THE USE OF ACTIVE MEMORY ENCODING STRATEGIES BY THOUGHT DISORDERED AND NON-THOUGHT DISORDERED SCHIZOPHRENICS

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APPROVAL SHEET

We the undersigned do certify that we have read this dissertation and that in our individual opinions it is acceptable in both scope and quality as a dissertation for the degree of Doctor of Education.

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ABSTRACT

THE USE OF ACTIVE MEMORY ENCODING STRATEGIES BY THOUGHT DISORDERED AND NON-THOUGHT DISORDERED SCHIZOPHRENICS

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Twelve thought disordered and 12 non-thought disordered schizophrenics were administered a memory test that involved remembering 6 lists of 12 words each. Two of the lists contained homophone pairs, 2 contained synonym pairs and 2 contained unrelated words. One of each list type was presented visually and 1 auditorially in random order. Subjects were scored on total number of words remembered and number of words remembered according to list type, presentation mode and membership in the top half (LTM) or bottom half (STM) of a list. Recall was free and unordered.

Results showed thought disordered schizophrenics to be inferior to non-thought disordered schizophrenics in STM for visually presented material and in LTM regardless of presentation mode. Within group comparisons showed the thought disordered group to be

inferior in STM-visual, LTM-auditory and LTM-visual as compared with STM-auditory, while the non-thought disordered group performed equally well regardless of condition. List type failed to show an effect.

Results were interpreted as demonstrating that thought disordered schizophrenics are inefficient at translating visually presented stimuli to an acoustic code and possibly are inefficient at making the semantic elaboration necessary for long term retention. It was therefore concluded that thought disordered and non-thought disordered schizophrenics could be differentiated according to their memory and that the differences are likely due to differences in use of information processing strategies.

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Chapter 1

Introduction

The concept of schizophrenia as we know it today was developed by Kraepelin in 1896 and was called dementia praecox. Although the term "dementia praecox" had been used earlier, in 1867, by Morel, his description of the entity was too variegated to be distinguishable as what we now call schizophrenia (Bleuler, 1950). Kraepelin defined dementia praecox as a poorly understood group of psychotic disorders characterized by early onset and progressive deterioration. This early definition, then, emphasized the course of the illness -- speed of onset and remission history and premorbid adjustment -- rather than the specific clinical manifestations.

Bleuler (1950) departed somewhat from Kraepelin's views by emphasizing the clinical manifestations of dementia praecox and renaming it "schizophrenia". While Bleuler recognized the multiplicity of the disorder, he saw enough clinical symptoms in common to consider schizophrenia a clinical entity. His dominant concept was lowered tension within the learned field of associations, which made it possible for irrelevant associations to intrude, resulting in bizarre, irrational thinking and behavior (Frey, 1973). This idea of unusual

thought content was further developed by Rorschach in 1911 with the publication of his inkblot test. Rorschach found that schizophrenics showed poor form quality, gave "sick" content, showed idiosyncratic associations and showed boundary problems in response to the Rorschach protocol.

Research on schizophrenia since that time has sought to further clarify the concept in terms of a definition of the entity and in terms of better definitions of subtypes of schizophrenia. The research has taken two directions. One line of research has been directed toward a better definition of subtypes according to clinical symptoms, while another line has been concerned with a two-dimensional classification based upon life history and prognosis.

Kraepelin, Bleuler and Meyer Sullivan all struggled with the issue of prognostic efficacy and suggested life-history factors that influenced the course of the schizophrenic disorder (Garmezy, 1970). It was Frank, however, in 1932, who first made the distinction of separate process and reactive groups of schizophrenics. The idea has been expanded to the point that there are now three widely used scales for diagnosing a patient along the process-reactive continuum; the Elgin Prognostic Scale, the Phillips Scale of Premorbid Adjustment in Schizophrenia, and the more recently developed Ullmann-Giovannoni Scale (Appendix A). A number of studies have evaluated the validity of these scales, and substantial relationships (.45-.97) have been reported (Higgins, 1969). Two important limitations of the scales are that

they are strongly sex-biased and, when used solely as self-report inventories, there may be strong doubts that subjects' responses truly reflect reality rather than delusional thinking or other biases.

The process-reactive concept as it has developed incorporates all points in the history of the schizophrenic disorder, since premorbid personality, time interval preceding onset, factors precipitating the illness and symptoms during the course of illness have all been related to prognosis. Garmezy has described the process patient as follows:

> The patient's prepsychotic personality is a poorly integrated one revealing markedly inadequate behavior in the sexual, social and occupational areas; trends to social isolation and a lack of emotional responsivity to others are clearly evident. There is usually no acute precipitant to characterize the turn toward psychosis; rather, the onset (usually in late adolescence) is an insidious one without a recognizable and consensually validated stressor evident. Symptomatically, there is a gradual onset of emotional blunting, a withdrawal from life's daily activity; apathy and indifference hold sway, and somatic delusions and marked disturbances in thinking may characteristically be present and maintained for long periods of time.
>
> (Garmezy, 1970, p. 35)

In contrast, the reactive patient has been described by Wiener as follows:

> From birth to the fifth year, the maturational and developmental history showed no defects, physical health was good. Generally school and home adjustment was good. Parents were accepting. Heterosexual relationships were established. The patient had friends, and domestic troubles did not disturb his behavior.
>
> The onset of the illness was often sudden with a clear-cut, understandable precipitating event. Aggression was expressed verbally. Decency was retained.

> The course was fulminating, with massive hallucinatory experiences, ideas of reference, and mild paranoid trends as well as sensorial impairment. A thought disorder was present according to some authors, but not others. Response to treatment was good.
>
> (Wiener, 1958, p. 123)

The second line of research has sought to better explain schizophrenia in terms of clinical symptoms. It is a common observation that schizophrenics appear to be disorganized in thought, speech and behavior. Cameron (1938) saw the underlying cognitive problem in the schizophrenic to be his difficulty in maintaining conceptual boundaries, allowing inappropriate responses to intrude upon thinking. This phenomena, which Cameron called "overinclusiveness", was reinterpreted by Payne (1961) in terms of impairment of a hypothetical filtering mechanism, which normally would exclude irrelevant stimuli from consciousness, allowing attention to be directed toward the task at hand. Payne, then, saw the basic deficit as a dysfunction in attention.

Research on attentional deficit in schizophrenia has used indices of reaction time, size constancy, arousal and tests of short term memory. Yates (1966) saw the problem as one of abnormally slow information processing, which lead to a STM (short term memory) overload and thus accelerated memory loss. McGhie studied the problem in terms of distractibility or inadequate filter, thus again leading to a STM overload and forgetting.

Other research has focused on organizational deficit. One way to lessen the load on STM is to use certain strategies that serve to organize the to-be-remembered material. According to Miller's (1956) unitization theory, the basic dysfunction in schizophrenia is difficulty in chunking material into higher units to lessen the load on STM. The model most often used to study this idea is the recall vs. recognition model. Apparently different operations are required for recall and recognition. According to a two-stage model of memory, which postulates a response-learning stage and an association-forming stage, recognition requires only the response-learning stage, while recall involves also the association forming stage. Since several investigators have shown that schizophrenics have a recall deficit but not a recognition deficit (Kay, Kayton and Berry, 1973; Nachmani and Cohen, 1969; and Bauman, 1971), it is possible that schizophrenics have a deficit in the association-forming stage of memory, or in their ability to organize for memory.

Theory

The present study, though based in part on the above studies on recognition and recall, rests on a related but different theoretical framework. It has recently been suggested that the memory problem in schizophrenics may not be due to inability to organize material but to their failure to use organization. For

instance, in an investigation of word sorting structures by Koh, Kayton and Schwartz (1974), structures obtained from schizophrenics and normals closely agreed, not supporting the hypothesis of a conceptual structure deficit. Larsen and Fromholt (1976), investigating word-storage structure and processes of organization and retrieval in schizophrenics, found that schizophrenics took more trials than normals to organize material, but once they arrived at consistent categories, they recalled as many words as normals. They interpreted this to support Koh, Kayton and Schwartz, that the structure of organization in schizophrenics is not different from that of normals, but that schizophrenics have some difficulty in arriving at stable categories. One possibility suggested by these findings was that schizophrenics have to be forced to organize. Koh, Kayton and Peterson (1976) demonstrated that storage and retrieval processes of schizophrenics were comparable to normals when material was appropriately coded for them.

Traupmann (1975) stated this position most clearly in a theoretical paper in which he attempted to relate the schizophrenic's underuse of certain information processing strategies to the theories of Cromwell on stimulus redundancy. Looking at scanning and size estimation studies (Silverman, 1964a, 1964b; Harris, 1957; Rodnick and Garmezy, 1957; Neale and Cromwell, 1968; Davis, Cromwell and Held, 1967; Webb, Davis and Cromwell, 1966), Cromwell proposed an explanation for the phenomena in terms of stimulus redundancy. Cromwell (1968) defined stimulus

redundancy as "the repetition, temporarily and spatially, of stimulation as it affects the organism. High redundancy would be exemplified by (1) the prolonged presentation of the same stimulus (2) within a highly homogeneous background (p. 367)". High redundancy would be expected to lead to size overestimation and low redundancy to size underestimation. Since individuals differ in their base line acceptance levels of stimulus input, given a constant external stimulus, individuals will differ in base line redundancy level. Cromwell explains that

> one individual may have increased motor activity, exploration, attentiveness, thought processes, autonomic feedback, proprioceptive feedback, etc.; consequently he responds to stimuli at a high frequency. Such an individual would have a base line acceptance level leading to low redundancy. Another individual may have few such activities and experiences -- and may even filter out such stimulation. This individual would have a base line acceptance leading to high redundancy.
>
> (Cromwell, 1968, p. 367)

Applying these notions to schizophrenics Cromwell proposed that good premorbid (reactive) schizophrenics have high stimulus input and therefore low redundancy, and the tendency to underestimate size, and that poor premorbid (process) schizophrenics have low stimulus input, high redundancy and the tendency to overestimate size.

This formulation is consistent with other descriptions of the good premorbid and poor premorbid schizophrenics. The good premorbid schizophrenic is usually seen as one who is over-inclusive, exercises his thought-processes extensively and has more ideation than is

appropriate. The poor premorbid, on the other hand, is seen as withdrawn from the external world and blocking out his own thought processes by which to construe what little input he receives.

Traupmann (1975), considering Cromwell's formulation along with certain notions from cognitive psychology (particularly Craik and Lockhart, 1972), proposed a hypothesis of cognitive functioning in schizophrenics. Memory is seen as a byproduct of cognitive operations on stimuli. Stimuli may be processed to various depths, and the durability of the memory trace is related to the depths to which the stimulus is processed. Processing may involve only simple feature analysis or extensive semantic elaboration. Strategies which provide for elaboration of the stimulus would be expected to facilitate memory encoding. Considering the research of Ann Brown and her coworkers, Traupmann saw as relevant the notion that "certain (information processing) strategies are actively implemented by the individual whereas other strategies operate quite automatically or by passive implementation (p. 2)".

Applying these ideas to Cromwell's stimulus redundancy formulation, Traupmann proposed that process (high redundant) schizophrenics, since they tend to avoid stimulation, may accomplish this by underusing active strategies for processing information. He further explained as follows:

> Among the active processes that appear to be essential to short-term memory are those that maintain attention to the stimulus and process the acoustic code. For example, if language information is presented visually, it will be retained better in short term memory if translated to the acoustic code...for high redundant schizophrenics, auditory presentation resulted in superior short term recall compared to visual presentation. For

> low redundant schizophrenics and normals, short term recall was not dependent on mode of presentation.
>
> (Traupmann, 1975, p. 4)

Long term memory seems to depend on active organizational strategies and semantic-associative elaboration, and high-redundant schizophrenics show poor long term recall, suggesting the possibility that they do not organize material for long term storage. Traupmann concluded that "process schizophrenics, or chronic schizophrenics or high-redundant schizophrenics are individuals who apparently fail to actively process their world to the extent that normal adults do (Traupmann, 1975, p. 6)". Reactive schizophrenics, or low-redundant schizophrenics, do not appear to show this deficit.

Statement of the Problem

The present study will further investigate schizophrenic thought disorder by attempting to differentiate types of schizophrenics according to their use of certain active information processing strategies. Cromwell's work on information processing in schizophrenics classified subjects as high-redundant or low-redundant schizophrenics (thought to be comparable to process and reactive). This researcher, however, believes that a thought disordered/non-thought disordered classification of schizophrenics is more apt to yield significant

group differences. However, because the process-reactive distinction is so often used in studies of schizophrenia, subjects will also be classified according to that criterion and the results compared to results using the thought disordered/non-thought disordered criterion.

There is certainly reason to believe that the two classificatory systems are related, since definitions given of process and reactive schizophrenics usually mention thought disorder as one of the criteria that may distinguish the two groups. Becker (1959) suggested that process schizophrenics are at a more primitive level of development than reactive schizophrenics and that this is reflected in their cognitive functioning. Becker asked whether or not level of thought disorder could be predicted from case history ratings on a process-reactive dimension. Measures used were a special Genetic-Level scoring of the Rorschach and Whittman's Elgin Prognostic Scale. Becker found that for his sample the Rorschach GL score correlated with the Elgin Scale -.641 ($p<.001$), meaning that a more process-like picture on the Elgin Scale was significantly correlated with a lower GL score on the Rorschach. In other words, process-reactive and thought disordered/non-thought disordered are significantly related.

The two active information processing strategies to be studied here are (1) translation of material to an acoustic code and (2) use of semantic-associative organization processes. As a result of much work carried out in recent years on the nature of coding in STM in normals,

there is now considerable evidence that information in STM is acoustically coded. One kind of evidence for this has been that intrusion errors made in recalling visually presented material are likely to be acoustically similar to correct items (Laughery, Welter and Spector, 1973). LTM, on the other hand, thought to some degree dependent upon acoustic coding, contains information representing a variety of codes relating to meaning and categorization.

Translation of material to an acoustic code may be investigated by manipulating mode of presentation of stimuli. If the subject is translating to an acoustic code, he should perform equally well on tests of STM for visually presented material and for auditorially presented material. If he is not translating to an acoustic code, then STM for visually presented material should be inferior to STM for auditorially presented material.

Use of acoustic coding can be further studied by looking at the effects on STM of acoustic similarity of stimuli. It has repeatedly been shown (Conrad, 1964; Wickelgreen, 1965; Baddeley, 1966) that if subjects are coding acoustically, STM will suffer from the effects of auditory confusion, whereas if they are not using acoustic encoding or only minimally using it, STM will be not at all or minimally affected.

