TWO KINDS OF ABSTRACTION IN SCHIZOPHRENIA

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ABSTRACT

An impairment in abstracting ability has frequently been proposed as a reason for schizophrenic thought disorder. The performance of hospitalized chronic paranoid schizophrenics and non-paranoid schizophrenics were compared to a normal control group on two types of abstraction; a traditional conceptual abstraction task (similarities, Trunnell, 1964) and an inferential abstraction task (relational abstraction, Bransford, Barclay & Franks, 1972). These two measures allowed a differential interpretation of the nature of the abstraction impairment in schizophrenia. The two clinical groups did not significantly differ on the traditional hierarchical measure of abstraction. Performance of both schizophrenic groups, however, differed significantly from that of controls in that schizophrenic subjects employed less abstract concepts to classify items in this task. On the second measure of abstraction no significant differences were found between schizophrenic subjects and the control group. Differences between paranoid and non-paranoid subjects did not reach significance on this task but there was some indication that each of these schizophrenic sub-groups used different cognitive strategies on this measure. Paranoid schizophrenics appeared not to elaborate information beyond its original form. The non-paranoids, on the other hand, appeared to elaborate stimulus material but were confused between inferential and original information. The present results indicate that chronic paranoid schizophrenics have a different type of abstraction impairment to chronic non-paranoid schizophrenics on the inferential conceptual abstraction task. These findings indicate the utility of using two indices of abstraction and the importance of not treating schizophrenics as a homogeneous group.

INTRODUCTION

Descriptions of schizophrenia place strong emphasis on thought disorder as a central characteristic of the syndrome. Initially, however, the speech of the schizophrenic is regarded as the primary diagnostic tool for inference of the disorder (Herron, 1977; Ho, 1974; Maher, McKean & McLaughlin, 1966). Consequently, a massive research effort has been directed to finding the distinctive properties or structural defects in schizophrenic language, an effort that has produced consistently disappointing results (Maher, 1966, p 433; Pavy, 1968; Vetter, 1968 p 25). For example results from a number of studies (Maher, 1972; Salzinger, 1973; Schwartz, 1978) indicate that schizophrenics rarely exhibit grammatically incorrect speech. Some studies do report schizophrenic speech to be more difficult to follow and more unpredictable than that of normal subjects (Hart & Payne, 1973; Rosenberg & Tucker, 1976), but this finding seems to be indicative of deviant conceptualisation or impaired cognitive processing rather than of a primary linguistic disturbance (Critchley, 1964; Lecours & Vanier-Clement, 1976).

This conclusion is in accordance with many traditional descriptions of thought disorder. For example, in 1911 Bleuler classically described the impairment in schizophrenic thinking and speech as when "fragments of ideas are connected in an illogical way to constitute a new idea" (1950, p 9). Schilder (1951) speaks of the schizophrenic as being "unable to pursue the determinative idea." Arieti (1955) refers to "... a lack of inhibition of peripheral ideas necessary for effective abstraction." McKellar (1957) explains the loss of abstract thinking in schizophrenia as due to "... the inability to inhibit associated but irrelevant ideas." Goldstein (1939), Vygotsky (1934) and more recently, Wright (1975) have considered the central feature of schizophrenia to be an impairment in the ability to abstract.

McGhie and Chapman (1961) quote a statement by a schizophrenic which illustrates the subjective difficulties these patients experience. "My thoughts get all jumbled up. I start thinking and talking about something but I never get there. Instead I wander off in the wrong direction ... People listening to me get more lost than I do" (p. 108).

Because "a true understanding of the nature of the thought disorder might illuminate the nature of schizophrenia itself" (Chapman & Chapman, 1973, p. ix), the study of thought disorder has been the most heavily researched area in schizophrenia (Herron, 1977). Many theoretical explanations have been offered, but so far no explanation has achieved general acceptance. For example, explanations of the process responsible for schizophrenic disordered thought have included an impairment in abstracting ability (Goldstein, 1944; Wright, 1975), a faulty decentering ability (Suchotliff, 1970), an attentional deficit (Payne & Caird, 1967), an accentuated response bias (Chapman & Chapman, 1973), a collapse in response hierarchies (Broen, 1968), and over inclusion of concepts into categories (Cameron, 1947).

It seems likely that little progress can be made in discrediting alternative explanations until theoretical constructs and research strategies are further refined. One reason that may account for why research explanations are often ambiguous and inconsistent is that schizophrenics are frequently treated as a single homogenous group. Schizophrenic subgroups have been found to have different cognitive abilities (Gillis & Blevens, 1978; Otteson & Holzman, 1976). But the main reason why progress has been slow in understanding the nature of schizophrenic thought disorder is that most research paradigms have been unrepresentative of ordinary comprehension and natural language processing. For example, the sorting tasks (Goldstein, 1939; Vygotsky, 1934), memory for lists of words (Koh, 1978; Traupman, 1975) and

the study of word meaning (Chapman, Chapman & Daunt, 1976) have been valuable for looking at various aspects of information processing, such as selective attention, discrimination, recognition process and association. But these studies do not sample the higher levels of ordinary information processing, such as the representation of information in memory (Craik, 1973; Craik & Lockhart, 1972).

In order to quantify the true nature of thought disorder in schizophrenia, cognitive paradigms which are more closely related to ordinary information processing may be more appropriate. As McGhie (1970) has observed from the subjective reports of schizophrenics, patients' difficulties in understanding speech arise "not from an inability to perceive the individual words comprising a connected discourse, but from an inability to perceive the words in meaningful relationship to each other as part of an organized pattern" (p. 12). The present study will quantify the theoretical construct of abstraction, in such a way that it samples more closely those abilities which are necessary for comprehending connected discourse than traditional measure of this ability.

LITERATURE REVIEW

It has been demonstrated consistently that schizophrenics are deficient in their performance on measures of higher cognitive functions, especially those which sample conceptualising skills (Buss & Lang, 1965; Chapman & Chapman, 1973; Lothrop, 1961; Payne, 1962). Despite concentrated research on the form and nature of this problem, there is as yet no generally accepted agreement about the reason such performance is deficient (Herron, 1977; Salzinger, 1973; Silverman, 1964). One of the oldest and most frequently hypothesized explanations of the nature of cognitive impairment in schizophrenia is in terms of inferior levels of abstracting ability (Blatt & Ritzler, 1974; Goldstein, 1939, 1959; Lothrop, 1961; Vygotsky, 1934).

Historically two main theoretical positions have been put forward to account for the difficulties experienced by schizophrenics in constructing abstract concepts. First, is the view that the inability to form abstract concepts is due to non-cognitive processes that interfere with this ability (Cameron, 1938; Lewine, 1978; Salzinger, 1973; Venables, 1964). The second proposal is that in schizophrenia thought processes are themselves centrally impaired and based on non-abstract principles of organisation (Goldstein, 1939; Lidz, 1975; Lothrop, 1961; Vygotsky, 1934; Wright, 1975). Until the term 'abstraction' is more clearly delineated, however, it is unlikely that we will be able to discriminate between these two accounts.

