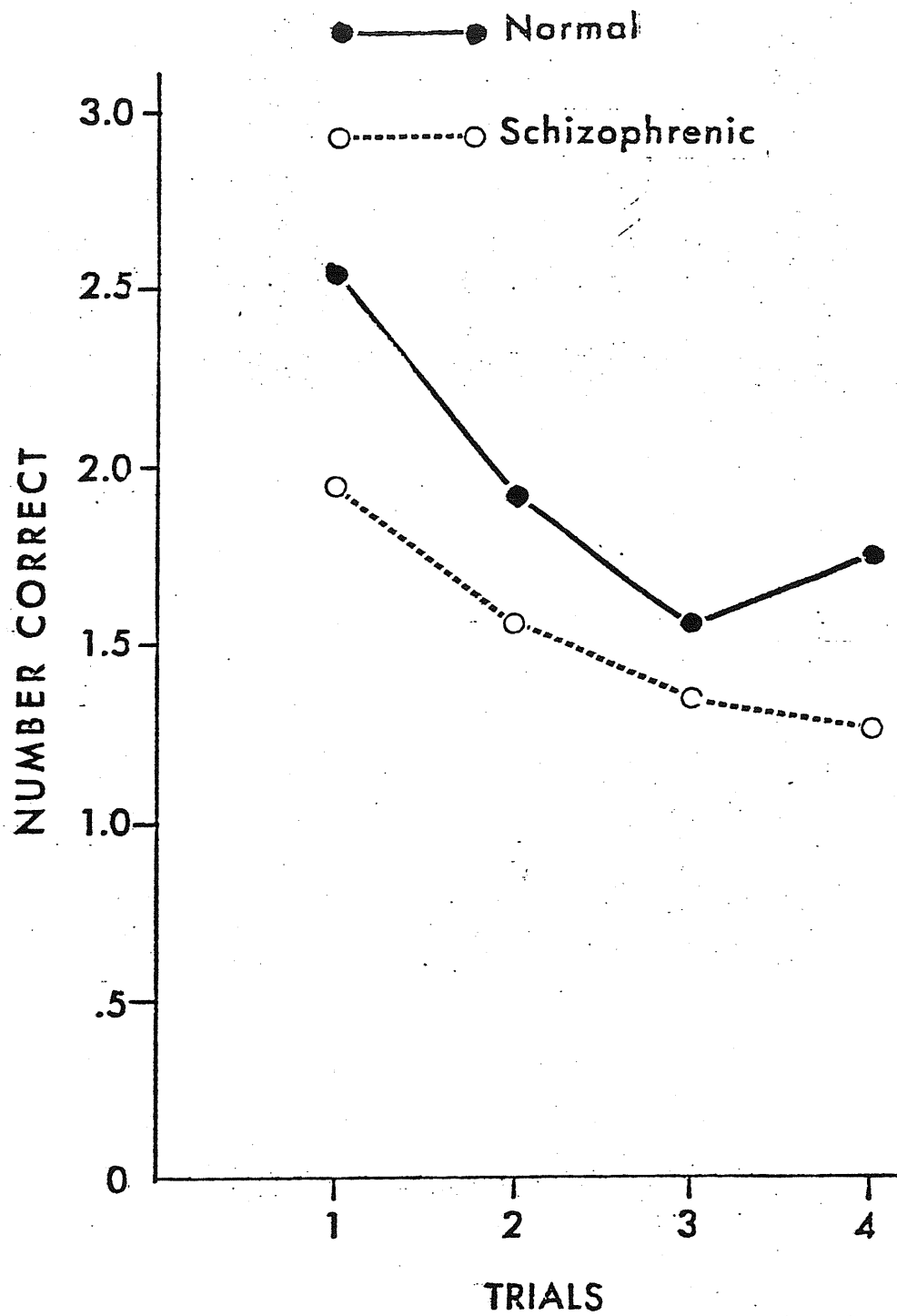
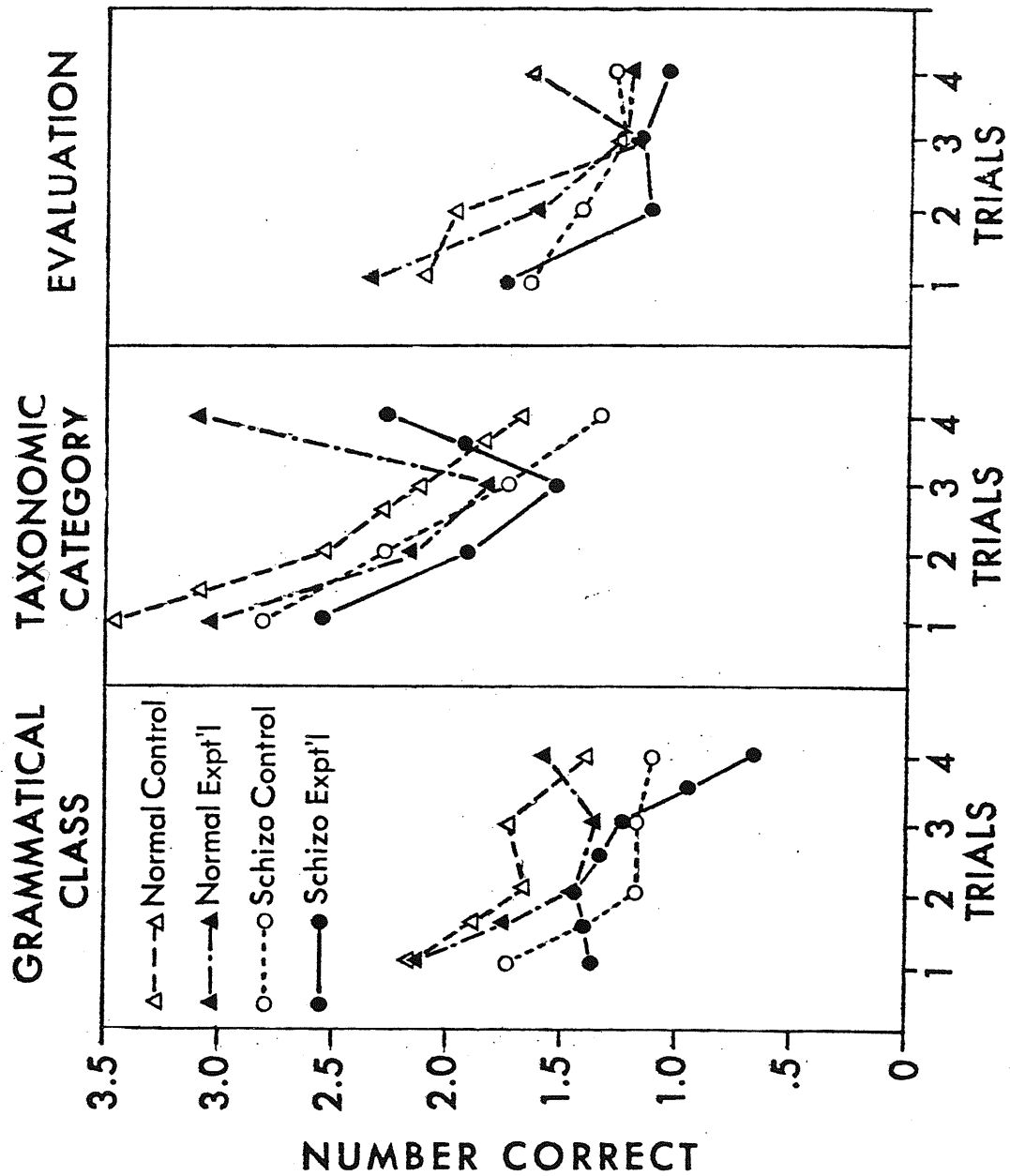


FIGURE 2
ENCODING DATA FOR
SCHIZOPHRENICS & NORMALS



that the data on Wickens' procedure for the normal subjects was generally consistent with Wickens' findings. Release seems to have occurred for taxonomic category but not for grammatical class. The schizophrenics' results tended to be similar to the normals and thus did not support the hypothesis of encoding differences between the two groups. The evaluation dimension appeared to be problematic in the present data. Wickens and others have consistently reported large release with the evaluation dimension, but this was not the case in the present data. This created some difficulties in the interpretation of the schizophrenics' performance on this dimension. Overall, the use of this procedure with schizophrenics appeared to have been relatively successful since they were able to attend to the procedure and also showed the build-up of PI. With this brief overview, we now turn to a detailed description of the results and analyses.

Recall

The recall data (Figure 1) suggests support for hypothesis 1 with the normal group superior to the schizophrenic group in overall recall ($t=3.07$; $df=94$; $p<.005$)¹. This was as hypothesized and is consistent with the literature in this area (Buss and Lang, 1965). This overall impairment is in agreement with a general interference effect, or specific interference effects at any stage or at several

stages in the information processing system.

Interference

The second hypothesis proposed that proactive inhibition should build-up over successive trials in schizophrenic as well as normal subjects. This result has been obtained repeatedly with normal subjects and should also have been obtained with the schizophrenics in this study, particularly since schizophrenics are considered to be more susceptible to interference. From Figure 1 it can be seen that there did appear to be a decrement in performance across the first three trials, although trial 4 for the normal group increased above trial 3 performance. Since trial 4 included both the shift and nonshift material it was not included in the planned comparison for this hypothesis. Two t tests were used to test this hypothesis. These were as follows:

- (1) a comparison of trial 1 with trial 3 for the schizophrenic group;
- (2) a comparison of trial 1 with trial 3 for the normal group. The results indicated that for the schizophrenic group trial 1 was superior to trial 3 ($t=4.04$; $df=376$; $p<.001$)². In addition, trial 1 for the normal group was superior to trial 3 ($t=6.28$; $df=376$; $p<.001$)³. Thus there was a statistically significant drop over trials for both the schizophrenics and normals. The build-up of PI over trials is of course consistent with the literature and is crucial to obtain when using Wickens' procedure for determining encoding differences. The

fact that PI built-up for both groups indicated a partial validation of the procedure.

