THE UNIVERSITY OF MANITOBA

INTERFERENCE AND RETRIEVAL DEFICIT IN SCHIZOPHRENIC MEMORY DYSFUNCTION

by

William John Barker

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

OCTOBER 1974

INTERFERENCE AND RETRIEVAL DEFICIT IN SCHIZOPHRENIC MEMORY DYSFUNCTION

by

William John Barker

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

DOCTOR OF PHILOSOPHY

ABSTRACT

The purpose of this research was to investigate the hypothesis that part of the memory deficit associated with schizophrenia can be accounted for in terms of a dysfunctional retrieval process. Traditional approaches have typically focused only on 'input' factors (i.e., attention, set) as explanations of the deficit. The present research attempted to evaluate the validity of this focus by investigating the role of the retrieval processes in schizophrenic memory deficit. One of the underlying assumptions of the present investigation was that a more accurate explanation of schizophrenic memory deficit could be obtained through the postulation of a more general cognitive dysfunctioning that has effects throughout the entire information processing system rather than just at any one stage.

Forty-eight schizophrenic inpatients and forty-eight staff members from four Provincial Psychiatric Hospitals served as subjects. The schizophrenic patients were carefully screened in an attempt to control for the possible influence of extraneous factors such as ECT, medication level, organicity, and institutionalization. None of the normal subjects had a history of psychiatric hospitalizations. There were four experimental conditions in each of the subject groups. These were based on the type of list (items per category = 1 or 4) and recall condition (cued or non-cued). All of the groups were similar in sex, age, educational level, and intelligence. In addition, the schizophrenic

groups showed similar hospitalization records, medication levels, and scores on premorbid adjustment and paranoia measures.

The results demonstrated significant qualitative differences in the recall performances of the schizophrenic and normal groups. The normal group's results replicated the findings of Tulving and Pearlstone (1966). Thus, cued recall was higher than non-cued recall, the difference varying inversely with the number of items per category. Under non-cued recall, recall was an increasing function of items per category. For the schizophrenics, on the other hand, recall increased as items per category increased under both cued and non-cued recall conditions. This recall pattern resulted in non-significant recall differences between the schizophrenics and normals under cued recall where items per category = 4. A post hoc analysis of the effects of the paranoid-non-paranoid and process-reactive dimensions revealed no significant differences in recall performance as a function of these parameters.

The finding of a recall equivalence between the two groups under cued recall where items per category = 4 was suggestive of a retrieval dysfunction in the schizophrenic group. That the schizophrenics were able to increase their recall to the level of the normals when provided with retrieval cues indicated an inaccessibility of items in memory under non-cued conditions; the items were available in storage but they could not be retrieved. The retrieval mechanism was therefore dysfunctional.

It was postulated that a retrieval deficit was not observed under the one item per category condition because of the inability of the schizophrenics to organize the information for proper encoding when the demand characteristics of the task necessitate the use of

organizational processes. The breakdown in encoding necessarily precluded the demonstration of a retrieval deficit. It was concluded that the results supported the hypothesis that schizophrenics suffer deficits throughout the information processing system. This was interpreted as indicating a more general cognitive dysfunctioning than has typically been suggested by previous studies.

ACKNOWLEDGEMENTS

The author would like to thank the many individuals without whose help the present research could not have been completed. Firstly, he would like to thank his thesis advisor, Dr. M. Wright, and the members of his committee, Drs. J. McIntyre, R. Martin, and J. Schallow, for their valuable comments, criticisms, and unfailing encouragement. Thanks is also extended to Dr. J. S. Lawson at Kingston Psychiatric Hospital for his valuable advice and comments and to Dr. T. P. Hogan whose sabbatical leave terminated his involvement as a committee member but whose status as an 'ex officio' member should be recognized.

A special thanks is also extended to the chief psychologists and hospital administrators at the hospitals from which the subjects were obtained. In particular, the author would like to express his appreciation and gratitude to Dr. J. B. Earle at Brockville Psychiatric Hospital; without his understanding and support the present research could not have been completed.

Most thanks are due to the people who make it worthwhile--to my wife, Nora, and our son, Joel. Their love, patience, and understanding made the completion of the task possible and their sacrifices cannot be easily forgotten.

This present research was supported in part by a grant from the National Research Council of Canada to Dr. J. S. McIntyre (APA 317) and by a Canada Council Doctoral Fellowship (W73 4706) to the author.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

A frequent complaint of the psychiatric patient is that he is unable to attend to or concentrate on environmental stimuli. Even when the patient does not make this complaint, it is usually held that a disorder of attention and/or concentration underlies the more obvious symptoms of the illness. It is probably because of this tendency to focus on what appear to be the obvious symptoms that the majority of explanations of schizophrenic thought disorder have emphasized the perceptual and attentional aspects of the information processing system (e.g., McGhie, 1969; Cameron, 1938; Shakow, 1963; Chapman, 1964; Venables, 1964a; Silverman, 1964a, 1964b).

This approach proves, however, to be somewhat simplistic. The adoption of a total information processing model reveals that the attentional and perceptual components are only a part of the learning and memory processes and, as such, may account for only a part of the variance attributable to the schizophrenic's observed dysfunction. Thus, those approaches that emphasize only the 'filtering' or 'screening' aspects, although adequate if we are concerned only with input, seem inadequate as an explanation of the total dysfunction. The processes that lie behind the input stage--storage and retrieval--may also contribute to the deficit. Consequently, a knowledge of these

processes as they function in the schizophrenic would be needed for an adequate understanding of the schizophrenic's observed dysfunctioning.

Besides this general neglect of the other processes involved in the information processing system, there is reason to believe that the attentional and perceptual abnormalities found in schizophrenics may be due to extraneous factors. Because these deficits are usually obtained with long-term (chronic, process) schizophrenics (Maher, 1966; Payne, 1970), they may be a result of hospitalization rather than of cognitive dysfunctioning. Such research suggests therefore that the attentional and perceptual explanations of schizophrenic deficit might be empirically based on changes in the schizophrenic that are extraneous to the actual illness. The dysfunctional cognitive processes of the schizophrenic, or at least other processes involved in the deficit, might therefore be occurring at higher levels of the information processing system (i.e., beyond the input stage).

For these reasons it was the purpose of this study to investigate the role of the retrieval process in both schizophrenics and normals in an attempt to obtain further evidence concerning the mechanisms involved in the schizophrenic deficit. While the major focus of investigation was the analysis of the schizophrenic memory impairment in particular, it was posited that the results of this investigation would have implications for the more general theories of schizophrenic thought disorder. It seems that since the learning and memory processes are basic to any understanding of the thought process, then an investigation of the relevant processes involved in learning and memory (in particular interference at retrieval) will provide crucial support for

any general theory of schizophrenic thought disorder. This is particularly true of those explanations based on interference theory (e.g., Buss & Lang, 1965). Because interference theory holds such a predominant position in the explanation both of errors in information processing and schizophrenic thought disorder, the importance of the learning and memory processes in providing a general account of these deficits cannot be over-estimated.

It was also posited that by adopting an information processing model a 'component' breakdown of the deficit could be achieved so that the variance associated with dysfunctioning at each stage of processing (storage and retrieval) might be suggested. While the purpose of the present study was to investigate the retrieval processes in particular, what is being suggested is an approach that recognizes the multifaceted nature of learning and memory. From this follows the recognition that schizophrenic dysfunctioning may be more accurately accounted for in terms of deficits throughout the entire processing system. This more general cognitive dysfunctioning may be occurring at a higher level than has heretofore been proposed and may account for the widespread interference effects observed in schizophrenic thought processes (Buss & Lang, 1965).

The dissertation will begin with a brief review of the interference theory explanation of schizophrenic thought disorder, followed by reviews of the literature on memory deficit in schizophrenia, and processes and issues involved in retrieval. Hopefully, these will outline 'step-wise' the logic of the present study. Subsequent chapters will deal with the methods, results, and conclusions of the present

research and their relationship to the issues raised in the introduction.

Interference Theory

Anyone who does research in the area of psychological deficit in schizophrenia is likely to be struck by the voluminous, often confusing and fragmented, literature. However, if a theoretical perspective is applied to the literature, a degree of order at least may be detected amid the confusion. Buss and Lang (1965) in a major attempt to organize the disparate approaches have proposed a sevenfold classification: (a) affect and reinforcement, (b) concept attainment, (c) attention, (d) set, (e) associative interference, (f) drive, and (g) somantic arousal. This classificatory system is based largely on the method of investigation employed and the explanatory emphasis of each approach.

Buss and Lang (1965) point out that despite the apparent diversity, there is a commonness among all these approaches that may indicate an overriding factor: interference theory. Interference theory, as that term is used by Buss and Lang (1965) and Buss (1966), has come to hold a predominant place in current theorizing about the nature of schizophrenic deficit. This is largely due to the devil's advocate role that interference theory holds in relation to the other theories of schizophrenic thought disorder. Thus, in each of the previously outlined classification areas, interference theory offers a viable alternative to the posited explanations. In addition, since schizophrenics show interference effects in all of the stated areas and over a wide range of perceptual, motor, and cognitive tasks, interference

theory is a broad explanation of schizophrenic deficit appears to be the only theory comprehensive enough to account for what is known.

According to Buss and Lang (1965), interference theory proposes that when a schizophrenic is faced with a task, he cannot attend properly or in a sustained fashion, maintain a set, or change the set quickly when necessary. His ongoing response tendencies suffer interference from irrelevant external cues, and from 'internal' stimuli which consist of deviant thoughts and associations. These irrelevant, distracting, mediated stimuli prevent him from maintaining a clear focus on the task at hand and the result is psychological deficit.

Interference theory, therefore, locates the fundamental deficit in the schizophrenic's information processing system. Somehow the mechanisms which normally handle information have broken down with the result that the schizophrenic does not handle information as efficiently or in the same manner as a normal person. This deficit in organizing, processing, and retrieving data is viewed as the fundamental deficit with symptomatology (e.g., withdrawal) seen as secondary to it (i.e., ways of coping with the deficit). As Buss and Lang's (1965) review indicates, the specific nature of this breakdown in information processing ability has typically been explained in terms of deficits in attention or set. Thus research investigating the interference theory hypothesis has generally attempted to show that schizophrenics manifest a deficit in selective attention. Zimet and Fishman (1970) indicate that this research has focused on three experimentally distinct areas: (1) inability to focus attention on task relevant sensory information and to ignore competing, irrelevant sensory information; (2) inability

to adopt and maintain a preparatory mental set; and (3) inability to screen out deviant, distracting associations.

As is obvious from this analysis, both the research and explanatory foci have been restricted to input and storage factors while the important role of the output factors and retrieval has largely been ignored. This has been a major shortcoming of much of the published research as well as the explanations based on interference theory. Of course, Buss and Lang's (1965) analysis did not address itself specifically to an investigation of memory functioning. Instead, theirs was a more general analysis of behavior. For this reason, the role of interference in the schizophrenic's memory functioning was not directly assessed or outlined. The present research constitutes an attempt therefore to extend the analyses of interference effects to include the processes involved in the schizophrenics' information processing system. This was accomplished through an analysis of the effects of the schizophrenic's retrieval processes on memory. An advantage of the interference model is that it permits an analysis of interference effects at various levels of the information processing system. In this way the deficit in functioning observed in schizophrenia can be broken down into its component parts.

One of the major contributions of interference theory has been its effect in focusing research on the schizophrenic information processing system since it is in the 'system' that the posited deficit lies. A problem, however, has resulted from this emphasis. While the generality of the concept of interference theory has succeeded in bringing together many of the heretofore diverse explanations, it has also

resulted in the loss of precision within the information processing system. Although interference theory does serve an explanatory function, it seems to have taken on a much greater descriptive component. Indeed, it frequently specifies the locus of the interference and defines the meaning of interference at various stages of the information processing system, but it fails to adequately recognize the differences between what is labelled as 'interference' between the various defined subprocesses in the information processing system. Buss and Lang (1965) appear to have been at least partially cognizant of this issue when they pointed out that "many specific hypotheses of interference theory still need to be substantiated by experiment" (p. 1).

This issue is of particular importance to the present investigation. Since the present research was involved in an analysis of schizophrenic memory functioning in particular, the more general concept of interference emphasized by Buss and Lang (1965) proves somewhat confusing. This is so because of the more specific use of 'interference' as an explanation of forgetting. Thus, despite the fact that one might view interference theory (in the forgetting model) as a more specific instance of the more general concept of interference theory employed by Buss and Lang (1965) the terminology remains confusing since the usage of 'interference' is qualitatively different in each case.

For this reason a brief explanation of the interference theory of forgetting is necessary. The theory in its broadest form states that the inability to recall learned material is either the result of interference from material learned prior to the recalled material (proactive inhibition), or the result of material learned in the retention

interval (retroactive inhibition). Although the evidence in support of general interference theory is extensive, the mechanisms involved in the loss of retention from interference has continued to be controversial. Keppel (1968), in a review of the literature, has presented a modification of the two-factor theory (Melton, 1940) in which he has attempted to evaluate the roles of both proactive and retroactive inhibition in forgetting. He concluded that two basic processes were involved in the loss of information as a result of interference. These two processes were: (a) competition of responses, and (b) unlearning. The competition of responses factor involved both proactive and retroactive inhibition. Forgetting, therefore, was explained in terms of competing responses and unlearning. Both of these processes function as sources of interference.

Although a much more detailed analysis is required for an adequate understanding of the processes involved in interference explanations of forgetting, this will not be presented since they do not bear directly on the focus of the present research. The major purpose for their mention was simply to illustrate the different meanings associated with the term 'interference'. Throughout the remainder of the presentation, 'interference theory' is used in reference to both explanations. The difference between each should be evident on a conceptual level. The model which is being presented therefore, is one in which interference theory (with regard to forgetting) is a specific instance of the more general term employed by Buss and Lang (1965). In this same way, other explanations of forgetting (e.g., cue-dependent forgetting) can also be viewed as more specific examples of the general usage of

interference theory since they too attempt to explain deficits in functioning as resulting from a loss of information. In the model being presented here, therefore, interference theory (as that term is used by Buss and Lang, 1965) can be seen as referring to any process within the information processing system where information is lost.

From all of the reviewed evidence, therefore, there seems to be a growing concensus that the schizophrenic deficit may be the result of excessive interference effects in the information processing system. As such, the 'noise' produced in their information processing system may be more disruptive than that for normals. This is probably both a quantitative and qualitative difference. In any event, because of the possibility of the occurrence of interference effects at all stages of the information processing system, the investigation of specific stages seems indicated. Most interference theorists have investigated only the attentional and associational encoding abnormalities specific to the schizophrenic deficit. Nevertheless, if we are to view the individual as a complete system then it seems imperative that we also investigate the other aspects of learning and memory, i.e., storage and retrieval. Only by investigating the role of interference at all stages of the processing system can we make any meaningful statements about the role of interference at any one stage. A review of the relevant studies on memory deficit in schizophrenia reveals that this approach is in most cases absent.

STUDIES OF MEMORY DEFICIT IN SCHIZOPHRENIA

The question of memory deficit in schizophrenia has not been extensively explored. Underwood (1957), in a review of the experimental studies relevant to this area of investigation, found a general lack of empirical research on all individual differences in forgetting:

> Thus far I have not said anything about forgetting as a function of characteristics of the subject, that is, the personality or intellectual characteristics. As far as I've been able to determine, there is not a single valid study which shows that such variables have an appreciable influence on forgetting. Many studies have shown differences in learning as a function of these variables but not differences in rate of forgetting. (1957), p. 58)

Payne (1961) also has criticized the earlier literature on memory functioning in mental illness as being methodologically unsound:

> ...in order to measure individual differences in long-term retention, it is essential to ensure that all subjects have learned the information to the same criterion. If this is not the case, retention scores will be a function of both the ability to learn and the ability to retain and will thus be quite ambiguous. Unfortunately there appear to be no studies of abnormal subjects in which retention has been adequately measured....What evidence there is suggests that retention may be almost completely unaffected in functional psychiatric disorders. (1961, pp. 234-235)

Thus, it seems that as late as 1961 investigations into schizophrenic memory dysfunction were largely inadequate and contradictory. A lack of methodological soundness and a failure to adequately define the subject populations under study appear to be the major factors contributing to this confusion (Zimet & Fishman, 1970).

More recent investigations can be similarly criticized. Donahue, Curtin and Lipton (1961) compared the learning and retention of 36 chronic schizophrenics with 36 psychology undergraduates in a serial learning task. They controlled for the degree of complexity of the

serial list by varying the amount of intra-list similarity. They found that the schizophrenic subjects experienced difficulty in learning a list of 13 nonsense syllables, and the list was progressively shortened to six syllables. Machine presentation of the list also proved to be too difficult for the schizophrenic subjects, so the schizophrenics were permitted to expose the syllables at a self-determined rate. Even under these conditions, the schizophrenics required more trials to learn the list than the normal controls, and they recalled fewer of the nonsense syllables, although the difference in retention did not reach significance. The authors suggested that the failure to obtain a significant difference on recall may have been the result of both groups retaining so few of the syllables.

This seems to be a doubtful explanation, particularly if one draws a distinction between learning and retention (Underwood, 1964). In all probability, most of the items in the list were not learned in the first place and this would provide an alternative explanation of the results. As Underwood (1964) points out, there is a very strong positive relationship between degree of learning and retention, and if we are to compare retention between two groups we must ensure that both groups have learned the material to the same degree.

In addition, a major problem militating against any valid explanation of the results is obvious in their method of subject selection; no attempt was made to match the subjects on any variables. The confounding effects of age, sex, education, socio-economic status, and intelligence, which were left free to vary, would necessarily make suspect any findings attempting to compare group differences (Zimet & Fishman, 1970).

Nachmani and Cohen (1969) investigated the recognition and recall performance of 30 schizophrenic and 30 non-schizophrenic psychiatric patients. Their results indicated that the schizophrenics were inferior to the non-schizophrenics in the number of correct items reproduced on the recall tests, but the two groups did not differ significantly in the number of correct items identified on the recognition tests. The schizophrenics also made more intrusion errors on both the tests of recall and recognition. Nachmani and Cohen interpreted these results as being supportive of the 'overinclusive' theory of schizophrenic thought disorder. An alternative explanation, however, which is equally supported is in terms of an 'output interference' hypothesis. This hypothesis implicates a faulty retrieval mechanism as the primary disorder in schizophrenic memory deficit (Bauman, 1971). In addition to this, it seems probable that Nachmani and Cohen's subject groups were not adequately defined. They based their classification of subjects only on clinical judgement. Thus, while controlling for age and education, the authors failed to take into account the unreliability of clinical evaluation and diagnosis. Because no standardized, objective diagnostic measure was employed, their inclusion of patients into either subject condition was probably not reliable. This would necessarily make suspect any interpretations of the data based on posited subject-group differences.

Cohen and Camhi (1967) investigated the speaker and listener skills of schizophrenics and normals in a communication task. They found a deficit in speaker skill but not in listener skill, and explained the deficiency as the result of the speaker task involving a high memory

load in contrast to the association task of the listener, which did not place great demands on memory. In the communication task, both the speaker and the listener were provided with identical lists of word pairs. The speaker then showed one of the word pairs to the listener and provided him with word clues so that the listener could identify which one of the two words had been chosen. Since the schizophrenics were found to be inferior to the normals in the speaker role but not in the listener role, it was suggested that the associative repertoires available to the schizophrenics for selecting clue words were the same as the associative repertoires of the normals, but that the selection process in the schizophrenic subject was faulty. As such, it seems that what is being described is a schizophrenic deficit due to 'output interference'. Although the authors did not conclude this, the results seem supportive of an explanation of schizophrenic deficit in terms of excessive interference at the retrieval stage.

In a series of studies, Bauman and Murray (Bauman & Murray, 1968; Bauman, 1971a, 1971b) attempted to investigate schizophrenic memory deficit in terms of defined sub-processes involved in short-term memory. These studies are particularly relevant to the present analysis because their findings formed the basis underlying the logic of the present investigation.

Bauman (1968) investigated the differences between recall and recognition in schizophrenics and normals. Both subject groups were further divided into two subgroups, those scoring highly on overinclusiveness tests and those making low scores ('non-overinclusive' subjects). Recognition was tested in a multiple-choice format using rhymes,

synonyms, and synonym-rhymes as alternative choices. Each subject was tested for recognition and recall using a different list of 20 words on the two tasks. Only one learning trial was used and subjects were tested immediately after the trial. The results indicated that there was a significant schizophrenic deficit on the recall task, but not on the recognition task. In addition to the absolute differences between the two groups, the difference between recognition and recall performances was more marked for the schizophrenic subjects. Also, contrary to expectation, the overinclusive schizophrenics performed better than the non-overinclusive schizophrenics on both the recognition and recall tasks.

These results had a twofold significance. In the first place, they seemed to argue against any explanation of schizophrenic deficit based on 'overinclusion' (Cameron, 1939; Payne, 1959) or disruption at the acquisition phase of memory. Second, at a theoretical level, they suggested that the recall deficit observed in the schizophrenics may be a result of the inability of schizophrenics to organize information for retrieval. If we accept the dual process theory of recall (Kintsch, 1970), then the primary difference between recognition and recall is that recall requires both the acquisition of responses and the formation of associations, whereas recognition requires mainly the acquisition of responses. Since the results indicate that patients and normals did equally well at recognition, then it is possible that the schizophrenics have little difficulty with the acquisition phase of memory. In the same manner, the deficit in recall may suggest a difficulty in the association-formation stage, which would be reflected in an inability

to organize the material for appropriate retrieval. As such, retrieval-induced interference would be greater in them than in the normals.

Bauman (1971) further investigated this hypothesis by varying experimenter controlled learning instructions. The purpose of the study was to specifically demonstrate that the earlier found recall deficit (Bauman, 1968) was due to the schizophrenic's inability to 'chunk' or 'subjectively organize' stored material for output. The design of the study was based on the earlier studies of Tulving and Arbuckle (1966) and Tulving and Osler (1967). These investigations had not only shown that free recall involves the organization of items into subjective units but also that recall of any one item is dependent upon the recall or non-recall of other items in the same subjective unit, but is independent of the recall of items in other subjective units.

The results indicated that while the schizophrenics improved in recall with practice, there was no facilitative effect due to instructions for organization of output. This was an opposite effect from that found with normals. The normals also improved with practice but their recall was significantly improved by instructions. In the recognition task, the schizophrenics neither improved over trials nor benefitted from instructions for organization. The normal subjects improved over trials, but the effect of instructions was not significant. Thus, the effect of trials was to increase schizophrenic recall but not recognition, while normals showed gains both in recall and recognition. The previous finding (Bauman, 1968) that schizophrenics have a recall but not a recognition deficit was supported.

It was concluded that since schizophrenics were unable to

subjectively organize output even with the aid of instructions, the hypothesis that their recall deficit is related to an inability to 'chunk' or organize information in memory store was supported. A problem, however, remained. If the schizophrenics suffer from an inability to organize then why is it that they performed as well as normals on the recognition task? An answer to this problem can be found in the dual process theory of recall (Kintsch, 1970) where it is indicated that organization has a differential effect on recall and recognition because recognition does not require retrieval from storage (Murdock, 1968). Thus, the fact that recognition in schizophrenics is unimpaired suggests that the input has been stored. The problem, therefore, would seem to be that schizophrenics are unable to organize their memory store and hence have difficulty in the retrieval phase of immediate memory.