Posner (1973) points out that the term 'abstraction' has a number of referents and distinctions within it. According to Posner, the term 'abstraction' can be broadly distinguished as referring to either:

1. The traditional concept of abstraction where information is classified at a higher level of generality as in the use of abstract concepts in classifying objects, attributes and relations (Braine, 1961; Piaget, 1954; Vygotsky, 1962).

or:

2. The selection of part of the information input in such a way that it is generalised or combined with other selected aspects to create a new integration (Bartlett, 1932; Nelson, 1974).

These distinctions have seldom been taken into account in relating abstraction to cognitive impairment in schizophrenia. Frequently only a single measure of abstraction has been used as an index of impairment. Most studies have used measures based on Posner's (1973) first definition of abstraction (Goldstein & Scheerer, 1941; Payne 1962; Trunnell, 1964, 1965; Vygotsky, 1962; Wright, 1975). It is possible, however, that schizophrenics are capable of some forms of abstract cognitive processing and that they are not totally impaired in this ability. Posner's second definition of abstraction seems a useful base from which to investigate this alternative explanation. Only one recent study has utilized this approach (Knight & Sims-Knight, 1979).

The Traditional Concept of Abstraction

Traditional theories of abstraction generally account for the construction of concepts in terms of a synthesis of common elements. A concept is formed by abstracting common features of attributes from exemplars. This active process of construction operates at the level of perceptual and cognitive functioning (White, 1974), and permits the individual to classify new experiences into generically compatible classifications (Homa, 1978; Nelson, 1974).

The theoretical principle of "levels of abstraction" highlights some of the distinctions within this concept of abstraction. The principle of levels can be clarified by observing how concepts can be placed in hierarchial order across the abstract-concrete dimension according to their degree of abstraction. By employing the principle of levels of abstraction concepts can be specified according to a set of elemental features, with more abstract concepts formed by combining these elemental features. Lunzer (1979) has proposed a series of levels of abstraction based upon Braine's (1961) hierarchial classification system.

At the first and lowest level of this hierarchy are concepts of a primary degree of abstraction. These concepts designate objects and describe their properties. This level of abstraction arises from immediate experience and corresponds to Piaget's (1954) pre-operational level of cognitive development.

At the second level of abstraction, concepts are constructed from the systemized classifications of objects, attributes and relations. Classification of objects along at least two dimensions is also included at this level. For example seriation of variable properties such as colour and size.

At the third level, concepts are determined by the simultaneous ordering of at least two sets of principles formed from the manipulations of objects. Concepts at this level include those which express inverse or reciprocal functions.

The fourth level postulated by Lunzer (1979) includes concepts not directly applying to reality but related by analogy. This level includes higher order mathematical concepts, such as exponential functions, all but the most

elementary logical and philosophical concepts and figures of speech such as metaphor.

The principle behind these levels of abstraction can be illustrated by the following sequence: fido, dog and species. These terms are progressively more abstract and designate an object, a class, and a class of classes respectively. Each term in this abstract hierarchy expresses the relationship between concepts at the same level of abstraction as its immediate predecessor (Lunzer, 1979; Nelson, 1974).

Research on Schizophrenia Based on the Traditional Concept

A diverse range of experimental procedures have been used to examine abstraction in schizophrenia. These procedures can be related to the four levels of abstraction defined by Lunzer (1979). The sorting task was one of the first methods used to examine abstraction and corresponds to the first two levels of Lunzer's hierarchial classification system. Goldstein (1939) and Vygotsky (1934) considered that the essence of an abstract concept was its formal and logical structure. These investigators employed object sorting tasks to differentiate abstract classifications from non-abstract classifications. From these tasks, Goldstein showed that schizophrenics have difficulty in selecting common attributes from similar objects. Vygotsky described schizophrenic thinking in terms of complexes, with objects classified according to autistic associations of their concrete physical relations.

Experiments investigating conceptualisation with schizophrenic subjects have also employed abstract and concrete words (Hamlin & Folsom, 1977). To establish the meaning of abstract words requires Lunzer's (1979) higher levels of abstraction. On the other hand, concrete words deal with physical realities which are by definition less

abstract (Braine, 1961). These concepts typically require only level one abstracting ability, which belongs to unanalyzed objects (dog, pencil, house, etc.) and also unanalyzed properties of objects (red, large, hot, etc.).

Proverbs have also been used to look at abstract thinking in schizophrenia. It has been recognised that schizophrenics have difficulty in translating the concrete stimuli of proverbs into a general interpretation. When an abstract interpretation is achieved it is frequently tangential to the correct translation (Shimkunas, Gynther & Smith, 1967; Watson, 1976). Proverbs correspond to Lunzer's (1979) level four which requires abstraction by analogy.

Some support has been given to Cameron's (1938) proposal that some kind of peripheral processes interfere with the capacity to abstract in schizophrenia by a series of experiments using stimulus enrichment (Blaufarb, 1962; Hamlin, Haywood & Folsom, 1965; Hamlin & Lorr, 1971; Schmolling & Lapidus, 1977). The concept of stimulus enrichment is based on the principle that performance on abstraction tasks can be improved if competing responses are reduced by structuring the task. For example, Blaufarb tested this hypothesis under two conditions. The first was the usual procedure of asking for explanations of proverbs. The second condition presented proverbs in sets of three with each proverb within a set requiring a similar abstract interpretation. Under the first condition Blaufarb found that the performance of schizophrenics was significantly inferior to that of normals. Under the second condition using sets of proverbs, the scores of schizophrenics improved to such a degree that they no longer differed from those obtained from normal subjects. Further research with this procedure has shown that mild and moderately disturbed schizophrenics benefit from a task which helps structure the correct response. Severely disturbed schizophrenics are affected by a more global disruption of cognitive functions

and do not exhibit the same marked improvement under stimulus enrichment (Hamlin et al., 1965). Blaufarb's procedure has also been replicated using the WAIS similarities test (Hamlin & Lorr, 1971; Schmolling & Lapidus, 1977). These experiments show that stimulus enrichment is effective across a wide range of experimental stimuli. Schmolling and Lapidus employed a version of the WAIS similarities test modified in such a way that when a subject failed to achieve the full score the item was repeated with four cue items instead of the original two. Stimulus enrichment was found to significantly improve abstracting ability. Schmolling and Lapidus suggested that the enrichment instruction helped reduce the complexity of the task by lessening the number of alternatives, and was not related to disturbances in either concentration or attention.