Other predictions about interference were made in the present experiment. The third hypothesis proposed that PI should build-up more for the schizophrenics than for the normals. This was based on literature which showed that schizophrenics seemed to be more susceptible to interference (e.g., Neale, 1971). Greater interference would have been indicated by a greater decrement in performance over trials 1-3 for the schizophrenics than for the normals. From Figure 1 it appears unlikely that this hypothesis was supported, and a trend analysis (Winer, 1962) showed that there was no difference in linear ($F=2.71$; $df=1,282$)⁴ or in quadratic ($F=.03$; $df=1,282$)⁵ trends between the two groups. Thus, it does not appear that interference effects built-up more rapidly for schizophrenics over trials, although there was an overall large performance deficit.

Encoding

The data for the three encoding dimensions is shown in Figure 2. Wickens has suggested that where PI builds up over trials and then releases with a change along a given dimension, it is indicative of an encoding dimension. Where no release occurs on a change trial this would indicate a dimension that is not a salient encoding dimension.

It is apparent that the strongest and most consistent results in

this study were obtained with taxonomic category. This seemed to have been used for encoding by both schizophrenics and normals. Encoding does not seem to have occurred along the dimensions of evaluation or grammatical class. Thus, the hypothesis proposing that the schizophrenic group should have encoded material differently from the normal group was not supported. This was tested by a series of planned comparisons. Two basic questions were asked in order to determine whether release occurred: (1) whether trial 4 performance exceeded trial 3 performance on the experimental lists; and (2) whether trial 4 performance on the experimental list exceeded trial 4 performance on the control list. Since these two questions had to be asked for every dimension for both schizophrenics and normals, there were a total of 12 comparisons.

For taxonomic category, trial 4 performance was superior to trial 3 performance on the experimental lists for the normal group ($t=4.89$; $df=2256$; $p<.001$)⁶ and for the schizophrenic group ($t=2.92$; $df=2256$; $p<.005$)⁷. For taxonomic category, trial 4 on the experimental list exceeded trial 4 on the control list for the normal group ($t=5.44$; $df=2256$; $p<.001$)⁸ and for the schizophrenic group ($t=3.62$; $df=2256$; $p<.001$)⁹. The results supported encoding along the dimension of taxonomic category. This was of course in agreement with the literature for normals (Wickens, 1970) where taxonomic category has consistently

produced a large amount of release.

For the grammatical class dimension, there was neither a significant rise in performance from trial 3 to trial 4 ($t=.79$; $df=2256$)¹⁰ nor a trial 4 control/experimental difference ($t=.63$; $df=2256$)¹¹ for normal subjects. For the schizophrenic subjects there was actually a decrease in performance from trial 3 to trial 4 for the experimental condition ($t= -2.12$; $df=2256$)¹². The difference between control and experimental conditions for schizophrenics on trial 4 was again in the opposite direction but not statistically significant ($t= -1.73$; $df=2256$)¹³.

For the evaluation dimension, trial 4 performance on the experimental lists did not exceed trial 3 performance for either the normal group ($t=0.00$; $df=2256$)¹⁴ or for the schizophrenic group ($t= -.39$; $df=2256$)¹⁵. The trial 4 difference between the experimental list and the control list for the normal group was not significant ($t= -1.58$; $df=2256$)¹⁶, nor was the same comparison for the schizophrenic group ($t= -.79$; $df=2256$)¹⁷. This suggests that neither normals nor schizophrenics used this dimension for encoding material. This finding is not consistent with the literature on encoding where large release has been obtained with normals for evaluation. Because these particular data were not consistent with the literature, the interpretation of possible encoding differences between schizophrenics and normals for the evaluation dimension was problematic. This will be discussed

later in the paper.

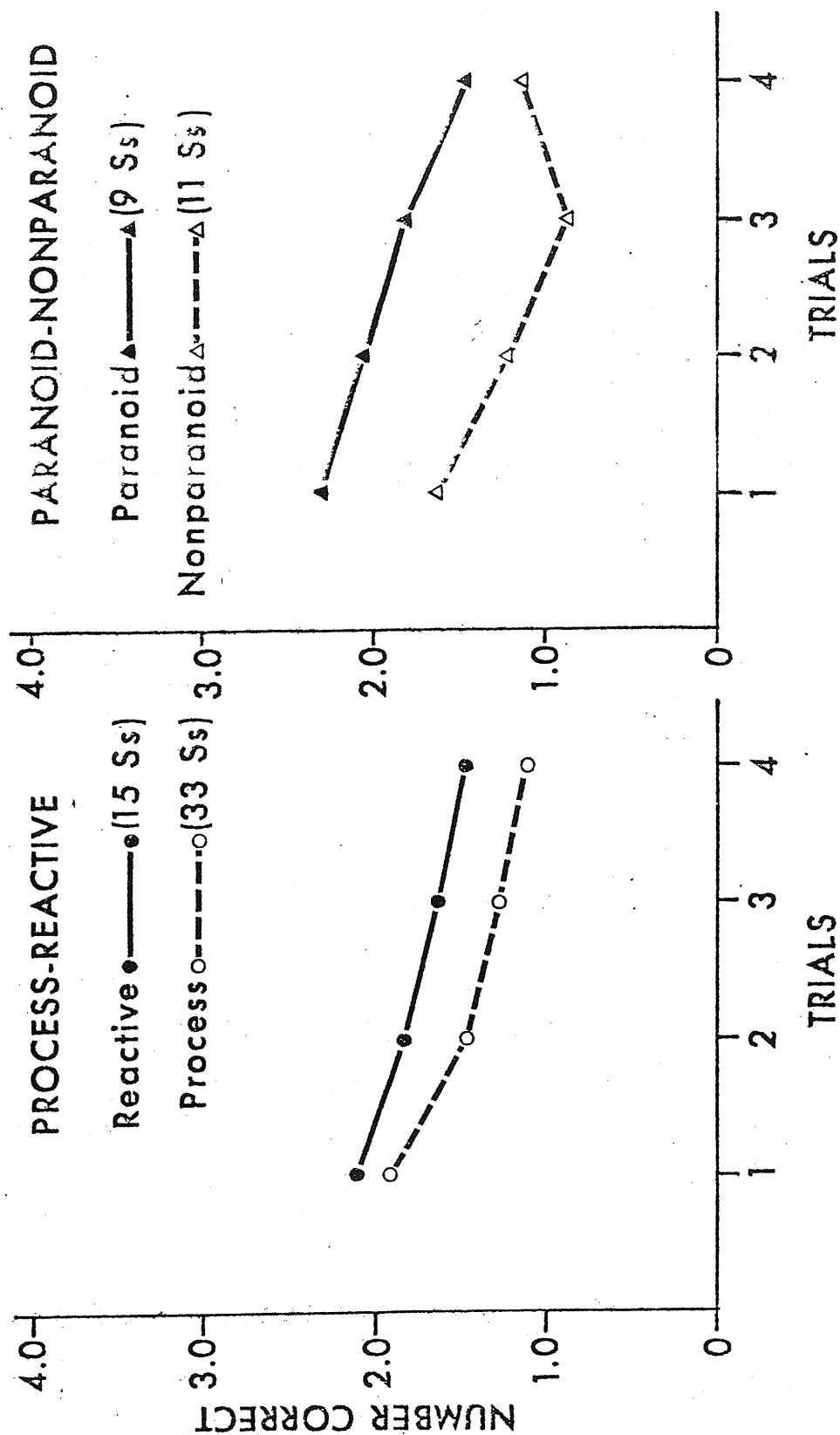
To sum up the results on encoding, a shift in taxonomic category produced release from PI for both schizophrenics and normals, whereas shifts in evaluation and grammatical class did not produce release for either group. These results (with the exception of evaluation) were consistent with the rest of the literature on encoding in normals and they present previously unobtained data on encoding in schizophrenics. It was hypothesized that schizophrenics and normals would encode material differently. However, this hypothesis was not supported.

Process-Reactive Dimension

In the total sample there were 15 reactive and 33 process schizophrenics according to the Ullmann-Giovannoni Scale. The mean for the reactive group was 15.6 and for the process group was 9.2. The recall data for the process and reactive subjects is shown in Figure 3. It appears that the reactive subjects had higher overall recall scores than the process subjects. However, an analysis of variance performed on these data (Appendix 11d) indicated no statistically significant difference between the two conditions ($F=2.60$; $df=1, 46$; $p>.20$). While this effect was not significant, the difference between the process group and the reactive group was certainly in a direction found earlier in the literature (Johannsen, Friedman, Leitschuh, and Ammons, 1963).

FIGURE 3

RECALL DATA FOR PROCESS-REACTIVE AND PARANOID-NONPARANOID



Paranoid-Nonparanoid Dimension

The schizophrenics were classified as paranoid if their scores were in the paranoid range on both the Pa' Scale and Whitman's Paranoid Checklist. This resulted in nine schizophrenics classified as paranoid and eleven classified as nonparanoid. The remaining 28 subjects could not be given a consistent classification. The recall data for the paranoid and nonparanoid subjects is shown in Figure 3. It appears that the paranoid subjects had higher recall scores than the nonparanoid subjects. An analysis of variance (Appendix 11e) showed that paranoids performed better overall than nonparanoids ($F=6.46$; $df=1, 18$; $p < .025$). This superiority of paranoids over nonparanoids is also in accord with the literature (Kincaid, 1964; Shaw, 1961).

Overall, it appeared that there were differences in recall for the paranoid group compared to the nonparanoid group. In addition, the reactive group had a higher recall score than the process group. Some checking was done to ensure that these two dimensions were not tapping the same subjects. In the paranoid group, six of the subjects were process and three were reactive. In the nonparanoid group, eight of the subjects were process and three were reactive. Thus the paranoid and nonparanoid group had approximately the same proportions of process and reactive patients. This suggested

that the two dimensions were reasonably independent in this sample.

Plotting the encoding data for the paranoid/nonparanoid and process/reactive dimensions indicated a high degree of variability but no suggestion of differential encoding effects. Because of these lack of apparent differences and the small and unequal ns involved, no analysis of the encoding data by schizophrenic category was undertaken.