The second active information processing strategy to be investigated here is the use of semantic-associative organization. Since organization according to semantic properties of stimuli is considered

minimally important to STM but of primary importance for LTM, it may be expected that, if a subject fails to organize TBR material according to semantic characteristics, he will show a LTM deficit. Whether or not this deficit is specifically related to a problem in use of semantic organization strategies may be examined by looking at the effects on LTM of semantic similarity of stimuli. It has been shown (Underwood, 1951; Baddeley, 1966; Baddeley and Dale, 1966) that with normal subjects semantic similarity does affect LTM but not STM. It may also be expected, then, that subjects who minimally organize or fail to organize according to semantic properties of stimuli will not be affected or will be only minimally affected by semantic similarity.

The problem, then, is to determine whether or not thought disordered schizophrenics can be differentiated from non-thought disordered schizophrenics on the basis of their use of these active information processing strategies. Specifically this study will attempt to answer the following questions:

1. Is there a schizophrenic memory impairment, and can it distinguish schizophrenics according to the criteria of thought disordered and non-thought disordered?

2. Do thought disordered schizophrenics have a particular problem in remembering visually presented stimulus materials?

3. Can the thought disordered schizophrenic's underuse of auditory encoding be further demonstrated by the lack of effect of acoustic similarity on his STM?

4. Do thought disordered schizophrenics show a LTM deficit, possibly indicating their underuse of coding according to semantic properties of stimulus materials?

5. Is the thought disordered schizophrenic's underuse of semantic encoding further demonstrated by the lack of effect of semantic similarity on his LTM?

Hypotheses

For purposes of statistical research the following hypotheses are stated:

1. There will be a difference in overall number of words remembered between thought disordered and non-thought disordered schizophrenics, in that thought disordered schizophrenics will remember fewer words.

2. As compared with non-thought disordered schizophrenics, thought disordered schizophrenics will show a deficit in STM for visually presented stimuli while performing at a level comparable to non-thought disordered schizophrenics in STM for auditorially presented stimuli.

3. Acoustic similarity of stimuli will impair STM of non-thought disordered schizophrenics, regardless of mode of presentation, while impairing STM of thought disordered schizophrenics only when presentation is auditory.

4. As compared with non-thought disordered schizophrenics, thought disordered schizophrenics will show a deficit in LTM, regardless

of mode of presentation.

5. Thought disordered schizophrenics will be unaffected by semantic similarity of stimuli while non-thought disordered schizophrenics will show LTM impairment, regardless of mode of presentation, when stimuli are semantically similar.

6. Non-thought disordered schizohrenics will remember words equally well regardless of memory store or presentation mode.

7. Thought disordered schizophrenics will show superior performance on STM for auditorially presented material as compared with any other combination of memory store and mode of presentation.

Definition of Terms

Thought-Disordered Schizophrenic - Non-Thought Disordered Schizophrenic -

For purposes of this study a Thought Disordered Schizophrenic is one classified as such by a clinical psychologist according to the Lorr, Klett and McNair (1963) criteria for the Z factor, arrived at from factor analytical studies of their Inpatient Multidimensional Psychiatric Scale (IMPS) developed in 1962. These studies identified three second order syndromes, X, Y and Z, roughly corresponding to manic-depressive illness, schizophrenic reaction, paranoid type, and an unnamed third factor, Z factor, that seems to represent elements common to the schizophrenic process. This Z factor is weighted heavily on Retardation and Apathy, Disorientation, Motor Disturbance and Conceptual

Disorganization. IMPS items used in identifying schizophrenics conforming to Z factor criteria are such terms as "irrelevant", incoherent", "rambling", using "neologisms", "stereotyping", "memory deficit", and "speechblocking and apathy". This type thought disordered schizophrenic seems to have much in common with process or high-redundant schizophrenics. Schizophrenics who do not conform to the criteria represented by the Z factor will be considered Non-Thought Disordered, even though they may have experienced delusions or hallucinations.

Process Schizophrenic - Reactive Schizophrenic -

Process Schizophrenics will be defined as those subjects scoring above the overall median on the Ullmann-Giovannoni Scale, while those scoring below the median will be considered Reactive Schizophrenics. Since it is generally agreed that the process-reactive dimension represents a continuum rather than a dichotomy, it does not seem particularly important to define an arbitrary cut-off point for distinguishing process from reactive.

The Ullmann-Giovannoni Scale (1964) is a self-report scale which was developed by selecting items in terms of face validity from a true-false inventory designed to predict post-hospital employment. Items were then subjected to internal consistency criteria and split-half reliability. The part-whole chi-squares were significant for 23 of the 24 items in the final Scale. Split-half reliability was .797. Concurrent validity has been reported (Johnson and Ries, 1967), when compared to the Phillips Scale, as -.78 and -.58 (negatives are due to

how the two scales are scored). Meichenbaun (1966) examined predictive validity of the Scale in relation to hospital discharges and found that the more reactive patients were discharged sooner than the more process patients. He also examined construct validity by examining the Scale's relation to thought disorder as measured by three verbal tests and found a low but significant ($p < .05$) correlation.

Short Term Memory - Long Term Memory -

From a list of twelve to-be-remembered (TBR) words, memory for those in serial positions 1-6 will be considered Long Term Memory (LTM), while memory for those in serial positions 7-12 will be considered Short Term Memory (STM). This line of reasoning is attributable to Glanzer and Cunity (1966), who showed that manipulation of a variable assumed to affect STM affected recall of only terminal list items, while manipulation of a variable assumed to affect LTM affected recall of only initial items.

Auditory Presentation - Visual Presentation -

Auditory presentation will refer to presentation of TBR stimuli by means of electronic tape recording device with no corresponding visual presentation. Visual presentation will refer to presentation of TBR stimuli by means of memory drum with no corresponding auditory presentation.

Chapter 2

Review of Related Literature

This review of related research is divided into four sections. The first section contains a very brief introduction to the literature on acoustic and semantic similarity with normal subjects. The next two sections deal specifically with studies of memory in schizophrenics. These studies seem to fall into two groups, those focusing on the initial receiving of information and those focusing on further processing of information and subjective organization. Studies in the first group are concerned with attention, distractibility and interference and are often interpreted in terms of overinclusiveness, a hypothesized filter mechanism or speed of processing theory. Studies in the second group have to do with categorizing, processing semantic features of stimuli and association-forming and are apt to be interpreted in terms of information processing theory.

There is overlap. For instance some studies dealing with organization of material at input are interpreted in terms of overinclusiveness or distractibility and so are included in the first group. Another study deals with subjective organization and so is included in the second group in spite of its being interpreted in terms similar to studies in the first group. Still it is thought that the distinction made here is useful for an understanding of the literature.

A brief summary follows the review of literature.

Acoustic and Semantic Similarity

Since it is not the intent of this study to investigate any aspect of current theory on memory of normal subjects, no extensive review of literature on normal subject memory will be presented here. However, to give some rationale for the particular methods used in the present study, several studies on the effects of acoustic and semantic similarity on memory will be discussed.

Conrad (1964), in a study of the effects of acoustic confusion on immediate memory, showed that items which are hard to discriminate when verbally presented are also hard to recall when presented purely visually. A subsequent study by Baddeley (1966) of short term memory for word sequences showed that this was not a general similarity effect, since although acoustic similarity led to massive impairment of short term memory, similarity of meaning had only a slight effect. Thus it seems that whereas short term memory relies very largely on acoustic coding, it is relatively unaffected by the semantic properties of the material to be remembered.

Baddeley (1966b) hypothesized that acoustic and semantic similarity would have the same influence on long term memory as on short term memory and found that the extreme vulnerability of short term memory to the effects of acoustic similarity is not shared by long term memory, but that long term memory is affected by semantic similarity (in the learning stage if not in eventual forgetting).

Baddeley and Dale (1966) studied the effect of semantic similarity on long term memory and short term memory and found again that retroactive interference effects based on semantic similarity do occur in long term memory, but, if they occur at all in short term memory, are not significant. Baddeley and Dale further suggest that "similarity along any dimension only influences forgetting if S codes the material in that dimension before storing it. For verbal material, short term memory appears to rely on acoustic coding, while long term memory appears to code words in terms of their meaning (p. 420)".

Kintsch and Bushke (1969), in a study somewhat different from those mentioned above, attempted to determine the effects of acoustic and semantic similarity on primary and secondary components of short term memory. (Primary and secondary memory are terms sometimes used synonymously with short term memory and long term memory.) They hypothesized that acoustic similarity affects primary memory, while semantic similarity does not and that semantic factors affect secondary memory while acoustic factors may or may not. Twelve-word lists of unrelated words, homophone pairs or synonym pairs were presented to subjects at a rate of two seconds per word. Presentation was auditory for synonym pairs and visual for homophone pairs. Responses were elicited using a probe technique. Recall of early words on the lists was used to estimate secondary memory and recall of recent words on the lists was used to estimate primary memory. (Immediate memory is believed to hold a maximum of seven units.) The hypotheses were supported, and Kintsch and Bushke concluded, "Primary

memory apparently retains only acoustic information, while semantic as well as sensory and phonetic features are important for secondary memory (p. 407)".

Attention, Distractibility and Interference

Lawson, McGhie and Chapman (1967) investigated distractibility in schizophrenics in a study based on Payne's interpretation of overinclusiveness in terms of impairment of the filtering mechanism which would normally exclude irrelevant stimuli from consciousness. The theory here is that schizophrenics have an impairment in selection of and attention to relevant stimuli. McGhie et al. (1965) had previously found that schizophrenics could be differentiated from normals and other patient control groups in an auditory distraction test but not in a visual test. This study further looked at the differential effects of auditory and visual distraction on schizophrenics.

Subjects for the study were 29 schizophrenics (specific selection criteria not given) with control groups of paranoids, normals and patients with organic cerebral disease (epileptic and arteriosclerotic). Subjects were given tests of STM with auditory presentation, without and with distraction, and with visual presentation, without and with distraction. For the auditory test without distraction subjects listened to 6 digits presented at a rate of one per two seconds and were instructed to repeat them back immediately (no mention is made of

order in responses). For the auditory test with distraction subjects listened to 6 digits again presented at a rate of one per two seconds, but in the intervals between relevant digits a different voice gave irrelevant digits for distractors. Subjects were asked to repeat the relevant digits immediately. The visual tests were similar to the auditory, except stimuli were projected on a screen. In the test with distraction, relevant digits were shown in blue while irrelevant digits were shown in white with a large green circle around each.

Scores were in terms of errors, and each subject had two scores, one a measure of basic retention without distractors and the other a measure of retention under distracting conditions. Results showed all groups significantly distracted in the auditory test ($p<.01$) except the paranoids and none significantly distracted in the visual test. There were also significant differences between all groups in distractibility. Since it was possible that differences would show up within the schizophrenic group, these subjects were further divided into hebephrenic and non-hebephrenic. Hebephrenics were described as chronic, thought disordered, delusional and having schizoid premorbid personalities. Comparison of hebephrenics and non-hebephrenics on distractibility was significant ($p<.05$) for auditory distractibility but not significant for visual distractibility.

Since there was such a difference in distractibility according to mode of presentation, the authors thought it worth while to look at modality differences in basic retention without distraction. They found

that for schizophrenics there was a significant difference ($p<.01$) in basic retention without distraction between auditory and visual modalities. In all other groups this difference was not significant except for the arteriosclerotic group ($p<.05$). Furthermore, there were significant differences between hebephrenics and non-hebephrenics, normals or paranoids ($p<.01$), in retention for visual or auditory stimuli.

This study was interpreted as confirming previous findings that schizophrenic distractibility is confined to the auditory mode in STM. Further, the effect is specific to hebephrenic schizophrenics. Another finding was that schizophrenics, particularly hebephrenics, have difficulty in retention of visually presented stumuli even without distraction. It is suggested that the problem in storage of visually presented materials in schizophrenics is due to a disorder in the mechanism which converts visually presented information into an auditory form for more permanent immediate memory storage. It is further suggested that the lack of distractibility in the visual presentation may be due to a deficit at the input stage of STM.

Relating to the idea that the schizophrenic thought disorder is a disturbance of attention, Kay and Singh (1974) attempted to isolate and measure one aspect of attention, that of sustaining focused alertness, by developing the Span of Attention Test. The test was designed to gauge this disorder with a task involving minimal cognitive demands. The test obtains a direct temporal measure based on attention spans

sampled from performance on a simple standard task.

Subjects for this study were 23 chronic schizophrenics (4 or more years of illness), 20 sub-acute schizophrenics (2-4 years' illness), 23 acute schizophrenics (less than 2 years' illness) and 23 non-psychotic adults. Material for the test consisted of a standard page filled with 500 X's. Subjects were instructed to circle each X on the page. While the subject performed this task, the examiner recorded any break in attention during the test, as evidenced by a subject's looking away from the test sheet for 10 seconds or discontinuing work. A maximum time of 400 seconds was allowed for the test, and no more than two breaks were allowed before termination. Scoring was as follows. If there was no break in attention for 400 seconds, or if the task was completed in less than 400 seconds, a score of 400 was given; if only one break in attention was observed, subject was credited with the number of seconds he had worked up to this break; if attention was broken twice before completion or before 400 seconds had elapsed, the score was the average of the two spans.

Forty-three of the subjects were tested once a week for 14 to 16 weeks; 10 were tested only twice; and 23 were tested only once.

The mean spans of attention for the four groups differed significantly ($p < .001$). Results reflected greater test impairment for schizophrenics but did not distinguish among the patient groups. The Span of Attention test, then, does distinguish schizophrenics from non-schizophrenics but not chronic, subacute and acute schizophrenics from

one another. One possible explanation for the lack of significant differences among the schizophrenic groups, the authors suggested, was in the demands of the Test. Since stereotype thought and behavior is a prominent feature in chronic schizophrenics, their attentional span may have been overestimated in comparison to other groups by the dull, repetitive tasks of the test. The results, then, do support the notion of an attentional deficiency in schizophrenics, but does not answer the question of differential attention span according to sub-type.

Studies suggesting interference as the main problem in schizophrenic STM have focused on either input interference or output interference. It has been observed (Bauman, 1971) that schizophrenics have a particular problem in recalling items in last aerial positions (when items are to be recalled in order). This has been explained in terms of output interference, suggesting that the process of responding itself is a source of interference. On the other hand, there is evidence that schizophrenics have a problem at the input phase of the memory process. The findings of Lawson, McGhie and Chapman (1967) that schizophrenics were particularly distractible in perception and recall of visually presented items, suggesting that schizophrenics have a problem in coding visually presented information auditorially, indicates that the problem lies at the input stage of memory.