Trunnell (1964, 1965) used a variation of the WAIS similarities test with stimulus enrichment using three cue items, but approached the problem of abstraction from a Piagetian perspective. One of Piaget's criteria for normal adult thinking is the ability to carry out classifications using the logical operations of division and multiple classification to form conjunctive classes. A conjunctive concept requires the joint presence of several attributes. The class "red squares" which corresponds to Lunzer's (1979) second level of abstraction is an example of a conjunctive class. Trunnell (1964) reasoned that since young children are unable to form conjunctive classes it would be useful to apply a task that utilises this ability to schizophrenics. Measures of abstraction derived from Piaget's work are probably the most sensitive instruments for looking at regressed cognition in schizophrenia (Ho, 1974; Nitsun, 1976). It has consistently been postulated that in schizophrenia there is a reversion to earlier levels of psychological and cognitive functions (Strauss, 1967). Piaget's developmental theory has been successfully applied to the

study of schizophrenia in a number of studies (Freeman, Cameron & McGhie, 1965; Kantor & Herron, 1966; Kilbury & Siegel, 1973; Nitsum, 1976).

The usual WAIS similarities measure requires only a single premise in order to make a comparison between the two items. Trunnell (1964) argued that in order to establish a class of commonality with three items two premises are necessary and hypothesised that schizophrenics, like children, would have great difficulty in forming the required conjunctive class.

Trunnell (1964) employed three subject groups in his pilot study. The schizophrenic sample comprised of seven acutes who had been hospitalised once and who had a good premorbid adjustment, and three chronics who had a long or repeated hospitalisation. Two normal groups were used, ten children with an average age of 10.5 years and an adult group of ten hospital staff. Trunnell confirmed that there was a significant difference in the performance of schizophrenics and adults on the similarities measure, but no significant difference was found between schizophrenics and children. Schizophrenics, like children, tended to find only two items with common features and were less able to form conjunctive classes. The attention of schizophrenics, in contrast to that of normals, concentrated on immediate physical perceptions. The findings of the pilot study were replicated by Trunnell (1965) in a second experiment which used a larger schizophrenic sample that was matched to an adult control group for age, educational attainment and sex.

Many of the measures employed in research on the abstraction deficit have been criticised for their high correlation with intelligence and possible confounding with other factors (Oltmanns & Neale, 1975). For example, the sorting tasks of Goldstein and Vygotsky were once considered

as an unambiguous measure of abstraction (Wright, 1975). Because of its high correlation with intelligence the validity of this type of measure is now questioned (Herron, 1977; Oltmanns & Neale, 1975). Proverb tests, as measures of abstraction, have also been criticised because of their high correlation with intelligence (Harrow, Adler & Hane, 1974; Wright, 1975). These criticisms also apply to the use of similarities measures.

The work that has been reviewed so far can be seen as sampling only one broad type of abstraction in schizophrenia, corresponding to what Posner (1973) terms as abstraction by generalisation. It is unlikely that studies of this form of abstraction deficit can provide an explanation for the more complex information processing deficit that schizophrenics show with natural language (Schwartz, 1978). In order to ascertain the nature of the cognitive deficit in schizophrenia experimental studies need to examine more closely natural language processing (Knight & Sims-Knight, 1979). Cognitive psychology may be useful here in looking at schizophrenic information processing in ways closer to real life situations (Koh, 1978).

New Perspectives on Research from an Information Processing Perspective

In the past two decades experimental psychologists have made considerable advances in understanding the various cognitive processes involved when an individual interacts with the environment. Broadbent (1958) suggested that human information processing involves a limited capacity system which requires filtering of incoming information. Broadbent's model has been useful in providing a methodology and conceptual framework for interpreting cognitive processes in both normal and abnormal conditions.

Shallice (1972) postulates the role of consciousness in information processing as a high level executive system which selects those elements of stimulus information to be represented in consciousness at any one time. A breakdown in this executive or filtering system has been suggested by many authors as a major factor in schizophrenic cognitive defects and abnormalities (Cromwell, 1968; Lang & Buss, 1965; Neale & Cromwell, 1970). Broen and Storms (1967) have also concluded that a defective filter system which fails to exclude irrelevant stimuli can account for many peculiarities of schizophrenic language and thought, especially overinclusive thinking.

This approach has had some success in explaining aspects of the schizophrenic cognitive disorder (Chapman & Chapman, 1973; McGhie, 1970), but a number of basic assumptions in the model are open to question. In particular, the assumption that stimulus selection in general has become defective. Frith (1979) presents a cogent argument in refutation of this assumption. First he contends that perception is so dependent on selection (Neisser, 1967; Pylyshyn, 1973), that such a defect would result in a reduction of general cognitive abilities to a level approaching severe subnormality. In fact most schizophrenic patients function and communicate adequately in many areas despite the presence of delusions and other forms of thought disorder. The defect cannot, therefore, be of a general kind and there is a need to clarify its more specific dimensions. Secondly, the defective filter model does not account for defects in response selection although this is an important component of schizophrenic cognitive abnormalities (Broen & Storms, 1967; Chapman, 1966).

Normal information processing involves several perceptual and cognitive functions. Many of these processes operate outside of awareness as was illustrated by Sperling's (1960) partial report technique. When people are shown very briefly

a large array of letters, they can generally only report four, although they are aware that other letters were displayed. This finding has been taken as evidence of the existence of a brief high capacity iconic store below the level of consciousness (Sperling, 1963, 1967; Sperling & Speelman, 1970).

The understanding of speech also relies to a considerable extent on sophisticated pre-conscious processing devices. Between the presentation of auditory stimuli and the production of a verbal response, normal subjects handle information by a series of transformations (Oltmanns & Neale, 1975). In each of these transformations stimuli are recorded into higher orders of abstraction and more lasting representations in memory (Craik & Lockhart, 1972). This has been illustrated in studies of word recognition where sensory input undergoes phonological and semantic analysis at a level below conscious awareness. The final result of this pre-conscious analysis is that some model of the actual word in both form and meaning reaches consciousness (Marcel & Patterson, 1976).

Frith (1979) has proposed a modification of the "defective filter" theory which is consonant with many of the symptoms of schizophrenia. He suggests that the basic cognitive deficit associated with schizophrenia is an awareness of automatic processes which are normally carried out below the level of conscious awareness. These processes are concerned with selection of interpretations of incoming stimuli and the selection of appropriate responses. The hypothetical consequences of such a defect have been summarised by Frith as follows:

1. Hallucinations arise from erroneous and multiple interpretations of incoming stimuli.

2. Misinterpretations occur especially with words because they are particularly arbitrary and complex stimuli.

3. While schizophrenics are aware of the importance of many stimuli and events, they attach special significance to certain events and stimuli that are normally disregarded as unimportant.

4. The schizophrenic is aware of the multiple meanings of words and this gives rise to the typical patterns of disordered speech.

5. These problems are especially critical when the schizophrenic's situation involves processing information which would normally be carried out in an automatic operation, but involves stimuli that can be perceived consciously.

Research on schizophrenic memory gives indirect support to these hypotheses. For example, the recognition memory of schizophrenics has been found adequate in experimental studies when simple stimuli are used with little need for interpretation or elaboration (Koh & Kayton, 1974; Larsen & Fromholt, 1976). Results of a number of experiments comparing schizophrenics and normals on recall of verbal information have suggested that the poorer performance of schizophrenic subjects on these tasks is due to a limited ability to organise material at encoding, for instance lack of organisation or categorisation (Koh, Kayton & Berry, 1973; Traupman, Berzofsky & Kesselman, 1976). It has been demonstrated that if schizophrenics successfully organise material at encoding then their memory performance is facilitated (Koh, Kayton & Peterson, 1976).