CHAPTER IV

DISCUSSION

The major purpose of this study was to assess whether part of the schizophrenics' psychological deficit could be attributed to encoding difficulties. There was little research in this area but those data which were available alluded to the possibility of encoding differences between schizophrenics and normals. Previous research on the psychological deficit had posited a problem at the input stage of information processing. Such explanations as attentional, filtering, or screening deficiencies refer to this initial stage of processing. The position taken in the present paper was that the deficit shown by schizophrenics was more general in that it was likely to occur throughout the system and not just at input.

The results of this experiment indicated an overall deficit for schizophrenics. This deficit is well documented in the literature (Buss and Lang, 1965; Oltmanns and Neale, 1975) and was shown in the present study by the schizophrenics having obtained a lower recall performance than the normals. Hypothesis 1 had proposed an overall deficit and this hypothesis was supported. The results also showed that PI built-up for both the schizophrenics and the normals. This was in accord with the literature on PI with normals (Wickens, 1970) and provided new data on obtaining PI with this procedure for schizo-

phrenics. Hypothesis 2 had proposed that PI would be obtained with both schizophrenics and normals and thus this hypothesis was supported. The results also showed that PI built-up to the same extent for schizophrenics and normals. This was contrary to prediction (hypothesis 3) and to some literature which has suggested that schizophrenics are more susceptible to interference (Greenberg, 1970; Neale, 1971).

A major prediction made in the present study was that there would be encoding differences between schizophrenics and normals. This possibility was an extension of studies such as that of Acres (1969) and thus the present study varied several encoding dimensions to determine if the psychological deficit might be due to encoding difficulties. Since an excellent technique had been devised by Wickens, Born, and Allen (1963) to assess encoding in short-term memory, this procedure was used to determine whether there were encoding differences between schizophrenics and normals on certain dimensions. These results indicated that the schizophrenics and the normals encoded and released similarly on all the dimensions used in the present study. Both groups employed taxonomic category for encoding material and did not use grammatical class nor evaluation. Thus, hypothesis 4 was not supported. The results for the normal group (with the exception of evaluation) were the same as Wickens has obtained and this provided confirmation of his results. In addition, PI built-up in a

similar fashion for the schizophrenics and normals with release having been obtained on one dimension. This indicated the usefulness of this procedure with schizophrenics.

The results of the post hoc analyses of variance were generally in accord with the literature on schizophrenia in suggesting differences in recall between process and reactive patients and also between paranoid and nonparanoid patients. Although the process-reactive distinction was not statistically significant, the reactive group was superior. This effect may have failed to attain significance due to the small number of reactive patients in the sample. In the paranoid-nonparanoid distinction, the difference was significant with the paranoid group being superior. The data were examined for possible encoding differences on these dimensions, but the trends were the same as in the larger data.

Interpretation of Results

The overriding purpose of the present study was to obtain some insight into the schizophrenic psychological deficit. Although two of the hypotheses in this study were not supported, this was nevertheless important data in our process of gathering information about the schizophrenic deficit. The schizophrenics demonstrated an overall deficit in recall as compared to the normals. From this we can conclude

that they are having difficulty at some point in the information processing system. Past research has focused mainly on input factors; however, the present research posited difficulties throughout the system with short-term storage (encoding) having been the focus of this particular investigation. The schizophrenics had fewer words correct from the first trial and maintained this difference throughout the trials. This difference could not have been due to "input" factors because considerable care was taken to ensure that the information "got in" to the schizophrenics' information processing system. This was done following the pilot study by increasing from 2 to 3 seconds the time given the subjects to view the word triad. In addition, the subjects were required to verbalize the three words to ensure they had attended to them. Thus, the deficit shown by the schizophrenics in this study cannot be attributed to input (sensory, perceptual) factors. Obviously there is interference somewhere in the system but the release from PI paradigm did not allow us to pin it down to a specific interference effect.

The present results suggest that the schizophrenics did not encode material along dimensions that were different from the normals. This of course is not conclusive evidence against other possible encoding differences between schizophrenics and normals since all possible semantic and nonsemantic dimensions were not tested. However, the

schizophrenics and the normals seemed to be processing information in the same way. PI built-up for both, and it was the same amount of PI. Release was obtained along the same dimension for both groups and not along the other two dimensions. Thus it would appear unlikely that the locus of the schizophrenic deficit is due to anomalies in the coding processes tapped by the Wickens' procedure.

Since the material had been attended to and perceived, this left the storage and output stage as possible locations for the deficit. As just mentioned, the results seem to suggest that the interference was not occurring at the storage stage. However, there may still be encoding differences that Wickens' procedure could not pick up. For example, it is possible that the schizophrenics encoded inappropriately on too many dimensions and that they therefore had more interference at retention from irrelevant encodings. This notion would certainly tie in with the idea of overinclusion as a basis for the deficit in schizophrenia. It is also possible that there were encoding differences along dimensions which were not tested in the present study. However, there was no evidence to suggest this. Furthermore, this would have been difficult to test because the dimensions which were chosen were those which produced the clearest results in Wickens' research. To choose dimensions which produced weaker results could have clouded any schizophrenic/normal differences. However, it

is possible that this is where the real differences lie.

From the present data, there are several other possibilities to consider as causes of the schizophrenic deficit. First of all, the schizophrenics may have had some "random" noise which once in the system caused interference. The problem with this explanation is that it is vague, general, and difficult to test.

The possibility of the schizophrenic/normal difference in this study being due to social-motivational factors needs to be mentioned again at this point. The social-motivational theory was already discussed in the introduction of this paper. The proponents of this view would typically attribute the deficit obtained with the schizophrenics in this study to lessened motivation on the types of tasks to which psychologists generally expose these subjects. Attempts to demonstrate this have shown that the valence of the environmental stimuli plays an important part in the efficiency of schizophrenics responding.

Buss and Lang (1965) have reviewed the research relevant to the social-motivational approach. They suggest that the literature showing that affective stimuli disrupt the functioning of schizophrenics may be due instead to a broader inability to inhibit any interfering stimuli. Thus, the present author does not favour a social-motivational explanation of the present results.

The explanation which the present author favours is that of an output problem—primarily a retrieval deficit. This conclusion is deduced from the present data because the information was "getting in", was processed in what appeared to be a very similar manner, and yet there was a consistent schizophrenic deficit right from trial 1. This pointed to a difficulty in retrieving the information that was stored.

Several recent studies are available which support the idea of a retrieval dysfunction as one possible basis for the schizophrenic deficit. Bauman (1971a, 1971b) compared recognition and recall performances of schizophrenics with normals. The schizophrenics performed as well as the normals on a recognition task but not on a recall task. Since the information must have been in the system if it was available for recognition, the deficit shown in Bauman's studies was likely a problem with retrieval. This made an important distinction between what was available (storage) and what was accessible. Nachmani and Cohen (1969) reported differences between recall and recognition learning for schizophrenics as compared to other psychiatric patients. The two groups did not differ significantly on the recognition test but the schizophrenics were significantly inferior to nonschizophrenics in number of items correct on the recall test. Nachmani and Cohen related this deficit to a general theory of interference at some point in the system rather than a specific retrieval dys-

function. However, it seems fairly clear that, if information can be recognized but it cannot be recalled, a retrieval problem is suggested.

Perhaps the clearest evidence that schizophrenics have difficulty in retrieving information is a study by Barker (1974). Barker specifically tested for a retrieval dysfunction by having conditions of cued and noncued recall for both schizophrenic and normal groups. There were 24 items in each list but in the first type of list each item was preceded by a category name, and in the second type every four items were preceded by a category name. The results indicated the superiority of cued over noncued recall for both the schizophrenics and the normals. The two results that suggested a retrieval dysfunction for the schizophrenic group were: (1) the inferiority of the schizophrenic group compared to the normal group under noncued recall when items per category were equal to four, and (2) under cued recall the schizophrenic group was able to increase their performance to be equivalent to the normal group.

Several other considerations must be looked at in relation to the present study. It is possible that the poorer performance of the schizophrenics might have been due to greater interference from the distractor task. The Stroop Colour-Word Test was used in the present experiment to prevent subjects from rehearsing the word triads. Thus no data was recorded on this test such as number of errors, etc. However, the experimenter discovered during the course of running sub-

jects that the schizophrenics seemed to have more difficulty with this test than the normal subjects did. Previous research with the Stroop Test (Kates, 1971; Langer, Stein, and Rosenberg, 1969; and Peixotto and Rowe, 1969) has indicated a greater interference effect for schizophrenics than for normals. If the poorer recall performance of the schizophrenic group was due to interference from the Stroop Test, this would argue against a retrieval dysfunction as the basis for the recall deficit obtained in this study. Although we had no way of directly assessing this from our present data, it seemed unlikely that Stroop-induced interference was the basis for this deficit. There were several studies available which showed a schizophrenic short-term memory impairment (e.g., Smith, 1969) in which no such distractor task was used. Thus, it is unlikely that our effect was due to the distractor task.

The last possibility to consider is that the recall difference between schizophrenics and normals was due to a drug effect. This has been discussed at length in the methods section of this paper where literature has been cited indicating that the effects of phenothiazines on memory tests are minimal.

In conclusion, a retrieval dysfunction appears to be the most logical way to account for the recall deficit of the schizophrenics. However, while the present study did not find encoding differences, this conclusion must be viewed as preliminary until further research

has been done on this question. It is also important to bear in mind that these results applied to "testable" schizophrenics. Klein and Spohn (1964), Lebow (1972), and Wilensky and Solomon (1960), have pointed out that the literature has generally not applied to schizophrenics who are functioning poorly or who are "untestable".

Although only one schizophrenic dropped out of the present experiment due to inability to complete the task, we must keep in mind that such a group does exist.

Interference

Contrary to expectation, interference built-up to the same extent for the schizophrenics and the normals in this study. This of course does not mean that the schizophrenics were not more susceptible to interference than the normals at some point in the information processing system. There is a great deal of evidence available suggesting that schizophrenics show greater susceptibility to interference on most tasks (Greenberg, 1970; Hirsch, 1971; Kausler, Lair, and Malsumoto, 1964; Taylor, 1971). Our failure to obtain more rapid build-up of interference effects for the schizophrenics with the release from PI procedure either pointed to some other locus (probably output) as the primary source of interference, or suggested that there might have been something about the release from PI procedure which did not allow for greater interference. One possibility was that the narrow range of the scoring system (0-4) may not have allowed for differences to show up.