Bauman and Kolisnyk (1976) attempted to assess the effects of input and output interference on schizophrenic STM. Subjects were 24 acute psychotics and 24 normals. Thirty-five lists of 7 digits were presented

on a memory drum at the rate of 2.3 digits per second. Immediately after presentation of each list subjects were asked to recall digits in probed serial position. In the course of the experiment each input position was probed five times in each output position, "input position" being defined as serial position in which a digit was presented and "output position" being defined as order in which a digit was to be recalled. Thus if an item appearing first on the list of 7 digits was probed for seventh, its input position would be 1 and its output position 7. Input interference was studied by analyzing each of the seven serial positions when it was probed for first (since in these cases there is no output interference). Output interference was studied by analyzing items presented in serial position seven (since in this case there would be no input interference). All other responses were not analyzed, because they would not give a pure measure of input or output interference.

The first analysis showed a significant groups effect ($p < .001$) and a significant input positions effect ($p < .001$) but no significant interaction effect. Thus when output interference is minimized, schizophrenics are still inferior to nonschizophrenics in recall, and recall of both groups is significantly affected by the number of items presented after the stimulus item and before the first response. The effect of interpolated inputs on recall, though, is similar for schizophrenics and normals.

The second analysis also showed a significant groups effect ($p < .001$), again indicating that schizophrenics were inferior to normals in recall. The significant output effect ($p < .001$) indicated that recall was determined by the number of responses interpolated between presentation of the item and recall. In this analysis, though, there was a significant Groups X Output Positions effect ($p < .02$), indicating that the interpolation of responses had a greater effect on the recall of schizophrenics than of normals.

Results were interpreted as supporting the idea that the decrement in schizophrenic recall is largely due to output interference resulting from the process of responding. The investigators somewhat discredited the idea that poor schizophrenic recall was due to inability to translate to auditory code, because if this were true, material that failed to enter auditory store would not be available for recall regardless of number of prior responses. This criticism seems not entirely justified, since it is possible that schizophrenics merely sub-optimally use auditory encoding rather than not using it at all and that this represents an entirely different problem from that of output interference. The authors seem to recognize this when they state that excessive output interference is not supposed to account for the problem of schizophrenic poor recall entirely and that schizophrenics probably do have an encoding problem. Although these results were found with acute schizophrenics, the authors suspect that the findings also apply to chronic schizophrenics. This study tells us nothing about differential performance of subtypes of schizophrenics.

Another study, somewhat related to the preceding in that it looks at both input and output aspects of memory, uses a choice reaction time (CRT) model. Marshall (1973) recognized that inadequate cognitive performance is a characteristic of schizophrenics and examined several theories of schizophrenic mnemonic deficit by trying to isolate the locus of difficulty in information processing. The purpose of his study was to compare the CRT performance of schizophrenics with other subjects when complexity was increased across stimulus values and response values independently, thus evaluating both the defective filter theories of McGhie and Payne and the theory of response selection difficulty of Broen (1969). Marshall stated that for the defective filter theory to be correct, schizophrenics should have not only slower reaction time than other subjects but should also be more affected by increases in stimulus complexity. For the response selection theory to be correct, then schizophrenics should show an abnormally high decision time as response uncertainty was increased.

Subjects for Marshall's study were 21 schizophrenics, 21 neurotics and 21 penitentiary inmates. No subtyping of schizophrenics was made. The experimental task was a card-sorting task in which subjects were asked to sort as fast as they could without making any errors. Three different decks of cards were used, each containing 32 cards. In deck 1, 16 cards showed a blue circle and 16 a yellow circle. Deck 2 showed 16 circles (8 blue and 8 yellow) and 16 squares (8 blue and 8 yellow). Deck 3 showed 8 circles, 8 squares, 8 diamonds and 8 triangles, each shape appearing

four times in blue and four in yellow. Each deck then had a different degree of stimulus uncertainty. Subjects were asked to sort Deck 1 into two piles according to color; Deck 2 once according to color and again according to shape and color; and Deck 3 once according to color, once according to shape and once according to both shape and color. Thus sorting of Deck 1 results in one bit of response uncertainty; Deck 2 in one bit of response uncertainty when sorted according to color and two when sorted according to color and shape; and Deck 3 in one bit of response uncertainty when sorted according to color, two when sorted according to shape and three when sorted according to color and shape.

Scores were recorded in terms of response time, divided into two periods; the time taken to make a decision and the time required by the subject to make the necessary sorting movement. The following results were found: (1) Schizophrenics were slower than other groups in executing the movements necessary to sort cards and in their ability to select an appropriate response. They were also slower in making decisions about stimuli than either control group; (2) Both response selection problems and stimulus analyzing problems of the schizophrenics became relatively more pronounced with increases in uncertainty as compared to control groups; and (3) Stimulus uncertainty was not as great a problem for schizophrenics as was response uncertainty.

Marshall interpreted his results as supporting both Broen's theory that schizophrenics have difficulties in selecting appropriate responses

and McGhie's idea that schizophrenics have problems in dealing with stimulus properties of input, and so possibly have a defective filtering mechanism. He adds, though, that the defective filter is not the only explanation, and that the results may be due to other difficulties, such as an encoding problem. Marshall further explains,

> The presence of difficulties at both the stimulus and response ends of the processing system is inconsistent with all theories (whether defective filtering, slowed transfer in the primary processing channel, or response selection problems) that claim a single specific defect as basic to the schizophrenics' problem. It is clear that schizophrenics' information processing capacities are defective compared with those of other subjects, and that this relative deficit is not isolated to any one aspect of processing.
>
> (p. 402)

Research on span of apprehension has shown that schizophrenics perform equal with normals when stimulus displays contain only a target letter, but that when noise letters are presented along with the target, schizophrenics perform significantly less well than normals. This schizophrenic deficit has been explained in terms of more rapid decay and in terms of defect in a central processor. McIntyre, Fox and Neale (1970) found that with normal subjects increasing the similarity between noise and target letters reduced the probability of correct detections while increasing redundancy increased the probability of correct detection. These results suggested that the normal subject's processor may operate like a hierarchically organized feature detection system (Neisser, 1967). Each stimulus is processed only until it is determined to be signal or noise, and if noise can be discarded without further processing,

thus permitting a more rapid search for the target.

Davidson and Neale (1974) suggested that schizophrenics may have a deficit in this search process, thus processing even irrelevant information fully rather than following the more efficient method of early discarding of irrelevant information. They hypothesized that manipulating signal-noise similarity would have no influence on span of apprehension of schizophrenics, since they would attempt to process all information fully, regardless of whether it was signal or noise.

Subjects for this study were 18 schizophrenics (8 good premorbid adjustment and 10 poor premorbid adjustment) and 18 hospitalized nonschizophrenics. Stimulus displays were arrays of letters, each display containing a target letter, either T or F, and five noise letters. Noise letters for each display were either randomly selected, E, I, U or O. Each subject was presented 40 trials on each of the display conditions. Trials were presented in groups of 10 with each group containing only one type of display.

Results showed that schizophrenics and nonschizophrenics differed significantly on number of correct detections and that differences across types of displays were significant. There were, however, no interaction effects. Thus, though the idea of a schizophrenic span of apprehension deficit was supported, the hypotheses of an interaction between target-noise similarity and subject classification was not supported. Schizophrenics did not perform as predicted by a deficit model based on a malfunctioning central processor. Results were therefore interpreted

as suggesting that the schizophrenic deficit is in speed of information processing. The schizophrenic is seen as capable of performing the search operation for selecting targets, but he is slower than the nonschizophrenic in carrying out this operation.

Korbott and Damiani (1976) examined Chapman and McGhie's theory of a breakdown in schizophrenics' selective filter mechanism and Yates's theory of abnormally slow rate of processing by comparing acute schizophrenics (paranoid and nonparanoid), chronic schizophrenics (paranoid and nonparanoid) and neurotics in shadowing and signal detection tasks. Varying rate of presentation (2, 4 and 6 seconds) and type distraction (same digit as target, letter, different digit and no distraction) they found significant differences according to diagnostic category ($p < .001$), presentation rate ($p < .001$) and distracting condition ($p < .001$). The Presentation Rate X Distraction interaction was also significant ($p < .001$). Results were interpreted to support Yates's theory, that chronic (nonparanoid) schizophrenics are characterized by an extremely slow rate of processing. Results do not support McGhie and Chapman, since schizophrenics were able to exclude irrelevant material as effectively as neurotics in both the shadowing and signal detection tasks.

The authors suggested that the factors underlying the schizophrenic's deficit in speed of processing may be that the schizophrenic has periods of "defocusing" or tuning out and that this may be a protective mechanism against information overload.

Mefferd et al. examined the idea that the schizophrenic deficit was one of attention. Twenty-six schizophrenics and 26 nonschizophrenics listened to 140 words presented in seven groups of 20 as follows: two with no distractions; two with instructions for special performance but no distractions; and three with various sound distractions. The subject was instructed to repeat each word as he heard it, and reproduction failures were scored whenever the subject gave a word that was distinctly different from the stimulus word.

Under every condition schizophrenics had more reproduction failures than nonschizophrenics ($p<.05$). Conditions X Groups interaction was not significant, indicating that the two groups reacted to the distractions similarly. Mean reaction time for schizophrenics was longer than for nonschizophrenics, but the differences were not significant.

Since there was very little change in the rate with which schizophrenics failed to reproduce words throughout the sessions of administration of the words, doubt is cast on the notion that poor performance of schizophrenics is due to drifting attention. Results were also interpreted as not supporting a theory of distractibility, since schizophrenics did not suffer from the effects of distraction significantly more than did nonschizophrenics. Mefferd interpreted these results as supporting the notion that impaired perception may be a fundamental dysfunction in schizophrenics.

Sattler and Nordmark (1971), relating to an interference theory of schizophrenic functioning, hypothesized that schizophrenic subjects would recall fewer words and have more imports (incorrect responses) than normals.

Subjects for their study were 27 schizophrenic patients and 27 normals. A memory drum was used to present 21 words at the rate of one word every ten seconds, with a 3 minute interval between trials. Subjects were instructed to remember the words as they appeared and to write down in any order as many as they could recall after each trial. Dependent measures were number of words recalled correctly and number of imports.

Results showed that schizophrenics recalled significantly fewer words than nonschizophrenics ($p < .001$), that number of words recalled correctly increased significantly for both groups across the three trials ($p < .001$), and that normal subjects had a greater relative increase in correct responses across trials ($p < .05$). Although there was a tendency for normals to have more imports than schizophrenics, this difference was not significant.

Results were interpreted as supporting a limited attention span or interference theory of schizophrenic thought disorder, although the reasoning behind this interpretation was not clear.

A recent model that has been used to study the information processing mechanism of schizophrenics, also including a notion of a filter mechanism, has been proposed by Rosenberg and Cohen (1966) and applied to schizophrenic performance in a communication task by Cohen and Camhi (1967). The Cohen and Camhi study compared the performance of schizophrenic and normal subjects in "speaker" and "listener" roles. Schizophrenic speakers were found to be inferior to normals while listeners

were approximately equal. Rosenberg and Cohen (1966) suggested that the speaker role involves a two-stage process while the listener role involves a one-stage process. The speaker role begins with a sampling stage, in which possible responses are selected. This is followed by a comparison stage, in which the possible responses are evaluated and the sampled response is either emitted or rejected and sampling repeated. This cycle is repeated until the speaker finds an appropriate response and emits it. The idea of a filter mechanism is implicit in the comparison stage. Thus when sampling and comparison were both involved (speaker), schizophrenic performance is poor, but when only comparison was involved (listener), their performance was comparable to that of normals. Comparison combined with sampling may be defective, although comparison alone is not.

Nachmani and Cohen (1969) saw the speaker and listener roles as analogous to recall and recognition. Recall is seen as similar to the speaker role, since the subject must first sample items and then compare to determine the probability that the sampled item will be emitted. In recognition, however, only comparison is involved. One may expect, then, that schizophrenic subjects will show a deficit on recall tasks but not on recognition. The schizophrenic's impaired ability to make comparisons in recall tasks may result in overexclusion - erroneous decisions to reject a correct response - or to overinclusion - increased intrusion errors. Neither of these effects would occur in recognition tests.

Nachmani and Cohen tested this theory in a study of 30 schizophrenics (nonparanoid, chronic, undifferentiated) and 30 nonschizophrenics (neurotics) on tasks of recall and recognition. Each subject was tested in two sessions, one for recognition and one for recall. In the recall test, the subject viewed a list of 15 words, presented at a rate of one word per two seconds with 1.5 second interstimulus intervals, and was asked to say aloud as many of the words as he could remember immediately following presentation. Three trials of the same words in different random orders were given in each session. The recognition test was similar to the recall test, except that following presentation subjects were given a page containing 90 items, all the correct responses plus words in the same category (states or edible plants) and unrelated words. The subject was instructed to check off all the items which appeared on the original list. Three trials were given.

Results showed that schizophrenics gave significantly fewer correct responses on the recall test than nonschizophrenics ($p<.05$). On the recognition test, although schizophrenics made fewer correct responses than nonschizophrenics, the difference was not significant. Improvement across trials was significant for both groups, meaning that schizophrenics learned as rapidly as nonschizophrenics in tests of recall as well as recognition.

All overt incorrect responses were considered intrusion errors, either intraset (related category) or extraset (unrelated). Schizophrenics

made significantly more intraset intrusion errors on both recall ($p<.05$) and recognition ($p<.01$) tasks. Extraset intrusions were rare for both groups and so were not analyzed.

Results were interpreted as consistent with the idea that schizophrenics are defective in their ability to make correct comparison stage judgements when sampling and comparison are both involved. Overexclusion was found on recall but not recognition tasks. Overinclusion was found to be more prominent in recall tasks but still present in recognition tasks. Results, then, supported an overinclusion theory of schizophrenic thought disorder.

Weinberger and Cermak (1973) examined two interpretations of the theory of overinclusion. Cameron (1951) has suggested that overinclusion is more characteristic of acute paranoic schizophrenia than of chronic schizophrenia. During the acute phase of illness the paranoid searches for stimuli to explain his illness. In the chronic stage the delusional system has already been established, and external stimulation is no longer sought, resulting in overexclusion. Mednick (1958) and Broen and Storms (1966) have suggested that overinclusiveness in the acute schizophrenic would be most pronounced when he is asked to remember meaningful material. Highly meaningful material, which produces more associations for normals, would evoke even more responses for the acute paranoid. In other words, the acute paranoid, who tends to be overinclusive anyway, would be even more effected than normals by high meaningfulness of material.