The distinctions between these different types of information processing in memory may be roughly divided into passive (automatic) and active (controlled) operations

(Neisser, 1967) and these may be seen as different levels of processing (Craik & Lockhart, 1972; Frith, 1979). Active processes, such as memory recall and rote rehearsal must be carried out consciously in a serial fashion in a strictly limited capacity system (Miller, 1956). Schizophrenics have been found to be severely impaired in this operation when compared to normal subjects (Koh et al., 1973). Passive operations are not so vulnerable to disruption in normal subjects, but Frith contends that schizophrenics often become confused because automatic processes become conscious and disrupt the normal information flow.

Cognitive Approach to Information Processing

The current trend in memory research is a movement away from the study of isolated words or digits, to experimental studies using meaningful material. This important line of research is based on Bartlett's (1932) classic studies which emphasised the role of abstractive and constructive processes in forming memory representations of stimulus situations or events. The basis of Bartlett's thesis is that both learning and remembering are active processes which involves an "effort after meaning". A concept central to these processes is that of schema.

Bartlett's concept of 'schema' has been more recently elaborated by Neisser (1967) who proposes that perception and memory are dependent not on the properties of the stimulus situation alone but on the interaction of these with the internal knowledge system of the perceiver. Stimuli as such are not perceived but may contain information. People apparently have a need to find 'meaning' in their environment. Perception and memory might therefore be seen as active processes that involve selection or abstraction from the stimulus field and organisation of the selected elements into an integrated memory representation in "an effort after meaning".

If, as Frith (1979) suggests, schizophrenics have difficulty in the selection of appropriate interpretations of stimuli from the preconscious level (Marcel, 1976) it could be expected that the process of forming an integrated memory representation from complex verbal stimuli would be seriously impaired in these subjects.

Results from a number of studies on recognition memory have shown that normal adult subjects remember the more abstract meaning of sentences rather than their verbatim form. This distinction is close to Chomsky's (1965) proposal that sentences have both a surface structure and a deep structure. For example passages of connected discourse were used as stimulus materials in a natural language experiment by Sachs (1967). Subjects were then presented with a recognition set of sentences some of which preserved the form and others the meaning of the original sentences. The time interval between acquisition and recognition was varied. Sachs found that recognition memory for the surface form of sentences declined much more rapidly than did memory for the meaning of the original sentences. Following Sachs' experiment a number of further experiments have suggested that sentence processing is influenced more by deep than surface structure and that the deep structural relations characterise what is retained (Barclay, 1973; Blumenthal, 1967; Katz & Postal, 1964; Levelt, 1970).

Integrative Memory Strategies in Schizophrenia: The Bransford and Franks Paradigm

A useful paradigm was developed by Bransford and Franks (1971) to study recognition memory for complex ideas. This procedure was used by Knight and Sims-Knight (1979) to examine the use of integrative and organisational memory strategies in schizophrenic subjects. Knight and Sims-Knight modified the procedure so that the experimental material was

presented to subjects visually instead of read to subjects. Three schizophrenic groups were used in their study: good premorbid acute, poor premorbid acute and chronics. A further group of nonpsychotic patients were used as a clinical control and a group of college students served as an additional control. The procedure consisted of an acquisition and a recognition phase. In the acquisition phase subjects were presented with a series of sentences with a varying number of ideas constructed from four semantically interrelated complex idea sentences (PROTOTYPE). The prototype sentence was constructed to represent the relations among four simple declarative sentences.

Each prototype sentence was broken down into its four simple, component sentences which were then recombined in a number of ways. The complete set of sentences were as follows: (a) the four complex prototype sentences (FOURS); (b) the four simple sentences of each of these complex prototype sentences (ONES); (c) sentences constructed by combining (embedding) two simple sentences from a particular prototype sentence (TWOS); and (d) sentences constructed by combining (embedding) three simple sentences from a particular prototype sentence (THREES). Acquisition sentences for each set consisted of two 'ONES', two 'TWOS' and two 'THREES', but never the prototype (FOUR). For example one prototype sentence was 'The ants in the kitchen ate the sweet jelly which was on the table.' Example of respective acquisition sentences for this prototype sentence are as follows: 'ONE': 'The ants were in the kitchen'; 'TWO': 'The ants in the kitchen ate the jelly'; and 'THREE': 'The ants ate the sweet jelly which was on the table'. After the acquisition sentences were presented there was a short break and the recognition list was presented. Recognition sentences included sentences actually seen during acquisition (OLD); sentences that were consistent with the prototype sentence but were not part of the acquisition sentences (NEW); and

sentences that were neither part of the acquisition list or consistent with the prototype sentence (NONCASE). The subject's task was to indicate which of these sentences they had seen during acquisition and to give a confidence rating to their judgement.

Bransford and Franks (1971) found that the performance of normal subjects on this paradigm are consistent with an integrative account of memory. Subjects believe they have heard the 'NEW' sentences even though they were not included in the acquisition sequence while 'NONCASE' sentences which deviate from the original prototype meaning are consistently rejected. In addition subjects are as confident in their recognition ratings of 'NEW' sentences as they are confident that they have not heard 'NONCASE' sentences before. The greater the number of ideas from the prototype sentence contained in the recognition sentence the more easily it is remembered. There is in fact a positive linear ordering of complexity from those sentences which have only one idea (ONES) to those that have all the ideas of the complex sentence (FOURS). Generally subjects recognise new sentences that confirm to the prototype (NEW) in the same ordered way as they recognise previously seen sentences (OLDS). There was a slight recognition advantage of 'OLDS' over 'NEWS' at the level of 'ONES', but 'OLD ONES' still received a lower rating than 'NEW TWOS'. Similarly sentence confidence recognition ratings for 'OLD' and 'NEW' sentences covary in order of the number of the prototype ideas that they contain. The order of confidence recognition ratings was as follows: 'FOUR'>'THREE'>'TWO'>'ONE'. These results demonstrate that when a subject is presented with a set of sentences each expressing a partial meaning of the complete idea sentences lose their unique status in memory and are integrated into a wholistic representation (Bransford & Franks, 1971).