The Evaluation Dimension

The results obtained in the present study with the evaluation dimension were not in accord with the results Wickens has obtained with evaluation. Turvey (1968) and Wickens and Clark (1968) reported a release from PI for evaluation and showed that it was one of the largest amounts of release produced. A thorough examination of the data, procedure, and materials used in the present research has led the author to suspect that the particular words chosen were responsible for the failure to replicate. Wickens and Clark (1968) did not indicate what particular evaluation words were used in their study. They stated, "A word was chosen if it fell on the extreme end of one dimension and was relatively neutral on the other two dimensions" (Wickens and Clark, 1968, p. 581). The present author tried to employ this same criterion but had difficulty finding words which were high on evaluation but neutral on potency and activity. In retrospect it seemed that the evaluation words which were chosen rated too low on the evaluation dimension (1.35 for the positive words and 1.78 for the negative words). In choosing the evaluation words the author also used the reasoning that the positive and negative evaluation words should have approximately the same mean so that a shift either way would have represented the same amount of change. Although this control was later though unnecessary, its implementation had already led to the omission of several negative evaluation words of high value

(e.g., bad, debt, enemy, fear, hate). Thus, these item selection differences could well have been responsible for a failure to replicate Wickens' findings.

Directions for Future Research

The release from PI procedure appears to be a promising method for the investigation of encoding in both normals and schizophrenics. The present author feels that additional sound techniques from verbal learning literature should be extended to the schizophrenic population to study their information processing. Barker (1974), Bauman (1971a, 1971b), and Smith (1969) have all applied fairly solid verbal learning procedures to schizophrenics and have provided us with important data as to how schizophrenics process information. We have learned that schizophrenics have difficulties at the input stage (particularly chronic or process schizophrenics) and that they also appear to have a retrieval dysfunction. Several specific future research suggestions are possible from the present study. The most important one is the comparison of schizophrenics and normals on as many dimensions as possible to test for encoding differences. Although the results of the present study suggest that there are no encoding differences, this conclusion is premature at this point. In particular, it seems important to re-test evaluation using words with higher ratings on the evaluation dimen-

sion than those used in this study. Other dimensions which have not been tested in this study should be tested as well. The release from PI procedure has proven to be a useful method and deserves more use in research with schizophrenics.

New Developments in the Release from PI Procedure

Subsequent to the running of the present study, some research has been published questioning Wickens' interpretation of his procedure. Wickens' position is that the effects produced by his procedure are interference effects which basically occur at the storage stage. In addition, he has stated that this type of encoding is fairly automatic.

Underwood (1972) had challenged the automaticity of encoding in Wickens' procedure. Underwood states that a typical release from PI experiment produces priming which encourages a search for a common way of encoding. This priming is produced by the use of triple word stimuli and the presentation of several trials of the material. Bennet and Bennet (1974) and Gardiner and Cameron (1974) have also stressed the role that priming may be playing in these experiments. However, except for the Bennet and Bennet study, no evidence for priming has been produced and thus it is difficult to determine the extent of its involvement in Wickens' procedure.

Other researchers have posed a noninterference interpretation of Wickens' results because Wickens' studies have not been in accord with some of Baddeley's findings. Baddeley's results (e.g., Baddeley and Dale, 1966) have suggested that there are no interference effects of

semantic similarity in primary memory but that secondary memory is sensitive to semantic similarity. This seems to contradict Wickens' results in which semantic factors have played a large role in short-term memory. Because of this difference in results, several researchers have posited noninterference interpretations of release from PI such as an alerting or perceptual explanation. This suggests that performance deteriorates over trials because subjects become bored or inattentive and that the subject is perceptually alerted by the change in the material at the critical trial. Thus the material is better registered in memory.

Elliott (1974) and Gumenik and Fay (1970) support an alerting interpretation but there are several studies which provide evidence against this interpretation (Bird and Goodwin, 1974; McIntyre, Stojak, and Mostoway, 1973; Reutener, 1972; Turvey, Cremins, and Lombardo, 1969). Wickens and Gittis (1974) stated that to suggest that performance declines over trials because subjects become bored or inattentive would make all laboratory research suspect because we are talking about such a short period of time. All in all, the evidence has been fairly conclusive against a novelty interpretation.

Another group of studies has suggested that the interference from Wickens' procedure occurs at the retrieval stage rather than at the storage stage. Bennet and Bennet (1974), Gardiner, Craik,

and Birtwistle (1972), and Loftus and Paterson (1975) all support this view, with the Gardiner et al. study providing the strongest support. On trial 1, all groups received at presentation as a cue the word "flower". On the release trial one group received (at the time of recall) a cue appropriate to the new subcategory of flowers (wild or garden), a second group received a comparable cue at the time of presentation, and a third group received no cue. The results indicated that there was substantial release under both cueing conditions, and none under the no-cue conditions. Since the no-cue and retrieval-cue conditions were treated identically until the time of recall on the release trial, and yet the presentation of a cue was sufficient to produce release, the authors attributed the release to a change in retrieval processes. These authors have suggested that the build-up of PI reflects the declining effectiveness of a retrieval cue common to the past few trials. Once the material has changed, the novel items supply a new and more effective retrieval cue. They have added that one way this might work is that when a subject is given a new cue at retrieval he generates examples of the subset and then edits these responses via an implicit recognition process. However, Dillon (1973) has argued against an interpretation of PI as being due to increasing retrieval failures. Dillon's results showed that recall with the previous trial responses displayed at the time of recall and identified as incorrect, was not better than normal recall.

Obviously, these issues regarding Wickens' procedure need a great deal more consideration. Different researchers have used different procedures and have had diverse interpretations of results. The results of the present study have some relevance for the locus of PI issue. As mentioned previously, several recent studies have suggested a retrieval deficit for schizophrenics. Although the schizophrenics in the present study did have an overall recall deficit, they demonstrated no specific deficit on the release from PI procedure. If PI and release from PI are retrieval phenomena, we would have expected the schizophrenics to have shown different results from the normals. Since they did not, this is not supportive of a retrieval interpretation of the locus of PI effect.

Conclusions

It should be noted that these issues suggesting alternative interpretations to those of Wickens, do not have any differential implications for the schizophrenics and normals in the present research. They are primarily "pure" verbal learning issues which needed to be discussed because of the methodology used in the present experiment. In fact, in none of these verbal learning studies was anything but a "normal" population ever used. The present study is one of only a few which have attempted to assess the thinking of a clinical group from a sound methodological verbal learning base.

Using this base has shown that schizophrenics' problems with information processing are more widespread than at input. The conclusion reached from the present study is that there is a retrieval dysfunction as well. Encoding was found to be much the same for schizophrenics as for normals. However, this must remain a tentative conclusion until other dimensions are tested.

The overriding purpose of all research on schizophrenia is to shed light on causation and therefore give clues as to treatment. Much data has been accumulated on schizophrenia with a great deal of trivia and many inconsistencies. Besides the lack of controls which are found in all areas of research, studies on schizophrenia are particularly prone to misdiagnosis of this clinical group. Overall however, much of the psychiatric literature attests to a large organic component (Kraus, 1973) in schizophrenia. This is certainly in accord with the present study and the rest of the psychological literature which have suggested schizophrenic deficits in such basic functions as information processing, particularly input and retrieval.

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APPENDICES

APPENDIX 1

PILOT STUDY

Recall Data (out of 4)

<u>Expt'l</u> (Shift to different dimension on trial 5)						<u>Control</u> (Continued on same dimension throughout)				
<u>S#</u>	<u>Trial</u>					<u>Trial</u>				
	1	2	3	4	5	1	2	3	4	5
1	2	2	1	1	1	1	2	0	0	1
2	4	2	3	2	2	4	4	4	2	1
3	2	2	1	1	1	0	1	2	4	2
4	2	4	2	1	1	1	0	2	0	1
5	1	4	3	1	4	4	2	2	2	2
6	2	1	2	1	1	3	2	2	1	1
7	2	2	1	1	1	4	2	1	1	2
8	0	0	0	1	4	2	0	0	1	0
9	1	0	2	1	1	2	1	1	1	0
16	17	15	10	16		21	14	14	12	10

(Dimension used was taxonomic
category - animals and vegetables).

APPENDIX 2a

EVALUATION LIST

<u>POSITIVE</u>	<u>NEGATIVE</u>
country	price
quality	burn
open	not
able	throw
farm	shoot
live	difficulty
gain	missing
best	refuse
save	about
land	cut
religious	hardly
fresh	situation
father	hide
health	cause
succeed	thing
gentleman	fall
satisfy	surround
unite	problem
milk	quiet
uncle	trouble
hope	must

APPENDIX 2b

GRAMMATICAL CLASS LIST

<u>ADJECTIVES</u>	<u>VERBS</u>
big	think
late	grow
rich	write
long	forget
good	speak
dark	allow
young	build
cold	feel
happy	try
full	continue
wild	fail
great	receive
modern	destroy
hard	know
few	appear
thin	enjoy
kind	begin
special	leave
real	carry
important	join
clean	remember

APPENDIX 2c

TAXONOMIC CATEGORY LIST

CLOTHING

shirt
dress
hat
jacket
pants
socks
coat
shoes
tie
skirt
blouse
sweater

FURNITURE

chair
bed
television
dresser
sofa
table
desk
lamp
couch

HUMAN BODY

legs
eye
finger
mouth
arms
ear
nose
toe
head
foot
stomach
hand

FRUIT

apple
plum
grape
pear
cherry
orange
grapefruit
peach
banana

APPENDIX 3

WHITMAN SCHIZOPHRENIC CHECKLIST

Directions: Please circle the yes in front of each statement which is true of the patient whose name appears at the top of the page and the no in front of each statement which is not true of him.