The second theory examined by Weinberger and Cermak has been purposed by Martin (1968), that highly meaningful material is actually more specifically encoded than material low in meaningfulness. Highly meaningful words are therefore encoded intact rather than by means of further associations; therefore acute paranoids' recall for material low in meaning should be more effected.

Weinberger and Cermak predicted that if Mednick's hypothesis was correct, highly meaningful material presented to acute paranoids would lead to greater overinclusion than if material low in meaningfulness were presented. On the other hand, if Martin's hypothesis is correct, then the opposite would be true; acute paranoids' recall of low meaning material would be impaired more than his recall of material high in meaningfulness. It was further predicted that intrusion errors would not occur for chronic patients and that errors would be due to omission.

Subjects were 10 acute paranoid schizophrenics, 10 chronic schizophrenics and 10 normals. Subjects were presented to-be-remembered (TBR) materials on a memory drum, were distracted from rehearsing for a few seconds, and then were asked to repeat the TBR material. Presentations consisted of 5 consecutive trials with each of 4 types lists; consonant trigrams, nonsense syllables with low association values, nonsense syllables with high association values and words. Number of correct words or letters recalled and intrusions were recorded.

Results showed that acute paranoid schizophrenics included a greater percentage of intrusion errors than did normals or chronic paranoids ($p<.01$).

This was most evident when stimulus materials were highly meaningful. When material was low in meaningfulness, acute paranoids recalled as well as normals. Apparently the acute paranoid schizophrenic was more distracted by highly associated information than were the other groups. This supports Mednick's theory that highly meaningful material produces more associations during the encoding process than does low-meaningful material and that this increase in associations affects acute paranoid schizophrenics to a greater extent than normals. Acutes are, that is, more easily distracted by irrelevant information than are normals or chronic patients. The hypothesized tendency for chronics to overexclude was also confirmed, in that they made more omission errors over all conditions.

Bauman (1971) investigated the possibility that schizophrenics could not use stimulus cues for organization at input. If schizophrenics see input as a mass of unrelated and unorganized material and are oblivious to stimulus cues to aid organization, then poor recall of both organized and unorganized material may be predicted. Schizophrenic recall would not show the improvement with increased organization at input that normals' recall shows. Bauman also looked at the ability of schizophrenics to use vocalization as an aid to immediate recall. It has been shown that in normal subjects vocalization facilitates recall, since it adds another cue. It has not been shown, though, whether schizophrenics could profit from this cue. Since schizophrenics seem to have difficulty in integrating input from more

than one modality at a time (Chapman and McGhie, 1963), it is possible that vocalization would result in a decrement in recall.

Subjects for Bauman's study were 24 schizophrenics (mostly acute) and 24 normals. Materials were 32 seven-letter lists. Half of the lists contained random letters while the other half contained CVCVCVC sequences. Each subject was instructed to voice 8 random and 8 organized lists. Lists were shown on a memory drum at the rate of 2 letters per second. At the end of one list presentation, subjects recalled the list items in order and recorded them on an answer sheet.

Results showed that normals made significantly more correct responses than schizophrenics ($p < .01$), both normals and schizophrenics recalled organized lists significantly better than unorganized lists ($p < .01$), and there was no difference between the two groups' ability to profit from organization at input. Voicing resulted in significantly better recall for both groups ($p < .01$) but produced a larger increment in recall of random lists than of organized lists ($p < .02$). The hypothesis that schizophrenics were deficient in their ability to use stimulus cues at input was rejected, since they were able to profit as well as normals from organization at input and from vocalization. Findings seem to be at odds with those of Lawson, McGhie and Chapman (1964) who found schizophrenics' recall to fall behind that of normals as degree of organization increased. This discrepancy may be explained, though, in terms of methodological differences in the present study and the Lawson et al. study. Tulving (1962) has shown that recall is directly proportional to degree of

organization subjects are able to impose on input and that the facilitating effect of subjective organization increases with trials for normals. In the Lawson et al. study subjects were given repeated trials with the same material, and schizophrenics were found not to profit from the opportunity to increasingly organize material. However, in the present study subjects were given only one trial per list, so performance was dependent upon ability to use contextual restraints imposed by the input material rather than upon any opportunity to increase organization from trial to trial. Further, the Lawson et al. study used 20-item lists, so long that chunking of material was necessary for recall, and schizophrenics have been found unable to organize in this manner.

Analyzing data according to serial position, Bauman found a very weak recency effect in schizophrenics. This result was explained in terms of output interference. In terms of signal detection theory the suggestion is that the process of responding produced an increase in background noise, thus reducing the signal-to-noise ratio in schizophrenics.

Subjective Organization

One study of memory organization in schizophrenics does not add much to understanding of the problem but is mentioned as representative of a study relating memory to the genetic conceptual framework as explained by Heinz Werner (1957), who found that when subjects were asked to remember a list of digits that greatly exceeded their capacity for retention, the amount of material retained by older children and adults was closer to their capacity than that of young children. Werner had interpreted this in terms of the inability of the developmentally immature subjects to build a continuous whole, whereas the more mature subjects could organize discrete items for retention.

In a study of schizophrenic patients Rieger and Friedman (1970) hypothesized that schizophrenic patients would show less differentiation and hierarchization in memory organization than normal subjects and that nonparanoid schizophrenics would show less organization than paranoid schizophrenics. Subjects for the study were 19 paranoids, 17 nonparanoids and 12 normals. Stimulus materials were 36 lists of letters, from four through twelve letters in length, shown by means of a memory drum, one letter at a time, at the rate of one per second. Each list was presented three times. At the conclusion of presentation of one list, subjects were to repeat as many letters from the list in correct order as they could remember. Using various criteria

for establishing capacity, Rieger and Friedman found that as the number of letters on a list increasingly exceeded a subject's capacity by one through six letters, schizophrenics recalled less and less than normals ($p < .01$ and $p < .05$). Significant differences between paranoids and nonparanoids were not found, though differences were in the predicted direction.

Although this study was carried out within the theoretical framework of genetic levels of hierarchization and differentiation, it is difficult to see how this study tests that theory.

Bauman and Murray (1968) looked at schizophrenic recognition and recall within the framework of overinclusiveness. Since recognition involves that the subject select a response from a limited number of responses while recall involves selecting from a wide repertoire within the subject himself, it was suggested that schizophrenics would be poorer at tasks of recall but not of recognition than normals. It was further suggested that overinclusive schizophrenics would have more difficulty with recall than would nonoverinclusive schizophrenics.

Twenty-four schizophrenics and 24 normals were classified as overinclusive or nonoverinclusive (the authors discovered quite by accident that normal subjects varied widely on overinclusiveness as well as did schizophrenics). Subjects were presented with 2 lists of 20 words each on a memory drum at the rate of 3 seconds per word. For the recall test, subjects were asked to immediately write down as many of the words as they could remember in any order. For the

recognition test, subjects were presented with a sheet of paper on which appeared 80 words, the 20 stimulus words, 20 rhymes, 20 synonyms and 20 rhymes of synonyms, and were asked to circle the 20 correct words. Measures of recall and recognition were numbers of words correctly recalled or recognized.

Results showed only the recall versus recognition factor to be significant ($p < .001$). No other factors (patients versus normals, overinclusive versus nonoverinclusive or interactions) were significant. However, when orthogonal comparisons were made of the recall, normals did better than patients ($p < .05$). Also the pure recognition scores of overinclusive patients were higher ($p < .02$) than those of nonoverinclusive patients, a result contrary to what was expected.

Results were interpreted as suggesting that schizophrenics have little difficulty with the acquisition phase of memory but may have difficulty in the association-forming stage, which would be reflected in their inability to organize material for retrieval.

Bauman (1971) investigated the problem of subjective organization in schizophrenics again in a study of schizophrenic short term memory, this time without reference to overinclusiveness, which did not distinguish groups as had been expected in the Bauman and Murray study (1968). The earlier study had shown that schizophrenics had a short term memory recall deficit; this study tried to find whether the recall deficit was due to inability to "chunk" or "subjectively organize" material for output.

Tulving (1962) has reported that normal subjects learn to organize output both by practice and by special instructions. Bauman tried to determine whether practice and special instructions could aid organization in schizophrenics as well as in normal subjects.

Twenty-four schizophrenics and 24 normals were subjects for this study. Stimulus materials were 2 ten-item lists of trigrams, each consisting of a vowel and two consonants. Subjects were assigned to a "special instructions" group or a "no instructions" group. In the special instructions group subjects were told that each trigram started with a different letter of the alphabet and that to remember this would help them recall the words. The "no instructions" group were told nothing about organization of the list. In each group lists were presented by memory drum at the rate of 3 seconds per word. Each list was presented 3 times. For recall subjects were asked to immediately remember as many trigrams as they could in any order. For recognition they were asked to select the stimulus trigrams from a list containing the ten stimulus words and twenty distractors.

Results showed that schizophrenics did show improved recall with practice ($p < .01$) but that organizational hints did not improve recall. In contrast, normals benefited from practice ($p < .01$) and from special organizational instructions ($p < .05$). Further, schizophrenics were inferior to normals in recall ($p < .05$) but not in recognition. Special instructions facilitated recall in normals, then, because they were able to use the suggested method of subjectively organizing material. The

hypothesis that schizophrenics were deficient in ability to chunk or subjectively organize material was supported. The fact that recognition in schizophrenics was unimpaired suggests that input was stored. The problem seems rather to be that they have difficulty in organizing material for retrieval. It is suggested that results would have been even more clear if the schizophrenic subjects had been a more homogeneous group.

Following Miller's (1956) unitization theory, Koh, Kayton and Berry (1973) concluded that the basic dysfunction in schizophrenia might be a difficulty in organizing or chunking input material to lessen the load on short term memory. They investigated this assumption by comparing schizophrenics' recall and recognition with that of normals.

Koh et al. conducted two experiments, one to investigate recall and the other recognition. The first used a multi-trial free recall procedure. The second used a list-learning procedure. In the free recall procedure the subject was allowed to recall items in any order. A list was presented repeatedly, with different order each time and allowing the subject to develop his own order and organization of words. This fixed-order recall that tends to develop is believed to reflect the organizational strategy the subject uses. Thus the organizational process can be inferred from the order of recall. In the recognition procedure, a list of study items was presented to the subject, who was at the end of a presentation asked to identify stimulus words from a list containing stimulus words and distractors. Words for this experiment

varied in terms of categorical membership, frequency and associative values.

Subjects for the first experiment were 12 schizophrenics, 12 other psychiatric patients and 12 normals. Two word lists were used, one categorized and the other uncategorized. The uncategorized list contained 20 unrelated words. The categorized list contained 20 words from 5 conceptual categories, 4 words belonging to each. Each word was presented by slide at a rate of 1 word per 2 seconds. At the end of presentation of a list, subjects were to say aloud as many of the words as they could remember in any order.

Results showed a significant group effect ($p<.05$). Normals recalled better than schizophrenics in both types lists (uncategorized $p<.01$; categorized $p<.01$). Nonschizophrenics recalled better than schizophrenics in both types lists, but this difference was not significant. A significant Group X Trial interaction was found for the categorized list ($p<.01$), showing a slow rate of recall learning in schizophrenics.

The organizational processes that might have contributed to these results was then examined in terms of subjective organization, categorical clustering and hierarchical clustering. Subjective organization was defined as the extent to which a subject recalled a pair of words in contiguity on two successive trials. This measured the extent to which a subject imposed organization on input material. Results showed that subjective organization of schizophrenics was inferior

to that of normals ($p < .01$) and of nonschizophrenics ($p < .05$). In fact there was no significant increase in organization over trials for schizophrenics, while the increase was significant for normals ($p < .05$) and for nonschizophrenics ($p < .05$).

Categorical clustering was defined as the number of times items from the same category were recalled consecutively and reflects the extent to which a subject was able to use the organizational cues provided for him by the experimenter. Results showed that scores of the normals were significantly higher than those of schizophrenics ($p < .05$), and there was a Groups X Trials interaction, indicating that schizophrenics showed a slower increase in clustering over trials than did normals.

Hierarchical clustering refers to connectedness and is measured by analysis of items recalled in immediate sequence by subjects. This analysis did reveal that normals tended to have more consensus in their clustering than did schizophrenics.

The experimenters concluded that the above results showed that schizophrenics' organizational strategies are loose, peculiar and idiosyncratic. While normals tend to build up organization to help them in recall over trials, schizophrenics do this only very weakly. The schizophrenic deficit in mnemonic organization is seen to be a matter of degree rather than a qualitative difference.

In the second experiment 20 schizophrenics and 20 normals viewed words and CVC combinations. For the word recognition 60 high

frequency words were selected from four conceptual categories and 60 low frequency words from four different categories. Twenty from each the high frequency and the low frequency group were selected as stimulus words and the remaining words were used as distractors. Stimulus words were presented on slides at a rate of 2 seconds per word. Immediately upon completion of a presentation subjects were asked to pick out the stimulus words from a mimeographed list containing both target and distractor words. The CVC test was similar. Two trials were given for each word recognition list and three for each CVC list.

Results of the word test showed a nonsignificant Groups effect and a nonsignificant Groups X Trials interaction, indicating that normals and schizophrenics learned equally well for recognition. For the CVC test, there was a significant Groups effect ($p < .05$) that was due only to trial 2 of the three trials, and this only for the low-association CVCs. Results were interpreted as meaning that recognition memory of schizophrenics was comparable to that of normals regardless of type material used (words or CVC combinations), and regardless of contextual variations (frequency, conceptual categories and association values). Thus the storage of appropriate information and the decision process are not impaired in schizophrenics. The deficit lies rather in difficulty in retrieving appropriate information from memory. This study confirmed the earlier findings of Bauman and Murray (1968), Bauman (1971) and

Nachmani and Cohen (1969). The first two studies, however, explained the deficit in terms of organizational deficit as does the present study, while Nachmani and Cohen explained it in terms of defective interaction between search and comparison.

Again looking at the search and decision processes involved in recall and recognition, Traupmann (1975) examined mnemonic organization of schizophrenics by manipulating variables assumed to affect search and decision. One variable that contributes to search is interitem association or categorization. Presumably such variables as meaningfulness and semantic constraints help normal subjects organize material in memory and thus make it more available for retrieval in the search stage of recall. Schizophrenics, however, have been shown to have a deficit in recall and not to benefit from organizational cues. Thus their search process is impaired.