In a more recent study, Bauman (1971) further investigated the role of organization at input in schizophrenic short-term memory. In particular, he was interested in examining any disturbances in the association-formation stages of recall that were specific to schizophrenics. It was his postulation that the particular susceptibility to interference that schizophrenics exhibited in the free recall situation could be explained by disturbances at the association-formation stage of recall. His task, therefore, was to demonstrate that schizophrenics have difficulty in forming the interitem and intraitem associations required for immediate recall. Because the difficulty in association forming may appear in at least two processes--in input or in output--Bauman was forced to decide at which stage to focus his

investigation. He chose input. It was his postulation that schizophrenics are unable to utilize stimulus cues for the formation of associative bonds at input. He reasoned that if schizophrenics perceive input as a mass of unorganized, unstructured, and unrelated bits of information, and are oblivious to stimulus cues which might aid association forming, then poor recall of both organized and unorganized input would result. Thus, in comparison to normal subjects, the schizophrenic's recall would show little improvement with increased organization of input.

The results did not support his hypothesis. As was expected, the normals showed a significantly better recall than the schizophrenics, but both the normals and schizophrenics recalled organized lists significantly better than random lists. Thus, increased input organization facilitated recall in both groups. The results indicated in addition that there was no significant difference between patients and normals in their ability to profit from the organization.

A further analysis on the serial position of omissions indicated that schizophrenics made significantly more omissions than normals. Most important, however, was the finding that the schizophrenic omission scores did not follow the serial position curve of the normals but continued to rise from the first to the last serial position. Bauman interpreted this as being supportive of an output interference explanation of schizophrenic memory deficit.

Bauman's findings are important for two reasons. Not only did he demonstrate that schizophrenics can utilize the contextual constraint of input in recall but he provided evidence which suggested that the

schizophrenic memory deficit might be explained in terms of the schizophrenic's increased susceptibility to output interference. Other research (e.g., Murdock, 1963; Tulving & Arbuckle, 1966) had previously indicated that the effects of output interference on the recall of items in the first and middle serial-input positions is negligible, but that the recall of items in the late input positions was largely determined by the number of previous outputs. Since the effects of output interference became apparent in the recall of items late in the input sequence and this was specifically where the schizophrenics showed a deficit, it seems reasonable to conclude that schizophrenics may be more susceptible to output interference. The act of recalling itself, therefore, may be what is dysfunctional. It is because of this that the important role of retrieval strategies in schizophrenic memory deficit seems implicated.

RETRIEVAL AND THE INFORMATION PROCESSING SYSTEM

It seems rather obvious from the literature on schizophrenic memory deficit and thought disorder that investigators have tended to ignore an approach to the individual which has proven particularly fruitful in other areas of psychological investigation; that is, the application of an information processing model to human functioning. Granted Venables (1964) has referred collectively to the "input dysfunction in schizophrenia" and Cameron (1939), although seemingly describing an interference in storage, instead interpreted his results within an attentional deficit framework. However, these investigators have failed to recognize the possibility of a dysfunction in the higher level

processes. Only Bauman (1968, 1971a, 1971b) appears to have considered this possibility. It would seem, therefore, that a more general approach which allows for dysfunctioning at various stages of processing may prove more fruitful. As pointed out earlier, such an approach would not only be supportive of explanations based on interference theory (e.g., Buss & Lang, 1965) but would also provide a means of empirically specifying variables that are relevant to both schizophrenic memory deficit and thought disorder.

Because of this attempt to specify more clearly the processes involved in the schizophrenic deficit, a rather detailed understanding of how information is processed, stage by stage through to recall, would seem to be a crucial prerequisite. Since comprehensive models of the information processing system are readily available (e.g., Atkinson & Shiffrin, 1968; Neisser, 1967; Norman, 1969), they will not be described here. However, research on the processes (in particular retrieval) which typically have been neglected in discussions of schizophrenic deficit and which are basic to the logic of the present study will be presented.

Storage Versus Retrieval Processes

An issue of great importance for any adequate theory of memory is whether it is necessary to distinguish between the processes involved in the storage and utilization of events (Wood, 1972). As early as 1963, Melton had defined the domain of the theory of memory in terms of these two broad classes of problems; one having to do with the storage of traces and the other with the utilization or retrieval of traces. A problem in his presentation, however, was that some of the more specific

issues he listed under problems of retrieval seemed to be as relevant to storage as to retrieval. At least one of them, however, the dependence of retrieval on the reinstatement of original stimulating conditions, illustrated the feasibility of the analytical separation of storage and retrieval processes and implies that retrieval depends not only upon the contents of the storage at any given time but on other factors as well.

In a discussion of this issue, Tulving (1964, p. 222) has pointed out:

> It is not the fact of storage of list items that is at issue in the free recall experiment, but rather the form of storage or accessibility of items...the list items have been 'stored' in the subject's memory for a long time...and the input list serves simply as a set of instructions as to which of the stored items the subject has to retrieve.

Therefore, to the extent that the learning materials consist of items in the subject's vocabulary, the problem of storage per se is essentially bypassed, and success in remembering depends upon the effectiveness of the retrieval operations at the time of test. The efficiency of retrieval is in turn determined by the rearrangement of items in storage. Higher order groupings increase the probability of retrieval of nominal items because they now become accessible not only as individual units but also via other items with which they are joined. Moreover, if a label such as a category name is attached to a higher order unit, then that label can serve as a potent retrieval cue for the individual components of the unit. Thus, what is limited in this conceptualization is not the amount of input that can be accommodated without overtaxing storage capacity but rather the number of retrievable units.

For these reasons, the separation of storage and retrieval proves of value both theoretically and empirically. In an attempt to experimentally support this distinction, Tulving and Pearlstone (1966) investigated the storage and retrieval processes through the experimental manipulation of retrieval cues. Their purpose was to interpret intratrial forgetting by drawing a distinction between what information or what traces are available in the memory storage and what are accessible. They hypothesized that a substantial part of non-recall of familiar words under typical experimental conditions is attributable to inaccessibility of otherwise intact memory units.

The lists they employed consisted of words belonging to explicitly designated conceptual categories. Three levels of list length (12, 24 and 48 words) were combined with three levels of number of words per category (1, 2 and 4 words) to yield nine input conditions. Both category names and words belonging to categories were presented in the input phase, but subjects were told that only their recall for words would be tested. For half the subjects in each of the nine input conditions, recall of words was tested in the presence of category names as retrieval cues, for the other half recall was not cued. Thus, since all subjects in a given input condition were treated identically until the end of the input phase, availability of information at the beginning of the output phase was equated for subjects in the cued and non-cued recall groups. Any differences in recall between these groups could thus be attributed to differences in accessibility.

The results indicated that cued recall was greater than non-cued recall for all nine input conditions, the difference varying directly

with list length and inversely with the number of words per category. It was also found that the presentation of category names as retrieval cues affected only the number of accessible categories but not the number of words within accessible categories. Thus, given that the subject could recall at least one word from a category, the number of additional words recalled for that category was the same regardless of whether he remembered the category on his own or was reminded of it by the experimenter. The results also showed that the number of accessible categories was considerably greater for 48 word lists than for 24 word lists, but again the number of words within accessible categories was identical for both list lengths.

These results were interpreted as demonstrating the independence of word recall within higher order units from the recall of higher order units. As such, the study gives firm support to the view that it is necessary to distinguish between the storage and utilization of events (Wood, 1972). The proportion of words accessible within higher order units was not influenced by the number of accessible higher order units or by the availability of names of higher order units as retrieval cues. It seems that even when the experimenter does not impose any particular organization on the material the subject has to memorize, subjects can and do organize the words into larger units. Some of these subject-units (S-units) consist of words from meaningful conceptual categories, but others seem to be based on other principles--associative groupings, structural characteristics, and similarity of sound patterns--and still others appear to be determined idiosyncratically (Tulving, 1962, 1964). It had been suggested earlier (Tulving, 1964) that the functional

significance of S-units, whatever their nature, lay in the increased accessibility of individual items constituting a unit. Thus, if an individual list item has been stored as a part of a larger unit, it does become more accessible for retrieval when other items in the same unit are accessible. While this organization of material, whether suggested by the experimenter or imposed by the subject, seems to affect recall performance by making the desired information more accessible, it need not have any effect on the availability of the information in the storage.

Numerous studies have replicated and extended the Tulving and Pearlstone findings. Retrieval cues facilitate recall when they are presented during both learning and recall. Retrieval cues do not facilitate recall when they are presented only for the recall trial unless the pre-established association between the cue and the to-be-recalled word is of considerable strength (Thomson & Tulving, 1970; Wood, 1967b). It seems likely therefore that a retrieval cue is effective only if the information about its relation to the to-be-recalled item is stored at the same time that the item is stored. This view is supported by the fact that, in general, the presence of a retrieval cue having a strong pre-experimental association with the to-be-recalled item has little influence on the recall of the item if the item has been studied in the presence of a weak associate (Thomson & Tulving, 1970).

Both theoretically and practically, therefore, retrieval operations complete the act of remembering that begins with encoding of information about an event into the memory store. Thus, remembering is regarded as a joint product of information stored in the past and

information present in the immediate cognitive environment of the rememberer. As such, some sort of a complex interaction between stored information and certain features of the retrieval environment seems to be involved in converting a potential memory into conscious awareness of the original event and corresponding behavior. Tulving and Thomson (1973) point out that these relations between the effects of the past and present inputs and the interaction of the memory trace with the retrieval environment, constitute the domain of theories of retrieval.

In a recent review of the literature, Tulving and Thomson (1973) have attempted to more adequately specify the processes involved in retrieval. They conclude that the 'encoding-specificity principle' appears to be the best able to account for most of the data from investigations of retrieval mechanisms. According to this principle, it is hypothesized that specific encoding operations performed on what is perceived determine what is stored, and what is stored determines what retrieval cues are effective in providing access to what is stored. As such, the memory trace of an event and hence the properties of effective retrieval cues are determined by the specific encoding operations performed by the system on the input stimuli. The trace itself is simply the link between encoding conditions and the retrieval environment and, from the point of view of psychological analyses of memory, need have no more reality than is implied by the relation between encoding and retrieval.

The crux, therefore, of the encoding specificity hypothesis is that the effectiveness of a retrieval cue depends primarily upon the nature of the encoding process, and not on pre-established language

habits. In order for a word to be an effective retrieval cue for another word, information about the two words must be stored at the same time. Given that the two words are encoded at the same time and one can serve as a retrieval cue for the other, it does not necessarily follow that the two words are stored together. The evidence (Wood, 1972) suggests that words may be stored independently. The fact that related words are frequently recalled consecutively could be due to the subject's use of a retrieval plan to link the related words. That is, by making a storage-retrieval distinction, one can attribute the dependency of words at recall to retrieval, not storage processes.

Organization and Memory

As can be seen from the foregoing, a crucial area of investigation inherent in any analysis of storage and retrieval in free recall involves the role of organizational processes in memory. This is necessarily so because of the consistent finding that individual list items are not always processed independently of one another, thus hinting at the discrepancy between nominal and functional units of material, or between experimenter or subject dictated units.

It is a generally observed phenomenon that subjects usually produce their responses in recall in an order different from the presentation order. This is a phenomenon specific to free recall where the output order is free to vary. As such, any discrepancies between input and output orders, under conditions where output orders show systematic consistencies provide evidence for organizational processes in remembering. There are, however, two approaches to defining organization. Organization defined in the weak sense refers to consistent discrepancies

between input and output orders that are independent of the subject's prior familiarity with a set of input items. This type of organization is typically referred to as 'primary organization' (Tulving, 1968). The recency effect, for instance, being related to the subject's tendency to recall terminal input items from a homogeneous list before recall of other items, regardless of the characteristics of these items, is one of the manifestations of primary organization.

Organization is also defined in a strong sense. Such organization occurs when the output order of items is governed by semantic or phonetic relations among items or by the subject's prior, extra-experimental acquaintance with the items constituting a list. This type of organization is typically labelled 'secondary organization' (Tulving, 1968). It can be measured in a variety of ways and can be related to both independent variables and other dependent variables, thus illuminating some of the underlying processes in free recall. As such, the 'secondary organizational processes' are particularly relevant to the present analysis.

Theoretical explanations of the factors underlying secondary organization have typically focused on two processes--association and superordination. The problem has been one of whether the organization of verbal responses can be explained in terms of relatively simple associative connections between words, or whether it is necessary to invoke an additional principle such as superordination. According to this principle individual items are organized into higher level units via mediational mechanisms.

That associational mechanisms are involved in organization cannot

be denied. The difficulty, however, is in defining on what basis items are associated. Conceptually (and empirically) the adoption of the conceptual category model allows for the study of these parameters through the study of more complex events (e.g., larger units manipulating organization independently of the to-be-recalled events) (Wood, 1972).

In any event, it seems that if material is organized recall is better and clustering tends to occur (Tulving, 1968). It does not seem to matter whether the organization is in terms of associations among the items of a list, superordinate categories, or sequential dependencies (Kintsch, 1970). In all of these cases, the organism is somehow able to take advantage of the structure which is present in the learning material. Logically, there are two ways in which this can happen: perhaps organized material is easier to store in memory, or perhaps organization of the material facilitates the retrieval process. The two possibilities are not mutually exclusive, of course. In fact, it seems clear that both are important in recall. From the available evidence (e.g., Tulving & Pearlstone, 1966; Osler, 1968), one is led to conclude that retrieval cues in recall are effective in the sense that they help subjects to recall items which they could not have recalled otherwise, but only if these cues are relevant to the way in which the subject had stored the learning material. Thus, information about the retrieval cue must be stored with the information about the learning material. As was pointed out earlier in the discussion of subjective organization, even if the input material is not organized by the experimenter, the subject will impose his own organization on it. It appears that the major problem which a subject is faced with in a free recall situation is to organize

the material for himself so that it can be retrieved later. If a list is already objectively organized, the subject's task is facilitated, but in either case, long-term recall pre-supposes organization of the learning material.

While there is much evidence to support the role of organizational processes in free recall learning, the nature of these processes remains controversial. It is still not clear whether free recall learning actually involves two distinct organizational processes. One organizational process is believed to be the groupings of items into higher order memory units, such that all the members of each unit are recalled or none is recalled. The second process is believed to involve the development of a retrieval plan to allow the subject to move from one higher order memory unit to another during recall (cf. Bower, 1970a; Tulving & Pearlstone, 1966). In this model, free recall learning can be viewed as involving a two-level storage system. The to-be-recalled material is organized into clusters and stored at one level, and labels for the clusters are stored at a different level. Retrieval from storage is accomplished by using the stored labels.

In addition, while the importance of cues for recall supports the need to make a distinction between storage and retrieval processes, it is not clear whether organization influences storage, retrieval, or both. Wood (1972) points out that the attempts to assess the influence of organizational processes on storage and retrieval have not been successful partially because there does not appear to be any way to directly assess storage. The suggestion is that it may be impossible to determine whether storage is independent (i.e., whether organization

influences retrieval only). This questions the position held by Tulving. Tulving (1968) has argued that organization is a property of retrieval. His position is that organization of material into coherent recall units does not occur because these items are stored together but rather because of a retrieval plan established during learning. Further research investigating both organization and retrieval is needed if these issues are to be clarified. Mandler (1967) has suggested that if we are to fully understand how these processes develop, we must go to the developmental study of language, semantics and verbal behavior.

Retrieval in Recognition and Free Recall

The processes involved in recognition and free recall have been a source of debate for some time. The basic issue is whether recognition like recall involves a retrieval process. This issue is one that distinguishes between one and two process theories of recall.

The dual process theory of recall assumes that while recall depends upon the retrieval of items by means of the organization of storage, recognition does not. Thus, what is presumably the case is that we are dealing with two distinct processes in memory--a retrieval process and a decision process. Recognition, therefore, depends solely upon a simple decision process unaffected by organizational variables. Subjects process a word presented in the recognition task, look up that in the long-term storage and, if in fact it had a tag indicating that it had been previously presented, then it would be recognized as an old item. Kintsch (1968) has summarized this point of view most emphatically by saying that organization "can have no effect on recognition, since organization facilitates retrieval and only recall involves

retrieval." The single process approaches assume, on the other hand, that recall and recognition involve basically the same processes. Organizational processes and hence, retrieval, are involved in both learning tasks. The dual process theories, therefore, claim that while recall involves a decision process and a retrieval process, recognition requires only a decision process. The single process theories assume, on the other hand, that decision processes and retrieval processes are involved in both recall and recognition.

The differences between the two approaches have not been resolved. Mandler (1972) argues for a one process approach while Murdock (1968) and Kintsch (1970) continue to argue for a dual process explanation. The weight of evidence, however, appears to be favoring the one process approaches. Tulving and Thomson (1973) have provided results that cannot occur according to the two process theory of recall and recognition, and other versions of the generation-recognition model. They also point out that differences in recall and recognition of identical material stored under different encoding conditions do not simply reflect established differences in "strength" of traces. They demonstrate how the recall and recognition of items stored under identical encoding conditions are influenced, sometimes greatly influenced, by the nature of information present in the retrieval environment. Thus, while memory traces may be said to vary in strength, or quality, or durability, more importantly, they vary in the specificity of code they carry as to the effectiveness of various kinds of retrieval information that govern the recovery of the stored information. In this way, encoding specificity and retrieval are crucial to both recognition and recall.

Despite the similarity of processes involved in recognition and recall, the fact that there are differences involved in the utilization of each seems undeniable. If we view recognition and recall on a continuum of complexity, then recall, because of the necessity of the production of an identifying response will be more susceptible to interference effects. Thus, even though recognition may require a retrieval process, it may not be as complex a function as that required in recall. In this way, it would not exhibit as great an interference effect if it became dysfunctional. This position is of crucial importance in the literature on memory disorder in schizophrenia, since investigators employing a recognition paradigm have typically not interpreted beyond their results in terms of evidence for retrieval deficit.

Besides implicating a retrieval difference, the consistent finding that schizophrenics perform as well as normals on a recognition memory task (e.g., Bauman, 1968; 1971a, 1971b) but perform quite poorly on a recall task, would tend to argue against interference at input as a result of attentional factors. Since the information is evidently 'getting in' on the recognition task, then it is also, in all probability, 'getting in' on the recall task. The poorer performance on the recall task by the schizophrenic, therefore, may be a result of the more complex organizational and retrieval functions demanded by the task. The retrieval dysfunction that is posited as occurring in the schizophrenic is thus hypothesized as occurring at a higher level than that required by recognition memory.

SUMMARY AND STATEMENT OF HYPOTHESES

From the available evidence, it seems that there are crucial methodological and theoretical approaches that have been developed in the investigation of information processing that can be applied meaningfully to the analysis of schizophrenic thought disorder. Typically, the application of these developments to clinical investigations has lagged far behind. Reviews (e.g., Zimet & Fishman, 1970) of clinical investigations into schizophrenic memory disorder still largely criticize the methodological soundness and sophistication of most of these studies. For these reasons, most of the literature in memory dysfunction in schizophrenia is fraught with contradictions and ill-defined processes.

As was pointed out earlier, interference theory, as a broad explanation of schizophrenic deficit, appears to be the only theory comprehensive enough to account for what is known (Buss & Lang, 1965). Interference theory assumes that when a schizophrenic is faced with a task he cannot attend properly or in a sustained fashion, maintain set, or change the set quickly when necessary. His ongoing response tendencies suffer interference from irrelevant, external cues and from 'internal' stimuli which consist of deviant thoughts and associations. These cause his associations to deteriorate because they act as distractors. To the extent that stimuli have individual, idiosyncratic meanings (associations), they will handicap the schizophrenic in his responding to them.

Thus, interference theory provides a broad explanation of schizophrenic thought disorder. However, it seems that what is needed is a specific application of various techniques at input, storage, and

output in an attempt to evaluate the role of interference at any or all of these stages. It seems logical that if a component analysis of these interference effects can be accomplished, then a greater understanding of the processes involved in the 'schizophrenic deficit' will result.

As such, the present investigation was designed to provide evidence on the effects of interference at output. By employing a modified Tulving and Pearlstone (1966) design, it was posited that a distinction between what information is available in the memory store of the schizophrenic as compared to what information is accessible could be accomplished. This distinction parallels the distinction between retention and recall and would indicate whether the schizophrenic is learning the material but is unable to recall it or whether he is simply not learning the material. If the former occurred, it would implicate a retrieval dysfunction among the schizophrenic group. Such a finding would tend to argue against the 'input' explanations of schizophrenic deficit (e.g., attention--McGhie, 1968; set--Shakow, 1963). On the other hand, if the latter was revealed, interference effects at input would seem to be implicated. In any event, the present research will provide evidence relevant to both of these processes.

Four hypotheses were evaluated in the present research. Hypotheses 1 to 3 tested various aspects of interference theory and were considered ancilliary to the major focus of the investigation. Hypothesis 4 was of critical importance since it provided the evidence that tested the effects of retrieval on schizophrenic memory functioning. In terms of specific hypotheses, the following predictions were tested:

Hypothesis 1--Across all conditions the schizophrenic group will show an absolute recall performance that is lower than the normal group.

Thus, the schizophrenics should show a more marked reaction to the interference produced in a free recall situation than the normals. This greater susceptibility to interference effects should be observed in all conditions and will be reflected in an overall poorer recall score.

Hypothesis 2--Relative to the normal groups, the schizophrenic group should show significantly less benefit from practice.

Thus, while both the schizophrenic and normal groups should show improvements in recall with practice, the normal group's gain should be significantly superior. This comparison was included in an attempt to replicate Bauman's (1971) finding where it was shown that while the schizophrenics improved in recall with practice, the effect of instructions for organization of output produced no significant facilitative effect. The normals, on the other hand, showed significant increases under both conditions.

Hypothesis 3--A greater recall will be observed where recall is cued as compared to not cued for both the schizophrenic and normal groups.

Thus, in terms of whether recall is cued or not cued, it is expected that for both groups the provision of cues will significantly increase the number of words recalled. This will support the distinction between 'availability' and 'accessibility' and will indicate that for both groups sufficient information was available in memory for the reproduction of the words but that this information was not accessible.

Hypothesis 4--The schizophrenic group will show a significantly greater increase than the normal group in the number of items recalled in the cued as compared with the non-cued condition.

The schizophrenic group will, therefore, show a much greater effect of cues. This will indicate that at least a part of the poorer performance observed in schizophrenic recall is a function of a faulty retrieval mechanism.

CHAPTER II

METHOD

Experimental Design

The basic design was a modification of the design employed by Tulving and Pearlstone (1965) in which categorized word lists consisting of both (a) category names, and (b) words representing instances of categories, are presented to subjects (Ss). Immediately after a single presentation of the list, two recall tests (either non-cued recall followed by cued recall [NCR-CR] or cued recall followed by cued recall [CR-CR] are given in succession. The second recall test is always given under the conditions of CR. This design allows for the experimental separation of information that is available and information that is accessible in the memory store through an analysis of the effects of retrieval on information loss. The present design differed from that of Tulving and Pearlstone in several significant ways:

(1) In the present study, list length was held constant at 24 items. In the Tulving and Pearlstone study, three levels of list length (12, 24 and 48 items) were employed. The exclusion of list length as a variable was dictated by two considerations. Tulving and Pearlstone had shown that the superiority of CR over NCR was an increasing function of list length. Thus, a median superiority of CR over NCR could be obtained by choosing the list of intermediate length. Another

consideration in the selection of list length was the capability of the Ss tested. It seemed necessary to employ a list that would not prove too difficult for the schizophrenic group and yet not prove too easy for the normal group. Thus, although Tulving and Pearlstone's results indicated that the superiority of CR over NCR would have been more clearly demonstrated with a list length of 48 items, this list length would have, in all probability, put the schizophrenic group at a greater disadvantage than the normal group. For this reason the list length of intermediate difficulty (24 items) was employed.