- | | | |
|-----|----|---|
| Yes | No | 1. He has a lack of emotions and feelings or his emotions and feelings are disorganized and disconnected. |
| Yes | No | 2. He has very little interest in external objects. |
| Yes | No | 3. He is illogical and disorganized in his conversation. |
| Yes | No | 4. He sometimes acts impulsively, eccentrically and unexplainably. |
| Yes | No | 5. He has little initiative and is suggestible. |
| Yes | No | 6. He seems to be more of a nonparanoid schizophrenic than anything else. |

APPENDIX 4

Sc' CHECKLIST (WELSH)

The inventory consists of numbered statements.
Read each statement and decide whether it is true as
applied to you.

You are to mark your answers after each item. If a statement is TRUE or MOSTLY TRUE, as applied to you, circle the T. If a statement is FALSE or NOT USUALLY TRUE, as applied to you, circle the F. If a statement does not apply to you or if it is something that you don't know about, make no mark.

Remember to give YOUR OWN opinion of yourself. Do not leave any blank spaces if you can avoid it.

- | | | |
|---|---|---|
| 1. Most any time I would rather sit and daydream than to do anything else. (T)* | T | F |
| 2. There is something wrong with my mind. (T) | T | F |
| 3. My father was a good man. (F) | T | F |
| 4. Everything tastes the same. (T) | T | F |
| 5. I dream frequently about things that are best kept to myself. (T) | T | F |
| 6. I loved my father. (F) | T | F |
| 7. Once in a while I feel hate toward members of my family whom I usually love. (T) | T | F |
| 8. I wish I were not bothered by thoughts about sex. (T) | T | F |

APPENDIX 4 (continued)

9. My mother was a good woman. (F)	T	F
10. I am so touchy on some subjects that I can't talk about them. (T)	T	F
11. My hands have not become clumsy or awkward. (F)	T	F
12. I refuse to play some games because I am not good at them. (T)	T	F
13. I like to visit places where I have never been before. (F)	T	F
14. I dislike having people about me. (T)	T	F
15. Many of my dreams are about sex matters. (T)	T	F
16. I loved my mother. (F)	T	F
17. I have never been in love with anyone. (T)	T	F
18. I enjoy children. (F)	T	F
19. The things that some of my family have done have frightened me. (T)	T	F
20. I get all the sympathy I should. (F)	T	F
21. Peculiar odors come to me at times. (T)	T	F
22. I cannot keep my mind on one thing. (T)	T	F
23. Most of the time I wish I were dead. (T)	T	F
24. I have had very peculiar and strange experiences. (T)	T	F
25. I often feel as if things were not real. (T)	T	F

APPENDIX 4 (continued)

- | | | |
|---|---|---|
| 26. I hear strange things when I am alone.(T) | T | F |
| 27. I am afraid of using a knife or anything
very sharp or pointed. (T) | T | F |
| 28. I have never been paralyzed or had any
unusual weakness of any of my muscles.(F) | T | F |
| 29. Sometimes I enjoy hurting persons I
love. (T) | T | F |
| 30. At times I have enjoyed being hurt by
someone I loved. (T) | T | F |

* The letter in parentheses after each statement indicates a schizophrenic response.

SHIPLEY-HARTFORD SCALE

in the test below, the first word in each line is printed in capital letters. Opposite it are four other words. Draw a line under the one word which means the same thing, or most nearly the same thing as the first word. A sample has been worked out for you. If you don't know, guess. Be sure to underline the one word in each line that means the same thing as the first word.

		sample			
	LARGE	red	big	silent	wet
(1)	TALK	draw	eat	speak	sleep
(2)	PERMIT	allow	sew	cut	drive
(3)	PARDON	forgive	pound	divide	tell
(4)	COUCH	pin	eraser	sofa	glass
(5)	REMEMBER	swim	recall	number	defy
(6)	TUMBLE	drink	dress	fall	think
(7)	HIDEOUS	silvery	tilted	young	dreadful
(8)	CORDIAL	swift	muddy	leafy	heartly
(9)	EVIDENT	green	obvious	sceptical	afraid
(10)	IMPOSTOR	conductor	officer	book	pretender
(11)	MERIT	deserve	distrust	fight	separate
(12)	FASCINATE	welcome	fix	stir	enchant
(13)	INDICATE	defy	excite	signify	bicker
(14)	IGNORANT	red	sharp	uninformed	precise
(15)	FORTIFY	submerge	strengthen	vent	deaden
(16)	RENOWN	length	head	fame	loyalty
(17)	NARRATE	yield	buy	associate	tell
(18)	MASSIVE	bright	large	speedy	low
(19)	HILARITY	laughter	speed	grace	malice
(20)	SMIRCHED	stolen	pointed	remade	soiled
(21)	SQUANDER	tease	belittle	cut	waste
(22)	CAPTION	drum	ballast	heading	ape
(23)	FACILITATE	help	turn	strip	bewilder
(24)	JOCOSE	humorous	poultry	fervid	plain
(25)	APPRISE	deduce	strew	inform	delight
(26)	RUE	eat	lament	dominate	cure
(27)	DENIZEN	senator	inhabitant	fish	atom
(28)	DIVEST	dispossess	intrude	rally	pledge
(29)	AMULET	charm	orphan	dingo	pond
(30)	INEXORABLE	untidy	involatile	rigid	sparse
(31)	SERRATED	dried	notched	armed	blunt
(32)	LISSOM	moldy	loose	supple	convex
(33)	MOLLIFY	mitigate	direct	pertain	abuse
(34)	PLAGIARIZE	appropriate	intend	revoke	maintain
(35)	ORIFICE	brush	hole	building	lute
(36)	QUERULOUS	maniacal	curious	devout	complaining
(37)	PARIAH	outcast	priest	lentil	locker
(38)	ARRET	waken	ensue	incite	placate
(39)	TEMERITY	rashness	timidity	desire	kindness
(40)	PRISTINE	vain	sound	first	level

ULLMANN-GIOVANNONI PROCESS-REACTIVE SCALE

- | | | |
|--|---|---|
| 1. When I leave the hospital I will live with my wife. (T)* | T | F |
| 2. I have paid regularly to buy a house. (T) | T | F |
| 3. When I was in school I didn't like Physical Education classes. (F) | T | F |
| 4. I have earned my living for longer than a year at fulltime civilian work. (T) | T | F |
| 5. I have had to stay in a mental hospital for more than one year at a time. (F) | T | F |
| 6. I finished at least one year of education after high school--trade apprenticeship, business school, college, etc. (T) | T | F |
| 7. My top wage in the last five years was less than \$1.25 an hour. (F) | T | F |
| 8. In my teens there was more than one girl with whom I had more than two dates. (T) | T | F |
| 9. I hardly ever went over to another kid's house after school or on weekends. (F) | T | F |
| 10. As a civilian I have worked steadily at one job or for one employer for over two years. (T) | T | F |
| 11. In my teens I was a regular member of a club or organization that had a grown-up who came to meetings (Scouts, school club, 4-H, church youth club, etc.). (T) | T | F |
| 12. Before I was seventeen I had left the home I was raised in and never went back except for visits. (T) | T | F |
| 13. In my teens I was member of a group of friends who did things together. (T) | T | F |

* The letter in parentheses after each statement indicates a reactive response.

(cont'd)

APPENDIX 6

ULLMANN-GIOVANNONI PROCESS-REACTIVE SCALE (cont'd)

- | | | |
|---|---|---|
| 14. When I leave the hospital, I will live with one or both of my parents. (F) | T | F |
| 15. Shortly before I came into the hospital there was some major change in my life--such as marriage, birth of a baby, death, injury, loss of job, etc. (T) | T | F |
| 16. More than once in the last year I have stayed on after some group meeting and talked with some other members about something that went on. (T) | T | F |
| 17. Alcohol has nothing to do with my difficulties. (F) | T | F |
| 18. Adding up all the money I earned for the last three years, it comes to less than \$750 before deductions. (F) | T | F |
| 19. I have been married. (T) | T | F |
| 20. In the kind of work I do, it is expected that people will stay on for at least a year. (T) | T | F |
| 21. I am married now. (T) | T | F |
| 22. I have fathered children. (T) | T | F |
| 23. I have been deeply in love with someone and have told them about it. (T) | T | F |
| 24. Within the last five years I have spent more than half of the time in a mental hospital. (F) | T | F |

APPENDIX 7

WHITMAN PARANOID CHECKLIST

Directions: Please circle the yes in front of each statement which is true of the patient whose name appears at the top of the page and the no in front of each statement which is not true of him.

- | | | |
|-----|----|---|
| Yes | No | 1. He is unrealistically suspicious and guarded. |
| Yes | No | 2. He is hostile when the environment presents no real threat toward him. |
| Yes | No | 3. He has delusional ideas of being plotted against or of being influenced by strange forces. |
| Yes | No | 4. He is grandiose in his verbal behavior and feels he is a person of great importance. |
| Yes | No | 5. He has peculiar fixed ideas but it not deteriorated (incoherent) in this thinking. |
| Yes | No | 6. He hears voices. |
| Yes | No | 7. He seems to be more of a paranoid schizophrenic than anything else. |

APPENDIX 8

Pa¹ CHECKLIST (WELSH)

This inventory consists of numbered statements. Read each statement and decide whether it is true as applied to you or false as applied to you.

You are to mark your answers after each item. If a statement is TRUE or MOSTLY TRUE, as applied to you, circle the T. If a statement is FALSE or NOT USUALLY TRUE, as applied to you, circle the F. If a statement does not apply to you or if it is something that you don't know about, make no mark.

Remember to give YOUR OWN opinion of yourself. Do not leave any blank spaces if you can avoid it.