Decision, the ability to choose from among alternate responses, is important both for recall and recognition. A variable that seems to affect decision is imagery. If the schizophrenic's decision process is unimpaired, which is a possibility, since his recognition memory has been shown to be comparable to that of normals, then he should be affected by manipulation of imagery in the same way as normals. Traupmann hypothesized that the decision process of schizophrenics operates normally and therefore the schizophrenic's recognition performance should be directly related to imagery. On the other hand, the search process of the schizophrenic is dysfunctional, so recall of

schizophrenics should be unaffected by categorization. Another hypothesis was that process and reactive schizophrenics would be differentially affected by these variables.

Subjects for Traupmann's study were 16 process schizophrenics, 16 reactive schizophrenics and 16 normals. Stimulus materials were four lists of 16 words each constructed as follows: list 1 and list 2 each were comprised of 8 low imagery uncategorized and 8 high imagery uncategorized words; lists 3 and 4 were each comprised of 8 low imagery words representing two categories (4 words in each) and 8 high imagery words representing two different categories (4 words in each). Stimulus words were projected on a screen at a rate of one word per 2 seconds with 1.5 interstimulus intervals. Immediately following a presentation, subjects were to either recall the list by writing as many of the 16 words as could be remembered or to recognize list items from a printed sheet containing the list items plus one synonym, one antonym and one rhyme for each stimulus word. Lists were viewed once for recognition. Four recall lists were viewed 10 times or until all words were learned, whichever came first.

Results of the recognition test showed that recognition did not differ significantly between the normals and reactive schizophrenics, but both groups recognized more items than did the process schizophrenics ($p < .01$). Neither categorization nor the Pathology X Categorization interaction was significant, indicating that categorization did not affect recognition for any of the groups. The main effect of imagery was

significant ($p < .05$), but the interaction Pathology X Imagery was not significant, indicating that imagery exerted the same influence on recognition for all groups.

Results of the recall test showed a significant difference between normals and reactive schizophrenics and between reactive and process schizophrenics (both $p < .01$) in items recalled. Also the Pathology X Trials interaction was significant ($p < .01$), indicating that group differences increased over trials. The Pathology X Categorization interaction was significant ($p < .05$), indicating that categorization helped normals and reactives but had no effect on process schizophrenics. The Pathology X Imagery interaction was significant ($p < .01$), showing that the effect of imagery on recall depended on pathology. Imagery facilitated memory in both normals and reactives but had no effect on the process group.

Results were interpreted to mean that schizophrenics can be distinguished along process-reactive lines, and that whereas the reactive schizophrenics seem to have a relatively intact information retrieval system, process schizophrenics are severely dysfunctional at imposing upon TBR material the kind of organization necessary for retrieval, that they suffer a search deficit. Traupmann observed that, whereas other investigators had found no recognition deficit in schizophrenics, he had found a deficit. He suggested a possible explanation for this in terms of the process schizophrenic's tendency to filter out external stimulation, thus the information being

unavailable to be stored in memory. This deficit may not be observed unless schizophrenics are divided into subgroups as in the present study. The schizophrenic's tendency to avoid stimulation may also be behind his deficit in mnemonic organization, in that the process schizophrenic may close down internal processes as well as closing out external stimuli. This may preclude active processing of information and prohibit the quality of organization necessary for proficient recall.

Koh, Kayton and Peterson (1976), looking at the literature showing a schizophrenic deficit in recall and at studies that saw this as at least partially due to a problem in use of organizational strategies, tried to find out whether the deficit was due to inability to organize or to a disuse or underuse of organizational strategies that was related to attention to those strategies. In other words, could schizophrenics be induced to code according to semantic properties of stimuli? Specifically the investigators asked; (1) whether the recall deficit in schizophrenics would disappear when affective-semantic coding was induced; (2) whether schizophrenics' recall of affective words differed from that of normals due to the schizophrenic disturbance in affect; (3) whether schizophrenics' rate of recall learning would be comparable to that of normals once encoding was achieved; and (4) whether schizophrenics used affective properties of stimuli for mnemonic organization.

Subjects for this investigation were 18 schizophrenics, 15 nonschizophrenic patients and 19 normals. Materials were two 50-word lists constructed from various sources of affectively rated words. The investigation involved two sessions, an incidental learning session and an intentional learning session.

In the incidental learning session subjects were given a list of 50 words and asked to rate them on a scale of one through seven as pleasant or unpleasant. They were then asked to repeat the process. After two independent ratings were completed, subjects were asked to recall as many of the words as they could in any order. After this was completed they were asked to recall the words again, but this time they were given an answer sheet with the seven degrees of pleasantness or unpleasantness appearing at the top of the page to serve as cues for recall.

In the intentional learning session subjects were asked to rate each word once but were told that they would later be asked to recall the words. They then viewed the words again one at a time projected on a screen for two seconds each. Then, following a brief distracting task, they were asked to recall the words in any order. This study, distraction and recall task was performed four times.

Results showed that the pleasantness encoding systems of the three groups were comparable. On the incidental learning task there was no significant difference in recall among the three groups, and

none of the groups showed significant differences in recall of pleasant words, unpleasant words or neutral words. Cued recall was not superior to free recall. Clustering scores, which reflected the degree to which words were stored according to their affective features, were not significantly different among the groups.

On the intentional learning test there was again no significant difference among groups in recall, but there was a significant trial effect, meaning that all groups improved comparably over trials. The groups were comparable in subjective organization as measured by the extent to which subjects recalled a pair of words in contiguity on two successive trials. Organization as measured by clustering did not differ significantly among the groups, except that normals' pleasant word clustering was higher ($p < .01$) than that of schizophrenics or nonschizophrenices.

Results were interpreted as demonstrating that the storage and retrieval processes of schizophrenics become comparable to those of normals, when TBR materials have been appropriately encoded, regardless of intent to learn. This is seen as supporting the notion of a schizophrenic dysfunction in selective attention and in mnemonic strategy. Apparently the semantic memory of the schizophrenic is intact, but he is less able than normals to use this storage structure in deriving mnemonic strategies.

Studies cited above have shown that schizophrenics, particularly process or chronic schizophrenics, do not organize material adequately

in memory, but it had not been shown whether schizophrenics actually fail to encode information conceptually or simply fail to use the information they have encoded. Traupmann, Berzofsky and Kesselman (1976) investigated whether or not schizophrenics encoded the attributes of verbal material by looking at whether or not they experienced proactive interference release. It has been shown (Wickens, 1972) that with normal subjects, in the course of several trials with TBR material sharing some common attribute, such as category membership, recall probability tends to decrease, that is, proactive interference occurs. If an additional set of material not sharing that attribute is presented, the probability of recall may increase, that is, proactive interference release will occur. Proactive interference release is taken as evidence that subjects have encoded according to the common attribute.

Subjects for this experiment were 20 paranoid schizophrenics and 20 chronic undifferentiated schizophrenics, divided equally between experimental and control conditions. Materials were index cards on which were printed groups of three words from one taxonomic category. There was a total of 24 cards, representing 9 categories. In the experimental deck cards were arranged so that all three cards from one category were together, whereas the control deck was arranged randomly. Under both conditions subjects were shown a card, performed a distracting task and then were asked to recall the stimulus words on the card. Scoring allowed one point for each correct item.

Results showed that both groups experienced PI release under experimental but not under control conditions. Experimental subjects showed a consistent pattern of high to low recall scores over three trials, whereas control subjects showed a very slight decline over the 24 trials. These results supported the idea of PI release following changes in taxonomic word classes for both paranoid and chronic, undifferentiated schizophrenics. Chronic schizophrenics, then, are able to encode attributes that characterize different conceptual categories.

Comparing these results to previous observations that chronic schizophrenics fail to cluster and fail to recall more items from categorized than from uncategorized lists, Traupmann et al. offered as an explanation for the apparent discrepancy the possibility that schizophrenics do use passive information processing strategies but perhaps not active strategies. PI release is seen as a passive, automatic process whereas clustering requires active strategic behaviors. The process or chronic, undifferentiated schizophrenic's tendency to avoid the external world may also involve under-using certain information processing strategies over which the schizophrenic has control but may not affect those which are more or less automatic.

Summary

The literature on memory deficit in schizophrenics was discussed in two sections, studies relating to attention, distractibility and interference and studies relating to subjective organization. The results of these studies can be integrated to some extent, particularly when the schizophrenic memory deficit is seen as involving more than one type dysfunction.

Before looking at results of the studies one may consider some problems in integrating and drawing conclusions from the studies. First, the different models used for the studies are so numerous as to make comparison difficult; very little replication has been done. Second, definitions of schizophrenia and subtypes of schizophrenia according to clinical symptoms and stages of illness are widely different from study to study. Those studies which do not subtype schizophrenics are particularly difficult to interpret, since there is strong evidence that some schizophrenics (reactives, hebephrenics, chronics) perform poorly on tasks whereas others (reactives, paranoids, acutes) may perform approximately as normals. Last, the same phenomena are explained in terms of different theories. The last few studies in this review are particularly important, since they differentiate between ability to perform certain operations and the consistent actual performing of the operations.

One result is fairly clear; schizophrenics do have some dysfunction that results in memory impairment. There is much evidence for this. The literature indicates that schizophrenics do have difficulty in attending to stimuli; that they have trouble selecting appropriate responses; that they are slow processors of information; that they have greater difficulty when presentation of stimuli is visual than auditory; that they are poorer at recall than at recognition tasks; and that they have difficulty in using organizational cues. No study shows that schizophrenics are completely incapable of performing any aspect of information processing but rather that they do not perform as fast, efficiently or consistently. The difference between schizophrenics and normals appears to be one of degree rather than of quality. Also, when specifically induced to organize material, schizophrenics are capable of performing as well as normals. A possible conclusion, then, is that schizophrenics suboptimally use information processing strategies and that Conrad's redundancy theory of schizophrenia may be a more adequate explanation of the schizophrenic memory deficit than any theory that focuses on one aspect of the deficit only, such as attention or subjective organization.

Chapter 3

Methodology

The purpose of this study was to investigate schizophrenic thought disorder by attempting to differentiate subtypes of schizophrenics according to their use of certain active information processing strategies. In this chapter the procedures and methods of research used to carry out this investigation are presented as follows: (a) subjects, (b) materials, (c) design, (d) procedure, and (e) statistical methods.

Subjects

Twenty-four inpatients (12 thought disordered and 12 non-thought disordered) chosen from the population of Eastern State Hospital, Williamsburg, Virginia, a state psychiatric hospital, were subjects. No subject was overtly psychotic at time of testing. All patients had been diagnosed as schizophrenic (paranoid type, 14, chronic undifferentiated type, 8, and schizo-affective type, 2) and did not also carry a diagnosis of organic brain disease or alcoholism. Diagnosis was made by the ward physician on the basis of psychological testing, social history and psychiatric interview. Criteria used were those of the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM - II). Patients used as subjects were selected by an experienced clinical psychologist who was familiar with them and were used in the experiment only if they could be clearly classified as thought disordered or non-thought disordered according to Lorr's

criteria. Patients were further classified, as process or reactive, on the basis of scores received on the Ullmann-Giovannoni Process-Reactive Scale (Appendix A), those scoring below the median for all subjects being considered process and those scoring above the median being considered reactive. Median score was 10, and the range was 3 - 23. Of the thought disordered patients 8 were classified as process and 3 reactive. Of the non-thought disordered patients 3 were classified as process and 8 reactive. Two patients, 1 thought disordered and 1 non-thought disordered, received the median score and so were not classified.

The mean length of hospitalization, defined as total years spent in a mental hospital, was 6.2 years and the range 1 - 17 years. Mean age was 38.9 years and the range 19 - 61 years. The thought disordered and non-thought disordered groups did not differ significantly in years hospitalization or age, though the thought disordered group was very slightly older and had slightly more years hospitalization than the non-thought disordered group. Mean education level was 12 years and the range 7 - 17 years. The groups did differ significantly on this factor ($t=3.62$, $p<.001$), mean education level for thought disordered schizophrenics being 10.5 years and for non-thought disordered schizophrenics 13.4.

Patients were left on phenothiazine medication partly because psychiatrists would have been reluctant to interrupt patients' therapy and partly because withdrawal from medication may have resulted in

patients' being untestable. The literature indicates, however, that phenothiazines have no significant effect on memory (Daston, 1959; Helper, Wilcott and Sol, 1963; Vestre, 1961). Median medication level, converted to milligrams of Thorazine, was 700 and the range 0 - 2000. Characteristics of the groups are summarized in Table 1.

Participation in the research was voluntary, and there were only 3 refusals (2 paranoid schizophrenics and 1 chronic, undifferentiated type).

Table 1

Characteristics of Subjects

Group	Age	Education (in yrs)	Length Hospitalization (in yrs)	Medication Level (in mgm. Thorazine)
Thought Disordered (N=12)				
Median	39.0	11.0	8.5	750.0
Mean	39.4	10.5	6.6	802.7
Range	19-59	7-13	1-11	0-2000
Non-Thought Disordered (N=12)				
Median	34.0	12.5	4.0	700.0
Mean	38.3	13.4	5.8	662.5
Range	28-61	11-17	1-17	0-2000

Materials

Six lists, each consisting of 12 simple and familiar words, were constructed (see Appendix C). Two of the lists, homophone lists, consisted of 6 homophone pairs. Rhymes, synonyms and closely related words were not used. Words on these lists were arranged in random order with the restriction that members of one pair of homophones never appeared in succession on a list. Two of the lists, synonym lists, were composed of 6 synonym pairs each, obtained from a synonym dictionary. Words on these lists were arranged in random order with the restriction that members of one pair of synonyms never appeared in succession on a list. The remaining 2 lists each consisted of 12 unrelated words, neither rhymes, synonyms nor homophones, arranged in random order.

For each of the 6 word lists, 3 different random orders were constructed.

Twenty-four random arrangements of lists were prepared. Thus, each subject was presented with a different random ordering of lists and one of three different arrangements of words within each list. One of each type list (homophone, synonym or unrelated) was assigned for visual presentation and one for auditory presentation for each subject on a random basis (see Appendix D).

A memory drum set at a rate of 2 seconds per word was used for visual presentation. A cassette tape recorder, playing a female voice saying words at a rate of 2 seconds per word, was used for auditory presentation.