(2) There were two levels of 'items per category' (IPC = 1 or 4) employed in the present investigation. 'Items per category' refers to the number of items to be remembered per category name. Thus, in IPC = 1 there was presented one category name followed by one item to be remembered, and in IPC = 4 there was one category name followed by four items to be remembered. Tulving and Pearlstone had employed three levels of IPC (one, two or four items). The exclusion of IPC = 2 from the present investigation was based on their finding that the superiority of CR over NCR was a decreasing function of IPC. As such, the manipulation of the two extreme IPC levels (one or four items) would provide the data relevant to the IPC variable comparison.

(3) The Ss in the present study were shown three separate lists to learn. The Tulving and Pearlstone study employed only one list. Multiple lists were included in the present investigation so that the practice effect could be evaluated in terms of normal-schizophrenic differences due to the effects of interlist interference (proactive inhibition) and practice on performance.

(4) In the present study, two S groups (schizophrenic and normal) were investigated. The Tulving and Pearlstone data was obtained solely from a normal sample. The normals in the present study acted as a control group while the major focus of investigation was on the schizophrenic performance. In all other aspects, the design and procedure of the present investigation were identical to that of Tulving and Pearlstone.

Thus, the design of the present investigation included four independent variables. Three of these were 'between' factors and one was a 'within' factor.

(a) between - items per category (IPC = one or four items)

(b) between - conditions of recall in the first recall test (CR versus NCR)

(c) between - subject group (schizophrenic versus normal)

(d) within - the effects of practice over the three lists.

In addition, the change in performance from recall Test 1 to recall Test 2 for each list was evaluated. This, however, was not considered as a major factor. The evaluation of this factor could only be performed between groups. A within group comparison of the second recall test could not be performed since no safe assumptions could be made about availability of information in the memory storage after different treatments in the first recall test.

The design, therefore, can be conceptualized as a 2 x 2 x 2 x 2 x 3 design. Besides the computation of the recall analysis of variance, the analysis was split across recall (recall Test 1 - recall Test 2) so that two separate 2 x 2 x 2 x 3 analysis of variance could be performed on the major variables. This was done to facilitate the comparison of

recall performance relevant to Hypothesis 4. A separate analysis of only the List 1 recall scores was performed in order to evaluate the effect of the cues on List 1 recall performance. The List 1 analysis was the critical analysis. The effects of List 2 and List 3 were analyzed in relation to List 1 to evaluate any change in performance as a result of practice.

Word Lists

The lists were comprised of items and categories derived from three sources: Battig and Montague (1969), Shapiro and Palermo (1970), and Hunt and Hodge (1971). There were six experimental lists as well as a practice list employed in the present study. The practice list consisted of 30 items and 12 categories. The number of items per category varied from one to four. The six lists employed in the experimental task were of two types: (a) lists 24 - 1 where there were 24 items to be learned and each item was preceded by a category name, and (b) lists 24 - 4 where there were 24 items to be learned but only six category names. Each of the six category names in lists 24 - 4 were followed by 4 items to be learned that were specific instances of that category. The six experimental lists as well as the practice list are presented in Appendices 1, 2a, 2b, 2c and 3a, 3b and 3c.

The composition of the lists was arrived at in two stages. In Stage one, the categories to be employed in the various lists were chosen randomly from the three established lists of norms (i.e., Battig & Montague, 1969; Shapiro & Palermo, 1970; Hunt & Hodge, 1971). In the next stage, the items or instances of the categories (IPC = 1 or 4) were selected randomly from the top 15 associations of each category reported

in the published norms. This procedure was followed in order to control for any inflation of recall scores as a result of free association to the category names.

The presentation order of the lists and list items was counterbalanced within each experimental condition. This was done in an attempt to control for any possible confounding effects of item or list.

Subjects

Schizophrenic Subjects

The schizophrenic subjects (N = 48) were selected from the medical case records of inpatients at the Brockville Psychiatric Hospital, Kingston Psychiatric Hospital, London Psychiatric Hospital, and Royal Ottawa Hospital. Each had a confirmed psychiatric diagnosis of schizophrenia, with no evidence of organic damage, convulsive disorders, alcoholism, or mental retardation. These subjects were then subjected to a progressively more definitive set of criteria. These were applied in an attempt to control for any possible extraneous influences on the memory performance of the schizophrenic sample (e.g., McGhie, 1969; Buss & Lang, 1965). The pretest standards involved a sequential application of the following criteria:

(1) a psychiatrist's diagnosis of schizophrenic reaction or schizophrenia, any subtype. This was always the patient's current and primary diagnosis and had been firmly established prior to testing.

(2) a current hospitalization of less than two years. Patients who had been hospitalized continuously for a period of time greater than two years were not included in the sample in order to control for the possible adverse effects of long-term continuous institutionalization

on the information processing abilities (e.g., Brown, 1960).

(3) between the ages of 20 and 40 inclusive.

(4) no electro-convulsive shock treatment for at least one year prior to testing.

(5) no diagnosis of an organic brain disorder and no mention of possible brain damage in the medical chart. Thus, anyone suspected of having any brain dysfunction due to organic involvement was excluded from the study.

(6) not currently on the disturbed ward or in seclusion.

(7) only patients whose antipsychotic medication was of the phenothiazine group were chosen. They also must have been on that medication for at least seven days. It was decided not to interfere with medication partly because it was a means of avoiding biasing the sample of patients (i.e., of patients well enough to be taken off drugs) and partly because a survey of the literature suggests that the effects of phenothiazines on memory tests are minimal (e.g., Vestre, 1961; Helper, Wilcott & Sol, 1963). Also, by statistically holding the type of medication constant any between medication variance could be controlled. The medications of each patient were recorded fully at the time of testing. They were recorded in chlorpromazine equivalent units through the use of the Kline and Lehman (1965) equivalency tables. The body weight of each patient was also recorded so that the ratio of milligrams of chlorpromazine to kilograms of body weight could be calculated. It was posited that a more meaningful analysis of the effects of the medication on performance could be presented if the dosage to body weight ratio was employed rather than dosage alone. By doing so, a post hoc analysis of

variance could be performed and the effects of medication on performance evaluated.

All of the schizophrenic subjects who met these criteria were then screened further. To validate the diagnosis of schizophrenia, two scales designed to assist in the diagnosis of schizophrenia were employed: (1) the Schizophrenic Checklist (Whitman, 1967) and (2) a thirty-item shortened form of the Sc Scale of the MMPI (Sc^1 Scale; Welsh, 1952). The cut-off point for the Schizophrenic Checklist was four items out of six. Thus, only those scoring four or above were included in the study. On the Sc^1 Scale, subjects had to achieve a minimum score of six. All of the subjects who met these criteria were then administered the Shipley-Hartford Scale (Shipley, 1940). Only those patients who received vocabulary scores above 21 were included in the study. The cut-off score of 21 roughly approximates the lower end of the average intelligence range as measured by the Wechsler Adult Intelligence Scale (Wechsler, 1949). Thus, only those subjects who were of average or above average intelligence were included in the study.

Since research with schizophrenics has suggested the importance of both the process-reactive dimension and symptom pattern (paranoid-non-paranoid) (Buss & Lang, 1965; Zimet & Fishman, 1970) ratings on these factors were obtained for each member of the schizophrenic group. These ratings were not part of the selection criteria and were obtained so that a post hoc analysis of these dimensions could be performed in order to provide information regarding their effects on performance that might be relevant to further research. The process-reactive classification was achieved by administering the Ullman-Giovannoni

Self-Report Scale (Ullman & Giovannoni, 1964) which consists of 24 True-False questions which are answered by the patient. Questions cover such areas as interpersonal relations, marital status, premorbid adjustment, work history, mental health status, etc. The questions are scored in the reactive direction. A median split was used to classify the patients into the two categories: 12 or below was considered process, while 13 or above was considered reactive. This procedure has been validated by Held and Cromwell (1968), Johnson and Reis (1967), Ober (1966), Watson and Logue (1969). The complete scale is given in Appendix 4.

In order to categorize the schizophrenic subjects on the paranoid-non-paranoid dimension, two measures were employed. These were: (a) Whitman's (1967) Paranoid Checklist which was rated by the ward psychiatrist, and (b) a shortened form of the MMPI Pa Scale (Pa^1 Scale; Welsh, 1952). Although both of these devices are True-False scales, the items were rated on a 7-point scale to allow for a more accurate discrimination along the dimensions. For purposes of analysis, only the schizophrenics falling at the extreme ends of the dimensions were included. This was defined as those subjects scoring at least one standard deviation above or below the mean on the dimension being analyzed. This procedure was followed in order to accentuate any differences in recall that occurred in conjunction with either paranoia or non-paranoia and process or reactive adjustment.

In addition to this analysis between the extreme groups, a supplementary analysis was performed in which multiple analyses of covariance were applied to the data. This was performed in an attempt

to control for any confounding that might have occurred as a result of the correlationship between the two dimensions. In this way, any interrelationship of these two dimensions and recall performance could be assessed.

Normal Subjects

The normal subjects (N = 48) were obtained from the Nursing Service staff and Support staff of the Brockville Psychiatric Hospital. The criteria for the normal subjects were as follows:

(1) no history of psychiatric hospitalization,

(2) age between 20 and 40 inclusive, and

(3) Shipley-Hartford Vocabulary score above 21.

The subjects meeting these criteria were assigned randomly to the two treatment conditions.

Because of the possibility of undiagnosed schizophrenia among the normal (control) group that could possibly tend to depress any normal-schizophrenic differences, the Sc^1 Scale of the MMPI (Welsh, 1952) was administered to all of the control group members. Any subjects who showed the presence of psychopathology as defined by a significantly high score on the Sc^1 Scale were excluded from the sample. As with the schizophrenic subjects, the normal subjects' participation in the experiment was completely voluntary.

Comparison of the Subject Groups

Schizophrenic Group

The means and standard deviations of the four schizophrenic subject groups on the pretest measures are presented in Table 1.

TABLE 1

Means, Standard Deviations and F Values of Pretest and Subject Characteristic Scores for Schizophrenic Groups

Variable	Schizophrenic Groups (N = 48)								
	CR-24-1 (N = 12)		NCR-24-1 (N = 12)		CR-24-4 (N = 12)		NCR-24-4 (N = 12)		F Value
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	
Age (years)	25.00	3.19	24.58	3.92	24.75	3.44	25.00	5.66	.08
Sc[1]	10.08	4.72	9.83	5.81	9.67	2.64	9.92	3.20	.04
Schizophrenic Checklist	5.00	.95	5.08	.67	4.92	.51	5.00	.60	.00
Shipley-Hartford Vocabulary Score	26.00	5.98	26.17	4.11	26.25	3.82	26.25	4.77	.00
Ullman-Giovannoni Process-Reactive Scale	10.08	3.40	10.83	3.61	10.67	2.27	10.08	3.75	.49
Pa[1]	5.42	2.15	5.00	2.34	5.08	1.88	5.00	.95	.09
Paranoid Checklist	3.33	2.15	3.00	1.41	3.25	1.42	3.17	.94	.08
Education (years)	11.25	2.09	11.25	1.96	11.50	2.07	11.17	1.34	.09
Number of Hospitalizations	2.00	.95	1.92	1.00	2.33	1.37	2.17	1.40	.01
Length of Current Hospitalization (months)	5.83	6.10	5.17	5.11	5.33	2.15	5.33	4.64	.06
Total Length of Hospitalization (months)	11.67	8.88	11.67	10.91	10.83	9.15	11.50	8.21	.02
Medication (ratio of milligrams to 1 kilogram)	7.76	2.45	7.64	3.64	7.50	2.80	8.16	3.33	.19

Descriptive data outlining age, education, number of hospitalizations, length of current hospitalization, total length of hospitalization, and medication dosage, are also presented in Table 1. The raw data on all of these measures are presented in Appendix 5.

One-way analyses of variance between the four experimental conditions on all of these factors failed to reveal any significant differences. The F values relevant to each of these comparisons are also presented in Table 1. As can be seen, none of these even approach significance. Thus, all four of the schizophrenic subject groups were highly comparable on all of the relevant pretest measures as well as all of the descriptive characteristics and medication.

Normal Group

The means and standard deviations of the four normal subject groups on the relevant pretest materials are presented in Table 2. Descriptive data indicating age and education are also included. The raw data on all of these measures are presented in Appendix 5.

One-way analyses of variance between the four experimental conditions on all five relevant factors revealed no significant differences. The F values relevant to each of these comparisons are also presented in Table 2. Thus, with regard to age, education, vocabulary, and Sc[1] score, all four of the normal groups were highly comparable.

Schizophrenic x Normal Comparison

Because the normal and schizophrenic groups' performances were being compared, it was important that both subject types be comparable on several relevant factors. From a comparison of Table 1 and Table 2, it can be seen that all four normal groups were highly comparable to the

TABLE 2

Means, Standard Deviations and F Values of Pretest and Subject Characteristic Scores for Normal Groups

Variable	Normal Groups (N = 48)								F Value
	CR-24-1 (N = 12)		NCR-24-1 (N = 12)		CR-24-4 (N = 12)		NCR-24-4 (N = 12)		
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	
Age (years)	24.83	1.85	25.00	1.76	24.83	4.32	24.83	2.86	.01
Shipley-Hartford Vocabulary Score	26.08	2.43	26.08	2.07	26.17	3.01	26.25	3.08	.00
Sc^1	3.33	.98	3.42	1.08	3.50	.52	3.42	1.24	.08
Education (years)	11.50	1.00	11.33	1.07	11.25	1.60	11.33	1.15	.12

four schizophrenic groups on age, level of education, and Shipley-Hartford Vocabulary score. An analysis of variance between the groups revealed non-significant differences on all three pretest measures: age ($F = .00$; $df = 1, 95$; $p > .10$), education ($F = .04$; $df = 1, 95$; $p > .10$), and vocabulary score ($F = .00$, $df = 1, 95$; $p > .10$). The only major difference concerned the greater standard deviations shown by the schizophrenic groups on the Shipley-Hartford Vocabulary test. This was suggestive of a greater variability in scores accepted above the minimum cut-off point for the schizophrenic groups. The normals, on the other hand, showed a greater homogeneity of scores. This difference reflected the greater difficulty in obtaining schizophrenics who met all of the pretest criteria and who scored greater than 21 on the Shipley-Hartford. Because the majority of normal subjects tended to score around the reported means, the extreme scores were eliminated. This resulted in less variance in the normal sample. The only significant differentiating factor was the $\underline{Sc}^1$ Scale ($F\ (1, 95) = 103.68$, $p < .001$). This indicated the statistical separation of the schizophrenic and normal groups by means of the $\underline{Sc}^1$ Scale.

In summary, therefore, all of the experimental groups tended to be comparable on the pretest and descriptive measures, with the exception of the $\underline{Sc}^1$ Scale. All four schizophrenic groups scored significantly higher on the $\underline{Sc}^1$ Scale than did the four normal groups.

Attrition Rates

The number of subjects lost as a result of exclusion or unwillingness to cooperate at each level of experimental involvement are presented in Table 3. As can be seen, a great many schizophrenic subjects (N = 131)

TABLE 3

Attrition Rate of Schizophrenics and Normals at Various Levels of Experimentation

	Schizophrenics	Normals
Pretest		
Sc[1]	6	15
Shipley-Hartford Vocabulary Scale	120	45
Schizophrenic Checklist	5	--
Experimental Task	3	--
Apparatus Breakdown	4	2

were excluded on the basis of their failure to meet the pretest criteria. Only a few (N = 3) of the schizophrenics who had met the pretest criteria and who had started the experimental task dropped out. Four schizophrenics were lost due to apparatus breakdowns.

Many normals (N = 60) were also excluded because of their failure to meet the pretest criteria. Unlike the schizophrenics, none of the normal subjects dropped out of the experiment once they had begun the experimental task. Two normal subjects were lost because of apparatus breakdowns.

Procedure

Schizophrenic Subjects

The patients whose medical file information met the initial criteria and whose Schizophrenic Checklist score as completed by the ward psychiatrist had partially validated the diagnosis of schizophrenia were seen individually so that the nature of the task could be explained in detail. They were told that the results of their performance would not be made known to the hospital and, therefore, could have no bearing on their treatment or discharge. They were then asked to volunteer for the study. Those volunteering were then administered the Sc[1] Scale (Welsh, 1952). The patients whose scores indicated a diagnosis of schizophrenia were then included as subjects in the experiment. These patients were then administered the Shipley-Hartford Vocabulary Test. They were told that the experimenter was looking for only those individuals whose vocabulary fell within a narrow range. Patients falling within the vocabulary limits were told that the test was sometimes used to estimate average intelligence of groups of people, but that it was not precise

enough to measure an individual's intelligence. Subjects rejected on the basis of their Shipley-Hartford vocabulary score were told the same thing and it was again stressed that the experimenter was interested only in the subject's vocabulary.

The subjects meeting the Shipley-Hartford criterion were then told that prior to the start of the experiment there were a series of questions that the experimenter wanted them to answer about themselves. The Pa[1] Scale (Welsh, 1952) and the Ullman-Giovannoni Self-Report Scale (Ullman-Giovannoni, 1964) were administered. In each case, the instructions for the scales were repeated until the patient demonstrated an understanding of the task. After the administration of these pretesting materials was completed, the subjects were assigned randomly to one of the four treatment conditions, with the provision that an equal number of males (six) and females (six) be assigned to each experimental condition.

Normal Subjects

The normal subjects who met the initial criteria of age and no psychiatric hospitalization were administered the Shipley-Hartford. They were told after taking the test that it was often used as an approximate measure of intelligence for groups of people, but that it was not precise enough to determine the intelligence of individuals. They were also told that the experimenter was primarily interested in determining their vocabulary level, since words were to be used in the experiment. Those subjects who met the vocabulary requirement were then given the Sc[1] Scale. Only those subjects who met the Shipley-Hartford and Sc[1] Scale requirements were included in the normal sample.

Assignment to the treatment groups was done randomly, using the same procedure as with the schizophrenic subjects. Thus, an equal number of males (six) and females (six) were represented in each experimental condition. Learning and testing procedures were also identical with the procedures used with the schizophrenic groups.

With the exception of the instructions for the experimental task itself (Appendix 5), no standardized narrative was used, although with all subjects all of the relevant points in the procedure were outlined. This was done in an attempt to facilitate rapport with both the schizophrenic and normal subjects. In all cases, care was taken to ensure that the subjects comprehended the instructions and task they were to perform.

Experimental Procedure

A practice list consisting of 30 nouns was administered to both subject groups approximately two weeks before the first experimental session. This was done individually. Both groups were provided with 12 category names and were required to classify the nouns into their respective categories. These nouns and categories were different from those employed in the experimental lists but were derived from the same three sources as the experimental lists (e.g., Battig & Montague, 1969; Shapiro & Palermo, 1970; Hunt & Hodge, 1971). The purpose of the practice list was to investigate whether the schizophrenic subjects were able to categorize the items into the same categories as normals.

The subjects were run individually. They recorded their recall in specially prepared recall booklets that were distributed at the beginning of the experimental session. Instructions about the subject's

task, and about the use of the recall booklets were presented by means of a tape recorder. The instructions for the experimental lists informed the subjects that they would see and try to memorize a list of nouns or "names of various things", or groups of four nouns, and that each word (or group of four words) would be preceded by another word or phrase that described the word(s) to be remembered, but which in itself did not have to be remembered (the complete instructions are presented in Appendix 5). The subjects were then told the number of categories, and the number of words per category in the lists that they would learn. Special care was taken to ensure that each subject understood all of the instructions. Apart from this information, no information was given to the subjects exactly what the conditions of the recall test were going to be, nor were they told that there would be different subjects in the same group.

The experimental lists were presented by means of a slide projector and screen. Each item in the lists was presented for two seconds. The category names also had a two-second presentation time. Thus, the total presentation time for lists 24-1 was 96 seconds and for lists 24-4 60 seconds. In the case of lists 24-1, each slide that was projected contained one category name and one item. The presentation time for each slide was therefore four seconds. In the case of lists 24-4, each slide contained one category name followed by four items. The presentation time for each slide was therefore ten seconds. On all of the slides, the category name was distinguishable from the items to be learned in two ways: (a) it always appeared at the top of the slide, and (b) it was always positioned closer to the left margin. Under all

conditions the subjects were asked to read aloud the category name and items. The lists were counterbalanced within groups so that any confounding effect of list items was controlled.

The amount of time given for the recall test was always three minutes. During this time the subjects attempted to recall as many of the items as they could and record them in specially prepared recall booklets. For the condition of NCR, the recall booklets contained 24 consecutively numbered lines. For the condition of CR, the recall booklet listed all of the category names that occurred in the list being recalled. These were in the same order as in the input list and each category name was followed by one or four lines depending upon IPC.

At the end of the first recall test of the list, all subjects recalled all the words they could remember a second time under the conditions of CR. There was a two-minute rest period between the second recall (CR) of a list and the presentation of the next list.

CHAPTER III

RESULTS

Since the analysis of the recall data required a multiple comparison of the different independent and dependent factors, multiple analyses of variance were performed. This allowed for a specific evaluation of the data relevant to the different hypotheses. The analysis employed was therefore chosen because of its ability to analyze multifactorial experiments where the factors are mixed (of independent and correlated levels). Because of the complexity of the design, these data were classified and presented according to the following categories: (a) recall test one, (b) recall test two, and (c) list. The recall test one to recall test two change for each list was measured by means of difference scores. Although the use of difference scores as a measure of change has been seriously criticized (see Bereiter, 1963; Harris, 1963; Cronbach, 1970), it was considered justifiable in this instance because of the nature of the data. Since the comparison being made was of a between group nature and was intended to measure a temporal change, it was felt that the change score would reflect representative changes across the recall tests. These changes would therefore be a function of reliable group differences.

The analysis of recall test one was of critical importance since it provided the evidence directly relevant to the effects of

cueing or not cueing recall as a function of group (schizophrenic and normal). This comparison was crucial to the present investigation since it tested the hypothesis that at least part of the variance associated with schizophrenic memory deficit could be attributed to a retrieval deficit. The analysis of recall test one was limited to the list 1 recall scores because of the confounding practice effects that occurred across the recall tests and the three lists. This analysis can be conceptualized as a 2 x 2 x 2 factorial.

The analysis of recall test two was also performed only on the list 1 recall scores. The second recall test was included in the design, and the data from the second test analyzed and included in the results primarily in order to investigate whether a subsequent presentation of category names as retrieval cues in the NCR-CR groups would result in an increase in the number of retrieved words. This, therefore, was a within subject verification of the between subject comparison in recall test one where recall was either cued or not cued. In order to evaluate this change across recall tests, difference scores were computed. A constant value of 20 was added to the difference score from recall test one to recall test two in order to eliminate any negative values.

It should be emphasized that a major conceptual difficulty was inherent in the analysis of the recall test two data. Tulving and Pearlstone (1966) pointed out in their discussion of the second recall test that aside from the evaluation of the NCR to CR change from recall test one to recall test two, a more detailed analysis of the recall test two data was not warranted. This was so because no safe assumptions

could be made about the availability of information in the memory storage after different treatments in the first recall test. This cautionary statement is only partially applicable to the present analysis. Because the present investigation involved the comparison of two groups which had received identical treatments, a between group analysis could be performed without violating the Tulving and Pearlstone logic. Thus, comparisons were made between the schizophrenic and normal CR-CR groups and the schizophrenic and normal NCR-CR groups.