- | | | | |
|----|---|---|---|
| 1. | Evil spirits possess me at times.(T)* | T | F |
| 2. | Most people are honest chiefly through fear of being caught.(T) | T | F |
| 3. | Something exciting will almost always pull me out of it when I am feeling low.(F) | T | F |
| 4. | I believe I am being followed.(T) | T | F |
| 5. | The man who provides temptation by leaving valuable property unprotected is about as much to blame for its theft as the one who steals it.(F) | T | F |
| 6. | Someone has been trying to poison me.(T) | T | F |
| 7. | Someone has control over my mind.(T) | T | F |

APPENDIX 8

Pa CHECKLIST (WELSH) (continued)

- | | | | |
|-----|---|---|---|
| 8. | I think nearly anyone would tell a lie to keep out of trouble.(F) | T | F |
| 9. | Most people inwardly dislike putting themselves out to help other people.(F) | T | F |
| 10. | I have certainly had more than my share of things to worry about.(T) | T | F |
| 11. | I feel uneasy indoors.(T) | T | F |
| 12. | My mother or father often made me obey even when I thought that it was unreasonable.(F) | T | F |
| 13. | I have no enemies who really wish to harm me.(F) | T | F |
| 14. | I tend to be on my guard with people who are somewhat more friendly than I had expected.(F) | T | F |

* The letter in parentheses after each statement indicates a paranoid response.

APPENDIX 9

Raw Data

SCHIZOPHRENIC GROUP
Pre-Test Measures

S#	Age	Sc'	Whitman Sc	Vocab	Process Reactive	Pa'	Whitman Pa	Final Pa Classif.	Educ. (Yrs.)	Previous Hosp.	Medic (Mg.)	S-E Class	Sex
1	30	14	4	27	13	2	3	NC	11	4 mos.	300	M	M
2	22	10	3	28	9	9	6	P	12	1 mc.	300	M	M
3	25	10	3	36	12	2	5	NC	16	4 mos.	400	M	K
4	29	10	4	32	16	5	1	NC	11	2½ yrs.	800	M	F
5	23	12	3	30	12	7	6	P	15	6 wks.	200	M	F
6	40	13	5	31	16	6	4	P	11	1st adm.	300	U	F
7	43	12	3	30	9	5	2	NC	6	9 mos.	400	L	F
8	22	13	3	26	12	7	4	P	15	6½ mos.	400	M	F
9	28	23	4	27	3	6	3	NC	11	4 yrs.	700	L	M
10	28	10	3	21	11	4	3	NC	12	3 mos.	450	F	F
11	29	10	4	22	10	3	0	NP	8	1st adm.	450	L	F
12	41	10	4	25	12	3	0	NP	10	3 yrs.	450	L	M
13	49	10	3	27	9	4	5	NC	6	20 yrs.	450	L	F
14	48	10	3	22	11	5	0	NC	8	3 wks.	450	L	F
15	20	14	3	22	7	4	1	NP	9	4 mos.	400	L	F
16	27	19	4	25	13	9	5	P	9	3½ mos.	450	L	M
17	32	10	3	21	9	5	0	NC	8	3 mos.	450	L	F
18	35	10	3	30	20	6	1	NC	13	2 mos.	450	L	M
19	44	10	3	24	5	3	1	NP	5	2 mos.	450	L	F
20	29	10	3	21	17	4	1	NP	12	1 mo.	450	M	M
21	39	11	4	21	10	1	0	NP	11	4 mos.	200	L	M
22	20	10	3	28	11	3	4	NC	11	4½ mos.	400	M	F
23	23	10	3	26	19	3	5	NC	13	7 wks.	450	M	M
24	31	10	3	30	9	5	0	NC	15	10 wks.	450	L	M

SCHIZOPHRENIC GROUP
Pre-Test Measures

<u>S#</u>	<u>Age</u>	<u>Sc'</u>	<u>Whitman</u> <u>Sc</u>	<u>Vocab</u>	<u>Process</u> <u>Reactive</u>	<u>Pa'</u>	<u>Whitman</u> <u>Pa</u>	<u>Firal</u> <u>Pa</u> <u>Classif.</u>	<u>Educ.</u> <u>(Yrs)</u>	<u>Previous</u> <u>Hosp.</u>	<u>Medic</u> <u>(Mg.)</u>	<u>S-E</u> <u>Class</u>	<u>Sex</u>
25	26	10	4	30	13	3	0	NP	11	1st adm.	200	N	M
26	20	10	3	23	12	4	1	NP	9	2 wks.	200	L	M
27	27	14	3	26	14	6	3	NC	11	1 wk.	450	L	M
28	21	14	4	23	10	8	0	NC	10	2 yrs.	225	L	M
29	20	12	3	25	10	11	3	NC	11	2 wks.	200	M	M
30	22	12	5	29	10	4	5	NC	10	1 mo.	400	L	M
31	48	19	3	29	16	3	2	NP	7	4 mos.	200	M	F
32	22	13	5	26	12	6	6	P	12	3 wks.	400	M	N
33	23	11	3	30	13	6	3	NC	7	3 mos.	400	M	M
34	33	13	3	26	17	7	5	P	10	6 wks.	400	L	M
35	26	14	3	27	10	6	5	P	12	2 1/2 mos.	450	M	M
36	30	10	3	21	15	6	5	NC	10	1 mo.	300	M	M
37	21	10	3	21	9	2	2	NP	6	4 wks.	200	L	F
38	21	10	3	21	10	2	4	NC	10	2 wks.	200	M	F
39	24	13	3	38	7	3	1	NP	15	2 mos.	700	M	M
40	26	14	3	31	4	4	4	NC	10	5 yrs.	500	L	M
41	27	15	3	27	10	7	3	NC	10	1 yr.	300	M	M
42	20	17	4	27	6	6	5	P	10	2 mos.	200	L	M
43	24	10	3	27	17	6	0	NC	10	1 mo.	550	L	F
44	20	10	4	29	10	8	0	NC	12	1st adm.	200	M	M
45	23	11	5	27	6	3	5	NC	11	6 mos.	200	L	M
46	25	16	5	32	7	8	2	NC	10	2 1/2 mos.	200	L	F
47	29	12	3	21	11	6	2	NC	7	1st adm.	200	L	F
48	30	10	4	34	15	4	5	NC	16	1st adm.	800	M	M

NORMAL GROUP
Pre-Test Measures

<u>S#</u>	<u>Age</u>	<u>Sci</u>	<u>Vocab.</u>	<u>Educ. (Yrs.)</u>	<u>S-E Class</u>	<u>Sex</u>
1	30	5	26	8	M	M
2	20	6	31	13	M	F
3	25	2	34	14	M	M
4	29	1	32	12	L	F
5	21	5	28	16	M	F
6	38	5	24	11	M	F
7	43	8	33	10	L	F
8	27	7	33	10	M	F
9	23	6	32	10	L	F
10	26	0	30	12	M	F
11	28	7	28	9	L	F
12	43	4	29	11	L	M
13	49	0	29	10	L	F
14	49	3	30	10	L	F
15	19	8	25	10	N	F
16	21	6	24	11	M	F
17	31	0	21	6	L	M
18	33	1	31	12	L	F
19	44	2	21	4	L	M
20	29	3	21	11	L	F
21	49	4	32	10	M	M
22	26	0	27	12	L	F
23	23	3	21	10	M	M
24	35	7	33	12	L	M

NORMAL GROUP
Pre-Test Measures

<u>S#</u>	<u>Age</u>	<u>Sci</u>	<u>Vocab.</u>	<u>Educ. (Yrs)</u>	<u>S-E Class</u>	<u>Sex</u>
25	26	7	29	10	M	M
26	21	3	21	9	L	M
27	30	7	26	9	L	M
28	20	5	25	10	L	M
29	17	6	21	8	M	M
30	18	3	27	11	L	F
31	50	1	35	10	L	M
32	21	7	26	10	M	M
33	24	6	23	8	L	M
34	36	4	28	12	L	M
35	24	7	27	11	L	M
36	27	4	22	10	L	M
37	21	3	21	6	L	F
38	21	4	21	10	M	M
39	34	1	35	15	M	M
40	23	5	29	10	L	M
41	34	4	31	11	M	M
42	24	4	24	9	M	F
43	26	7	26	9	L	M
44	19	2	28	11	M	F
45	24	3	27	11	M	F
46	21	0	36	12	M	F
47	23	2	29	11	M	F
48	38	0	34	12	M	M

SCHIZOPHRENIC GROUP
Recall Scores

S#	Ee Trials 1 2 3 4	Ec Trials 1 2 3 4	Gc Trials 1 2 3 4	Gcc Trials 1 2 3 4	Tc Trials 1 2 3 4	Tcc Trials 1 2 3 4
1	0	2	1	1	3	4
2	2	4	0	1	3	4
3	1	0	1	1	1	2
4	2	4	1	1	2	2
5	2	4	1	4	0	4
6	1	2	2	1	2	4
7	2	0	1	2	2	1
8	2	0	0	0	2	4
9	0	0	2	1	4	0
10	0	0	0	1	0	1
11	0	2	0	2	2	0
12	1	1	0	1	1	0
13	0	2	0	0	2	2
14	1	0	0	1	1	0
15	0	1	0	0	0	2
16	0	0	4	2	0	4
17	4	0	1	0	1	1
18	4	1	0	0	1	1
19	0	4	2	4	2	2
20	1	1	1	1	1	1
21	0	1	0	0	0	1
22	1	0	2	2	2	1
23	1	2	1	1	0	2
24	2	1	0	1	4	2
25	0	2	1	1	2	2
26	2	1	0	0	0	4
27	2	0	0	0	2	4
28	2	0	0	0	2	4
29	2	0	0	0	2	4
30	2	0	0	0	2	4
31	2	0	0	0	2	4
32	2	0	0	0	2	4
33	2	0	0	0	2	4
34	2	0	0	0	2	4
35	2	0	0	0	2	4
36	2	0	0	0	2	4
37	2	0	0	0	2	4
38	2	0	0	0	2	4
39	2	0	0	0	2	4
40	2	0	0	0	2	4
41	2	0	0	0	2	4
42	2	0	0	0	2	4
43	2	0	0	0	2	4
44	2	0	0	0	2	4
45	2	0	0	0	2	4
46	2	0	0	0	2	4
47	2	0	0	0	2	4
48	2	0	0	0	2	4
49	2	0	0	0	2	4
50	2	0	0	0	2	4
51	2	0	0	0	2	4
52	2	0	0	0	2	4
53	2	0	0	0	2	4
54	2	0	0	0	2	4
55	2	0	0	0	2	4
56	2	0	0	0	2	4
57	2	0	0	0	2	4
58	2	0	0	0	2	4
59	2	0	0	0	2	4
60	2	0	0	0	2	4
61	2	0	0	0	2	4
62	2	0	0	0	2	4
63	2	0	0	0	2	4
64	2	0	0	0	2	4
65	2	0	0	0	2	4
66	2	0	0	0	2	4
67	2	0	0	0	2	4
68	2	0	0	0	2	4
69	2	0	0	0	2	4
70	2	0	0	0	2	4
71	2	0	0	0	2	4
72	2	0	0	0	2	4
73	2	0	0	0	2	4
74	2	0	0	0	2	4
75	2	0	0	0	2	4
76	2	0	0	0	2	4
77	2	0	0	0	2	4
78	2	0	0	0	2	4
79	2	0	0	0	2	4
80	2	0	0	0	2	4
81	2	0	0	0	2	4
82	2	0	0	0	2	4
83	2	0	0	0	2	4
84	2	0	0	0	2	4
85	2	0	0	0	2	4
86	2	0	0	0	2	4
87	2	0	0	0	2	4
88	2	0	0	0	2	4
89	2	0	0	0	2	4
90	2	0	0	0	2	4
91	2	0	0	0	2	4
92	2	0	0	0	2	4
93	2	0	0	0	2	4
94	2	0	0	0	2	4
95	2	0	0	0	2	4
96	2	0	0	0	2	4
97	2	0	0	0	2	4
98	2	0	0	0	2	4
99	2	0	0	0	2	4
100	2	0	0	0	2	4