Design

Twelve subjects were assigned to the thought disordered group and 12 to the non-thought disordered group, according to methods and criteria already defined. In individual sessions, subjects from the two groups performed identical tasks, trying to remember 6 lists of words varying in mode of presentation (visual or auditory) and list type (homophone, synonym or unrelated). Each subject viewed three lists, one synonym, one homophone and one unrelated list, and listened to three lists, one synonym, one homophone and one unrelated. Each subject was presented with a different random ordering of the 6 lists and one of three different intralist word arrangements for each list. After presentation of a list a subject was asked to remember as many words from the list as he could before presentation of the next list. This procedure was repeated until all six lists has been presented and responded to. The dependent measure was number of words remembered correctly, according to type presentation, type list and membership in the top half (positions 1-6, LTM) or bottom half (positions 7-12, STM) of a list.

Procedure

Testing involved one individual session with each subject, lasting from 20-60 minutes. The subject was informed of the nature of the research and was told that it would involve trying to remember some word lists. He was assured that it would not harm him in any way and that it was not related to his treatment or plans for release from the hospital. The subject's written permission to participate in the research was then obtained by his signature on Form of Consent to Research, as required by the Patients' Rights Committee of Eastern State Hospital (see Appendix E).

Before beginning testing the researcher asked the subject to read a brief and simple passage from a magazine to be sure the subject could read well enough to participate in the research. The researcher then asked the subject if he could hear her voice well, to be sure there was no hearing problem that would preclude the subject's participation. The researcher then demonstrated the testing equipment so that the subject would feel comfortable with it once testing began.

The subject was then told that testing was about to begin. He was told to concentrate on each word as it was presented, because at the end of a presentation he would be asked to remember as many words as possible in any order. The subject was told to start saying the words he could remember as soon as the memory drum or recorder stopped and not to wait for the researcher to ask him to say the words. As soon as the researcher believed that the subject understood the instructions, testing began.

The subject was told to look at or listen to the first list of words, depending upon mode of presentation. Then the list was presented at a rate of one word per 2 seconds on either the memory drum or the recorder. After a list of 12 words had been presented, the researcher waited for the subject to say aloud as many words as he could remember. If the subject hesitated, the researcher said, "You may start now.", or, "Can you remember any more?". The subject was allowed to take as much time as he needed to respond until the researcher was convinced he could recall no more words. As the subject responded, the researcher recorded responses verbatim, in the order given, on Subject Data and Response Sheet (see Appendix F).

This procedure was repeated until the subject had listened to one of each type list and had viewed one of each type list, a total of 6 presentations.

After testing was completed the researcher let the subject talk about the experience and ask questions. The researcher then administered the Ulmann-Giovannoni Process-Reactive Scale by letting the subject read it and by helping out if the subject appeared to have any difficulty reading or understanding the Scale (responses were later checked against information in clinical records).

Statistical Methods

The one-tailed independent t-test was used to examine differences between thought disordered and non-thought disordered schizophrenics in over-all recall (hypothesis 1) and in recall under the four conditions, STM-visual, STM-auditory, LTM-visual and LTM-auditory (hypotheses 2 and 4).

The dependent t-test was used to examine the relationship among performances under each of the four conditions within each group (hypotheses 6 and 7). Separate t-tests were used for each group, thought disordered and non-thought disordered. Since it was predicted that the mean for STM-auditory for thought disordered schizophrenics would be significantly higher than the means for the other three conditions, the one-tailed t-test was used for comparisons of thought disordered STM-auditory with STM-visual, LTM-auditory and LTM-visual. The two-tailed t-test was used for all other comparisons within the thought disordered group and for all comparisons in the non-thought disordered group, since no directional differences were predicted for these comparisons.

The dependent t-test was used to compare each group's performance according to list type (hypotheses 3 and 5), using the one-tailed or two-tailed test, according to whether a directional difference was predicted.

Since the two groups differed significantly on education level, some effort was made to examine the effects of this difference.

Correlation coefficients between education level and performance of the combined groups under each condition and total words correct were calculated. Because it was already known that the two groups differed significantly on education level, it would violate one of the assumptions of covariance to use education level as a covariate. This has been done anyway, but the results must be interpreted quite cautiously.

Although no prediction was made about what differences would have occurred if subjects had been grouped according to the process-reactive distinction rather than according to the thought disordered/non-thought disordered distinction, it was believed that a comparison of results using the two different criteria for grouping subjects would be useful. This is particularly so, since some of the related research uses the process-reactive distinction. Therefore, the same analyses that were done for hypotheses 1, 2, 4, 6 and 7 were repeated using process-reactive groupings.

Chapter 4

Results

The results of this investigation are presented in this chapter. Results pertaining to hypotheses 1, 2 and 4 will be presented first. Results pertaining to hypotheses 6 and 7 will be presented next. Third, results pertaining to hypotheses 3 and 5 will be presented. Last, other results, pertaining to the possible influence of education level and the process-reactive grouping will be presented.

Hypothesis 1: There will be a difference in over-all number of words remembered between thought disordered and non-thought disordered schizophrenics, in that thought disordered schizophrenics will remember fewer words.

Hypothesis 2: As compared with non-thought disordered schizophrenics, thought disordered schizophrenics will show a deficit in STM for visually presented stimuli while performing at a level comparable to non-thought disordered schizophrenics in STM for auditorially presented stimuli.

Hypothesis 4: As compared with non-thought disordered schizophrenics, thought disordered schizophrenics will show a deficit in LTM, regardless of mode of presentation.

Table 2 shows comparisons between thought disordered and non-thought disordered schizophrenics in total words correctly recalled and words correctly recalled under the four conditions, STM-visual, STM-auditory, LTM-visual and LTM-auditory. Mean total words correct

for thought disordered schizophrenics was 15.25 and for non-thought disordered schizophrenics 27.08 ($t=5.495$, $p<.0001$). In other words, thought disordered schizophrenics remembered significantly fewer words than did non-thought disordered schizophrenics. Hypothesis 1 is supported by these results. The serial position curve shown in figure 1 depicts this difference. One may see that the serial position curve for thought disordered schizophrenics lies below the curve for non-thought disordered schizophrenics at every point.

Under the condition STM-visual the mean number of words remembered for thought disordered schizophrenics was 3.92 and for non-thought disordered schizophrenics 6.75 ($t=2.9820$, $p<.0069$), showing that thought disordered schizophrenics remembered significantly fewer words under this condition than did non-thought disordered schizophrenics. Under the condition STM-auditory the mean number of words remembered for thought disordered schizophrenics was 6.17 and for non-thought disordered schizophrenics 7.25 ($t=.9605$, n.s.), showing that the two groups did not differ significantly on STM for auditorially presented stimuli. These findings support hypothesis 2.

Under the condition LTM-visual mean number of words remembered by thought disordered schizophrenics was 2.67 and for non-thought disordered schizophrenics 7.16 ($t=4.0578$, $p<.0005$), showing that thought disordered schizophrenics remembered significantly fewer words under this condition than did non-thought disordered schizophrenics. Under the condition LTM-auditory, thought disordered schizo-

Table 2

Differences in Number of Words Remembered by Thought Disordered and Non-Thought Disordered Groups Under Various Conditions

Condition	Mean	SD	ST Error	t	Df	P<
STM-visual						
TD (N=12)	3.917	2.539	0.733	2.982	22	0.007
NTD (N=12)	6.750	2.094	0.605			
STM-auditory						
TD	6.167	3.243	0.936	0.961	22	0.347
NTD	7.250	2.179	0.629			
LTM-visual						
TD	2.667	2.059	0.595	4.058	22	0.001
NTD	7.167	3.243	0.936			
LTM-auditory						
TD	2.500	1.732	0.500	3.444	22	0.002
NTD	5.917	2.968	0.857			
TOTAL						
TD	15.250	6.538	1.887	5.455	22	0.001
NTD	27.083	3.704	1.069			

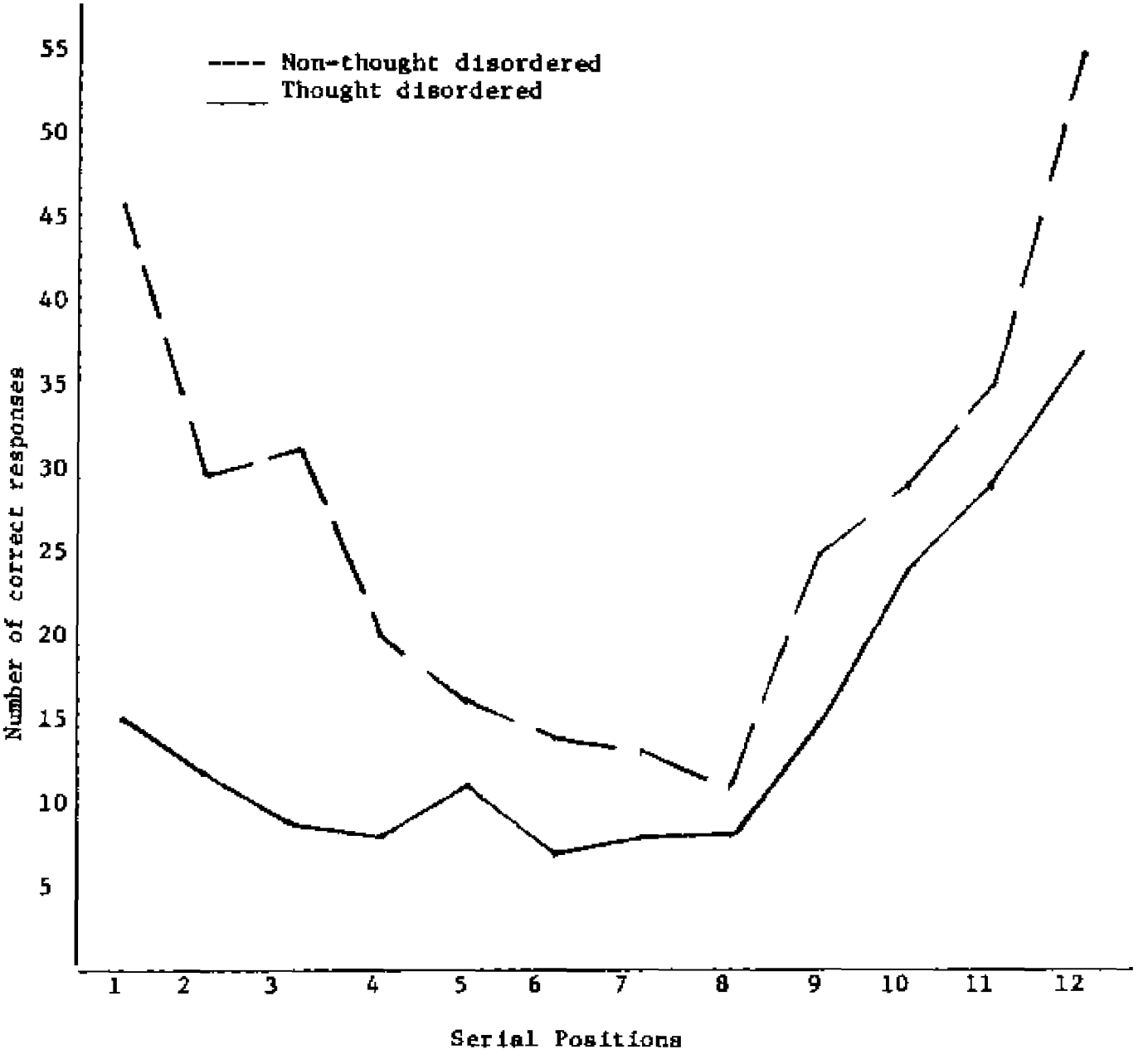

Fig. 1. Number of words remembered in each serial position by thought disordered and non-thought disordered groups.

phrenics remembered a mean of 2.50 words while non-thought disordered schizophrenics remembered a mean of 5.92 words ($t=3.4440$, $p<.0023$), showing that thought disordered schizophrenics remembered significantly fewer words than did non-thought disordered schizophrenics under this condition. Thus hypothesis 4 was supported, thought disordered schizophrenics being inferior to non-thought disordered schizophrenics in LTM, regardless of mode of presentation.

Figure 2, showing number of words correctly remembered by each group in each serial position according to condition, depicts these results. Words in serial position 7-12 (STM) of the auditory presentation were remembered almost as well by thought disordered schizophrenics as by non-thought disordered schizophrenics, while words in earlier serial positions and words presented visually were not remembered as well by thought disordered schizophrenics as by non-thought disordered schizophrenics. It may also be noted that the serial position curves for non-thought disordered schizophrenics resemble a typical serial position curve, while the curves for thought disordered schizophrenics are flattened out on one end, showing this group's deficit in LTM.

The reader who is interested in correlations of number of words correct under various conditions with total words correct and words correct under every other condition may find these in Appendix G.