The analysis of the subjects' changes in performance as a function of list was performed only on the recall test one recall scores. This was done for two reasons. Since the analysis of the effects of list was intended to provide information regarding any Group differences as a function of practice, the restriction to recall test one scores eliminated the confounding problem of availability of information that was specific to recall test two. Also, since the primary purpose of this analysis was to provide evidence relevant to Hypothesis 2, a more detailed analysis than that on recall test one was not needed. This analysis can be conceptualized as a 2 x 2 x 2 x 3 factorial.

In addition to the analysis of recall scores by Group, a post hoc analysis of the schizophrenic group's recall scores as a function of the process-reactive and paranoid-non-paranoid factors was performed. This was investigated in an attempt to evaluate the effect of these factors on the schizophrenic group's recall scores. Two procedures were followed in this analysis. First, analyses of variance were performed in the recall scores of the schizophrenics who had been classified into each of the four groups. These groups represented the schizophrenics who

scored at the extreme ends of either dimension. Second, analyses of covariance were performed on the recall data of the entire schizophrenic sample in an attempt to evaluate whether recall scores varied as a function of scores on the two dimensions. Both of these analyses were restricted to the schizophrenics' recall test one recall scores. The raw data outlining the recall scores of each subject are presented in Appendix 5.

Practice List

The results of the subject's performance on the practice list were analyzed by means of a test of proportions between independent samples (see McNemar, 1969, pp. 58-63). This was performed because of the lack of variance in the scores of the normal subjects. The results of the analysis indicated that there were no significant differences between the schizophrenic and normal groups in their ability to correctly categorize items ($z = 1.15$, $df = 1$, $p > .10$). All of the normal subjects were able to classify the items without error and 45 of the 48 schizophrenic subjects were able to match this performance. Three of the schizophrenics made one error each on the practice list. These three errors were distributed over three of the experimental groups. This performance equivalence suggested therefore that both groups were comparable in their ability to categorize items by category name. Any differences elicited in the experimental task were therefore a result of the experimental manipulation.

First Recall Test

The analysis of the effects of the independent variables in the

first recall test was based only on the subject's list 1 performance. An analysis of these results (Table 4) yielded several rather interesting findings. As can be seen, two of the three independent variables showed significant main effects and two interactions were significant. The main effect of Group ($F = 47.71$; $df = 1, 88$; $p < .001$) revealed that the normal group recalled significantly more items than the schizophrenic group (normal recall, $\bar{x} = 15.62$; schizophrenic recall, $\bar{x} = 11.04$). This finding was, therefore, supportive of Hypothesis 1 which predicted that across all conditions the schizophrenic group would show an absolute recall performance that was lower than that of the normal group.

The main effect of Condition ($F = 77.28$; $df = 1, 88$; $p < .001$) was also significant. This finding was critical to the present investigation and revealed that overall, subjects recalled a significantly greater number of items under the condition of cued recall ($\bar{x} = 16.25$) than under the condition of non-cued recall ($\bar{x} = 10.42$). The Group x Condition interaction proved non-significant ($F = 1.91$; $df = 1, 88$; $p > .10$). This finding suggested that the superiority of cued recall over non-cued recall was significant for both the schizophrenic and normal groups. A <u>post hoc</u> Scheffé test supported this suggestion. It revealed a significant superiority of cued recall over non-cued recall in both the normal ($F = 22.16$; $df = 7, 88$; $p < .01$) and schizophrenic ($F = 26.37$; $df = 7, 88$; $p < .01$) groups. This finding can, therefore, be seen as being supportive of Hypothesis 3 which predicted that a greater recall would be observed where recall was cued as compared to not cued for both the schizophrenic and normal groups.

TABLE 4

Summary of Analysis of Variance of Correct Recall Scores on Recall Test One on List 1 as a Function of Group, IPC, and Recall Condition

Source	df	MS	F	p
Group	1	504.1646	47.71	<.001
IPC	1	1.5000	.14	>.10
Group x IPC	1	20.1667	1.91	>.10
Condition	1	816.6650	77.28	<.001
Group x Condition	1	20.1669	1.91	>.10
IPC x Condition	1	130.6665	12.36	<.001
Group x IPC x Condition	1	95.9993	9.08	<.005
Within Cells	88	10.5682		
TOTAL	95			

At first glance, the finding of a non-significant interaction between Group and Condition seemed to suggest that Hypothesis 4 was not supported. That is, the schizophrenics did not show a significantly greater recall of items under cued recall than the normals. An investigation of this result in relation to the variable IPC, however, indicated a significant differential group functioning as a function of recall condition. The Group x Condition x IPC interaction therefore provided support for Hypothesis 4 and was indicative of a retrieval deficit in the schizophrenic group.

The interaction of IPC x Condition ($F = 12.36$; $df = 1, 88$; $p < .001$) proved significant. More important than this, however, was the significant Group x IPC x Condition interaction ($F = 9.08$; $df = 1, 88$; $p < .005$). This finding was indicative of a differential group recall performance as a function of IPC and Condition and suggested that the previously stated significant IPC x Condition interaction must have been significant for only one of the groups. Post hoc analyses of variance on each of the group's recall scores confirmed this suggestion. The analyses revealed a non-significant IPC x Condition interaction ($F = 109$; $df = 1, 44$; $p > .10$) within the schizophrenic group and a significant IPC x Condition interaction ($F = 34.61$; $df = 1, 44$; $p < .001$) within the normal group.

Thus, as can be seen from Figure 1, under cued recall, the normal group recalled a greater number of items learned under IPC = 24-1 than under IPC = 24-4. Under the condition of non-cued recall, the opposite was true. Thus, under non-cued recall a greater number of items learned under IPC = 24-4 were recalled than under IPC = 24-1.

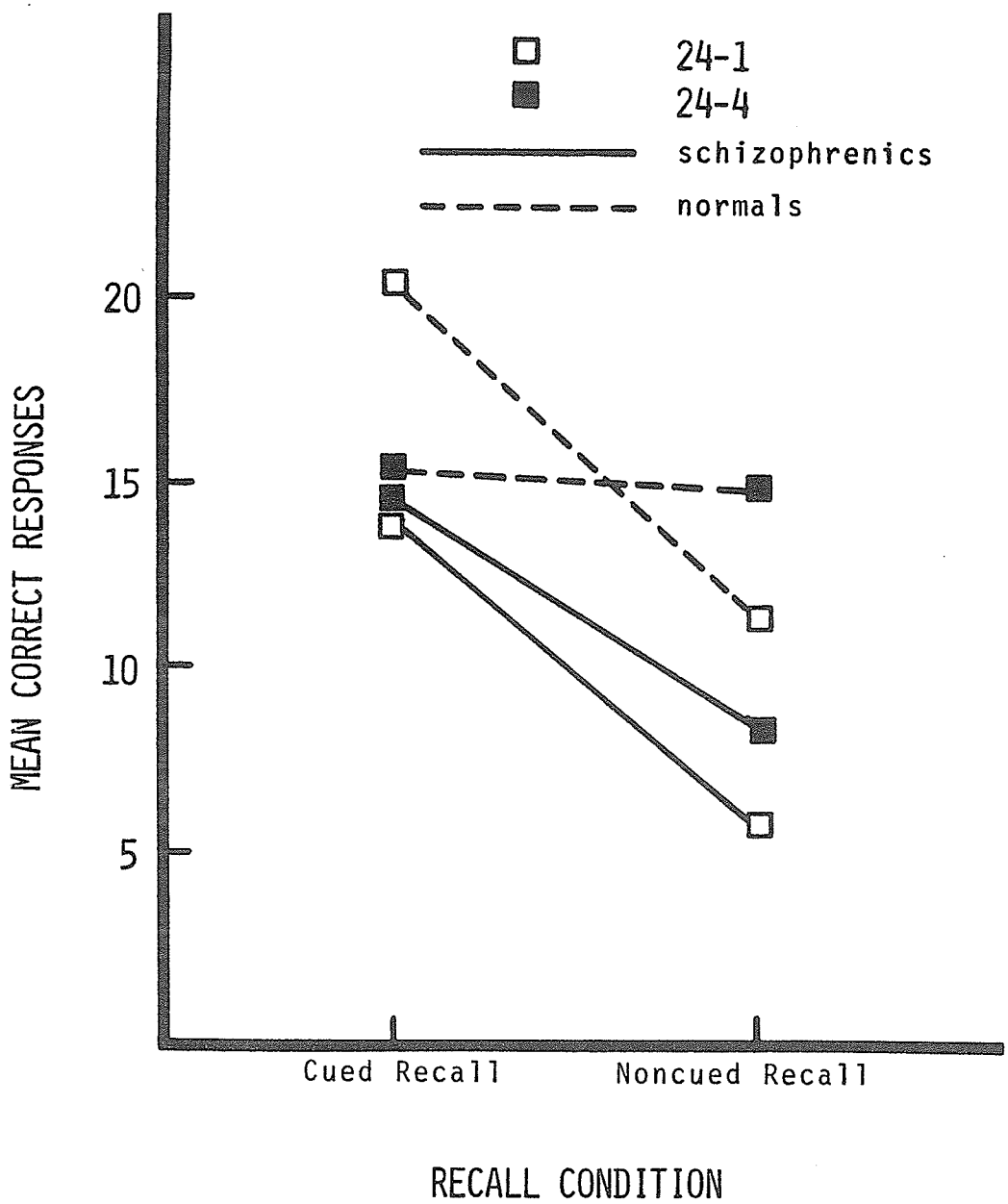

FIGURE 1. Mean correct recall scores for list 1 on recall test one as a function of Group, IPC, and Recall Condition.

These results indicated, therefore, that for the normals, under cued recall, recall decreased as IPC increased; whereas, under non-cued recall, recall increased as IPC increased. This finding is similar to that of Tulving and Pearlstone (1966) and can be seen as being directly supportive of their results. The schizophrenic subjects, on the other hand, did not show this pattern. Their recall performance indicated that under both the non-cued and cued recall conditions, recall increased as IPC increased.

This differential recall by the normals and the schizophrenics as a function of IPC and Condition was critical to the present investigation because of the support it gave to Hypothesis 4. Hypothesis 4 predicted that the schizophrenic group would show a greater increase in the recall of list items than the normal group from the non-cued to cued recall conditions. In the present analysis, the results of the schizophrenic group's recall relevant to this prediction differed as a function of IPC. Thus, for the schizophrenic's recall of items learned under IPC = 4 supported the prediction but recall of items learned under IPC = 1 did not. As can be seen from Figure 1, under IPC = 1 similar increases were observed in both the schizophrenic and normal groups as a function of recall condition. A <u>post hoc</u> Scheffé test indicated that, for IPC = 1, the increase in recall from non-cued to cued recall conditions was significant for both groups (normals, $F = 48.58$; $df = 7, 88$; $p < .01$ and schizophrenics, $F = 28.49$; $df = 7, 88$; $p < .01$). Thus, for both groups a similar effect of cueing was observed. This finding was not supportive of Hypothesis 4 and did not indicate a retrieval deficit in the schizophrenic group.

Where the items were learned under IPC = 4, however, a different pattern of recall was observed. Figure 1 suggested that the schizophrenics' increase in recall from the non-cued to cued recall conditions was significantly greater than that of the normals. A post hoc Scheffé test of this result supported this suggestion. Thus, for the schizophrenics a significant increase from non-cued to cued recall was observed ($F = 23.38$; $df = 7, 88$; $p < .01$); the normals, on the other hand, showed a non-significant increase ($F = .19$; $df = 7, 88$; $p > .10$). The schizophrenics' significant increase and the normals' non-significant increase resulted in a non-significant ($F = .82$; $df = 7, 88$; $p > .10$) group difference under cued recall where IPC = 4. This was the only condition in the present investigation where significant group differences were not observed as a result of the experimental manipulations.

The finding of a significant effect of cues in the schizophrenic group under IPC = 4 was directly supportive of Hypothesis 4; the schizophrenics did demonstrate a retrieval deficit. The fact that this deficit was not observed under IPC = 1 suggested that the schizophrenics were affected differently by the task demands of each of the conditions. It would seem, therefore, that under different conditions which demand the involvement of different processes in the information processing system of the schizophrenic, the locus of the breakdown in functioning will differ.

In an attempt to identify the factors that might be responsible for the significant increase in recall shown by the schizophrenics under IPC = 4 where recall was cued, a post hoc analysis that investigated category recall, and words-within-category recall was performed.

Category recall (Rc) is defined in terms of the number of categories from which at least one word is recalled (Tulving & Pearlstone, 1966). Words-within-category recall (Rw/c) is defined in terms of the ratio of the number of words recalled to the number of categories recalled. The word recall score (Rw) is, therefore, a simple multiplicative function of category recall score (Rc) and words-within-category recall score (Rw/c).

The mean number of categories and words-within-categories recalled are presented in Table 5. A t-test designed to evaluate the significance of the difference between two means for independent samples (see Ferguson, 1966, p. 167) indicated that the only significant difference was between cued and non-cued recall in the number of categories recalled by the schizophrenic group ($t = 2.23$; $df = 22$, $p < .05$). This finding indicated, therefore, that the primary cause of the schizophrenics' significant increase in recall from non-cued to cued recall conditions under IPC = 4 was the significant increase in the number of categories available for recall. As can be seen from Table 5, the number of words within categories also contributed to this increase. This increase in the number of words-within-category recalled was non-significant, however ($t = 1.67$; $df = 22$; $p > .10$). In both instances, recall under cues recall was superior to recall under non-cued recall.

The results of the category recall and words-within-category recall for the normal group replicated the findings of Tulving and Pearlstone (1966). Thus, the mean number of categories recalled increased from non-cued to cued recall but the mean number of words-within-category recalled decreased from non-cued to cued recall. The

TABLE 5

Mean Number of Categories Recalled (Rc) and Words-Within-Categories Recalled (Rw/c) in the First Recall Test of List 1 Where IPC=4

Group	Rc	Rw/c
Schizophrenic		
CR	5.25	2.84
NCR	3.50	2.62
Normal		
CR	5.67	2.77
NCR	5.17	2.94

normal group, therefore, demonstrated a differential effect of cueing. In combination with other findings, Tulving and Pearlstone (1966) interpreted this result as indicating that Rc and Rw/c represent two independent processes of recall; one of these has to do with the accessibility of higher order memory units into which material has been organized, while the other is concerned with the accessibility of individual items comprising the higher order units. Accessibility of higher order units depends upon appropriate retrieval cues and on the total number of stored higher order units, while accessibility of items within higher order units is largely independent of these variables. Since the schizophrenics showed a significant increase in the number of categories recalled, this, therefore, was supportive of an explanation of recall deficit based on retrieval processes.

Second Recall Test

The second recall test was administered to all subjects under the condition of cued recall, where the category names were provided on recall sheets. The analysis of recall performance in recall test two, as in recall test one, was limited to list 1 because of any confounding practice effects across the lists. The analysis of recall test two was performed in order to evaluate the differential effects of the application of retrieval cues on recall, where the subjects had previously experienced either cued recall or non-cued recall. The actual change in performance from recall test one to recall test two was measured by means of difference scores. Thus, the analysis of the results of recall test two involved two foci: (a) the actual recall scores on the second recall test, and (b) the difference scores which reflected the change

from recall test one to recall test two. Because of the problem of interpreting the results in terms of the availability or accessibility of items after different treatments in the first recall test, only the main effect of Group and the interactions involving the Group factor were evaluated. These were the only results in the second recall test and in the difference score analysis that could be validly interpreted.

The analysis of variance of the results of the second recall test is presented in Table 6. As can be seen, three main effects and one interaction were significant. Of these, only the main effect of Group and the Group x Condition interaction were evaluated. The main effect of Group remained significant ($F = 52.70$; $df = 1, 88$; $p < .001$). This again indicated a significant superiority of recall of items by the normal group (normal recall, $\bar{x} = 17.69$; schizophrenic recall, $\bar{x} = 12.46$). As such, this finding was supportive of Hypothesis 1.

The Group x Condition interaction was also significant ($F = 4.22$; $df = 1, 88$; $p < .05$). This finding suggested a differential recall by the Groups on recall test two as a function of whether they experienced CR or NCR in the first recall test. A post hoc Scheffé test indicated non-significant differences between the Groups as a function of having experienced CR in the first recall test ($F = 7.71$; $df = 7, 88$; $p > .10$) but significant differences between the Groups as a function of having experienced NCR in the first recall test ($F = 23.05$; $df = 7, 88$; $p < .01$). This finding suggested that the schizophrenic group experienced particular difficulty utilizing the cues in the second recall test after experiencing the NCR condition in recall test one. The fact that a differential responding by Group occurred seems supported by the fact

TABLE 6

Summary of Analysis of Variance of Correct Recall Scores on Recall Test Two on List 1 as a Function of Group, IPC, and Recall Condition

Source	df	MS	F	p
Group	1	656.2566	52.70	$<.001$
IPC	1	102.0936	8.20	$<.01$
Group x IPC	1	31.5116	2.53	$>.10$
Condition	1	123.7601	9.94	$<.01$
Group x Condition	1	52.5114	4.22	$<.05$
IPC x Condition	1	4.5936	.37	$>.10$
Group x IPC x Condition	1	44.0092	3.53	$<.08$
Within Cells	88	12.4517		
TOTAL	95			

that the Group x Condition interaction was not significant in the first recall test. An analysis of the difference scores provided the information relevant to the explanation of this change.

The results of the analysis of variance of the difference scores between recall test one and recall test two are presented in Table 7. Again, as in the analysis of the recall test two recall scores, only the main effect of Group and the interactions that involved the Group factor were evaluated. The Condition factor is presented only in order to evaluate the effect of the subsequent presentation of cues on recall after an initial non-cued recall trial. This comparison was employed to verify the between subject NCR-CR difference obtained in the first recall test.

As can be seen from Table 7, the main effect of Group was not significant ($F = 3.23$; $df = 1, 88$; $p > .05$). This finding suggested, therefore, that there were no significant differences between the schizophrenic and normal groups in their change in recall from the first to the second recall test ($\bar{x}$ increase in recall; normals = 2.06, schizophrenics = 1.42).

The interaction of Group x Condition also proved non-significant ($F = 2.45$; $df = 1, 88$; $p > .05$). This finding indicated that there were no significant group differences across recall test as a function of either the CR-CR or NCR-CR recall conditions. The schizophrenics under CR-CR showed a mean loss of .08 items whereas under NCR-CR they showed a mean gain of 2.92 items. The normals under CR-CR showed no loss whereas under NCR-CR they showed a mean gain of 4.13 items. Thus, across the recall tests for both groups, recall remained relatively

TABLE 7

Summary of Analysis of Variance of Difference Scores Across Recall Tests One and Two on List 1 as a Function of Group, IPC, and Recall Condition

Source	df	MS	F	p
Group	1	10.0104	3.23	<.08
IPC	1	128.3437	41.46	<.001
Group x IPC	1	1.2605	.41	>.10
Condition	1	304.5935	98.39	<.001
Group x Condition	1	7.5934	2.84	<.10
IPC x Condition	1	86.2601	27.87	<.001
Group x IPC x Condition	1	10.0104	3.23	<.08
Within Cells	88	3.0956		
TOTAL	95			

stable under the CR-CR condition whereas recall increased for both groups under the NCR-CR condition. A post hoc Scheffé test revealed that this increase from NCR-CR was significant for both the groups only under IPC = 1. Thus, under IPC = 1, the schizophrenics ($F = 35.04$; $df = 7, 88$; $p < .01$) and normals ($F = 86.14$; $df = 7, 88$; $p < .01$) showed significant increases from NCR to CR. Under IPC - 4, the gain from NCR to CR was non-significant for both groups (schizophrenics, $F = 5.94$; $df = 7, 88$; $p \geq .10$; and normals, $F = 4.86$; $df = 7, 88$; $p > .10$).

The main effect of Condition was highly significant ($F = 98.39$, $df = 1, 88$; $p < .001$). This indicated that for both groups recall under the CR-CR condition proved relatively stable (recall test one, $\bar{x} = 16.25$; recall test two, $\bar{x} = 16.21$). Under the NCR-CR condition, however, recall increased significantly (recall test one, $\bar{x} = 10.42$; recall test two, $\bar{x} = 13.94$). This finding therefore supported the Tulving and Pearlstone (1966) finding where it was shown that the subsequent presentation of category names as retrieval cues in the NCR-CR groups resulted in an increase in the number of retrieved words. The finding that the subjects under the CR-CR condition showed a mean recall of items in the second recall test that was practically identical with the mean number of words recalled on the first test (first recall test, $\bar{x} = 16.25$; second recall test, $\bar{x} = 16.21$) suggests that for both groups there was neither any forgetting nor "reminiscence" from the first to the second test.

List

The analysis of the effects of List on recall was performed only on the recall test one recall scores. In this way, any change in

learning strategy and/or effects of interference could be evaluated specifically in terms of the independent variables without the confounding effects inherent in the recall test two analysis.

The analysis of variance of recall test one as a function of Group, IPC, Recall Condition, and List is presented in Table 8. As can be seen, three main effects and eight interactions were significant. The main effect of List itself was significant ($F = 3.284$; $df = 2, 176$; $p < .05$). This finding suggested that recall varied significantly as a function of List. The mean number of items correctly recalled by List were as follows: list 1, $\bar{x} = 13.33$; list 2, $\bar{x} = 14.03$; list 3, $\bar{x} = 13.99$. Thus, recall increased from list 1 to list 2, and then decreased from list 2 to list 3. An analysis of the effects of practice from list 1 to list 3 by means of a t-test designed for use with correlated samples (see Ferguson, 1966, pp. 169-171) indicated that the list 3 recall was significantly higher than the list 1 recall ($t = 1.673$; $df = 95$; $p < .05$). Thus, overall, subjects showed a significant increase in recall with practice.

The main effect of Group was also significant ($F = 103.297$; $df = 1, 88$; $p < .001$). An analysis of this result indicated that, overall, the normal group recalled significantly more items than the schizophrenic group (normal recall, $\bar{x} = 16.77$; schizophrenic recall, $\bar{x} = 10.79$). This finding was, therefore, directly supportive of Hypothesis 1 which predicted that across all conditions, the schizophrenic group would show an absolute recall performance that was lower than that of the normal group. The Group x List interaction proved significant ($F = 11.661$; $df = 2, 176$; $p < .001$). This finding was suggestive of a differential

TABLE 8

Summary of Analysis of Variance of Correct Recall Scores on Recall Test One as a Function of Group, IPC, Recall Condition, and List

Source	df	MS	F	p
Group	1	2568.0420	103.297	<.001
IPC	1	112.4989	4.525	<.05
Group x IPC	1	39.0165	1.569	>.10
Condition	1	3945.6628	158.711	<.001
Group x Condition	1	18.0029	.724	>.10
IPC x Condition	1	241.9980	9.734	<.01
Group x IPC x Condition	1	100.3448	4.036	<.05
S's W	88	24.8607		
List	2	14.7115	3.284	<.05
Group x List	2	52.2354	11.661	<.001
IPC x List	2	54.2607	12.113	<.001
Group x IPC x List	2	15.6273	3.488	<.05
Condition x List	2	53.7142	11.991	<.001
Group x Condition x List	2	6.1313	1.369	>.10
IPC x Condition x List	2	5.0083	1.118	>.10
Group x IPC x Condition x List	2	14.7537	3.293	<.05
S's W	176	4.4797		
TOTAL	287			

recall by the two groups as a function of List. As can be seen from Figure 2, the normal group maintained its superiority in recall over all three lists. Different patterns of recall were evident however. Figure 2 shows that the normal group's recall increased from list 1 to list 2, and then decreased from list 2 to list 3. Their list 3 recall was significantly superior to their list 1 recall ($t = 1.9516$; $df = 47$; $p < .05$). The schizophrenic group, on the other hand, showed a decrease in recall from list 1 to list 2, then an increase from list 2 to list 3. Their recall on list 3 was almost identical to their list 1 recall (list 1, $\bar{x} = 11.042$; list 3, $\bar{x} = 11.083$). This increase from list 1 to list 3 was non-significant ($t = .079$; $df = 47$, $p > .10$). This finding was, therefore, supportive of Hypothesis 2. Hypothesis 2 predicted that relative to the normal group, the schizophrenic group would show significantly less benefit from practice across the lists. As can be seen from the Group x List interaction, the normal group showed a significant increase in recall as a function of practice but the schizophrenic group showed a non-significant increase.