SCHIZOPHRENIC GROUP
Recall Scores

S#	Ee Trials 1 2 3 4	Ec Trials 1 2 3 4	Gce Trials 1 2 3 4	Gcc Trials 1 2 3 4	Tce Trials 1 2 3 4	Tcc Trials 1 2 3 4
25	1	1	2	1	4	4
26	0	1	1	1	1	1
27	4	1	1	0	0	2
28	4	2	0	2	3	4
29	4	2	0	1	2	1
30	1	4	0	2	1	0
31	4	2	1	2	4	3
32	2	0	1	0	2	2
33	4	4	2	4	4	2
34	0	1	4	0	2	0
35	1	4	2	4	4	4
36	2	1	1	1	2	2
37	2	0	1	1	4	2
38	2	1	1	3	2	2
39	1	2	1	4	4	0
40	0	4	3	2	0	3
41	2	0	1	1	1	0
42	2	0	1	0	0	0
43	2	0	2	0	2	0
44	0	1	4	0	4	2
45	0	0	4	1	2	0
46	0	1	2	2	0	0
47	4	4	2	4	4	2
48	4	1	2	2	4	2

NORMAL GROUP
Recall Scores

S#	Ec Trials 1 2 3 4	Gc Trials 1 2 3 4	Gcc Trials 1 2 3 4	Tc Trials 1 2 3 4	Tcc Trials 1 2 3 4
1	2 1 1 0	4 1 0 1	2 3 2 1	4 2 0 0	4 2 0 0
2	2 2 1 0	4 4 4 4	1 4 0 2	4 4 4 4	4 4 4 4
3	4 2 2 2	4 2 0 4	1 2 2 2	4 4 2 2	4 4 4 4
4	4 1 1 0	4 2 4 1	4 1 0 4	4 4 4 4	4 4 4 4
5	2 2 2 4	2 4 2 4	2 4 2 2	4 4 4 4	4 4 4 4
6	2 2 0 2	0 1 1 1	1 1 2 2	4 4 4 4	4 4 4 4
7	0 4 2 2	2 4 1 1	1 4 2 2	4 4 4 4	4 4 4 4
8	1 1 3 0	0 4 1 0	1 1 1 1	4 4 4 4	4 4 4 4
9	2 0 0 0	0 1 0 2	1 0 2 2	4 4 4 4	4 4 4 4
10	0 4 1 1	4 0 0 0	2 1 1 2	1 0 4 3	1 0 4 3
11	0 1 1 1	1 2 1 2	2 2 1 4	2 2 1 1	2 2 1 1
12	2 2 1 1	1 4 1 2	2 1 4 2	2 2 1 1	2 2 1 1
13	4 0 2 2	4 0 0 1	2 1 1 1	2 2 1 1	2 2 1 1
14	1 0 2 2	2 3 2 0	2 1 1 1	2 2 1 1	2 2 1 1
15	4 1 2 3	1 3 4 1	3 0 4 3	4 4 3 0	4 4 3 0
16	4 2 1 1	2 1 1 0	2 2 2 1	4 4 4 0	4 4 4 0
17	4 0 1 0	4 2 0 0	2 1 1 0	4 4 4 0	4 4 4 0
18	2 1 0 1	1 2 1 0	2 1 1 0	4 4 4 0	4 4 4 0
19	4 2 0 1	2 0 1 4	3 0 1 0	4 4 4 0	4 4 4 0
20	2 0 2 1	2 0 1 4	1 1 2 0	4 4 4 0	4 4 4 0
21	0 0 1 1	1 0 0 1	1 0 1 1	1 2 1 1	1 2 1 1
22	0 1 1 2	4 1 2 0	2 1 0 1	3 3 2 2	3 3 2 2
23	4 4 4 2	4 4 2 2	4 4 1 4	4 4 4 4	4 4 4 4
24	2 2 0 1	1 1 1 1	1 2 1 0	4 4 4 4	4 4 4 4

NORMAL GROUP
Recall Scores

S#	Ec Trials 1 2 3 4	GCc Trials 1 2 3 4	GCc Trials 1 2 3 4	TCc Trials 1 2 3 4	TCc Trials 1 2 3 4
25	2 0 1 1	2 0 2 1	2 1 2 2	3 1 4 0	1 4 1 0
26	1 2 1 0	1 1 2 1	1 1 2 1	4 2 1 1	4 4 1 0
27	1 1 0 0	1 1 1 1	1 1 0 0	2 1 2 2	1 2 2 0
28	4 1 1 2	4 1 1 1	2 0 2 2	4 2 0 2	0 2 0 0
29	0 4 0 1	0 0 0 0	0 1 1 0	0 1 2 2	4 2 0 0
30	2 2 2 0	4 0 2 0	2 0 1 2	4 4 0 4	2 1 1 0
31	4 0 0 0	1 0 0 1	4 0 1 0	0 0 2 1	4 4 0 4
32	2 0 0 4	4 0 4 4	4 2 2 1	4 4 0 3	4 2 2 0
33	0 1 3 0	1 1 1 1	4 0 1 0	4 4 2 2	4 4 2 2
34	1 0 2 4	4 2 1 1	2 2 4 2	4 4 1 4	4 3 1 0
35	2 0 1 4	2 1 0 4	4 2 2 1	3 4 2 1	4 4 1 1
36	4 2 1 1	1 1 2 1	1 1 2 1	4 4 2 2	4 4 2 2
37	3 2 0 0	1 0 1 0	1 0 1 2	4 4 1 1	4 4 1 1
38	4 0 4 2	4 2 2 1	2 4 2 2	4 4 2 2	4 4 2 2
39	4 2 2 1	4 2 2 1	4 4 3 3	4 4 2 2	4 4 2 2
40	2 4 0 1	4 4 4 4	4 4 3 3	4 4 2 2	4 4 2 2
41	2 3 2 0	4 2 2 2	4 2 2 2	4 4 2 2	4 4 2 2
42	3 4 1 2	4 2 1 1	4 2 1 1	4 4 2 2	4 4 2 2
43	2 2 1 1	1 1 1 1	2 2 1 1	4 4 2 2	4 4 2 2
44	2 4 1 0	2 4 1 1	0 0 2 2	4 4 2 2	4 4 2 2
45	4 2 2 1	4 2 2 1	4 2 2 1	4 4 2 2	4 4 2 2
46	4 4 2 0	4 4 2 0	4 4 2 2	4 4 2 2	4 4 2 2
47	4 1 1 4	4 1 1 4	4 4 2 2	4 4 2 2	4 4 2 2
48	4 2 0 0	4 2 0 0	2 2 1 1	4 4 2 2	4 4 2 2

Means and Standard Deviations of Recall Data for Schizophrenics and Normals

		<u>Means</u>		<u>Standard Deviations</u>	
		Schizophrenics	Normals	Schizophrenics	Normals
Trials					
Evaluation (expt'l)	1	1.75	2.35	1.59	1.44
	2	1.13	1.63	1.12	1.35
	3	1.19	1.23	1.25	1.02
	4	1.08	1.23	1.23	1.24
Evaluation (control)	1	1.69	2.13	1.45	1.44
	2	1.42	1.98	1.51	1.47
	3	1.27	1.19	1.30	1.27
	4	1.29	1.65	1.32	1.33
Grammatical class (expt'l)	1	1.40	2.17	1.25	1.48
	2	1.42	1.44	1.43	1.35
	3	1.23	1.23	1.12	1.23
	4	0.67	1.54	0.81	1.43
Grammatical class (control)	1	1.73	2.13	1.51	1.21
	2	1.17	1.67	1.14	1.31
	3	1.19	1.71	1.10	1.11
	4	1.13	1.38	1.23	1.12
Taxonomic class (expt'l)	1	2.58	3.02	1.30	1.21
	2	1.94	2.17	1.17	1.31
	3	1.52	1.81	1.25	1.38
	4	2.29	3.10	1.40	1.19
Taxonomic class (control)	1	2.83	3.50	1.28	0.98
	2	2.29	2.54	1.40	1.34
	3	1.79	2.13	1.35	1.48
	4	1.33	1.67	1.15	1.40

ORDER OF CONDITIONS
(For Schizophrenics and Normals)