Knight and Sims-Knight (1979) reported that the ability to integrate complex ideas in the Bransford and Franks'

(1971) paradigm was related to subtypes of schizophrenia. They found that all subjects, including those in the schizophrenic groups, recognised 'OLD' sentences and were able to distinguish sentences which did not comply with the prototype sentence. Chronic schizophrenics were less confident that they had not previously seen the 'NONCASES' than the other groups, except the good premorbid acute schizophrenics. Contrary to the findings of Bransford and Franks (1971) all groups were more confident in their recognition of 'OLD' sentences than 'NEW' sentences. It is possible that the visual presentation of sentences facilitated memory of specific acquisition information (Flagg & Reynolds, 1977; Heilbrun, 1977). The mean recognition ratings for 'NEW' sentences indicated that the non-psychotic and the control groups integrated the part ideas into the complex semantic unit. The order of their ratings was as follows: 'FOURS'> 'THREES'>'TWOS'>'ONES'. The recognition ratings of good premorbid subjects for 'NEW' sentences indicated that they also integrated the complex idea although their performance was not equivalent to that of non-psychotic and normal groups. The recognition ratings of the poor premorbid acute schizophrenics on the 'NEW' sentences were essentially curvilinear. They were no more confident in recognizing the 'FOURS' than they were with the 'ONES' or 'TWOS'. The recognition ratings of the chronic schizophrenics had an essentially flat pattern across all levels of 'NEW' sentences.

These results were interpreted by Knight and Sims-Knight (1979) as meaning that there are distinct differences in the integrating ability between schizophrenic subtypes. Premorbid acute subjects could take advantage of the interrelatedness of sets of information, poor premorbid acutes could only make an itermediate use of interrelations, while chronic schizophrenics were unable to use the interrelations within ideas to organise their memory. Knight and Sims-Knight (1979) suggested three possible explanations for the deficient performance of chronic schizophrenics in this experiment:

1. Chronic schizophrenics may be unable to integrate across distinct elements.

2. They may be only able to integrate when it is specifically required.

3. "Poor prognosis schizophrenics may have had difficulty because they were asked to abstract an idea from everyday discourse. Since discourse failures are thought to be central to schizophrenic cognitive deficit, it may be the sentence format and not the integration or encoding of interrelations that was problematic (1979, p.200)."

On the basis of this experiment Knight and Sims-Knight (1979) were unable to differentiate between these three alternatives. This problem of differentiation could be a function of the experimental paradigm chosen. For example, the Bransford and Franks (1971) paradigm has been criticised on the grounds that the linear effect appears to be an artifact of the procedure used and can be explained in terms other than an integrative account of memory processes. Reitman and Bower (1973) used groups of letters and numbers instead of groups of sentences and still obtained a significant linear relationship between recognition confidence ratings and the number of letters and numbers appearing together. They accounted for the linear effect using what they termed a tally model, and proposed that the more complex strings are recognised more confidently because information within them is repeated more often than the shorter information units. Other researchers have also expressed doubts about the paradigm. Katz (1973) reported a linear effect using highly abstract sentences that subjects found almost incomprehensible. He concluded that the effect was due to the procedure rather than to anything central to the understanding of semantics. The linear effect has been shown to be so

sensitive to instructions that it is unacceptable as evidence for schema formation (White, 1974).

Inference as a Measure of Integration and Organisation

Bransford and Franks in a later series of experiments (Bransford, Barclay, & Franks, 1972) attempted to overcome the limitations of their 1971 experiment. The rationale for this later study was based on Bartlett's (1932) concept of the 'abstract schema'. Bartlett considered schema formation and the process of abstraction as identical operations and the formation of schemata as the critical component in cognition. Exemplars of a construct provide two types of information essential to the formation of schemata. The first relates to those specific critical features of the stimulus and is primarily perceptual. The second is the relationship between the different stimuli and this is cognitive (White, 1974). It is the relational component between exemplars that is constructed into the schemata which makes the essential quality of a concept one of function as opposed to substance (Nelson, 1974).

Many researchers have suggested that the deep structure of a sentence (Chomsky, 1965) provides a satisfactory account of what is remembered (Blumenthal & Boakes, 1967; Katz & Fodor, 1963; Sachs, 1967). But Bransford et al. (1972) proposed that this is not sufficient to characterise what is retained. They suggested that linguistic inputs act as cues which people use to modify their existing knowledge structures of the world. A sentence does not merely stand alone but is also a source of information that a listener assimilates into existing schemata. Sentences are used to construct semantic descriptions of situations. Because these constructed descriptions may actually contain more information than is given in the actual linguistic inputs from which they are derived, a purely linguistic analysis of the input sentences is not sufficient to describe all the information available (cf. McCawley, 1968).

Bransford et al. (1972) reasoned that an inference measure is the best means of establishing whether subjects have constructed semantic descriptions of situations based on relationships between exemplars. Other studies have investigated the integration of inferences derived from propositional sentences into memory representations. For example, Moeser (1976) reported that the ability to form inference is available across the developmental spectrum, from kindergarten children to adults. Paris and Carter (1973) employed a procedure in which children were presented with semantically related single idea sentences and asked to identify which of a group of recognition sentences were part of the original acquisition list. Children were more likely to identify novel sentences that were based on inferences agreeing with the original proposition sentences as having been presented before, than they were novel sentences that were false inferences. They found no developmental differences in the tendency to derive inferences from integrated verbal material for Grade 2 and Grade 5 children, other than a generally superior memory performance in the older children. This ability is affected, however, by the manner in which information is presented to subjects. Moeser observed that when related information is entered as a single unit, subjects organise the information into a semantically related structure and they are better at recognising inferential information than when the related information was presented in a nontemporal order as discrete units. She also found that the ability of subjects to derive and to integrate inferences into memory representation was facilitated by various cues which helped them to focus on the relations between the parts.

In their 1972 study Bransford et al. investigated the hypothesis that semantic memory representations of situations frequently contain more information than is specifically presented in the acquisition sentences. In Experiment Three of their 1972 series they presented subjects

with a number of descriptive passages composed of three sentences, such as the following:

> "There is a tree with a box beside it, and a chair is on top of the box. The box is to the right of the tree. The tree is green and extremely tall (1972, p.201)."

Bransford et al. were concerned with the question of whether subjects were able to remember information that was not provided linguistically, but could be derived inferentially from the acquisition sentences. The recognition sentences were constructed to provide an answer to this question. Of the four recognition sentences one was an original acquisition sentence; the second was a novel sentence based on an inference that was logically consistent with the original description; the third and fourth sentences were also novel sentences but these sentences were not consonant with the description of the situation given in the original acquisition sentences. These recognition sentences were presented to subjects who were asked to choose the actual sentence they had heard during acquisition.

Bransford et al. (1972) reasoned that according to the constructive account of memory, subjects should remember something about the general linguistic style of what was communicated, but if they forget this they should not be reduced to guessing. They should choose sentences that are consonant with the overall constructed description, even if these sentences were not originally heard during acquisition. A purely linguistic approach, however, postulates no overall wholistic description of the situation since sentences are remembered as a set of linguistic entities. If the subject can not remember which sentence was heard during acquisition

the subject will select the recognition sentence that is linguistically similar or be reduced to guessing.

The results from this experiment agreed with the predictions made from the constructive approach. The greatest number of recognition responses were given to the original recognition sentence indicating a tendency to remember the linguistic form in which the information was originally presented. However, novel inference sentences which were in accord with the overall description were recognised significantly more often than novel sentences which were not in accord with this description. Bransford et al. (1972) interpreted this result as strong evidence in support of constructive account of memory for related sentences. Subjects appear to spontaneously integrate information from semantically related information sentences in an effort to construct wholistic semantic descriptions.