The main effect of IPC was significant ($F = 4.525$; $df = 1, 88$; $p < .05$). This finding suggested that overall, the subjects' recall was significantly superior under IPC = 4 ($\bar{x} = 14.410$) than under IPC = 1 ($\bar{x} = 13.160$). This finding is particularly interesting since the main effect of IPC was not significant in the previously reported list 1 results ($F = .14$; $df = 1, 88$; $p > .10$). This indicated, therefore, that a significant change occurred from list 1 to list 3 with regard to the effect of IPC such that items learned under IPC = 4 were recalled more frequently than items learned under IPC = 1. The non-significant Group

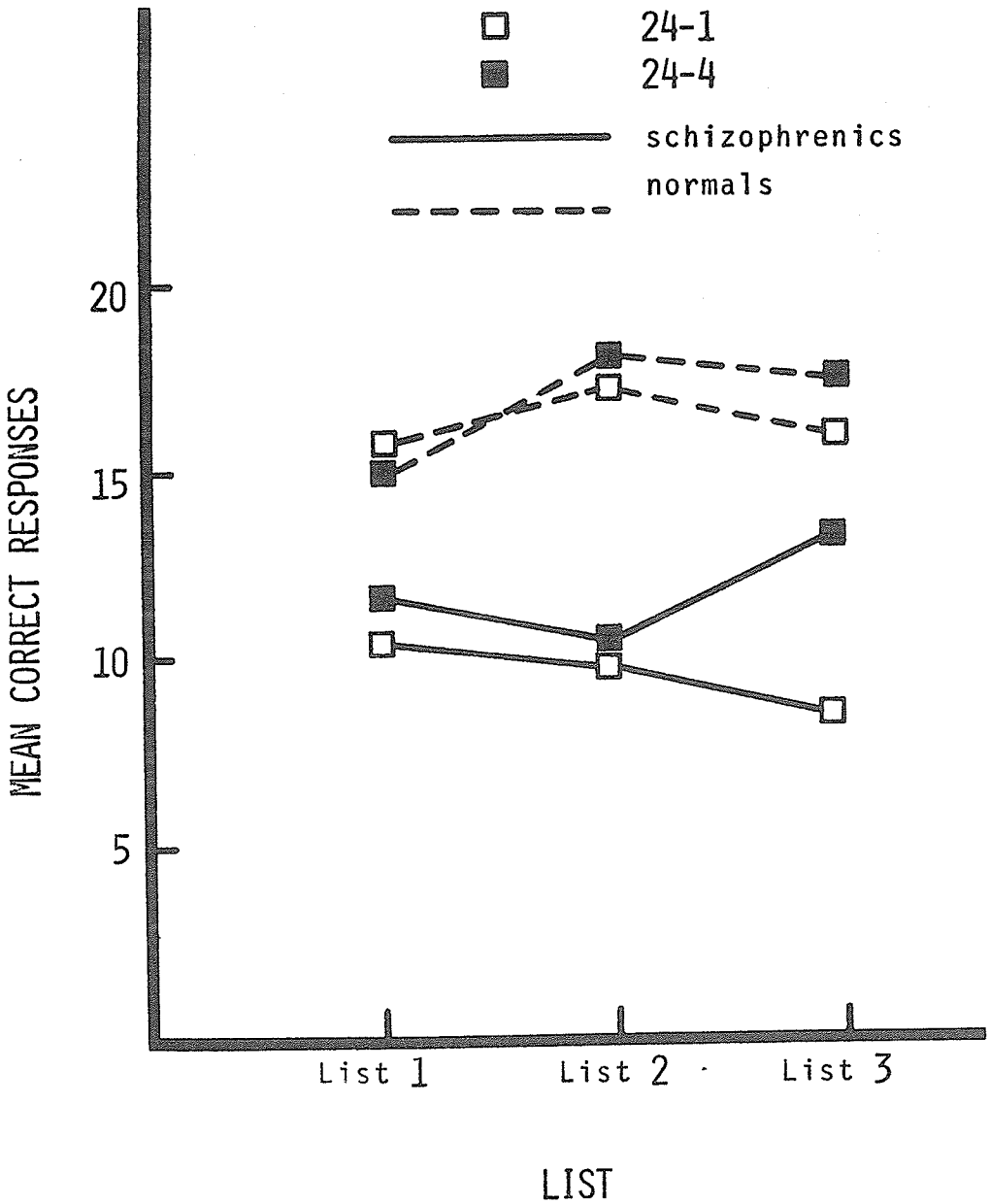

FIGURE 2. Mean correct responses in recall test one as a function of Group, IPC, and List.

x IPC interaction ($F = 1.569$; $df = 1, 88$; $p > .10$) suggested that this superiority of recall under IPC = 4 occurred for both Groups. The results supported this suggestion. The IPC x List interaction was also significant ($F = 12.113$; $df = 176$; $p < .001$). Figure 2 shows that under IPC = 4 recall increased across all three lists, whereas under IPC = 1 recall increased from list 1 to list 2 and then decreased from list 2 to list 3. Post hoc Scheffé tests indicated that the superiority of IPC = 4 over IPC = 1 was significant only for list 3 ($F = 12.86$; $df = 7, 88$; $p < .10$). On list 1 ($F = .14$; $df = 7, 88$; $p > .10$) and list 2 ($F = 2.51$; $df = 7, 88$; $p > .10$) any differences were non-significant. Thus, the significance of the previously mentioned main effect of IPC can be seen as being largely due to the list 3 factor. The significant Group x IPC x List interaction ($F = 3.49$; $df = 2, 176$; $p < .05$) indicated a differential recall performance between the two groups as a function of IPC and List (Figure 2). On list 1, the normal group recalled more items under the condition of IPC = 1 than IPC = 4, whereas by list 3 they had reversed this pattern so that more items under IPC = 4 were being recalled. Also, from list 1 to list 3, there was a significant increase in the number of items recalled that had been learned under IPC = 4 ($t = 2.030$; $df = 46$; $p < .025$) but not under IPC = 1 ($t = .094$; $df = 46$; $p > .10$). The schizophrenics, on the other hand, showed a consistent superiority of recall of items learned under IPC = 4. From list 1 to list 3 they showed a significant increase in the number of items recalled that were learned under IPC = 4 ($t = 2.631$; $df = 47$; $p < .01$) and a significant decrease in the number of items recalled that were learned under IPC = 1 ($t = 1.687$; $df = 47$; $p < .05$). On list 3, their

recall of items learned under IPC = 4 was significantly superior to their recall of items learned under IPC = 1 ($F = 13.78$; $df = 7, 88$; $p < .10$). The findings indicate, therefore, that by list 3 the schizophrenic group was recalling significantly more items that were learned under IPC = 4 than IPC = 1. On the other hand, the normal group showed a non-significant superiority of IPC = 4 over IPC = 1 ($F = 4.31$; $df = 7, 88$; $p > .10$).

The main effect of Condition was significant ($F = 158.711$; $df = 1, 88$; $p < .001$). This finding suggested that overall, more items were recalled under the condition of cued recall ($\bar{x} = 17.486$) than under the condition of noncued recall.($\bar{x} = 10.083$). The non-significant Group x Condition interaction ($F = .724$; $df = 1, 88$; $p > .10$) suggested that the superiority of cued recall over non-cued recall was significant for both the schizophrenic and normal groups. Post hoc Scheffé tests revealed that the superiority of cued recall over non-cued recall was significant for both groups on all three lists:

List 1: schizophrenic ($F = 26.37$; $df = 7, 88$; $p < .01$)
normal ($F = 22.16$; $df = 7, 88$; $p < .01$)

List 2: schizophrenic ($F = 48.72$; $df = 7, 88$; $p < .01$)
normal ($F = 36.14$; $df = 7, 88$; $p < .01$)

List 3: schizophrenic ($F = 29.42$; $df = 7, 88$; $p < .01$)
normal ($F = 36.34$; $df = 7, 88$; $p < .01$)

This finding was, therefore, directly supportive of Hypothesis 3 which predicted that a greater recall would be observed where recall was cued as compared to not cued for both the schizophrenic and normal groups.

The Condition x List interaction was significant ($F = 11.991$; $df = 2, 176$; $p < .001$). Figure 3 shows that under cued recall the

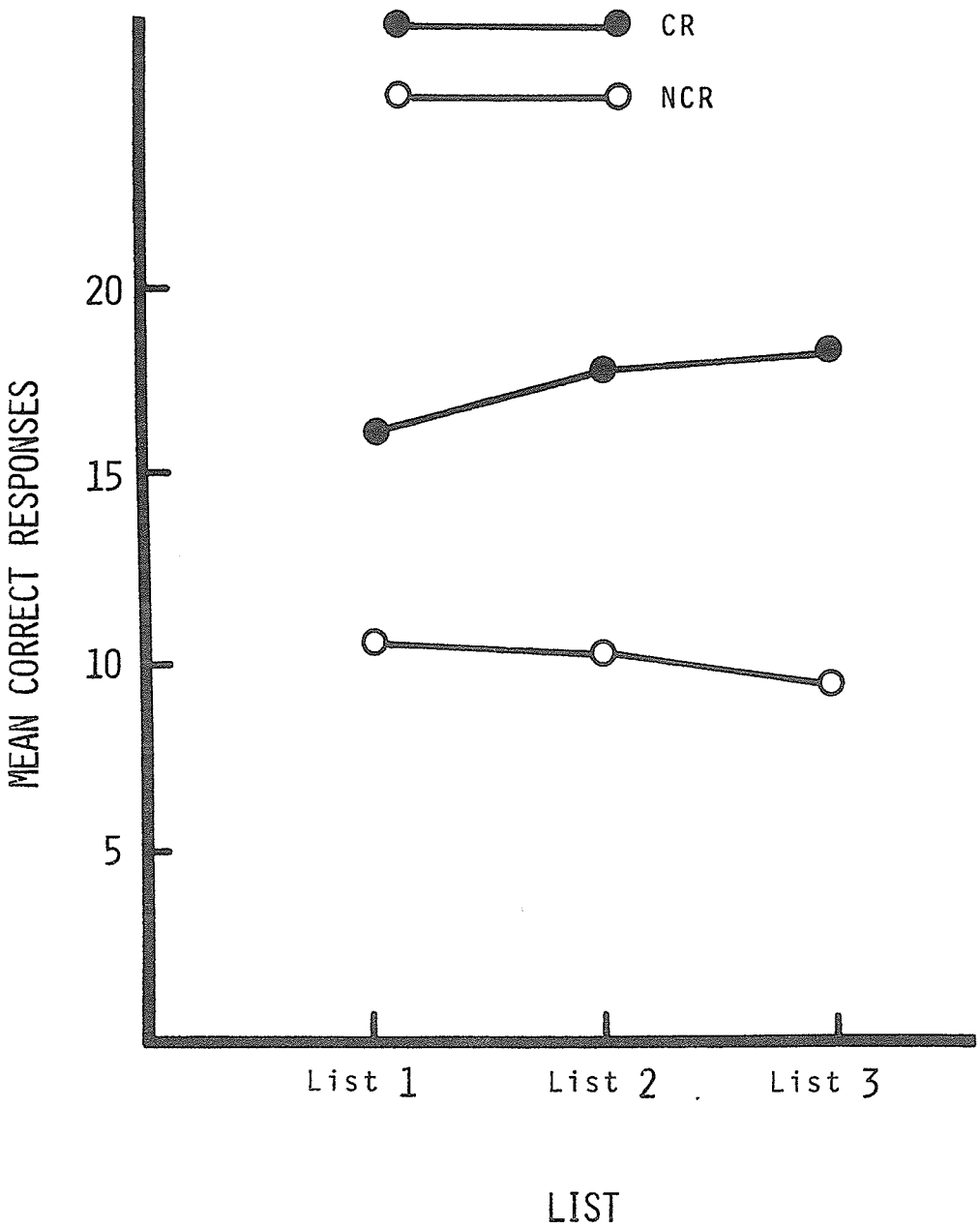

FIGURE 3. Mean correct responses in recall test one as a function of Recall Condition and List.

number of items that were recalled increased significantly from list 1 to list 3 ($t = 2.12$; $df = 95$; $p < .05$) whereas, under non-cued recall, the number of items recalled decreased. The list 1 to list 3 decrease under non-cued recall was non-significant ($t = 1.27$; $df = 95$; $p > .10$). This finding suggested, therefore, that with practice the effect of cueing serves to increase recall whereas the effect of not cueing serves to decrease recall.

Crucial to the present investigation was the significant Group x IPC x Condition interaction ($F = 4.036$; $df = 1, 88$; $p < .05$). This indicated a differential group recall performance as a function of IPC and Condition (Figure 4). This finding was similar to the previously reported Group x IPC x Condition interaction in list 1 (Figure 1). As such, the effect observed in list 1 can be seen as having held true from list 1 to list 3. This finding not only gave support to Hypothesis 4 but indicated that the effects observed previously on list 1 were of sufficient strength to manifest themselves over the three lists. The reliability of the results was, therefore, verified.

The interaction of Group x IPC x Condition x List was significant ($F = 3.293$; $df = 2, 176$; $p < .05$). This interaction is presented in Figure 5. Major group differences are obvious, particularly under cued recall. The schizophrenic group demonstrated a definite preference for recalling items learned under IPC = 4. The only condition in the schizophrenics' recall where IPC = 4 was inferior to IPC = 1 was on list 2 under cued recall. The normal group, on the other hand, demonstrated a mixed preference. Under cued recall, the normals recalled more items across all three lists where IPC = 1. Under non-cued recall,

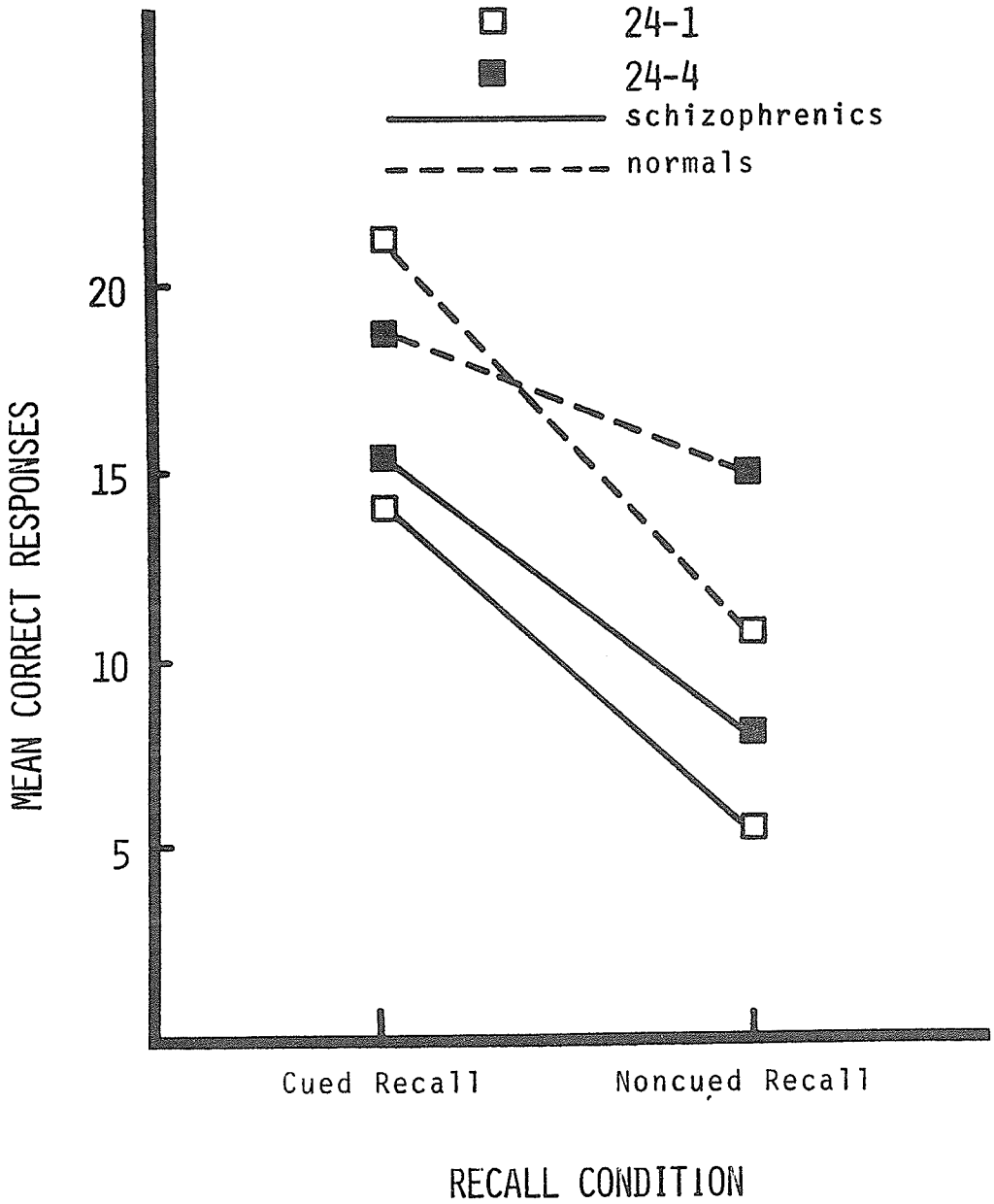

FIGURE 4. Mean correct responses in recall test one across all three lists as a function of Group, IPC, and Recall Condition.

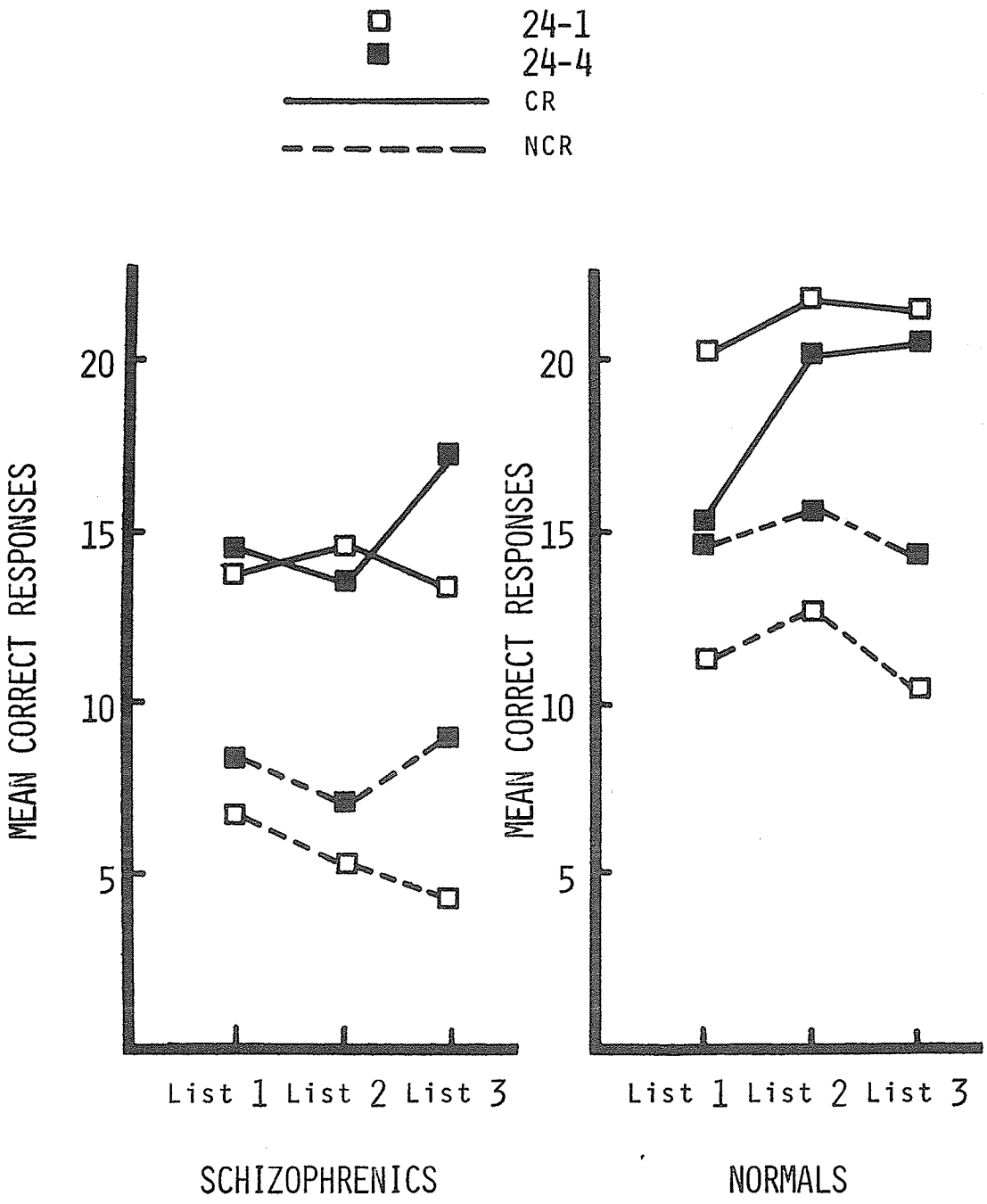

FIGURE 5. Mean correct response in recall tests one for the schizophrenic and normal group as a function of IPC, Recall Condition, and List.

the opposite was true; they showed a definite preference for IPC = 4 across all three lists.

Error Data

The error data for the schizophrenic and normal groups was analyzed in terms of the number and kinds of errors that were committed. It was posited that an analysis of these data might provide further evidence regarding the processes involved in schizophrenic recall. The analysis was performed on only the recall test one data for all three lists. The errors of recall were classified into three categories:

(1) repetitions - repetitions of words that occurred within the list being analyzed. These included both the list items and the category names.

(2) non-categorical intrusions - extralist intrusions that were not members of one of the categories used in a given list.

(3) categorical intrusions - extralist intrusions that were members of one of the categories used in a given list.

As can be seen from Table 9, the frequency of occurrence of the first two types of errors in the normal sample was minimal and precluded any statistical analysis. The categorical intrusions, however, occurred more frequently. The mean numbers of these intrusions are presented in Table 10. Two observations are of interest. First, with the exception of CR on list 3, the frequency of intrusions increased with IPC. Second, in all instances, except IPC = 1 on list 3, the number of intrusions for a given list was always greater for CR than NCR.