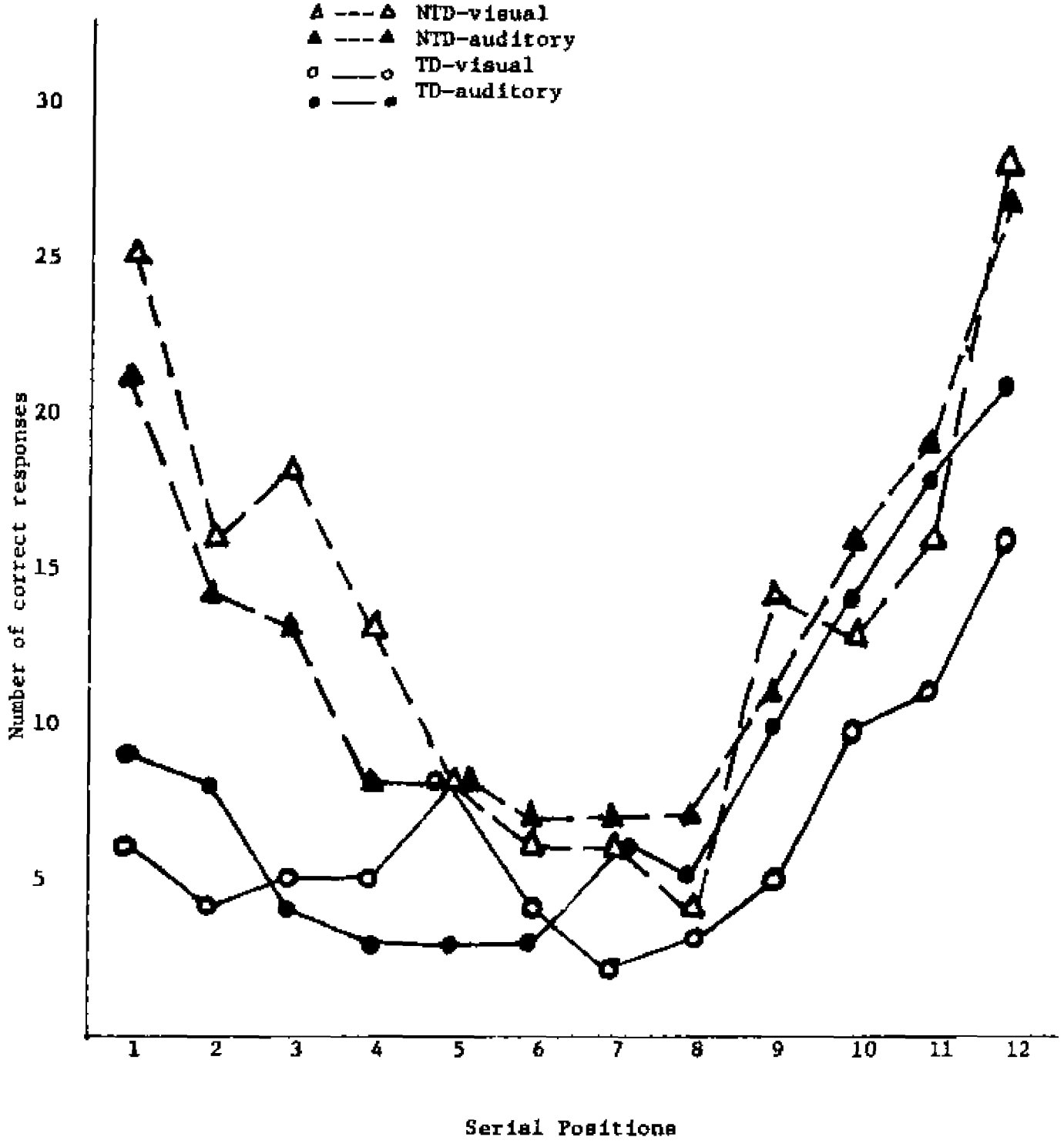

Fig. 2. Number of words remembered in each serial position according to presentation mode by thought disordered and non-thought disordered groups.

Hypothesis 6: Non-thought disordered schizophrenics will remember words equally well regardless of memory store or presentation mode.

Hypothesis 7: Thought disordered schizophrenics will show superior performance on STM for auditorially presented material as compared with any other combination of memory store and mode of presentation.

Table 3 shows all possible comparisons of words remembered under different conditions for non-thought disordered schizophrenics. In other words, the six possible comparisons (STM-visual with STM-auditory; STM-visual with LTM-visual; STM-visual with LTM-auditory; STM-auditory with LTM-visual; STM-auditory with LTM-auditory; and LTM-visual with LTM-auditory) are shown. These comparisons show that non-thought disordered schizophrenics remember words equally well under each condition, since none of the differences were significant. Thus hypothesis 7 is supported.

Table 4 shows all possible comparisons of numbers of words remembered under different conditions for thought disordered schizophrenics. The same comparisons were made as for the non-thought disordered schizophrenics. Of these comparisons only the comparisons of STM-auditory with each of the other three conditions reached acceptable levels of significance, showing that thought disordered schizophrenics were superior in STM for auditorially presented material as compared with STM-visual, LTM-auditory and LTM-visual and that they

Table 3

With-in Group Comparisons of Number of Words Remembered by Non-Thought Disordered Group Under Various Conditions (N=12)

Comparison	Mean Diff.	SD	ST Error	t	Df	p<
STM-visual vs. STM-auditory	0.500	2.276	0.657	0.76	11	n.s.
STM-visual vs. LTM-visual	0.417	4.602	1.329	0.31	11	n.s.
STM-visual vs. LTM-auditory	0.833	3.809	1.099	0.76	11	n.s.
STM-auditory vs. LTM-visual	0.083	4.209	1.215	0.06	11	n.s.
STM-auditory vs. LTM-auditory	1.333	4.849	1.399	0.95	11	n.s.
LTM-visual vs. LTM-auditory	1.250	4.245	1.226	1.02	11	n.s.

did not differ significantly in number of words remembered among the other conditions. Hypothesis 7 is therefore supported.

Hypothesis 3: Acoustic similarity of stimuli will impair STM of non-thought disordered schizophrenics, regardless of mode of presentation, while impairing STM of thought disordered schizophrenics only when presentation is auditory.

Hypothesis 5: Thought disordered schizophrenics will be unaffected by semantic similarity of stimuli, while non-thought disordered schizophrenics will show LTM impairment regardless of mode of presentation when stimuli are semantically similar.

It was clear from the raw data that list type did not affect performance of either group as had been predicted. Although it was true that thought disordered schizophrenics were unaffected by semantic similarity, as had been predicted, the fact that neither group was affected by semantic similarity or acoustic similarity negated the usefulness of this finding. Appendix H shows these results. All the t-values are non-significant. Apparently list type simply did not have any effect, so hypotheses 3 and 5 were not supported.

Other Results

Since it was thought possible that the two groups would differ on several factors -- medication level, years hospitalization, age and education level -- that could affect results, the groups were compared on these factors. It was found that groups did not differ on

Table 4

With-in Group Comparisons of Number of Words Remembered by Thought Disordered Group Under Various Conditions (N=12)

Comparison	Mean Diff.	SD	ST Error	t	Df	p<
STM-visual vs. STM-auditory	2.250	2.667	0.769	2.96	11	.01
STM-visual vs. LTM-visual	1.250	3.137	0.906	1.39	11	n.s.
STM-visual vs. LTM-auditory	1.417	2.678	0.773	1.83	11	n.s.
STM-auditory vs. LTM-visual	3.500	4.011	1.158	3.04	11	.01
STM-auditory vs. LTM-auditory	3.667	3.367	0.971	3.77	11	.01
LTM-visual vs. LTM-auditory	0.167	1.586	0.458	0.35	11	n.s.

medication level ($t=.80$, n.s.), years hospitalization ($t=.79$, n.s.), or age ($t=.56$, n.s.). They did, however, differ on education level ($t=3.62$, $p<.0015$).

As already explained, using education level as a covariate to account for its effect on the dependent variable would violate the assumption of equality of groups and would not be appropriate. Because of the lack of an appropriate method for analyzing the effects of education level, however, analysis of covariance was done, and it was found to have some effect, but the effect was not significant at the .01 level. It may be cautiously said, then, that education level is not nearly as important as other differences between the groups. Further evidence that education is not an important difference between the groups is the fact that education level does not correlate highly with total words remembered or with words remembered under various conditions. These correlation coefficients are presented in Appendix G.

In order to see how a division of subjects into process and reactive groups would compare with the thought disordered and non-thought disordered grouping of subjects, analysis was repeated using process and reactive groups. The independent t-test, used to examine differences between groups, showed no differences significant at the .01 level. It may be said, then, that the process and reactive groups were more similar than were the thought disordered and non-thought disordered groups. These results may be found in Appendix I.

The dependent t-test was used to examine differences within each group. The t-values for the reactive group were all non-significant, as they were for the non-thought disordered group. However, the t-values were higher for the reactive group, meaning that there was more with-in group difference in the reactive group than in the non-thought disordered group.

Comparing the with-in group differences of the process group with that of the thought disordered group shows no consistent pattern of higher or lower t-values. In these groups, though, it was expected that there would be a significant difference between STM-auditory and other conditions. In the thought disordered group these differences were as predicted, but in the process group only one significant difference, that between STM-auditory and LTM-auditory, was found. Thus the process group did not show the with-in group differences that were predicted as consistently as did the thought disordered group. These results are shown in Appendix J and Appendix K.

Chapter 5

Summary, Conclusions, Limitations and Recommendations

Chapter 5 will present a summary of this study, conclusions based on the findings, limitations of the study and recommendations.

Summary

The major question addressed in the present study was whether types of schizophrenics could be differentiated according to their use of certain active information processing strategies. Word lists varying in type (homophone, synonym or unrelated) and mode of presentation (visual or auditory) were presented to thought disordered and non-thought disordered schizophrenics, who were asked to remember in any order as many words as they could immediately following presentation. The dependent variable was number of words correctly remembered. Subjects received scores on total number of words remembered and number of words remembered according to list type, mode of presentation and place on a list (positions 1-6 considered LTM, positions 7-12 considered STM).

The information processing strategies studied were translation to an acoustic code and use of semantic associative organization processes. It was expected that thought disordered schizophrenics used these strategies suboptimally and that this was a factor which could partially account for their memory impairment as compared with

non-thought disordered schizophrenics. Between group and within group comparisons on number of words remembered under the four conditions, STM-visual, STM-auditory, LTM-visual and LTM-auditory, and within group comparisons according to list type were made.

It was found that thought disordered schizophrenics were inferior to non-thought disordered schizophrenics on total words remembered and in words remembered under the conditions STM-visual, LTM-visual and LTM-auditory. Further, it was found that non-thought disordered schizophrenics performed equally well regardless of condition, while thought disordered schizophrenics performed equally poorly under all conditions except STM-auditory. In other words, thought disordered schizophrenics have a deficit in memory for visually presented material and in LTM regardless of presentation mode. They are comparable to non-thought disordered schizophrenics only in STM for auditorially presented material.

The use of different list types in this study was included to give further evidence that thought disordered schizophrenics were suboptimally using the information processing strategies being examined here. In the case of the LTM deficit, it was actually the only way provided by the study to pin-point the reason for the deficit. This variable, however, did not act on the subjects as had been expected and, in fact, did not seem to make any difference at all.

Conclusions

The main findings of the present study were (a) that thought disordered schizophrenics had a memory deficit as compared with non-thought disordered schizophrenics, (b) that this deficit appeared in STM in the visual but not the auditory modality, and (c) that the deficit appeared in LTM regardless of modality.

There are no studies of thought disordered versus non-thought disordered schizophrenics with which these results may be compared. The findings, however, that there is a memory deficit in certain schizophrenics, is consistent with studies comparing schizophrenics with non-schizophrenic psychiatric patients (Marshall, 1973; Davidson and Neal, 1974; Nachmani and Cohen, 1969) and with studies comparing hebephrenic with nonhebephrenic schizophrenics and process with reactive schizophrenics (Lawson, McGhie and Chapman, 1967; Traupmann, 1975). The finding that some schizophrenics have a particular problem in the visual modality is consistent with the finding (Lawson, McGhie and Chapman, 1967) that hebephrenics have a problem with the visual modality as compared with nonhebephrenics.

The finding that thought disordered schizophrenics have difficulty in STM for visually presented material while remembering auditorially presented material as well as non-thought disordered schizophrenics is consistent with the theory that they are not translating to an acoustic code efficiently. When material is given in the auditory modality -- that is, already "translated" -- they remember as well

as non-thought disordered subjects.

It may be asked whether this inefficiency in translating to an acoustic code is a specific problem in itself to the thought disordered schizophrenics or whether it is a part of an overall problem of slowness. It is thought that acoustic encoding of visual information takes a relatively long time. It is possible, then, that the relative inefficiency in the storage of visually presented material by the thought disordered schizophrenics is due to slowness in converting the material to an auditory form. This idea is, in fact, not unlikely, since one of the characteristics of Lorr's Z type schizophrenic is retardation. This study does not answer the question of whether the underuse of acoustic encoding is due to partially shutting down the converting mechanism to avoid stimulation as suggested by Traupmann (1967) or due to inability to use the mechanism because of general slowness (Yates, 1966). Results are consistent with either interpretation.

The finding that thought disordered schizophrenics have a particular deficit in LTM is more difficult to interpret, particularly since manipulation of the variable list type did not have the expected effect. If it could have been shown that semantic similarity affected the performance of non-thought disordered schizophrenics but did not affect the performance of thought disordered schizophrenics, it could have been assumed that non-thought disordered schizophrenics were using semantic associative elaboration

for encoding while thought disordered were not.

Another problem in interpretation is that LTM and STM may not have been accurately represented by position in the top half or bottom half of a list, because of the subjects' freedom to recall words in any order. For instance, if a subject recalled words in serial positions 1, 2, 3, 5, 11 and 12, it would be difficult to say whether there had been more interference and time lapse between presentation and remembering of word 1 or word 12. Following presentation of word 1 the subject experienced input interference as words 2 through 12 were presented. However, since word 12 was repeated last by the subject, he experienced output interference as he remembered words 1, 2, 3, 5 and 11. Bauman and Kolinsky (1976) have studied input and output interference effects on schizophrenic STM and have concluded that output interference largely accounts for the schizophrenic STM deficit. This does not seem to explain the present results, though, since thought disordered schizophrenics showed a deficit in early rather than late serial positions and regardless of order of output.

A possible explanation is that thought disordered schizophrenics, realizing that they could not remember all the words on a list, to a large extent ignored the first few words presented and concentrated on the last words presented, since they had a better chance of remembering them. This would make sense except for the fact that non-thought disordered schizophrenics were experiencing the same problem,

in that they too could not remember all words on a list, yet they did not choose to ignore the early presented words but rather continued to remember words from both ends of the list. This, then, can at best be only a partial explanation of the thought disordered group's deficit.

This suggests the possibility that non-thought disordered schizophrenics were doing something to enable them to continue to remember from both ends of the list, while thought disordered could not or did not do so. Since the lists contained 12 words each, more words than can be held in immediate memory without help from some sort of memorial strategy -- chunking, associations or rehearsal -- it may be suggested that non-thought disordered schizophrenics were using these strategies while thought disordered were not. This is consistent with the idea that the thought disordered schizophrenics' deficit in LTM is due to underuse of semantic-associative organization of material, though other interpretations are still possible. For instance, it may be suggested that the general slowness of the thought disordered schizophrenic prevents rehearsal necessary for longer term retention.

It may be asked why it is believed that the thought disordered schizophrenic's problem is in information processing rather than at the point of input, such as a defective filtering mechanism or attentional deficit. There was no indication that thought disordered

schizophrenics were not attentive, but this could certainly be deceptive. A better indication that the problem is not due entirely to some dysfunction at input is that thought disordered subjects could often remember, as many as five lists later, words that they could not remember when they were asked immediately following presentation. The words, therefore, were perceived but somehow not available for recall on demand. In terms of levels of processing theory (Craik and Lockhart, 1972), this would suggest that the words were not processed to a depth that would allow free recall on demand; they were not sufficiently elaborated to be easily remembered. This is not to say that a dysfunction at input may not contribute to the problem, but it does not appear adequate to fully explain it.