A Schema for Investigating Abstraction in Schizophrenia

The 1972 paradigm of Bransford et al. seems a useful way to study schizophrenic performance on a task based on Posner's (1973) second definition of abstraction: the selection of part of the information input in such a way that it is generalised or combined with other selected aspects to create a new integration. The Trunnell (1964, 1965) similarities test investigates quite a different type of abstraction, namely what Posner refers to as classificatory abstraction. This measure makes considerable use of the principle of levels of abstraction (Braine; 1961; Lunzer, 1979) in the scoring criteria, and is the traditional way abstraction has been examined in schizophrenia.

Evidence from a number of studies (Koh & Peterson, 1978; Nachman & Cohen, 1969; Traupman, 1975) suggests that the memory deficit in schizophrenia is a consequence of inefficient abstracting and encoding strategies. Frith (1979) has

also postulated difficulties in the selection of appropriate aspects of stimulus information as central to the schizophrenic thought disorder. Normal information processing involves the transfer of information abstracted from linguistic stimuli from sensory to semantic encoding which requires increasing depth of semantic elaboration and organisation (Craik & Lockhart, 1972; Craik & Tulving, 1975). Bransford et al.'s (1972) paradigm exercises these various stages in semantic elaboration and at the same time investigates a phenomenon which occurs spontaneously in normal subjects across a range of developmental levels. Because of schizophrenics known organisational and processing deficits in memory, it is likely that they will be impaired in their ability on this task.

By using a natural language task to investigate the cognitive deficit in schizophrenia Knight and Sims-Knight (1979) have extended the basis for research in this area beyond the conceptual framework traditionally used. As was noted in the previous discussion, however, the paradigm (Bransford & Franks, 1971) utilised by Knight and Sims-Knight is open to criticism as an inadequate measure of cognitive integration on methodological grounds. A further difficulty in interpreting the results obtained by Knight and Sims-Knight is that chronic schizophrenics were treated as an undifferentiated group in their study. Results from a number of experiments (e.g. Lang & Buss, 1965; Nitsum, 1976) have illustrated that the cognitive strategies used by chronic schizophrenics are not homogenous. It seems to be important to examine how different subtypes of chronic schizophrenics perform on abstraction tasks involved in natural language processing using an experimental paradigm that is not open to the same criticisms as that of Bransford and Franks (1971). The Bransford et al. (1972) study is clearly a useful basis for this. Difficulties experienced on more traditional abstraction tasks (e.g. Trunnell, 1964, 1965) by chronic schizophrenics may also be clarified if the chronic group is not treated as homogenous.

THE PRESENT STUDY

The present study was designed to compare the performance of schizophrenic subjects with that of a control group on cognitive tasks designed to measure two dimensions of the abstraction process. The first measure of abstraction used was the similarities paradigm of Trunnell (1964, 1965) which is regarded as a prototype of traditional abstraction theory (Braine, 1961; Lunzer, 1979). The second measure was derived from the Bransford, Barclay and Franks (1972) paradigm which looks at the relational component of the abstraction process postulated by Cassirer, (1923/1953), Nelson (1974, 1977), and Posner (1973).

It seems to be both theoretically important and experimentally useful to use two measures of abstraction to investigate the cognitive deficit in schizophrenia. Chapman and Chapman (1977) point out that in the light of the massive literature available demonstrating schizophrenics as performing less accurately than normals on many cognitive tasks, it has become trivial to demonstrate that a schizophrenic group performs less well than a normal group on a particular task. One escapes triviality only by studying differential deficit. Differential deficit can be defined as a greater deficit on one task than on at least one other task in the same domain. Questions are thereby addressed to the nature of the cognitive deficit in schizophrenia rather than to establishing whether a global and unspecified deficit exists. Many researchers consider that the study of cognitive deficit in schizophrenia requires a differential measure (Gillis & Bleven, 1978; Herron, 1977; Oltmanns & Neale, 1975). Chapman and Chapman (1977) believe that this is the most important issue confronting research in the area today.

A further important consideration in designing and interpreting research into the nature of the cognitive

deficit in schizophrenia is related to subject variables. Chapman and Chapman (1977) point out that schizophrenics should not be treated as a homogenous group. A great deal of the conflicting evidence found in comparison of results from different research studies, could well be due to treating hetereogeneous groups as homogenous (Otteson & Holzman, 1976). It is therefore important to consider diagnostic subgroups of schizophrenia when designing research. A number of dimensions have been proposed to reduce the homogeneity of schizophrenic samples. These dimensions include the acute/chronic, process/reactive and paranoid/non-paranoid dichotomies.

In the present study, chronicity was selected as the common dimension in two groups of schizophrenic subjects. Chronicity has been found to be an especially important determinant of results across a number of studies (Chapman & Chapman, 1977). The differentiating factor between the groups was the paranoid/non-paranoid dimension which is the most common symptom grouping (Herron, 1979). Both the paranoid and the chronic dimensions are considered to span the diagnostic typology (Herron, 1977; Wing, 1978). No acute subjects were included in the present study as it was considered that paranoid/non-paranoid differences could be more clearly isolated if they were considered in relation to only one pole of the chronic/acute dimension. In a number of reviews of chronicity classification systems (Chapman & Chapman, 1977; Cromwell, 1975; Herron, 1977) it has been considered that the length of time symptoms have been present is the critical factor in classifying patients. As recommended by Feighner, Robins, Guze, Woodruff, Winokur and Munoz (1972) subjects were included in the clinical sample if the duration of their illness was at least six months. With the current emphasis on intermittent hospitalisation and out-patient care, length of hospitalisation as a criterion was considered likely to introduce a confounding

factor into the study.

Of all the diagnostic classifications chronic schizophrenics have been found to almost always do worse on cognitive tasks than acutes (Chapman & Chapman, 1973; Herron, 1977; Knight & Sims-Knight, 1979). Chronic schizophrenics have been found to be under-inclusive and to show much more concrete kinds of thinking than other schizophrenic groups (Blatt & Ritzler, 1974). It is important to differentiate paranoid from non-paranoid subgroups in research on cognitive functioning in schizophrenics as a number of studies have reported important cognitive differences between these groups (Chapman & Chapman, 1973, chap. 16; Gregson & Fearnley, 1974; Neufield, 1976, 1977).

Cromwell (1975) has suggested that because paranoid delusions require a fairly advanced cognitive structure, paranoids are perhaps less cognitively impaired than non-paranoids (Shean, 1978, p. 47). Gillis and Blevens (1978), however, have suggested that paranoid schizophrenics and non-paranoid schizophrenics are cognitively impaired but for different reasons. These authors were able to demonstrate that paranoids had excellent task control, but their task knowledge did not improve with guidance or feedback, while the opposite occurred with non-paranoids.