TABLE 9

Total Number of Data Errors in the First Recall Test of the Three Experimental Lists for the Normal and Schizophrenic Samples

	Repetitions		Non-Categorical		Categorical	
Condition	Normal	Schizo-phrenic	Normal	Schizo-phrenic	Normal	Schizo-phrenic
LIST 1						
CR 1	0	3	0	5	17	16
NCR 1	0	3	1	1	5	1
CR 4	0	0	0	1	34	51
NCR 4	0	2	0	4	18	20
LIST 2						
CR 1	1	2	0	5	6	18
NCR 1	0	1	1	1	0	2
CR 4	0	0	0	5	18	39
NCR 4	0	0	0	6	17	20
LIST 3						
CR 1	1	0	0	6	12	38
NCR 1	0	2	0	8	2	1
CR 4	0	2	0	0	5	23
NCR 4	0	0	0	3	11	12
	2	15	2	45	145	241

TABLE 10

Mean Number of Categorical Intrusion in the First Recall Test of the Experimental Lists for Normal and Schizophrenic Samples

	IPC = 1		IPC = 4	
		$\bar{x}$		$\bar{x}$
Condition	Normal	Schizophrenic	Normal	Schizophrenic
LIST 1				
CR	1.42	1.38	2.83	4.25
NCR	.42	.008	1.50	1.67
LIST 2				
CR	.50	1.50	1.50	3.25
NCR	.00	.02	1.42	1.67
LIST 3				
CR	1.00	3.17	.42	1.92
NCR	.17	.008	.92	1.00

The frequency of the different types of errors by condition for the schizophrenic group is presented in Table 9. As can be seen, the schizophrenic group committed significantly more errors of all types than did the normal group. An analysis of the three types of errors by group was not possible since the low frequency of the repetition errors and non-categorical intrusions in the normal group precluded any statistical analysis. A comparison of both groups by experimental condition for the categorical intrusions, however, was possible. The mean numbers of categorical intrusions for the schizophrenic group is presented in Table 10. A comparison of the normal and schizophrenic recall by experimental condition shows a similarity between the two groups in their pattern of responding with regard to categorical intrusions. For both groups, the frequency of intrusions increased with IPC, with the exception of CR on list 3. Both groups also showed a greater number of intrusions under CR than NCR. This was true of all conditions in the schizophrenic group, and all conditions but IPC = 1 on list 3 in the normal group. The major difference between the two groups was the higher frequency of intrusions by the schizophrenic group.

Thus, as can be seen from the data, the schizophrenic group differed from the normal group basically in the number rather than the type of errors committed. Errors of repetition and non-categorical intrusions, while occurring very infrequently in the normal group occurred significantly more frequently in the schizophrenic group (repetition errors--$t = 2.07$, $df = 94$, $p < .05$; non-categorical intrusions--$t = 2.75$, $df = 94$, $p < .01$). Categorical intrusions, on the other hand, occurred significantly more frequently in both groups than the

other types of errors but the schizophrenics again committed significantly more of this type of error ($t = 2.12$, $df = 94$, $p < .05$). This difference in quantity rather than quality of errors can be seen as a direct function of the schizophrenics' impaired information processing system.

Process-Reactive Dimension

In the total sample there were 18 reactive and 30 process schizophrenics, according to the Ullman-Giovannoni Scale. Of these, 12 of the reactive and 12 of the process schizophrenics were included in the preliminary analysis of variance. These 24 subjects scored at least one standard deviation below or above the mean for the entire sample. Their mean scores on the Ullman-Giovannoni Scale were as follows: process group = 5.75; reactive group = 15.50. There were, therefore, three subjects from each group in each of the four experimental conditions.

The analysis of recall scores was limited to the subject's recall test one performance. In this way, any problem of interpretation associated with the availability or accessibility of information was avoided.

The results of the analysis of variance of the process and reactive schizophrenics' recall scores are presented in Table 11. As can be seen, there were no significant differences between the groups on any of the factors. Thus, even when the extreme ends of the distribution were compared, no significant differences occurred as a function of the process-reactive classification.

TABLE 11

Summary of Analysis of Variance of Correct Recall Scores on Recall Test One for all Three Lists as a Function of IPC, Recall Condition, List, and Group (process-reactive)

Source	df	MS	F	p
Group	1	6.2009	.168	>.10
IPC	1	196.7582	2.262	>.10
Group x IPC	1	66.6690	.766	>.10
Condition	1	1161.3735	31.507	<.01
Group x Condition	1	4.2880	.116	>.10
IPC x Condition	1	249.6130	7.634	<.05
Group x IPC x Condition	1	87.6749	1.340	>.10
S's W	22	86.9847		
List	2	5.8746	.870	>.10
Group x List	2	2.4042	.356	>.10
IPC x List	2	36.3865	6.207	<.05
Group x IPC x List	2	3.0724	.524	>.10
Condition x List	2	16.0769	2.382	>.10
Group x Condition x List	2	7.0471	1.097	>.10
IPC x Condition x List	2	4.1572	2.792	>.10
Group x IPC x Condition x List	2	12.7310	1.523	>.10
S's W	44	1.7924		
TOTAL	71			

In addition to the analyses of variance, multiple analyses of covariance were computed in order to investigate any change in recall score when the interrelationship between the dimensions was controlled. Three analyses of covariance were performed, one for each list. These analyses could only be performed on overall recall.

As can be seen from Table 12, no significant difference in recall scores occurred between the process and reactive groups when paranoia was a covariate. This finding, therefore, supports the results of the analyses of variance and suggests that no significant difference in recall scores resulted as a function of being classified as either a process or reactive schizophrenic.

Paranoid-Non-paranoid Dimension

Of the total sample of schizophrenics, there were 14 subjects who were considered 'paranoid' on the basis of their Pa[1] and Pa Checklist ratings. These subjects scored at least one standard deviation above the mean of the entire sample. The remaining subjects (N = 34) were considered as 'non-paranoid' for purposes of this analysis. Of these, 16 scored at least one standard deviation below the mean of the entire sample. Twelve subjects were randomly chosen (with the provision that there be at least three subjects in each experimental condition) from each of these extreme groups for inclusion in the preliminary analysis of variance. There were, therefore, three subjects from each group in each of the four experimental conditions. Again, as in the analysis of the process-reactive dimension, the analysis of recall scores was limited to the subject's recall test one performance.

TABLE 12

Summary of Analyses of Covariance of Correct Recall Scores on Recall Test One for all Three Lists as a Function of Group (process-reactive) with Paranoia as Covariate

List	Source	df	MS	F	p
1	Group	1	22.808	.93	>.10
2	Group	1	3.664	.12	>.10
3	Group	1	24.146	.54	>.10
	S's W	45			
	TOTAL	46			

The results of the analysis of variance of the paranoid and non-paranoid schizophrenics' recall scores are presented in Table 13. As can be seen, there were no significant differences in recall as a function of the paranoid classification.

In an attempt to investigate the effect of the paranoid dimension while controlling for any effect of the process-reactive dimension, three analyses of covariance were performed, one for each list. These analyses were performed only on overall recall.

The results of the analyses of covariance are presented in Table 14. As can be seen, there were no significant differences in recall as a function of the paranoid-non-paranoid dimension when process-reactive adjustment was controlled. These findings can, therefore, be seen as supportive of the results of the analysis of variance and suggests that recall did not vary as a function of the paranoid-non-paranoid dimension.

Thus, from the results of the analyses of the paranoid-non-paranoid and process-reactive dimensions, there appear to be no significant differences in recall as a function of each of these parameters. These factors, therefore, did not bias in any way the results of the overall analyses involving the schizophrenic and normal groups. The results of the investigation of these two factors must be viewed with some caution, however, because of the small number of subjects (four) in each experimental condition.

TABLE 13

Summary of Analysis of Variance of Correct Recall Scores on Recall Test One for all Three Lists as a Function of IPC, Recall Condition, List, and Group (paranoid-non-paranoid)

Source	df	MS	F	p
Group	1	.0110	.000	>.10
IPC	1	437.0447	4.592	<.05
Group x IPC	1	32.6942	.343	>.10
Condition	1	1209.9998	25.338	<.01
Group x Condition	1	9.3457	.196	>.10
IPC x Condition	1	281.7412	5.013	<.05
Group x IPC x Condition	1	65.1490	1.782	>.10
S's W	22	62.4301		
List	2	3.7179	.570	>.10
Group x List	2	.2153	.033	>.10
IPC x List	2	30.3714	5.733	<.05
Group x IPC x List	2	2.9516	.557	>.10
Condition x List	2	17.0350	2.842	>.10
Group x Condition x List	2	4.4754	.747	>.10
IPC x Condition x List	2	6.7143	3.172	>.10
Group x IPC x Condition x List	2	7.5930	1.149	>.10
S's W	44	1.3514		
TOTAL	71			

TABLE 14

Summary of Analyses of Covariance of Correct Recall Scores on Recall Test One for all Three Lists as a Function of Group (Paranoid-non-paranoid) with Process-Reactive Adjustment as Covariate

List	Source	df	MS	F	p
1	Group	1	1.255	.05	$\geqslant .10$
2	Group	1	.579	.01	$\geqslant .10$
3	Group	1	3.000	.10	$\geqslant .10$
	S's W	45			
	TOTAL	46			

CHAPTER IV

DISCUSSION

It was the primary purpose of this study to demonstrate that at least part of the variance associated with schizophrenic memory deficit could be attributed to a retrieval dysfunction. Reviews of the literature (i.e., Buss & Lang, 1965) had revealed that most investigators have tended to ignore this area of research and have, instead, focused on filtering, screening, or attentional explanations of schizophrenic memory deficit. Only Bauman (1971b) had suggested that schizophrenic memory deficit might be explained in terms of the schizophrenic's increased susceptibility to output interference. In extending the field of investigation into areas that are located higher in the information processing system than the attentional processes (i.e., retrieval), it was posited that an explanation in terms of a more general cognitive dysfunctioning would be supported. This would, therefore, indicate deficits in processing that are located throughout the schizophrenic's information processing system rather than just at input.

Summary of Results

The results of this experiment clearly demonstrated significant quantitative and qualitative differences in the recall performances of the schizophrenic and normal groups. Thus, besides the overall

superiority of the normal group's recall performance over that of the schizophrenics, specific differences in the responses of the groups to the various experimental conditions suggested major differences in the functioning of their information processing systems.

The findings from the analyses of the normal group's data replicated the previous findings of Tulving and Pearlstone (1966). Thus, for the normals, the investigation of the effects of recall condition on recall suggested that the recall of items was better under the cued recall condition than under the non-cued recall condition over all three experimental lists. This finding was significant both when investigated as a between subject factor (recall test 1) and a within subject factor (NCR-CR across recall tests). This superiority of CR over NCR was found to be a decreasing function of IPC. Under non-cued recall, recall was an increasing function of IPC. An examination of the normal group's recall performance across the three lists revealed a significant practice effect; from list 1 to list 3 the normal group's recall performance increased significantly. An analysis of this performance across lists showed that on list 1 more items learned under IPC = 1 were recalled than under IPC = 4, but by list 2 this pattern had reversed so that more items learned under IPC = 4 were being recalled. This superiority of recall of items learned under IPC = 4 was also found on list 3.

The schizophrenic group, on the other hand, while showing a similarity in functioning to the normal group along some dimensions, differed significantly in a few critical aspects. Thus, while their overall performance was consistently and significantly lower than that

of the normals across all three lists, there was one condition where this inferiority in recall was not observed. Under the cued recall condition where items were learned under IPC = 4, there were no significant differences between the two groups. This absence of any differences reflected the significant increase in recall experienced by the schizophrenic group for items learned under IPC = 4 where recall was cued as compared to not cued. The normal group did not show this significant effect of cues where IPC = 4; their recall remained relatively stable. This finding revealed, therefore, a basic difference in the recall functioning of the schizophrenic and normal groups. For the schizophrenics, recall increased as IPC increased under both the cued and non-cued recall conditions. The normals, on the other hand, showed an increase in recall with IPC only under non-cued recall conditions; under cued recall, recall decreased as IPC increased. Under all conditions, the schizophrenic group's recall showed that cued recall was superior to non-cued recall. An examination of the schizophrenic group's recall performance across the three lists revealed a non-significant practice effect; from list 1 to list 3 the schizophrenic group showed a non-significant practice effect; from list 1 to list 3 the schizophrenic group showed a non-significant increase in recall. An analysis of this performance across lists revealed a superiority of recall of items learned under IPC = 4 across all three lists.

Supplementary data obtained from an analysis of recall scores on the second recall test and the difference scores illustrated a further difference in functioning between the two groups. The results indicated that the schizophrenic group experienced particular difficulty

utilizing the cues in the second recall test after having experienced the NCR condition in recall test one. The normal group did not show this significant pattern. This indicated, therefore, a greater difficulty in the ability of the schizophrenic to retrieve items across recall tests.

Evaluation of Hypotheses

An evaluation of the hypotheses in terms of the results showed that all of the hypotheses were supported. Hypothesis 1 was largely supported. Except for the results of the condition of IPC = 4 under cued recall, the schizophrenic group demonstrated a consistently significant poorer recall performance than the normal group. This finding of a poorer recall reflected the deficit in information processing abilities which has been shown consistently typifies the schizophrenic's recall performance. Explained in general interferences theory terms, the lowered recall performance can be seen as resulting from the increased susceptibility of the schizophrenic to the interference produced in a free recall situation. This finding, therefore, replicates the previous findings (e.g., Bauman & Murray, 1968; Bauman, 1971a, 1971b) that showed an inferior schizophrenic recall performance in free recall situations. The condition of CR - 4 where significant differences between the recall performances of the two groups were not found was critical to the investigation of the retrieval functions. This finding suggested that under certain conditions the deficit typically associated with the schizophrenic's information processing system can be largely overcome.

Hypothesis 2 was supported. The results indicated that the schizophrenic group showed a non-significant increase in the number of

items recalled across the lists, whereas the normal group showed a significant increase. This finding, therefore, supported the suggestion that the schizophrenics show a basic inability to benefit from practice. An analysis of the change that occurred across the lists proved quite revealing. The results indicated that for the schizophrenic group the recall of items under both cued and non-cued recall increased across the lists where IPC = 4 but decreased where IPC = 1; IPC, therefore, seemed to be the discriminating factor in recall. For the normal group, however, the recall of items learned under both IPC = 1 and IPC = 4 increased under cued recall but decreased under non-cued recall. Recall condition, therefore, seemed to be the discriminatory factor in the recall performance of the normal subjects.

The results were supportive of Hypothesis 3. For both groups, recall under cued recall conditions was consistently superior to recall under non-cued conditions. This finding suggested, therefore, that for both groups specific information about many words must have been available in the storage, in a form sufficient for the reproduction of words, even when this information was not accessible under a given set of recall conditions. Retrieval cues obviously constituted an extremely important factor in determining the level of recall, therefore. The presence of a single experimentally manipulated retrieval cue, the category name, resulted in large increments in the number of recalled words. Tulving and Pearlstone (1966) point out that "it is entirely within the realm of possibility that additional and more powerful retrieval cues would produce an even greater facilitation of recall" (p. 389). A problem, however, is that experimental work on memory has largely ignored recall

conditions as an important source of variance in recall.

Hypothesis 4, as stated, received partial support. Hypothesis 4 had predicted that the schizophrenic group would show a significantly greater increase than the normal group in the number of items recalled from the non-cued to the cued recall conditions. The results indicated that this was only true of items learned under IPC = 4; where IPC = 1 the schizophrenics and normals showed a similar increase. Thus, under IPC = 4 the schizophrenics demonstrated a retrieval dysfunction whereas under IPC = 1 no safe assumptions could be made about the role of the retrieval mechanisms. It was posited that an explanation in terms of dysfunctional organizational processes was appropriate for the IPC = 1 results.

Theoretical Considerations

A theoretical evaluation of the data from the present study, with regard to the processes involved in the recall of information, provides several rather interesting findings. As was outlined previously, the results showed that under IPC = 1 both the schizophrenic and normal subjects showed a similar increase in recall when provided with cues. Under IPC = 4, however, this pattern was not observed; with the provision of cues the normal group showed a non-significant increase in recall, whereas the schizophrenics showed a significant improvement. This enabled the schizophrenics to increase their inferior recall under non-cued conditions to a level under cued conditions that was not significantly different from that of the normals.

These findings are indicative of several crucial differences in functioning between the two groups. Under IPC = 1 where there were 24

items and 24 category names to be remembers, the schizophrenics recalled significantly less items than the normals under both cued and non-cued recall conditions. The increase in recall as a result of the provision of cues was similar in both groups. In this condition, therefore, whether under cued or non-cued recall conditions, the schizophrenics' recall performance resulted in a pattern that was indicative of a major recall deficit. Because of the inferior recall in the schizophrenic group even with the provision of cues this deficit was explained in terms of a major unavailability of items in the schizophrenic's memory system. Thus, a retrieval deficit did not seem implicated.

Under IPC = 4 a different recall pattern was observed. Where recall was not cued the schizophrenics, when compared to the normals, showed a significantly inferior recall performance. Under cued recall conditions, however, there were no significant differences in the number of items recalled by each group. This finding suggested that the schizophrenics were able to utilize the cues to increase their recall to a level similar to that of the normals. Thus, given the cues, they were able to overcome the significant memory deficit observed under non-cued recall. This indicated, therefore, that many items were available in the schizophrenic's memory store but these were inaccessible. This finding was interpreted as being indicative of a retrieval deficit in the schizophrenic subjects.

Thus, taken together these findings are of critical importance since they provide significant insight into the processes involved in the schizophrenic's information processing system. As was outlined above, the results of the recall analysis where items were learned under

IPC = 4 were interpreted as being indicative of a retrieval deficit in the schizophrenic group. Since the schizophrenics could recall nearly as many items as the normals when provided with cues but demonstrated a significantly inferior recall performance under non-cued recall, it was suggested that the items were available in the memory store but were inaccessible. Thus, all that the schizophrenics needed to increase their recall performance to the level of the normals was the retrieval cues. The provision of cues, therefore, provided the schizophrenic with additional category names to which he could attribute previously inaccessible but available information. The non-significant increase from non-cued to cued recall demonstrated by the normals suggests that most of the category cues were already available to them (i.e., were recallable) under non-cued recall. This suggests that for the schizophrenic group, therefore, it was the number of retrievable units that were limited. Thus, what was limited was not the amount of input that could be accommodated without overtaxing storage capacity but rather the number of units that could be retrieved in succession without intervening external instructions (Tulving, 1964).

The results of the schizophrenic group's recall of items learned under IPC = 1 were not indicative of a retrieval deficit. By itself, this finding was impossible to interpret. Thus, suggestions as to the cause of the significant inferiority in recall performance by the schizophrenic group could not be made. Viewed in conjunction with the findings from IPC = 4, however, some explanations were indicated. Thus, because of the non-significant difference between the schizophrenics and normals in the recall of items learned under IPC = 4 where recall was cued, any

explanation in terms of input factors (e.g., attention, set) seemed inaccurate. The results indicated that the items to be remembered were entering storage and were available; the problem in recall was that they were inaccessible. It would seem logical from this to assume that the items under IPC = 1 were also entering storage. Since a retrieval deficit was not indicated directly, an explanation in terms of organizational dysfunctioning seemed appropriate. Thus, the information was unsatisfactorily being organized into storage so that much of the information in memory was left inaccessible.

A theoretical explanation of the processes involved in the organizational deficit is practically impossible because of the contradictory state of the literature. Postman (1972) has pointed out that in assessing the role of organization, one may choose to adopt either a strong or a weak principle. According to the strong form, the limits of the system are those observed in the measurement of the immediate memory span, and the development of higher order units is always and inescapably required if these limits are to be exceeded. Thus, if the principle is accepted as valid, one is forced to infer that higher order units have been formed whenever an individual succeeds in reproducing significantly more than seven items. The weak principle of limited capacity takes its point of departure from the fact that there is indeed a ceiling on the amount of information that can be processed and stored during any one period of time. It is not assumed that the ultimate limits of the system are indexed by the span of immediate memory. Thus, organization is not accepted as absolutely necessary for the recall of more than about seven items.

Despite the confusion surrounding the processes involved in organization, there is some support for the view that subjects can recall only a fixed number of memory units (Wood, 1972). The increase in performance over trials reflects an increase in the size, not the number, of memory units. Postman (1972) has pointed out that the higher order groupings increase the probability of retrieval of nominal items because they now become accessible not only as individual units but also via other items with which they are joined.

It seems an accepted fact, therefore, that there are limitations on the storage of attributes. Through organizational and other processes, we overcome these limits. Viewed in this light, therefore, the finding of a significantly inferior schizophrenic recall performance under both NCR-1 and CR-1, would seem to be indicative of an inability of the schizophrenics to organize information so as to extend the limits of the memory span. The fact that the inability to organize information did not affect the schizophrenic's ability to recall items successfully under IPC = 4 may have been due to the fact that there were fewer (six) category cues to remember. This is within the span of immediate memory which has traditionally been proposed by Miller (1956) and Mandler (1968). This inability to organize efficiently probably affected both storage and retrieval. Such a gross deficit would seem to have necessarily precluded the demonstration of any deficits as a result of retrieval dysfunctions.

Process-Reactive and Paranoid-Non-paranoid Dimensions

The finding that there were no significant differences in recall within the schizophrenic group as a function of their classification as

being paranoid or non-paranoid and process or reactive proved unexpected. Reviews of research (Zimet & Fishman, 1970; Phillips & Dragins, 1971) investigating these dimensions have shown that in addition to providing a means of reducing the heterogeneity in schizophrenia (Cromwell & Dokecki, 1968; Garmezy, 1964, 1967), they reflect useful ways of discriminating within the schizophrenic group in terms of information processing abilities (Cromwell, 1968; Pearl, 1962; Silverman, 1967; Venables, 1964) and perceptual-cognitive processes (Kantor & Herron, 1965; Rodnick, 1967; Silverman, 1964).

The fact that no significant differences were found in an important one, since it raises several rather crucial issues which question the use of these scales as a means of inferring differences in information processing abilities. The first issue deals with the apparent confusion between severity of illness and ratings on these dimensions. This issue pertains specifically to the process-reactive concept but can be seen as also applying to the paranoid-non-paranoid dimension. Blumenthal (1964) and Strain (1967, 1968) have presented evidence that illustrates that severity of illness as measured by the Montrose Mental Health Scale (Blumenthal, 1964) and Overall and Gorham's Brief Psychiatric Rating Scale (symptom severity) (Blumenthal, 1964) is essentially unrelated to the process-reactive dimension. However, both Cicchetti (1967) and Lewinsohn (1967), employing different scales, have provided evidence supportive of definite severity of illness relationships, with the process schizophrenics being more severely ill. It would seem, therefore, that whether or not severity of illness is considered to be a contaminating variable in process-reactive (and probably

paranoid-non-paranoid) research depends upon the assessment technique employed to measure severity (Higgins, 1969). Nevertheless, because of the findings that have shown a negative relationship between severity of illness and the process-reactive dimension, the logic involved in relating deficits in information-processing abilities to either of these dimensions is open to serious question.

The second issue involves the relationship between the acute-chronic distinction and ratings on these dimensions. Brown (1960) in a review of the literature on the acute-chronic distinction concluded that there was definite support for the use of a minimum stay of two years as a definition of chronicity. This was because two years had been repeatedly shown to be the time by which the majority of patients who were to leave the hospital had been discharged. In the present study, none of the current hospitalizations of any of the subjects was greater than two years. Also, the mean age of the schizophrenics was relatively low (24.83 years). Thus, according to the most widely accepted criteria, the schizophrenics in the present research could all be considered acute.

Despite the fact that the schizophrenic subjects could all be classified as being acute cases, 18 of these were classified as reactive and 30 as process according to the Ullmann-Giovannoni scale. Thus, even though process and reactive schizophrenics were being compared, they were still all acute cases. Because the focus of the Ullman-Giovannoni Scale is on social adjustment and maturity attained before hospitalization rather than ability, it might be meaningless as a method of discriminating among patients who demonstrate different information processing abilities. It seems logical that what might be more important

is the acute-chronic distinction since this may correlate higher with cognitive dysfunctioning. Such an argument suggests that the research employing the Ullman-Giovannoni Scale which has found significant cognitive differences between process and reactive schizophrenics may have done so solely because the process schizophrenics tested were also chronic (> two years). The results of the present investigation suggest that at least when chronicity is controlled significant differences do not result as a function of subject classification into process and reactive groups.