Results of this study, then, are seen as consistent with the theory of underuse of active information processing strategies by thought disordered schizophrenics, though they are not seen as excluding other possible explanations. It is concluded that thought disordered schizophrenics can be differentiated from non-thought disordered schizophrenics according to memory and that the differences are likely due to differences in use of information processing strategies.

Limitations

Two possible limitations of this study have to do with number and

method of selection of subjects. In any schizophrenia research there is a problem in getting a large number of subjects with clear diagnoses of schizophrenia that are not complicated by other factors, such as a secondary diagnosis of alcoholism. It is, therefore, usually believed that using a small number of subjects with clear-cut schizophrenic diagnoses is preferrable to using a larger number of subjects with questionable diagnoses. This does, however, weaken the results of the research and makes replication very important.

A second limitation has to do with method of selection of subjects. Subjects were selected by an experienced clinical psychologist on the basis of Lorr's definition of the Z type schizophrenic. No objective scale was used or was available for distinguishing thought disordered from non-thought disordered schizophrenics according to Lorr's criteria. There is, however, no reason to believe that the method of selection was not valid.

Two other problems, relating to research procedure, have already been mentioned. It was impossible to assess the effect of list type because, most likely, the variable was too weak. This study used pairs of similar words, but it is possible that sets of 3, 4 or 6 similar words were needed in order for the similarities to have an effect, that is, for confusion to result. Since the literature shows studies using anything from pairs to whole lists that are similar, it is difficult to say what might have been best for this study. If this

problem had been anticipated, pre-tests with different number groupings of similar words could have been done.

Last, because of the unordered recall, it is somewhat difficult to interpret LTM and STM in this study. It is possible that the use of a probe technique could have overcome this problem, though that would have sacrificed other information, that is, how a subject will respond, given complete freedom, as in the present study.

Recommendations

It may be asked what this study has to do with schizophrenia as it is experienced by the patient and those around him or with those who must treat schizophrenics. Is some rapprochement of the experimental and clinical aspects possible? Experimentally derived findings may be applied toward better classification of schizophrenia and toward better understanding in interpersonal contacts with schizophrenics. It appears that of the many classificatory systems of schizophrenia one idea which has received much support is that of a "nuclear" form of schizophrenia that closely resembles Kraepelin's original concept of dementia praecox. These patients are usually diagnosed as hebephrenic and are very like the process, high-redundant or thought disordered schizophrenics. Some studies have mentioned a similarity of hebephrenic schizophrenia to organic psychoses (McGhie, 1966; Chapman, 1966). Thus better understanding

of the more subtle psychological manifestations of schizophrenia can result in better diagnosis, which is crucial for differential treatment.

Psychological studies also have implications for understanding schizophrenic interpersonal relationships. Everyday life demands almost constant organization and integration of facts and experiences and decision-making based on those facts and experiences. If the thought disordered schizophrenic has a problem in organizing and integrating material, he is at a great disadvantage in handling social interactions. If he finds it necessary to close down certain mental operations to protect himself from stimulus bombardment, he is apt to view this world in a quite over-simplified and disintegrated way.

In the treatment of schizophrenia one of the main aims is to establish better communication with the patient. It seems likely that a better understanding of the basic psychological problems of the schizophrenic will lead to better understanding of schizophrenic language and better patient-therapist communication. It has been observed that patients who were initially withdrawn in therapy were able to speak more freely and became more communicative when they understood that their basic difficulties were appreciated by the therapist (McGhie, 1966).

It is recommended, therefore, that experimental investigations of psychological aspects of schizophrenia be continued in order to

create a better basic understanding of what we call schizophrenia. It is further recommended that greater effort be made to integrate the clinical observations and experimental findings, clinical observations suggesting areas of scientific investigation and experimental findings being fed back to clinicians for use in handling schizophrenic patients.

APPENDICES

Appendix A

Ullmann-Giovannoni Scale

		Reactive
1.	I am married now.	True
2.	I have fathered children.	True
3.	I have been married.	True
4.	Before I was seventeen I had left the home I was raised in and never went back except for visits.	True
5.	When I leave the hospital, I will live with one or both of my parents.	False
6.	As a civilian I have worked steadily at one job or for one employer for over two years.	True
7.	I finished at least one year of education after high school -- trade apprenticeship, business school, college, etc.	True
8.	Adding up all the money I earned for the last three years, it comes to less than $700, before deductions.	False
9.	In my teens I was a member of a group of friends who did things together.	True
10.	I hardly ever went over to another kid's house after school or on weekends.	False
11.	When I was in school I didn't like Physical Education classes.	False

12. Alcohol has nothing to do with my difficulties — False
13. I have paid regularly to buy a house. — True
14. 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. — True
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. — True
16. I have been deeply in love with someone and have told them about it. — True
17. In the kinds of work I do, it is expected that people will stay for at least a year. — True
18. My top wage in the last five years was less than $1.50 an hour. — False
19. I have earned my living for longer than a year at full-time civilian work. — True
20. I have had to stay in a mental hospital for more than one year at a time. — False
21. Within the last five years I have spent more than half of the time in a mental hospital. — False
22. 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.) — True

23. In my teens there was more than one girl with whom I had more than two dates. True

24. When I leave the hospital, I will live with my wife. True

Appendix B

Medication Conversion Chart

Equivalent to 100 mgm. Thorazine	
Mellaril	100 mgm.
Stelazine	5 mgm.
Loxipine	33 mgm.
Haldol	2 mgm.
Navane	5 mgm.
Prolixin	1 cc. q. 2 weeks = 400 mgm. Thorazine/da. I.M.

Appendix C

Word Lists

Unrelated	Homophone	Synonym
hot	clue	map
skirt	add	cent
tape	seek	slash
list	bark	go
duck	deal	pair
big	claw	broad
mud	race	penny
rare	dial	two
time	aid	leave
house	back	cut
say	seem	chart
off	rice	wide
boil	neck	close
hand	want	bag
dirt	last	begin
stone	went	fast
crow	fear	oil
plate	mash	sack
dear	list	start
fan	true	strike
pole	nick	grease
laugh	fair	quick
fit	mesh	near
out	try	hit

Appendix D

Random Arrangements of Lists, Word Orders and Mode of Presentation

SUBJECT	LIST	ORDER	MODE
1	3	2	V
	2	2	A
	6	1	A
	5	1	V
	1	2	V
	4	1	A
2	2	1	V
	3	3	A
	5	1	A
	6	3	V
	1	2	A
	4	1	V
3	3	1	A
	4	1	V
	2	3	A
	5	2	V
	6	1	A
	1	1	V
4	3	1	V
	5	1	A
	2	1	V
	6	1	V
	1	2	A
	4	3	A
5	5	1	V
	2	1	A
	3	1	V
	6	2	A
	4	2	A
	1	3	V

Random Arrangements
(cont.)

SUBJECT	LIST	ORDER	MODE
6	2	1	V
	5	1	A
	4	2	V
	1	3	A
	3	2	A
	6	3	V
7	1	2	V
	6	2	A
	4	1	V
	2	1	A
	5	3	V
	3	3	A
8	6	1	V
	4	1	A
	3	1	V
	2	1	V
	5	1	A
	1	1	A
9	4	2	A
	3	2	V
	1	1	V
	6	1	A
	2	1	A
	5	2	V
10	5	1	A
	3	1	A
	6	1	V
	1	3	A
	2	1	V
	4	2	V
11	2	3	A
	3	2	A
	4	1	V
	5	1	V
	6	2	A
	1	3	V

Random Arrangements
(cont.)

SUBJECT	LIST	ORDER	MODE
12	2	3	V
	6	1	V
	1	1	A
	3	2	V
	5	3	A
	4	1	A
13	1	2	V
	6	1	A
	3	3	V
	5	3	V
	2	1	A
	4	1	A
14	2	3	V
	5	1	A
	6	2	V
	4	3	V
	1	1	A
	3	2	A
15	4	3	V
	3	2	A
	2	3	A
	5	1	V
	6	3	A
	1	1	V
16	4	2	A
	6	3	V
	3	2	V
	5	3	A
	2	1	V
	1	3	A

Random Arrangements
(cont.)

SUBJECT	LIST	ORDER	MODE
17	5	1	V
	6	3	A
	3	1	V
	2	1	A
	1	2	V
	4	1	A
18	5	1	A
	2	1	V
	4	2	V
	3	3	A
	1	2	A
	6	3	V
19	2	2	A
	4	3	V
	6	2	A
	3	1	A
	5	3	V
	1	3	V
20	3	1	V
	4	1	A
	5	2	A
	1	3	A
	6	3	V
	2	2	V
21	4	1	A
	5	3	V
	2	1	A
	3	3	V
	6	2	A
	1	3	V
22	2	1	V
	4	3	V
	5	2	A
	6	1	V
	3	2	A
	1	3	A

Random Arrangements
(cont.)

SUBJECT	LIST	ORDER	MODE
23	2	3	A
	5	3	V
	6	2	A
	3	3	A
	4	3	V
	1	3	V
24	6	3	V
	3	1	V
	2	2	V
	5	3	A
	4	2	A
	1	3	A

Appendix E

Form of Consent to Research

Researcher: Lois W. Abramczyk

I agree to participate in this research, which will involve one session of approximately one-half hour's duration. During that session I will listen to or view words and will be asked to recall those words after presentation. I realize that the purpose of this session has to do with describing memory strategies of different kinds of people.

I understand that participation in this research cannot possibly have any harmful effects for me, neither physical nor emotional, and will involve no risks or discomfort to me. I understand that this research will not be therapeutic for me but is rather an investigation intended to increase scientific knowledge.

I understand that my participation in this research is voluntary; that I may refuse to answer any questions or refuse to take part in the research; that my responses will in no way affect my treatment at or release from the hospital; and that all my responses will remain completely confidential.

Eastern State Hospital has a Patients' Protection Committee, operating independently of the Hospital administration, the purpose of which is to monitor research of this sort. Any complaints or questions about this research may be referred to that Committee through Chaplain Morgan, Hospital liason to the Committee.

Signature _____

Date _____

Appendix F

Subject Data and Response Sheet

Subject Number:_____
Thought Disordered_____ or Non-Thought Disordered_____
Process_____ or Reactive_____
Medication:_____
Age:_____ Education_____
Length of Hospitalization_____

Responses

L__O__M__	L__O__M__	L__O__M__	L__O__M__	L__O__M__	L__O__M__

Appendix G

Correlation Coefficients Among Conditions and between Conditions and Total and Education Level (N=24)

	STM-Visual	STM-Auditory	LTM-Visual	LTM-Auditory	TOTAL	Ed.
STM-Visual	1.000 0.000*					
STM-Auditory	0.551 0.005	1.000 0.000				
LTM-Visual	0.214 0.315	0.038 0.861	1.000 0.000			
LTM-Auditory	0.346 0.097	0.109 0.609	0.526 0.008	1.000 0.000		
TOTAL	0.752 0.001	0.509 0.011	0.721 0.001	0.681 0.001	1.000 0.000	
Ed.	0.233 0.272	0.282 0.181	0.395 0.056	0.164 0.443	0.412 0.046	1.000 0.000

* Second numbers given are significance levels.

Appendix H

Number of Words Remembered by Thought Disordered and Non-Thought Disordered Groups according to List Type*

Group	List Type: Homophone M	Homophone SD	Synonym M	Synonym SD	Unrelated M	Unrelated SD	t
Thought Disordered (N=12)							
STM - A	1.67	1.11			2.17	1.35	1.11 (n.s.)
STM - V	1.50	1.04			1.17	1.14	1.00 (n.s.)
LTM - A			0.75	0.52	0.83	0.69	0.79 (n.s.)
LTM - V			0.83	1.07	1.25	0.92	1.05 (n.s.)
Non-Thought Disordered (N=12)							
STM - A	2.33	0.94			2.25	1.55	0.17 (n.s.)
STM - V	2.17	0.99			2.08	0.69	0.21 (n.s.)
LTM - A			1.67	1.11	2.25	1.61	1.02 (n.s.)
LTM - V			2.08	1.15	2.42	1.61	0.55 (n.s.)

* Statistics are given only for those comparisons concerning which hypotheses were stated.

Appendix I

Differences in Number of Words Remembered by Process and Reactive Groups under Various Conditions

Condition	Mean	SD	St. Error	t	Df	p<
STM-Visual						
Process (N=11)	4.636	2.501	0.754	1.158	20	0.261
Reactive (N=11)	6.000	3.000	0.905			
STM-Auditory						
Process	6.364	3.558	1.073	0.437	20	0.667
Reactive	6.909	2.119	0.639			
LTM-Visual						
Process	3.364	3.325	1.002	2.116	20	0.047
Reactive	6.363	3.325	1.002			
LTM-Auditory						
Process	3.000	2.324	0.701	1.792	20	0.088
Reactive	4.727	2.195	0.662			
TOTAL						
Process	17.364	8.789	2.650	2.274	20	0.034
Reactive	24.454	5.447	1.642			

Appendix J

With-in Group Comparisons of Numbers of Words
Remembered by Reactive Group
Under Various Conditions
(N=11)

Comparison	Mean Diff.	SD	St. Error	t	Df	p≤
STM-Visual vs. STM-Auditory	0.909	2.256	0.680	1.32	10	n.s.
STM-Visual vs. LTM-Visual	0.364	4.411	1.329	.27	10	n.s.
STM-Visual vs. LTM-Auditory	1.273	3.495	1.054	1.20	10	n.s.
STM-Auditory vs. LTM-Visual	0.545	3.933	1.186	.45	10	n.s.
STM-Auditory vs. LTM-Auditory	2.182	3.656	1.102	1.98	10	n.s.
LTM-Visual vs. LTM-Auditory	1.636	3.529	1.064	1.53	10	n.s.

Appendix K

With-in Group Comparisons of Number of Words Remembered by Process Group Under Various Conditions (N=11)

Comparison	Mean Diff.	SD	St. Error	t	Df	p≤
STM-Visual vs. STM-Auditory	1.727	2.149	0.648	2.68	10	n.s.
STM-Visual vs. LTM-Visual	1.273	3.823	1.153	1.10	10	n.s.
STM-Visual vs. LTM-Auditory	1.636	2.541	0.766	2.14	10	n.s.
STM-Auditory vs. LTM-Visual	3.000	4.427	1.335	2.25	10	n.s.
STM-Auditory vs. LTM-Auditory	3.364	3.529	1.064	3.16	10	.01
LTM-Visual vs. LTM-Auditory	0.364	2.541	0.766	0.47	10	n.s.

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