In the present structure a normal control group was chosen in preference to a non-psychotic psychiatric group as it has been noted that finding a difference between two pathological groups does not necessarily mean that the deficit is unique to one group (Chapman & Chapman, 1977).

A further difficulty in designing research into schizophrenic cognition is the serious hazard of using patients who are on drugs. This has been discussed by Chapman and Chapman (1973) and Buss and Lang (1965). However, it has

been pointed out that if the researcher is to do the study at all he often has no choice in this matter (Chapman & Chapman, 1977). It is a reasonable assumption to believe that drugs have an influence on the higher mental operations. Oltmanns (1978) reported that when chronic schizophrenics were removed from their normal range of antipsychotic drugs they were more easily distracted. The use of phenothyezine medication has been reported to reduce schizophrenic associative errors and also to improve task knowledge and response consistency (Gillis & Blevens, 1978). In the present study schizophrenics were maintained on their regular drug treatment for the experiment.

Summary - Within the constraints of hospital regulations, time and the availability of subjects, it was decided to investigate cognitive deficit in schizophrenia in an experimental group of chronic schizophrenic patients classified into two diagnostic sub-groups (paranoid and non-paranoid). Randomly selected normal subjects were used as a control group.

A traditional abstracting and classifying task was used to establish a basis for comparison within the experimental group and between the experimental and the control group. Trunnell's (1964) similarities experiment was replicated for this purpose as it is a well established but brief measure of abstracting ability. It has consistently been shown that schizophrenics perform poorly on a test of this type (Blatt & Ritzler, 1974; Chapman, 1958; Wright, 1975).

To establish further boundary conditions beyond which schizophrenics' cognitive processes cease to function adequately, schizophrenic performance on the relational component of the abstraction process was investigated using a natural language task based on a paradigm derived from the Bransford et al. (1972) study. Performance on this experimental paradigm requires that subjects are able to abstract

information about relationships between items in the stimulus situation and to organise these into an integrated memory representation. A number of studies have shown that schizophrenics are less efficient than normals in the use of organisational strategies in memory tasks (Cash, Neale & Cromwell, 1972; Koh, 1978). This deficit does not, however, seem to reflect an absolute inability to use organisational strategies but only a partial one (Traupmann, Berzofsky & Kesselman, 1976). As subgroups of schizophrenics have been shown to vary in their information processing abilities and since paranoids show more structured cognitive processing than non-paranoids it is likely that these two groups will perform differentially on this measure.

In light of these considerations the aim of the present study is to investigate the following predictions:

a. The combined schizophrenic group will perform less adequately than the control group on each of the two abstraction tasks.

b. Paranoid schizophrenics will perform better than non-paranoids on both abstraction tasks but less well than controls.

c. Schizophrenic subjects will perform less adequately compared to controls on the similarities abstraction measure than they do on the relational measure.

METHOD

Design - A between-subjects factorial design was used. The independent variable in each experiment was the psychological status of the subjects; paranoid schizophrenic, non paranoid schizophrenic and non psychiatric control. The dependent measure used in the first experiment was the score obtained on Trunnell's (1964) similarities test (for scoring procedure see Appendix A). In the second experiment the dependent measure used was performance on the recognition test items derived from Bransford, Barclay and Franks' (1972) paradigm (for recognition sentences see Appendix A).

Subjects - All subjects voluntarily participated in the experiments. Age, sex, educational level and occupational status were matched as closely as possible between the groups. The mean age of paranoid schizophrenic subjects was considerably higher than subjects in the non-paranoid schizophrenic group or the control group. This was a function of the older age of the paranoid population from which the sample was drawn and could be due to the later onset of paranoid type of schizophrenic illness noted in previous research (Hamlin & Folsom, 1977; Shean, 1978, p.31).

Sex differences in performance were controlled for by the inclusion of an equal number of male and female subjects in each group. As full verification of educational level was not available for all subjects the vocabulary subscale of the WAIS was administered to subjects as an additional control for the effects of verbal ability on performance (Koh & Peterson, 1978; Russell & Knight, 1977). The standard form was presented and scored in the usual manner. The raw scores have been converted and are presented as scaled scores. (See Table 1.)

TABLE 1

Means and Standard Deviations for Age, Illness Duration and Wais Vocabulary Scores (Scaled) for Paranoid Schizophrenic, Non-Paranoid Schizophrenic and Control Groups

Variable		Group Paranoid	Non-Paranoid	Control
Age	Mean	38.7	31.0	33.5
	S.D.	9.12	12.10	11.20
Illness Duration in Years	Mean	6.5	5.9	-
	S.D.	3.17	4.25	-
Wais Vocabulary Score (Scaled)	Mean	11.2	9.9	13.0
	S.D.	2.3	3.0	2.1

Subgroup Criteria

Clinical - The selection and examination of clinical subjects took place over a two month period in 1979. All subjects were residents of a medium sized psychiatric hospital. The initial identification of schizophrenia was made from hospital records, which were composed chiefly of psychological and psychiatric assessments and nursing reports. The preliminary assessment of schizophrenia was supported by the 'New Haven Schizophrenic Index' (Astrachan, Harrow, Adler, Bauer, Schwartz, A., Schwartz, C., & Tucker, 1972) as used by Knight and Sims-Knight (1979) and Russell and Knight (1977). The division of clinical subjects into the diagnostic subcategories of paranoid and non-paranoid was based on the agreement of two clinical psychologists and a psychiatrist. Only chronic schizophrenics were included in the sample, chronicity was defined by illness duration of six months or longer (Feighner, Robins, Guze, Woodruff, Winokur & Munoz, 1972).

Subjects with evidence of organicity, alcoholism, or those who had received electroconvulsive therapy within the

previous six months of the experiment were excluded from the study. During the experiment, two subjects were deleted from the sample: one because of an adverse drug reaction and another who proved incapable of understanding the instructions. The experiment was completed by ten paranoid and ten non-paranoid schizophrenics.

Nearly all patients were receiving phenothiazine medication. Patients were maintained on their regular drug regime during the experiment, since it was not considered likely that medication would impair performance on the experimental tasks. It has been reported that these drugs have little effect on memory tasks (Koh & Kayton, 1974; Koh, Kayton & Berry, 1973) and may even improve cognitive performance in schizophrenic subjects (Herron, 1977; Gregson & Fearnley, 1974).

Control - The control group consisted of twenty subjects, without evidence or history of psychiatric illness. This sample was randomly selected from a suburb in a medium sized city and was composed of a broad range of occupational codes.

Experimental Procedure

All subjects were tested individually and completed the experimental task in one session. Clinical patients were tested in a small interview room within the hospital. Time taken to complete the full protocol was dependent on the psychological state of the subject; control subjects averaged thirty minutes and clinical subjects took between three quarters of an hour and two hours. The first five to ten minutes of the experiment was spent establishing a good rapport with the subjects. When the opportunity arose with the clinical sample biographical data and social history was verified.

Experiment 1

Materials - Trunnell's (1964) similarities measure was used. This consists of twelve sets of three words. Each set of words forms a concept or word class. (For the full set of words and instructions given to subjects see Appendix A.)