The same type of argument can be made about the paranoid-non-paranoid distinction. Reports in the literature have suggested that the paranoid schizophrenic tends to be younger and brighter than other schizophrenics (McGhie, 1969). Since in the present research age, education, intelligence, and length of current hospitalization were all controlled this may have precluded any significant differences as a result of this dimension. While it is agreed that paranoid schizophrenics may demonstrate a style of attention that is different from other schizophrenics (Silverman, 1964), this may not differentiate them in terms of the cognitive demands of the experimental task employed in the present research. Thus, at least in terms of retrieval mechanisms, no differences were obtained as a result of being classified as either paranoid or non-paranoid where age, education, intelligence and length of current hospitalization were controlled. In any event, in order to ferret out the problems associated with an analysis along these dimensions what is needed are longitudinal studies which examine multifaceted cognitive functions from the early acute stages of illness through to the more chronic phase.

Implications of Findings

The results of the present investigation have rather dramatic implications for the current theorizing about schizophrenic memory deficit and thought disorder. It has been demonstrated that the organizational and retrieval processes of the schizophrenics' information processing system contribute to the overall interference evident in the schizophrenic deficit. These findings, therefore, challenge all of the approaches which focus solely on input factors as explanations of schizophrenic deficit and demonstrate the necessity of investigating output factors as being sources of interference. The position proposed in the present study is not that these approaches are totally wrong but that they are limited in explanatory power and precision. A more practical approach empirically and theoretically is to view the schizophrenic as being characterized by a general cognitive dysfunction that has effects throughout the entire information processing system. Thus, a certain proportion of the variance associated with schizophrenic deficit can be explained in terms of deficits at each stage of processing. The proportion of the variance attributable to each stage will probably vary as a function of the age and chronicity of the schizophrenics tested. In the present study, the schizophrenics were all classified as reactive and were fairly young. This may account for the fact that attentional difficulties contributed little to their deficit. Buss and Lang (1965) have indicated that the reactions of patients vary somewhat according to subtype. According to their analysis, the defect is seen most clearly in the behavior of chronic, withdrawn patients.

In an attempt to further specify conditions under which schizophrenics either show recall equivalence or recall deficit in relation to normal subjects further research seems warranted. It seems logical that investigations varying category sizes greater than IPC = 4 and list length are needed in order to investigate further the capacity of the schizophrenics' information processing system. Further investigations into the effects of presentation rate, recall latency and type of learning material are also needed in order to qualitatively assess the efficiency of their system along various dimensions.

Of course, a major problem in this type of research on schizophrenia has in determining whether the observed deficits are the cause of the schizophrenic syndrome or the effect of the illness. Mednick and McNeil (1968) clearly pointed out that testing schizophrenics seems to yield more information about the illness rather than the etiology. This point certainly applies to this experiment and practically the whole body of research on psychological deficit. All that can be validly concluded from these studies is that the schizophrenics exhibit certain lowered levels of performance on specified tasks. Resolution of the cause-effect problem will not occur until other research strategies are used, such as longitudinal family research.

REFERENCES

Adams, J. A. Human memory. New York: McGraw-Hill, 1967.

Alvarez, R. R. A comparison of the preferences of schizophrenic and normal subjects for rewarded and punished stimuli. Unpublished doctoral dissertation, Duke University, 1957.

Arey, L. B. The indirect representation of sexual stimuli by schizophrenic and normal subjects. Journal of Abnormal and Social Psychology, 1960, 61, 424-431.

Atkinson, R. C., & Shiffrin, R. M. Human memory: A proposed system and its control processes. In K. W. Spence & J. T. Spence (Eds.), The psychology of learning and motivation: Advances in research and theory. Vol. 2. New York: Academic Press, 1968.

Bahrick, H. P. Two-phase model for prompted recall. Psychological Review, 1970, 77, 215-222.

Bahrick, H. P., & Bahrick, P. D. A re-examination of the interrelations among measures of retention. Quarterly Journal of Experimental Psychology, 1964, 16, 318-324.

Bartlett, F. C. Remembering. Cambridge: Cambridge University Press, 1932.

Battig, G., & Montague, W. E. Category norms for verbal items in 56 categories. Journal of Experimental Psychology Monograph, 1969, 80, (3, pt. 2).

Bauman, E. Schizophrenic short-term memory deficit in subjective organization. Canadian Journal of the Behavioral Sciences, 1971, 3(1), 55-66.

Bauman, E. Schizophrenic short-term memory: the role of organization at input. Journal of Consulting and Clinical Psychology, 1971, 30(1), 14-19.

Bauman, E., & Murray, D. J. Recognition versus recall in schizophrenia. Canadian Journal of Psychology, 1968, 22(1), 18-26.

Bleke, R. C. Reward and punishment as determiners of reminiscence effects in schizophrenic and normal subjects. Journal of Personality, 1955, 23, 479-498.

Blumenthal, R. The effects of level of mental health, premorbid history, and interpersonal stress upon the speech disruption of chronic schizophrenics. Journal of Nervous and Mental Diseases, 1964, 139, 313-323.

Bousfield, W. A. The occurrence of clustering in the recall of randomly arranged associates. Journal of General Psychology, 1953, 49, 229-240.

Bower, G. H., Clark, M. C., Lesgold, A. M., & Winzenz, D. Hierarchical retrieval schemes in recall of categorized word lists. Journal of Verbal Learning and Verbal Behavior, 1969, 8, 323-343.

Broadbent, D. E. Perception and communication. New York: Macmillan (Pergamon), 1958.

Broen, W. E. Response disorganization and breadth of observation in schizophrenia. Psychological Review, 1966, 73, 579-585.

Broen, W. E. Jr. Schizophrenia. New York: Academic Press, 1968.

Broen, W. E. Jr., & Storms, L. H. A reaction potential ceiling and response decrements in complex situations. Psychological Review, 1961, 68, 405-415.

Broen, W. E. Jr., & Storms, L. H. Lawful disorganization: the process underlying a schizophrenic syndrome. Psychological Review, 1966, 73, 265-279.

Broen, W. E. Jr., & Storms, L. H. A theory of response interference in schizophrenia. In B. A. Maher (Ed.), Progress in experimental personality research. Vol. 4. New York: Academic Press, 1967.

Brown, G. W. Length of hospital stay and schizophrenia: a review of statistical studies. British Journal of Psychiatry, 1960, 24, 414-430.

Brown, R., & McNeill, D. The "tip of the tongue" phenomenon. Journal of Verbal Learning and Verbal Behavior, 1966, 5, 325-337.

Bruce, D., & Cofer, C. N. An examination of recognition and free recall as measures of acquisition and long term retention. Journal of Experimental Psychology, 1967, 75, 283-289.

Buss, A. H. Psychopathology. New York: Wiley, 1966.

Buss, A. H., & Lang, P. J. Psychological deficit in schizophrenia: I. affect, reinforcement, and concept attainment. Journal of Abnormal Psychology, 1965, 70(1), 2-24.

Buss, A. H., & Lang, P. J. Psychological deficit in schizophrenia: II. interference and activation. Journal of Abnormal Psychology, 1965, 70(2), 77-106.

Cameron, N. Reasoning, regression and communication in schizophrenics. Psychological Monographs, 1938, 50(221), 1-34.

Cameron, N. A study of thinking in senile deterioration and schizophrenic disorganization. American Journal of Psychology, 1938, 51, 650-664.

Cameron, N. Deterioration and regression in schizophrenic thinking. Journal of Abnormal and Social Psychology, 1939, 34, 265-270.

Cameron, N. Experimental analysis of schizophrenic thinking. In J. Kasanin (Ed.), Language and thought in schizophrenia. Berkeley, California: University of California Press, 1944.

Cameron, N., & Margaret, A. Behavior pathology. Boston: Houghton Mifflin, 1951.

Carmicheal, L., Hogan, H. P., & Walter, A. A. An experimental study of the effect of language on the reproduction of visually perceived forms. Journal of Experimental Psychology, 1932, 15, 73-86.

Cavanaugh, D. Improvement in the performance of schizophrenics on concept formation tasks as a function of motivational change. Journal of Abnormal and Social Psychology, 1958, 57, 8-12.

Chapman, J., & McGhie, A. A comparative study of disordered attention in schizophrenia. Journal of Mental Science, 1962, 108, 487-500.

Chapman, L. J. Distractibility in the conceptual performance of schizophrenics. Journal of Abnormal and Social Psychology, 1956, 53, 286-291 (a).

Chapman, L. J. The role of type of distracter in the "concrete" conceptual performance of schizophrenics. Journal of Personality, 1956, 25, 286-291 (b).

Chapman, L. J. Intrusion of associative responses into schizophrenic conceptual performance. Journal of Abnormal and Social Psychology, 1958, 56, 374-379.

Chapman, L. J. Confusion of figurative and literal usages of words by schizophrenics and brain-damaged patients. Journal of Abnormal and Social Psychology, 1960, 60(3), 412-416.

Chapman, L. J. A reinterpretation of some pathological disturbances in conceptual breadth. Journal of Abnormal and Social Psychology, 1961, 62, 514-519.

Chapman, L. J. Emotional factors in schizophrenic deficit. Psychological Reports, 1961, 9, 564(b).

Chapman, L. J. Stimulus generalization and verbal behavior in schizophrenia. Paper read at Midwestern Psychological Association, Detroit, May 1962.

Chapman, L. J., & Taylor, Janet A. Breadth of deviate concepts used by schizophrenics. Journal of Abnormal and Social Psychology, 1957, 54, 118-123.

Chapman, L. J., & Chapman, Jean P. Atmosphere effect re-examined. Journal of Experimental Psychology, 1959, 58, 220-226.

Chapman, L. J., Chapman, Jean P., & Miller, G. A. A theory of verbal behavior in schizophrenia. In B. A. Maher (Ed.), Progress in experimental personality research. Vol. 1. New York: Academic Press, 1964.

Cicchetti, D. V. Reported family diagnosis and psychopathology: I. the reaction of schizophrenics and normals to parental dialogues. Journal of Abnormal Psychology, 1967, 72, 282-289.

Cofer, C. N. On some factors in the organizational characteristics of free recall. American Psychologist, 1965, 20, 261-272.

Cofer, C. N. Does conceptual organization influence the amount retained in immediate free recall. In B. J. Kleinmuntz (Ed.), Concepts and the structure of memory. New York: Wiley, 1967.

Cohen, B. D. Motivation and performance in schizophrenia. Journal of Abnormal and Social Psychology, 1956, 52, 186-190.

Cohen, B. D., & Camhi, J. Schizophrenic performance in a word-communication task. Journal of Abnormal Psychology, 1967, 72, 240-246.

Cromwell, R. L. Stimulus redundancy and schizophrenia. Journal of Nervous and Mental Disease, 1968, 146, 360-375.

Cromwell, R. L., & Dokecki, P. R. Schizophrenic language: A disattention interpretation. In S. Rosenberg and J. H. Koplin (Eds.), Developments in applied psycholinguistics research. New York: Macmillan, 1968.

Culver, C. M. The effect of cue value on size estimation in schizophrenic subjects. Unpublished doctoral dissertation, Duke University, 1961.

Dale, H. C. A. Response availability and short term memory. Journal of Verbal Learning and Verbal Behavior, 1967, 6, 47-48.

Dale, H. C. A. Familiarity and free recall. Quarterly Journal of Experimental Psychology, 1967, 19, 103-108.

Daston, P. G. Effects of two phenothiazine drugs on concentrative attention span of chronic schizophrenics. Journal of Clinical Psychology, 1959, 15, 106-109.

Deering, Gayle. Affective stimuli and disturbance of thought processes. Journal of Consulting Psychology, 1963, 27, 338-343.

DeWolfe, A. S. The effect of affective tone on the verbal behavior of process and reactive schizophrenics. Journal of Abnormal and Social Psychology, 1962, 64, 450-455.

Downing, R. W., Ebert, J. N., & Shubrooks, S. J. Effects of three types of verbal distractors on thinking in acute schizophrenia. Perceptual and Motor Skills, 1963, 17, 881-882.

Draguns, J. G. Responses to cognitive and perceptual ambiguity in chronic and acute schizophrenics. Journal of Abnormal and Social Psychology, 1963, 66, 24-30.

Dunham, R. M. Sensitivity of schizophrenics to parental censure. Unpublished doctoral dissertation, Duke University, 1959.

Dunn, W. L. Visual discrimination of schizophrenic subjects as a function of stimulus meaning. Journal of Personality, 1954, 23, 48-64.

Epstein, S. Overinclusive thinking in a schizophrenic and a control group. Journal of Consulting Psychology, 1953, 17, 384-388.

Estes, W. K., & Dapolito, F. Independent variation of information storage and retrieval processes in paired-associate learning. Journal of Experimental Psychology, 1967, 75, 18-26.

Feffer, M. H. The influence of affective factors on conceptualization in schizophrenia. Journal of Abnormal and Social Psychology, 1961, 63, 588-596.

Gardiner, M. J., Hawkins, H. M., Judah, L. N., & Murphee, O. D. Objective measurement of psychiatric changes produced by chlorpromazine and reserpine in chronic schizophrenia. Psychiatric Research Reports, 1955, 1, 77-83.

Gardiner, R. W. Cognitive controls of attention deployment as determinants of visual illusions. Journal of Abnormal and Social Psychology, 1961, 62, 120-127.

Gardiner, R. W., Holzman, P. S., Klein, G. S., Linton, H. B., & Spence, D. P. Cognitive control: A study of individual consistencies in cognitive behavior. Psychological Issues, 1959, 1, 4.

Garmezy, N. Some determiners and characteristics of learning research in schizophrenia. American Journal of Orthopsychiatry, 1964, 34, 643-651.

Garmezy, N. Contributions of experimental psychology to understanding the origins of schizophrenia. Paper read at the First Rochester International Conference on the Origins of Schizophrenia, Rochester, N.Y., March, 1967.

Gottesman, L., & Chapman, L. J. Syllogistic reasoning errors in schizophrenia. Journal of Consulting Psychology, 1960, 24, 250-255.

Hawkes, D. V. The clinical usefulness of some tests of overinclusive thinking in psychiatric patients. British Journal of Social and Clinical Psychology, 1964, 3, 186-195.

Held, J. M., & Cromwell, R. L. Premorbid adjustment in schizophrenia. Journal of Nervous and Mental Disease, 1968, 146, 264-483.

Helper, M. M., Wilcott, R. C., & Sol, L. G. Effects of chlorpromazine on learning and related processes in emotionally disturbed children. Journal of Consulting Psychology, 1963, 27, 1-9.

Higgins, J. Process-reactive schizophrenia. Journal of Nervous and Mental Disease, 1969, 149(6), 450-472.

Hunt, J. McV., & Cofer, C. Psychological deficit in schizophrenia. In J. McV. Hunt (Ed.), Personality and the behavior disorders. Vol. 2. New York: Ronald Press, 1944.

Jenkins, J. J., & Russell, W. A. Associative clustering during recall. Journal of Abnormal and Social Psychology, 1952, 47, 818-821.

Johnson, M. H., & Ries, H. A. A self-report scale for process-reactive schizophrenia. Journal of Nervous and Mental Disease, 1966, 143, 481-483.

Johnson, N. F. The role of chunking and organization in the process of recall. In G. H. Bower (Ed.), The psychology of learning and motivation. Vol. 4. New York: Academic Press, 1970.

Kantor, R. E., & Herron, W. G. Perceptual learning in the reactive-process schizophrenias. Journal of Projective Techniques, 1965, 29, 58-70.

Kintsch, W. Recognition and free recall of organized lists. Journal of Experimental Psychology, 1968, 78, 481-487.

Kintsch, W. Learning, memory and conceptual processes. New York: J. Wiley and Sons, 1970.

Kreinik, Phyllis S. Parent-child themes and concept attainment in schizophrenia. Unpublished doctoral dissertation, Duke University, 1959.

Lehmann, H. E. Drug treatment of schizophrenia. In G. Kline, & H. E. Lehmann (Eds.), International psychiatry clinics, 1965, 2, 717-751.

Lewinsohn, P. M. Does the Phillips Scale of Premorbid Adjustment predict improvement or initial status? Proceedings of the 75th Annual Convention of the American Psychological Association, 1967, 2, 225-226.

Lovibond, S. H. The Object Sorting Test and conceptual deficit in schizophrenia. Australian Journal of Psychology, 1954, 6, 52-70.

Maher, B. A. Principles of psychopathology. New York: McGraw-Hill, 1966.

Mandler, G. Organization and memory. In K. W. Spence, & J. T. Spence (Eds.), The psychology of learning and motivation. Vol. 1. New York: Academic Press, 1967.

Mandler, G. Organized recall: Individual functions. Psychonomic Science, 1968, 13, 235-236.

Mason-Browne, N. L., & Borthwick, J. W. Effect of perphenazine (Trilafon) on modification of crude consciousness. Diseases of the Nervous System, 1957, 18, 2-8.

McGeoch, J. A. Forgetting and the law of disuse. Psychological Review, 1932, 39, 352-370.

McGhie, A. Psychological studies of schizophrenia. British Journal of Medical Psychology, 1966, 39, 281-288.

McGhie, A. Pathology of attention. Harmondsworth: Penguin Science Series, 1969.

McGhie, A., & Chapman, J. Disorders of attention and perception in early schizophrenia. British Journal of Medical Psychology, 1961, 34, 103-116.

McGhie, A., Chapman, J., & Lawson, J. S. Disturbance in selective attention in schizophrenia. Proceedings of the Royal Society of Medicine, 1964, 57, 419-422.

Melton, A. W. Implications of short-term memory for a general theory of memory. Journal of Verbal Learning and Verbal Behavior, 1963, 2, 1-21.

Melton, A. W. Repetition and retrieval from memory. Science, 1967, 158, 532.

Moriarity, D., & Kates, S. L. Concept attainment on materials involving social approval and disapproval. Journal of Abnormal and Social Psychology, 1962, 65, 355-364.

Murdock, B. B. Modality effects in short-term memory: Storage or retrieval? Journal of Experimental Psychology, 1968, 77, 79-86.

Nachmani, G., & Cohen, B. D. Recall and recognition free learning in schizophrenics. Journal of Abnormal Psychology, 1969, 74, 511-516.

Neisser, U. Cognitive psychology. New York: Appleton Century Crofts, 1967.

Norman, D. A. Memory and attention. New York: John Wiley, 1969.

Orne, M. On the social psychology of the psychological experiment: With particular reference to demand characteristics and their implications. American Psychologist, 1962, 17, 776-783.

Paivio, A. Imagery and verbal processes. New York: Holt, Rinehart, & Winston, 1971.

Pascal, C., & Swensen, G. Learning in mentally ill patients under unusual motivation. Journal of Personality, 1952, 21, 240-249.

Payne, R. W. Cognitive abnormalities. In H. J. Eysenck (Ed.), Handbook of abnormal psychology. New York: Basic Books, 1961.

Payne, R. W. An object classification test as a measure of overinclusive thinking in schizophrenic patients. British Journal of Social and Clinical Psychology, 1962, 1, 213-221.

Payne, R. W. The measurement and significance of overinclusive thinking and retardation in schizophrenic patients. Paper presented to American Psychopathological Association, 1964.

Payne, R. W., Matussek, P., & George, E. An experimental study of schizophrenic thought disorder. Journal of Mental Science, 1959, 105, 627-652.

Payne, R. W., & Hewlett, J. H. Thought disorder in psychotic patients. In H. J. Eysenck (Ed.), Experiments in personality. Vol. II. London: Routledge, 1960.

Payne, R. W., Ancevich, S. S., & Laverty, S. G. Overinclusive thinking in symptom-free schizophrenics. Canadian Psychiatric Association Journal, 1963, 8, 225-234.

Payne, R. W., Caird, W. K., & Laverty, S. G. Overinclusive thinking and delusions in schizophrenic patients. Journal of Abnormal and Social Psychology, 1963, 68, 562-566.

Payne, R. W., Frielander, D., Laverty, S. G., & Haden, P. Overinclusive thought disorder in chronic schizophrenics and its response to "proketazine". British Journal of Psychiatry, 1963, 109, 523-530.

Pearl, D. Stimulus input and overload in relation to classifications of schizophrenia. Newsletter of Research Psychology, 1962, 4, 44-56.

Peterson, L. R. Search and judgement in memory. In B. J. Kleinmuntz (Ed.), Concepts and the structure of memory. New York: Wiley, 1967.

Phillips, L., & Draguns, J. G. Classification of the behavior disorders. In P. Mussen & M. Rosenzweig (Eds.), Annual review of psychology. Palo Alto: Annual Reviews Inc., 1971.

Postman, L. Organization and interference. Psycholcgical Review, 1971, 78, 290-302.

Postman, L. A pragmatic view of organization theory. In E. Tulving & W. Donaldson (Eds.), Organization of memory. New York: Academic Press, 1972.

Postman, L., & Stark, K. The role of response availability in transfer and interference. Journal of Experimental Psychology, 1969, 79, 168-177.

Raush, H. L. Object constancy in schizophrenia: The enchancement of symbolic objects and conceptual stability. Journal of Abnormal and Social Psychology, 1956, 52, 231-234.

Rodnick, E. H. Cognitive and perceptual response set in schizophrenics. In R. Jesson & S. Feshbach (Eds.), Cognition, personality, and clinical psychology. San Francisco: Jossey-Bass, 1967.

Rodnick, E. H., & Garmezy, N. An experimental approach to the study of motivation in schizophrenia. In M. R. Jones (Ed.), Nebraska symposium on motivation: 1957. Lincoln: University of Nebraska Press, 1957.

Shakow, D. Segmental set: A theory of the formal psychological deficit of schizophrenia. Archives of General Psychiatry, 1962, 6, 1.

Shakow, D. Psychological deficit in schizophrenia. Behavioral Science, 1963, 8, 275-305.

Shapiro, S. L., & Palermo, D. S. Conceptual organization and class membership: Normative data for representatives of 100 categories. Psychonomic Monograph Supplements, 1970, 3 (11, Whole No. 43).

Shiffrin, R. M., & Atkinson, R. C. Storage and retrieval processes in long-term memory. Psychological Review, 1969, 76, 179-193.

Shipley, W. C. A self-administering scale for measuring intellectual impairment and deterioration. Journal of Psychology, 1940, 99, 371-377.

Silverman, J. Noxious cue sensitivity in schizophrenia. Paper read at American Psychological Association, Philadelphia, August 1963.

Silverman, J. Scanning control and cognitive filtering. Journal of Consulting Psychology, 1964, 28, 285(a).

Silverman, J. The problem of attention in the research and theory of schizophrenia. Psychological Review, 1964, 71, 352(b).

Silverman, J. Variations in cognitive control and psycho-physiological defense in the schizophrenias. Psychosomatic Medicine, 1967, 29, 225-251.

Strain, G. S. Performance of process and reactive schizophrenic subjects in an extended learning situation. Paper read at the 13th Annual Convention of the Southeastern Psychological Association, Atlanta, April 1967.

Strain, G. S. Severity of behavioral symptoms in schizophrenia. Paper read at the 15th Annual Convention of the Southwestern Psychological Association, New Orleans, April 1968.

Thomson, D. M., & Tulving, E. Associative encoding and retrieval: Weak and strong cues. Journal of Experimental Psychology, 1970, 86, 255-262.

Tulving, E. The effect of alphabetical subjective organization on memorizing unrelated words. Canadian Journal of Psychology, 1962, 16, 185-191.

Tulving, E. When is recall higher than recognition? Psychonomic Science, 1968, 10, 53-54.

Tulving, E. Intratrial and intertrial retention. Psychological Review, 1964, 71, 219-237.