S#	1	2	3	4	5	6	S#	1	2	3	4	5	6
1	Ec	GGe	Tcc	Tce	He	Gcc	25	Ec	GGe	Tcc	Tce	He	Gcc
2	Tce	He	Gcc	Ec	Tcc	GGe	26	Tcc	He	Gcc	Ec	Tcc	GGe
3	Gcc	Tce	Ec	Tcc	GGe	He	27	Gcc	Tcc	Ec	Tcc	GGe	He
4	He	Tcc	GGe	Gcc	Tce	Ec	28	He	Tcc	GGe	Gcc	Tce	Ec
5	Tcc	Gcc	He	GGe	He	Tcc	29	Tcc	Gcc	He	GGe	He	Tcc
6	GGe	Ec	Tce	He	Gcc	GGe	30	GGe	Ec	Tce	He	Gcc	GGe
7	Ec	GGe	Tcc	Tce	He	Gcc	31	Ec	GGe	Tcc	Tce	He	Gcc
8	Tce	He	Gcc	Ec	Tcc	GGe	32	Tce	He	Gcc	Ec	Tcc	GGe
9	Gcc	Tce	Ec	Tcc	GGe	He	33	Gcc	Tce	Ec	Tcc	GGe	He
10	He	Tcc	GGe	Gcc	Tce	Ec	34	He	Tcc	GGe	Gcc	Tce	Ec
11	Tcc	Gcc	He	GGe	He	Tcc	35	Tcc	Gcc	He	GGe	He	Tcc
12	GGe	Ec	Tce	He	Gcc	GGe	36	GGe	Ec	Tce	He	Gcc	GGe
13	Ec	GGe	Tcc	Tce	He	Tcc	37	Ec	GGe	Tcc	Tce	He	Tcc
14	Tce	He	Gcc	Ec	Tcc	GGe	38	Tce	He	Gcc	Ec	Tcc	GGe
15	Gcc	Tcc	Ec	Tcc	GGe	He	39	Gcc	Tcc	Ec	Tcc	GGe	He
16	He	Tcc	GGe	Gcc	Tce	Ec	40	He	Tcc	GGe	Gcc	Tce	Ec
17	Tcc	Gcc	He	GGe	He	Tcc	41	Tcc	Gcc	He	GGe	He	Tcc
18	GGe	Ec	Tce	He	Gcc	GGe	42	GGe	Ec	Tce	He	Gcc	GGe
19	Ec	GGe	Tcc	Tce	He	Tcc	43	Ec	GGe	Tcc	Tce	He	Tcc
20	Tce	He	Gcc	Ec	Tcc	GGe	44	Tce	He	Gcc	Ec	Tcc	GGe
21	Gcc	Tce	Ec	Tcc	GGe	He	45	Gcc	Tce	Ec	Tcc	GGe	He
22	He	Tcc	GGe	Gcc	Tce	Ec	46	He	Tcc	GGe	Gcc	Tce	Ec
23	Tcc	Gcc	He	GGe	He	Tcc	47	Tcc	Gcc	He	GGe	He	Tcc
24	GGe	Ec	Tce	He	Gcc	Tcc	48	GGe	Ec	Tce	He	Gcc	Tcc

APPENDIX 10

INSTRUCTIONS

As I told you before, I will need to see you for 2 days. This will be the first day, and I will see you again tomorrow. You will be paid \$10.00 at the end of the two days, but only if you participate in both sessions.

In this experiment we are studying your ability to recall words and to name colours. First you will see the word "ready". Then you will see 3 words. These words will be shown for only a short time so make sure you look at them carefully. As soon as you see the words, say each word aloud starting from the left and reading to the right. Remember to read the words aloud as quickly as you can because the words are presented for a very brief period of time. Following the 3 words, you will see names of colours printed in different colours. Read the colour of the ink that each word is printed in. Try not to name the word. Go as fast as you can but do not stop if you make a mistake. Just do the best you can. After the colour naming, the word "recall" will be shown. This is your signal to recall out loud in the proper order the three words which were shown previously. If you cannot remember them, try to guess. After the recall period the word "ready" will be shown and we will start all over again. We will go through this procedure 4 times before we take a rest.

APPENDIX 10

INSTRUCTIONS (cont'd)

Do not worry about remembering all this right now because before we begin the actual experiment we are going to have a practice. In our practice we are going to use 3 letters instead of 3 words.

(After subject has mastered the practice trial) Now we are going to begin the experiment. If you have any questions, don't be afraid to ask, but please ask me now. Once we start I will not be able to answer any questions. Remember to do your best on all parts of the experiment and not to worry if you don't get everything correct. Ready?

Appendix 11a

Summary of the Analysis of Variance of Correct Recall
 Scores as a Function of Group (Schizophrenic - Normal), Item Type,
 Release Condition, and Trial (1 - 4)

<u>Source</u>	<u>Sum of squares</u>	<u>Degrees of freedom</u>	<u>Mean Square</u>
Mean	7052.35547	1	7052.35547
Groups	87.50781	1	87.50781
Error a*	870.94775	94	9.26540
Item type (IT)	328.51172	2	164.25586
Item type x grps	1.39917	2	0.69958
Error b	263.50220	188	1.40161
Expt'l/contr(E/C)	2.44135	1	2.44135
E/C x grps	0.09764	1	0.09764
Error c	114.08513	94	1.12367
IT x E/C	3.46869	2	1.73434
IT x E/C x grps	0.04166	2	0.02083
Error d	252.23825	188	1.34169
Trials (Ts)	232.19556	3	77.39851
Trials x grps	9.95630	3	3.31877
Error e	451.04932	282	1.59947
Item type x Ts	25.08252	6	4.18042
IT x Ts x grps	8.02344	6	1.33724
Error f	759.80322	564	1.34717
E/C x Ts	19.44482	3	6.48161
E/C x Ts x grps	5.21265	3	1.73755
Error g	378.87988	282	1.34354
IT x E/C x Ts	74.48096	6	12.41349
IT x E/C x Ts x grps	10.36060	6	1.72677
Error h	695.73389	564	1.23357

*Letters of alphabet refer to terms pooled. See Appendix 11c.

Appendix 11b

Summary of the Analysis of Variance of Correct Recall
 Scores as a Function of Group (Schizophrenic - Normal), Item Type,
 Release Condition, and Trials (1 - 3)

<u>Source</u>	<u>Sum of squares</u>	<u>Degrees of freedom</u>	<u>Mean square</u>
Mean	5742.06250	1	5742.06250
Groups	57.79199	1	57.79199
Error i*	690.46143	94	7.34533
Item Type (IT)	234.65454	2	117.32727
Item Type x grps	0.12598	2	0.06299
Error j	261.43848	188	1.39063
Expt'l/contr(E/C)	12.33531	1	12.33531
E/C x grps	0.45372	1	0.45372
Error k	106.54315	94	1.13344
IT x E/C	6.42461	2	3.21230
IT x E/C x grps	1.18169	2	0.59084
Error l	253.05879	188	1.34606
Trials (Ts)	195.00757	2	97.50378
Trials x grps	8.95947	2	4.47974
Error m	329.91699	188	1.75488
Item type x Ts	23.79102	4	5.94775
IT x Ts x grps	6.06421	4	1.51605
Error n	548.58423	376	1.45900
E/C x Ts	0.79974	2	0.39987
E/C x Ts x grps	1.64696	2	0.823348
Error o	246.55135	188	1.31144
IT x E/C x Ts	5.68921	4	1.42230
IT x E/C x Ts x grps	4.46704	4	1.11676
Error p	469.83911	376	1.24957

*Letters of alphabet refer to terms pooled. See Appendix 11c.

Appendix 11c

Appropriate Error Terms for Each Planned Comparison

<u>Comparison</u>	<u>Error Terms</u> <u>Pooled</u>	<u>Combined</u> <u>DF</u>	<u>Combined</u> <u>MS</u>
1*	a	a	9.27
2 - 5	i & m	i & m	3.62
6 - 17	a, b, c, d, e, f, g, h	a, b, c, d, e, f, g, h	1.68

* Numbers refer to planned comparisons.
See superscripts in text.

Appendix 11d

Summary of Analysis of Variance of Recall as a Function of
Trials (1-4) and Group (Process-Reactive)

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>	<u>p</u>
Group	1	3.96	2.60	>.20
Error 1	46	1.52		
Trials	3	4.53	18.51	4.001
Groups x Tls	3	.09	.36	>.25
Error 2	138	.25		

Appendix 11e

Summary of Analysis of Variance of Recall as a Function
of Trials (1-4) and Group (Paranoid-Nonparanoid)

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>	<u>p</u>
Group	1	10.30	6.46	<.025
Error 1	18	1.59		
Trials	3	1.78	7.83	<.001
Group x Tls	3	.40	1.78	>.20
Error 2	54	.23		

VITA

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PLACE OF BIRTH: Winnipeg, Manitoba

YEAR OF BIRTH: 1947

POST-SECONDARY
EDUCATION AND
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1965-1968 B.A. (Psychology)

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1968-1970 M.A. (Psychology)

Pre-doctoral Internship
Health Sciences Centre
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Major Graduate Field:
Clinical Psychology

Minor Graduate Field:
Verbal Learning

HONOURS AND AWARDS: Deans Honour List
1967-1968

University Gold Medal for Highest
Standing in the Graduating Year
Arts/General Course
1968

Taylor Statton Memorial Fellowship
1968-1969

Arts Assistantship Award
1968-1969

National Research Council Scholarship
1969-1970

National Research Council Scholarship
1970-1971

National Research Council Scholarship
1971-1972

University of Manitoba Graduate Fellowship
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Research Assistant to Dr. J. Pear
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1968-1969

Research Assistant to Dr. J. McIntyre
Department of Psychology
University of Manitoba
1969-1971

Consultant Psychologist
Children's Aid Society
Winnipeg, Manitoba
1971-1972

Clinical Psychology Extern
Psychological Services Centre
University of Manitoba
1971-1972

Senior Psychologist
Forensic Services
Department of Health & Social Development
1973-Present

PUBLICATIONS:

Cohen R. G. A comparison of subjects' own imagery versus experimenter-supplied imagery as a mnemonic device in paired-associate learning. M.A. Thesis, University of Manitoba, 1970.

Pear, J. J. and Cohen, R. G. Simple and complex imagery in individual subjects. The Psychological Record, 1971, 21, 25-33.

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