Tulving, E. Theoretical issues in free recall. In T. R. Dixon & D. L. Horton (Eds.), Verbal behavior and general behavior theory. Englewood Cliffs, N.J.: Prentice-Hall, 1968.

Tulving, E. Episodic and semantic memory. In E. Tulving & W. Donaldson (Eds.), Organization of memory. New York: Academic Press, 1972.

Tulving, E., & Osler, S. Effectiveness of retrieval cues in memory for words. Journal of Experimental Psychology, 1963, 77, 593-601.

Tulving, E., & Pearlstone, Z. Availability versus accessibility of information in memory for words. Journal of Verbal Learning and Verbal Behavior, 1966, 5, 381-391.

Tulving, E., & Arbuckle, T. Y. Input and output interference in short-term associative memory. Journal of Experimental Psychology, 1966, 72, 145-150.

Tulving, E., & Osler, S. Transfer effects in whole/part free-recall learning. Canadian Journal of Psychology, 1967, 21, 253-262.

Tulving, E., & Thomson, D. M. Retrieval processes in recognition memory: Effects of associative context. Journal of Experimental Psychology, 1971, 87, 116-124.

Tulving, E., & Thomson, D. M. Encoding specificity and retrieval processes in episodic memory. Psychological Review, 1973, 80(5), 352-373.

Turbiner, M. Choice discrimination in schizophrenic and normal subjects for positive, negative, and neutral affective stimuli. Journal of Consulting Psychology, 1961, 25, 92.

Ullman, L. P., & Giovannoni, J. M. The development of a self-report measure of the process-reactive continuum. Journal of Nervous and Mental Disease, 1964, 138, 38-42.

Underwood, B. J. An orientation for research on thinking. Psychological Review, 1952, 59, 209-220.

Underwood, B. J. Interference and foregetting. Psychological Review, 1957, 64, 49-60.

Underwood, B. J., & Schulz, R. W. Meaningfulness and verbal learning. Chicago: Liffincott, 1960.

Underwood, B. J., & Postman, L. Experimental sources of interference in forgetting. Psychological Review, 1960, 67, 73-95.

Venables, P. H. Factors in the motor behavior of functional psychotics. Journal of Abnormal and Social Psychology, 1959, 58, 153-156.

Venables, P. H. The effect of auditory and visual stimulation on the skin potential response of schizophrenics. Brain, 1960, 83, 77-92.

Venables, P. H. Changes due to noise in the threshold of fusion of paired light flashes in schizophrenics and normals. British Journal of Social and Clinical Psychology, 1963, 2, 94-99.

Venables, P. H. Selectivity of attention, withdrawal, and cortical activation. Archives of General Psychiatry, 1963, 9, 74-78.

Venables, P. H. Input dysfunction in schizophrenia. In B. A. Maher (Ed.), Progress in experimental personality research. Vol. 1. New York: Academic Press, 1964.

Venables, P. H., & Wing, J. K. Level of arousal and the subclassification of schizophrenia. Archives of General Psychiatry, 1962, 7, 114-119.

Vestre, N. D. The effects of thorazine on learning and retention in schizophrenic patients. Journal of Abnormal Psychology, 1961, 63, 432-435.

Watson, C. G., & Logue, P. E. Interrelationships of several process-reactive measures. Journal of Consulting and Clinical Psychology, 1968, 24, 64-66.

Webb, W. W. Conceptual ability of schizophrenics as a function of threat of failure. Journal of Abnormal and Social Psychology, 1955, 50, 221-224.

Welsh, G. S. A factor study of the MMPI using scales with item overlap eliminated. American Psychologist, 1952, 7, 341.

White, M. A. A study of schizophrenic language. Journal of Abnormal and Social Psychology, 1949, 44, 61-74.

Whitman, T. L. Effects of verbal training on concept sorting behavior on three schizophrenic groups. Unpublished doctoral dissertation, University of Illinois, 1967.

Wickelgren, W. A. Exponential decay and independence from irrelevant associations in short-term memory for serial order. Journal of Experimental Psychology, 1967, 73, 165-171.

Wood, G. Mnemonic systems in recall. Journal of Educational Psychology Monographs, 1967, 58 (6, pt. 2).

Wood, G. Category names as cues for the recall of category instances. Psychonomic Science, 1967, 9, 323-324.

Wood, G. Retrieval cues and the accessibility of higher order memory units in multitrial free recall. Journal of Verbal Learning and Verbal Behavior, 1969, 8, 782-789.

Wood, G. Organizational processes and free recall. In E. Tulving & W. Donaldson (Eds.), Organization of memory. New York: Academic Press, 1972.

Wright, M. E. Use of the Shipley-Hartford test in evaluating intellectual functioning of neuropsychiatric patients. Journal of Applied Psychology, 1946, 30, 45-50.

Zahn, T. P. Acquired and symbolic affective value determinants of size estimation in schizophrenic and normal subjects. Journal of Abnormal and Social Psychology, 1959, 58, 39-47.

Zaslow, R. W. A new approach to the problems of conceptual thinking in schizophrenia. Journal of Consulting Psychology, 1950, 14, 335.

Zimet, C. N., & Fishman, D. B. Psychological deficit in schizophrenia and brain damage. In P. Mussen & M. Rosenzweig (Eds.), Annual Review of psychology. Palo Alto: Annual Reviews, Inc., 1970.

APPENDICES

APPENDIX 1

Practice List

a Biblical name

Jesus
Mary
Jacob

a part of a boat

sail
oar
cabin
anchor

a sport played with a ball

baseball
volleyball
golf

a drug

heroin
morphine
methedrine
opium

a composer

Bach
Chopin

a philosopher

Plato

a cleaning instrument

vacuum
dustpan
brush
mop

a month of the year

March

an item of sports equipment

tennis raquet

a piece of jewelry

necklace
earring
brooch

a planet

Jupiter
Mercury

a milk product

butter
yogurt

APPENDIX 2a

Experimental List 1 (24 - 1)

a unit distance
inch

a metal
nickel

a military title
sergeant

a building for religious services
synagogue

a part of the human body
nose

a fruit
cherry

a weapon
machine gun

an alcoholic beverage
rum

a country
Italy

a crime
rape

a carpenter's tool
chisel

a member of the clergy
nun

a substance for flavoring food
paprika

a type of fuel
gas

an occupation
salesman

a natural earth formation
rock

a sport
wrestling

a weather phenomenon
storm

a type of clothing
socks

a part of a building
basement

a chemical element
sulpher

a musical instrument
drum

a kind of money
peso

a type of music
jazz

APPENDIX 2b

Experimental List 2 (24 - 1)

a bird
cardinal

a nonalcholic beverage
ginger ale

a type of vehicle
tractor

a science
biology

a toy
truck

a type of dance
jitterbug

a vegetable
carrot

a type of footgear
boots

an insect
gnat

a girl's first name
Judy

a flower
pansy

a disease
chicken pox

a boy's first name
Bob

a tree
birch

a type of ship
submarine

a fish
swordfish

a snake
water moccasin

a city
St. Louis

a member of royalty
duke

a conqueror
Julius Caesar

a liquid
tea

a part of a bicycle
seat

a number
four

a type of meat
veal

APPENDIX 2c

Experimental List 3 (24 - 1)

a precious stone
gem

a unit of time
week

a relative
sister

a type of reading material
comic book

a four-footed animal
bear

a kind of cloth
corduroy

a color
brown

a kitchen utensil
pot

a part of speech
adjective

an article of furniture
table

an elective office
treasurer

a type of human dwelling
trailer

a season of the year
autumn

a kitchen appliance
dishwasher

a part of a bed
blanket

a kind of wood
maple

a kind of jam
strawberry

a part of a car
wheels

a day of the week
Thursday

a piece of farm equipment
combine

an ocean
Antarctic

a part of a church
bell

a geometrical shape
arche

a part of a watch
spring

APPENDIX 3a

Experimental List 1 (24 - 4)

a precious stone
- pearl
- topaz
- amethyst
- gem

a unit of time
- century
- millisecond
- era
- millenium

a relative
- aunt
- father
- nephew
- son

a type of reading material
- testbook
- comic book
- journal
- encyclopedia

a four-footed animal
- cat
- horse
- cow
- elephant

a kind of cloth
- silk
- rayon
- satin
- orlon

APPENDIX 3b

Experimental List 2 (24 - 4)

a colour
- yellow
- pink
- gray
- gold

a kitchen utensil
- pan
- spatula
- stove
- mixer

a part of speech
- noun
- verb
- participle
- words

an article of furniture
- chair
- bed
- bureau
- bookcase

an elective office
- vice-president
- councilman
- chairman
- alderman

a type of human dwelling
- house
- hut
- mansion
- igloo

APPENDIX 3c

Experimental List 3 (24 - 4)

a unit of distance
- kilometer
- decimeter
- foot
- mile

a military title
- lieutenant
- major
- commander
- corporal

a part of the human body
- foot
- nose
- heart
- mouth

an alcoholic beverage
- beer
- champagne
- wine
- scotch

a country
- Spain
- Brazil
- Russia
- Germany

a sport
- tennis
- hockey
- badminton
- baseball

APPENDIX 4

Ullman-Giovannoni Self-Report Scale

1. When I leave the hospital I will live with my wife. (T)*

2. I have paid regularly to buy a house. (T)

3. When I was in school I didn't like Physical Education classes. (F)

4. I have earned my living for longer than a year at full-time civilian work. (T)

5. I have had to stay in a mental hospital for more than one year at a time. (F)

6. I finished at least one year of education after high school--trade apprenticeship, business school, college, etc. (T)

7. My top wage in the last five years was less than $1.25 an hour. (F)

8. In my teens there was more than one girl with whom I had more than two dates. (T)

9. I hardly ever went over to another kid's house after school or on weekends. (F)

10. As a civilian I have worked steadily at one job or for one employer for over two years. (T)

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)

12. Before I was seventeen I had left the home I was raised in and never went back except for visits. (T)

13. In my teens I was a member of a group of friends who did things together. (T)

14. When I leave the hospital, I will live with one or both of my parents. (F)

(Cont'd)

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

APPENDIX 4 (Cont'd)

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)

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)

17. Alcohol has nothing to do with my difficulties. (F)

18. Adding up all the money I earned for the last three years, it comes to less than $750 before deductions. (F)

19. I have been married. (T)

20. In the kind of work I do, it is expected that people will stay on for at least a year. (T)

21. I am married now. (T)

22. I have fathered children. (T)

23. I have been deeply in love with someone and have told them about it. (T)

24. Within the last five years I have spent more than half of the time in a mental hospital. (F)

APPENDIX 5

Raw Data

Schizophrenic Groups

Pre-Test Measures

Experimental Condition	Age	Sc	Pa	Process Reactive	Vocab.	Educ. (yrs)	No. Hosp.	Current Hosp. (mons.)	Total Hosp. (mons.)	SC Check.	PA Check.	Pract. List	Medic. (mg.)	Weight (kg.)
GROUP 1														
IPC=24-1	27	9	5	14	21	10	1	2	2	5	13	30	350	78
Rec. Con.	24	7	6	14	25	9	1	1	1	6	1	30	700	76
CR - CR	30	19	7	6	37	13	2	22	24	4	7	30	450	70
	29	15	10	9	22	14	2	3	5	4	6	29	400	89
	21	9	3	6	22	10	1	2	2	5	2	30	900	87
	22	7	3	10	21	9	2	4	16	4	2	30	700	71
	22	17	6	6	26	9	2	6	22	6	3	30	700	65
	22	12	8	11	21	10	2	10	13	4	7	30	300	52
	22	5	4	18	25	13	1	1	1	6	3	30	400	76
	27	9	2	8	38	12	3	9	18	6	1	30	600	68
	26	4	5	8	30	15	4	9	20	6	2	30	600	56
	28	8	6	11	24	11	3	1	16	4	3	30	400	57
GROUP 2														
IPC=24-1	21	12	3	6	24	9	3	5	16	6	3	30	400	70
Rec. Con.	20	12	8	6	22	13	2	20	38	5	3	30	300	86
NCR-- CR	30	6	2	16	26	13	2	2	4	4	0	30	600	81
	24	6	3	12	24	12	2	3	9	6	4	30	800	78
	26	14	8	18	27	11	1	2	2	4	4	30	250	66
	21	4	3	11	21	8	1	3	3	5	3	30	400	67
	21	23	8	9	32	12	4	4	22	6	3	30	800	61
	22	13	2	5	26	12	3	5	22	5	1	30	600	41
	31	14	7	10	25	10	1	3	3	5	4	29	200	59
	24	5	6	11	35	15	1	9	9	5	2	30	500	51
	30	5	4	16	29	10	2	1	7	5	5	30	400	70
	25	4	6	10	23	10	1	5	5	5	4	30	350	45

Schizophrenic Groups (Cont'd)

Experimental Condition	Age	Sc	Pa	Process Reactive	Vocab.	Educ. (yrs)	No. Hosp.	Current Hosp. (mons.)	Total Hosp. (mons.)	SC Check.	PA Check.	Pract. List	Medic. (mg.)	Weight (kg.)
	Pre-Test Measures													
GROUP 3														
IPC=24-4	26	9	7	11	29	9	1	3	1	4	5	30	200	51
Rec. Con.	20	7	3	10	26	15	2	3	7	5	4	30	500	53
CR - CR	25	10	7	8	25	11	2	5	11	5	3	30	600	65
	30	8	6	12	33	13	2	10	14	5	5	30	450	60
	30	13	3	12	27	10	2	9	31	5	4	30	800	64
	29	8	6	14	20	12	2	4	12	6	4	30	750	96
	22	13	7	16	29	12	5	5	4	5	4	30	450	65
	25	10	7	6	20	9	1	6	26	5	2	29	450	71
	24	7	3	6	26	10	5	4	10	4	1	30	250	66
	22	6	3	15	26	10	3	5	5	5	4	30	650	63
	23	11	6	12	30	12	2	5	5	5	1	30	650	74
	21	14	3	6	24	15	2	5	4	5	2	30	250	73
GROUP 4														
IPC=24-4	23	7	3	15	38	13	1	4	5	5	4	30	700	79
Rec. Con.	20	8	8	6	26	12	1	3	4	5	4	30	420	66
NCR - CR	20	11	7	10	24	13	1	3	4	5	3	30	400	63
	34	11	6	4	26	9	5	3	29	4	4	30	750	71
	20	17	5	12	30	11	3	4	8	5	3	30	600	62
	35	7	8	7	32	12	1	14	17	6	4	30	300	49
	29	8	6	14	23	10	4	2	15	4	2	30	200	56
	20	14	6	16	22	10	3	2	9	5	2	30	600	43
	30	11	5	13	23	12	33	5	11	5	2	30	600	63
	21	7	3	9	24	10	2	16	24	5	2	30	200	93
	22	7	6	6	24	10	1	3	5	6	4	30	700	71
	26	11	3		23	12	1	5	7	5	4	30	850	78

Schizophrenic Groups

Recall Scores

Experimental Condition	List 1 Recall Test 1 CR	List 1 Recall Test 2 CR	List 2 Recall Test 1 CR	List 2 Recall Test 2 CR	List 3 Recall Test 1 CR	List 3 Recall Test 2 CR
GROUP 1						
IPC=24-1	17	18	19	19	15	16
Rec. Con.	18	19	13	14	16	16
CR - CR	19	19	15	15	16	15
	19	8	11	8	6	4
	16	17	17	17	18	18
	11	12	13	14	12	12
	15	15	21	21	20	20
	8	8	8	8	9	9
	9	10	13	1	7	5
	16	16	18	19	16	17
	10	10	12	11	11	12
	19	20	18	18	15	18
	NCR	CR	NCR	CR	NCR	CR
GROUP 2						
IPC=24-1	9	11	7	13	4	5
Rec. Con.	9	14	4	6	3	1
NCR - CR	4	7	5	10	3	15
	3	11	3	15	2	7
	8	14	7	11	1	7
	12	17	6	15	7	10
	9	14	9	17	9	15
	8	9	3	3	6	5
	2	6	3	10	5	9
	3	11	4	11	1	13
	6	7	6	7	4	6
	10	17	7	15	7	18

Schizophrenic Groups (Cont'd)

Recall Scores

Experimental Condition	List 1 Recall Test 1 CR	List 1 Recall Test 2 CR	List 2 Recall Test 1 CR	List 2 Recall Test 2 CR	List 3 Recall Test 1 CR	List 3 Recall Test 2 CR
GROUP 3						
IPC=24-4	15	15	18	18	17	15
Rec. Con.	15	13	10	12	8	9
CR - CR	15	14	14	14	18	17
	18	18	16	17	23	22
	12	11	12	11	14	13
	16	15	14	15	20	21
	19	18	18	17	22	22
	5	5	3	2	7	7
	16	16	16	16	20	18
	16	16	14	13	22	22
	16	18	20	20	23	23
	15	13	12	11	161	14
	NCR	CR	NCR	CR	NCR	CR
GROUP 4						
IPC=24-4	5	9	10	14	7	17
Rec. Con.	10	9	10	12	12	16
NCR - CR	3	6	1	5	6	9
	7	7	6	7	7	10
	18	16	8	15	13	15
	11	15	10	17	13	15
	9	7	8	7	6	15
	6	9	5	11	5	16
	10	12	7	10	11	14
	13	17	11	17	19	17
	4	3	6	4	10	16
	5	6	2	7	0	10

Normal Groups

Experimental Condition	Pre-test Measures: Age	Sc	Vocab.	Educ.	Practice List	Recall Scores: List 1 Recall 1 CR	List 1 Recall 2 CR	List 2 Recall 1 CR	List 2 Recall 2 CR	List 3 Recall 1 CR	List 3 Recall 2 CR
GROUP 1											
IPC=24-1	25	3	29	12	30	22	23	24	24	24	24
Rec. Con.	29	4	28	11	302	20	19	20	20	23	22
CR - CR	24	3	27	13	30	16	16	24	24	23	24
	24	3	24	11	30	22	22	21	23	23	23
	24	3	28	11	30	23	23	24	24	23	23
	22	2	27	10	30	22	22	24	24	24	24
	27	3	22	13	30	18	18	19	21	18	18
	26	3	22	11	30	20	20	20	21	22	23
	25	5	27	13	30	20	20	21	21	18	17
	24	5	24	11	30	21	21	21	21	20	20
	23	4	28	11	30	23	23	24	24	22	22
	25	2	27	11	30	29	29	22	22	22	21
						NCR	CR	NCR	CR	NCR	CR
GROUP 2											
IPC=24-1	28	2	26	11	30	15	23	11	22	9	23
Rec. Con.	24	4	27	13	30	11	17	10	18	11	17
NCR - CR	26	3	28	12	30	11	18	15	24	14	24
	22	5	26	11	30	8	13	12	19	12	22
	24	4	26	12	30	10	14	15	18	6	15
	26	2	24	13	30	15	19	15	21	14	21
	28	2	29	11	30	11	22	10	21	8	18
	24	3	28	12	30	11	21	13	23	9	22
	25	4	28	10	30	12	17	16	22	13	20
	24	5	22	10	30	12	16	13	17	9	15
	24	3	25	10	30	12	23	16	23	13	24
	25	4	24	11	30	8	13	9	15	7	12

Normal Groups (Cont'd)

Experimental Condition	Pre-test Measures: Age	Sc	Vocab.	Educ.	Practice List	Recall Scores: List 1 Recall 1 CR	List 1 Recall 2 CR	List 2 Recall 1 CR	List 2 Recall 2 CR	List 3 Recall 1 CR	List 3 Recall 2 CR
GROUP 3											
IPC=24-4	25	4	26	12	30	21	22	21	21	24	24
Rec. Con.	20	3	29	15	30	18	17	21	21	22	22
CR - CR	22	4	26	12	30	17	17	23	23	23	23
	33	4	22	10	30	15	15	20	20	22	21
	23	3	25	10	30	14	15	22	22	23	21
	33	3	26	9	30	14	14	23	23	22	22
	25	4	28	12	30	16	16	22	21	20	19
	20	3	32	11	30	19	19	18	18	16	16
	24	3	29	10	30	16	14	19	19	22	22
	24	4	22	12	30	9	10	18	17	20	20
	27	3	26	10	30	14	14	18	18	14	15
	22	4	23	12	30	14	14	21	21	22	22
						NCR	CR	NCR	CR	NCR	CR
GROUP 4											
IPC=24-4	29	2	28	11	30	20	19	18	20	13	21
Rec. Con.	27	4	25	12	30	15	18	14	16	15	19
NCR - CR	25	5	27	12	30	20	20	20	24	21	22
	24	4	21	13	30	13	16	16	17	13	16
	22	3	25	12	30	14	16	13	16	22	23
	22	2	31	12	30	16	16	18	18	10	21
	25	4	29	12	30	17	18	16	17	16	19
	28	3	28	10	30	14	15	12	15	9	17
	26	5	25	10	30	14	17	18	17	17	21
	21	1	26	9	30	12	13	15	16	13	19
	21	4	21	11	30	12	13	13	17	10	14
	28	4	29	12	30	13	18	16	17	15	18

VITA

NAME:	William John Barker
PLACE OF BIRTH:	Smiths Falls, Ontario
YEAR OF BIRTH:	1948
POST-SECONDARY EDUCATION AND DEGREES:	University of Western Ontario London, Ontario 1967-1968
	University of Guelph Guelph, Ontario 1968-1971 B.A. (Honours Psychology)
	University of Manitoba Winnipeg, Manitoba 1971-1972 M.A. (Psychology)
	Pre-doctoral Interneship Brockville Psychiatric Hospital Brockville, Ontario
	Major Graduate Field: Clinical Psychology
	Minor Graduate Fields: Psychopathology Neuropsychology
HONOURS AND AWARDS:	Bachelor of Arts conferred with distinction
	Canada Council Doctoral Fellowship Summer, 1973
	Canada Council Doctoral Fellowship 1972-1973
	University of Manitoba Graduate Fellowship, 1971-1972
	A.T.A. Trucking Bursary 1969-1970
	J. B. Watson Memorial Bursary 1968-1969
	King's College Entrance Scholarship University of Western Ontario 1967-1968
	Markham District Veterans' Association Memorial Bursary, 1967-1968

RELATED WORK EXPERIENCE:

Research Assistant to Dr. A.D. Yarmey
Department of Psychology
University of Guelph
January 1968 - December 1970

Research Assistant to Dr. R. W. Gatehouse
Department of Psychology
University of Guelph
May 1970 - September 1970

Teaching Assistant
Department of Psychology
University of Manitoba
January 1971 - August 1973

Participant Lecturer
Department of Psychology
University of Manitoba
September 1971 - May 1972

Consultant Psychologist
Childrens Aid Society
Winnipeg, Manitoba
May 1972 - September 1972

Clinical Psychology Extern
Psychological Services Centre
University of Manitoba
January 1973 - July 1973

PUBLICATIONS:

Barker, W. J. Repetition versus imagery instructions in the short and long term retention of picture and word paired associates. Honours Thesis, University of Guelph, 1970.

Yarmey, A. D. and Barker, W. J. Repetition versus imagery instructions in the immediate and delayed retention of picture and work paired associates. Canadian Journal of Psychology, 1971, 25(1), 56-61.

Barker, W. J. The effect of 'cognitive styles' on learning. M.A. Thesis, University of Manitoba, 1972.

Barker, W. J. and Perlman, D. The effects of volunteer bias and personality traits in sexual standards research. Archives of Sexual Behaviour, in press.

RESEARCH CITED:

In Koulack, D. and Perlman, D. Readings in Social Psychology. Wiley, Toronto, 1973, pps. 139, 140, 142, 151.