Procedure - A practice set of three words was given to familiarise subjects with the task. The words 'shoe', 'belt' and 'coat' were presented and subjects were asked whether three, two or none of these objects could be grouped on the basis of what they have in common. When the practice example was completed the twelve experimental word sets were presented, one set at a time. Word sets were presented on cards and repeated verbally by the experimenter. No time constraint was placed on completion of the test but subjects were asked to complete it as quickly as possible.

Experiment 2

Materials

Acquisition - Four sets of descriptive passages were constructed by modifying slightly Bransford et al's (1972) paradigm (See Appendix A). Each descriptive passage was composed of three sentences which described a relationship between three objects from which a further inference could be drawn. In the first sentence a specific relationship is established between two objects, using concepts such as 'under', 'inside' and 'right'. In the second sentence a third object is introduced and related to one of the earlier mentioned objects. The two sentences provide enough information to derive a logical inference about the relationship between the three objects. The final sentence provides no further information concerning the relationship between these objects and gives descriptive colour to the passage.

Acquisition story set.

1. A chair is on top of the box.
2. The box is to the right of the tree.
3. The tree is green and extremely tall.

Recognition - For each story set there was a recognition sequence which consisted of four sentences. One of these sentences was the original sentence which had been previously heard; the second was a permissible inference which could be derived from the original story set but had not been heard before; the third changed the spatial relationship of the original sentence and therefore contained a false premise; the fourth sentence was also false and changed both the spatial relation and the subject noun of the original sentence.

Recognition set.

A. The box is to the right of the tree. (Original)
B. The chair is to the right of the tree. (Permissible inference)
C. The box is to the left of the tree. (False premise)
D. The chair is to the left of the tree. (False object and relation)

Procedure - Subjects were told that they would hear a number of brief sets of sentences each of which described a simple scene. They were asked to listen carefully to these sentences as they would be asked some questions about them later. (For verbatim instructions to subjects see Appendix A). Before beginning the experimental story sets, a practice example was read and subjects were asked to tell the experimenter something about what they had heard. Following the practice example, the four experimental story sets were read at a normal speaking rate with a seven second pause between each set.

Confidence ratings were used while testing for recognition. The three confidence levels used were 'very certain, 'reasonably

certain', and 'uncertain'. To familiarise subjects in the use of confidence ratings a recognition example was given from the early practice story set. Subjects were asked to say whether they had heard the sentence before and then to indicate, by pointing to the rating card, the level of confidence they placed in their judgement.

After subjects had completed the confidence rating practice the recognition sequence was presented. Recognition sentences were presented in story blocks. To control for ordering effects a Latin Square design was used so that each subject was given a different order of story sets and a different order of recognition items within story sets. Recognition sentences were presented separately on printed cards and repeated verbally by the experimenter. For each sentence, subjects were asked whether they had heard that sentence before and then to give a confidence rating to their judgement.

RESULTS

Similarities - Responses were scored using Trunnell's (1964; 1965) criteria (See Appendix A). Protocols were scored by both the experimenter and an independent rater who was not informed of the status of subjects. The inter-rater co-efficient of reliability obtained was .96.

TABLE 2

Percentage of Correct Responses, Means and Standard Deviations on Similarities for Three Groups of Subjects

	Group			
	Paranoid	Non-paranoid	Combined Schizophrenic	Control
Mean	45.8	40.6	43.2	59.25
Stanard Deviation	12.58	12.83	12.65	5.49
% Correct	63.61	56.11	60.00	82.29

Table 2 presents mean scores and percentage of correct responses given by all groups on the similarities measure. For the combined schizophrenic group percentage of correct responses was lower (60%) than for the control group (82%). The highest percentage (82%) of correct responses was given by control subjects. Paranoid subjects gave 63% correct responses which was higher than that given by non-paranoid subjects (56%). There was considerably more variability in the performance of the schizophrenic group than in the control group indicated by the greater standard deviation shown for schizophrenic scores (See Table 2).

A one way analysis of variance (unequal n's) showed that there was a significant difference between the three groups; paranoid, non-paranoid and control ($F(2,37) = 11.83$, $p < .005$).

(For summary table see Appendix B). Separate analyses of variance showed a significant difference between the combined schizophrenic group and the control group ($F(1,37) = 8.22$, $p < .01$). Differences between the paranoid and non-paranoid schizophrenic groups were nonsignificant ($F(1,37) = 1.73$, $p > .10$). There was a significant difference between the non-paranoid and the control group ($F(1,37) = 22.20$, $p < .001$, unequal n's) and also for comparison of the paranoid groups with controls ($F(1,37) = 11.55$, $p < .005$, unequal n's). (For summary table of these analyses see Appendix B). A summary of the results are presented in Table 3.

The results obtained by Trunnell (1964) are included for comparison (see Table 3).

TABLE 3

Comparison of Differences Between Schizophrenic and Control Subjects on Similarities

Comparison	F	p
Paranoid vs non-paranoid vs control	11.83	< .005
Combined schizophrenic vs control	8.22	< .01
Paranoid vs non-paranoid	1.73	> .10
Non-paranoid vs control	22.20	< .001
Paranoid vs control	11.55	< .005
Adults vs schizophrenics (*)	-	< .016

* (Trunnell, 1964: Mann-Whiteny two tailed probability test).

Of the total variance in the study, the percentage of variance accounted for by the comparison between non-paranoid schizophrenic and control was 37% ($\eta^2 = .37$) and only 19% ($\eta^2 = .19$) for the paranoid versus control comparison. (For eta calculation see Appendix B). This indicates that while both comparisons are significant, the non-paranoids produced the largest effect.

Relational Abstraction - Only 'YES' responses to the recognition sentences were included in this analysis. Percentage of 'YES' responses given to each sentence category are summarised in Table 4. (For raw frequencies see Appendix C).

TABLE 4

Percentage of Recognition Responses in Each Sentence Category for All Groups

Group	Recognition Sentence Type			
	A %	B %	C %	D %
Control	41.84	31.21	14.18	12.77
Combined Schizophrenic	38.64	30.30	19.70	11.36
Paranoid	43.33	28.33	20.00	8.33
Non-paranoid	34.72	31.94	19.44	13.88

Table 4 shows that for all groups the original (A) sentence was recognised more readily than any of the three alternative (B,C and D) sentences. For each group the general pattern of responses given was A>B>C>D indicating that for all subjects the strongest tendency was to remember the specific form of the sentence in which information was originally presented. The highest percentage of recognition responses to the original (A) sentences was given by paranoid subjects (43%) and the lowest percentage by non-paranoids (34%).

Given that subjects did not remember the original sentence, all groups picked the reality preserving inference (B) sentence more often than either of the reality distorting alternative (C and D) sentences. For all groups except the non-paranoid group there was a marked drop in the percentage

of responses given to reality preserving (B) sentences compared to original (A) sentences. Non-paranoid subjects differentiated less clearly between these two sentence types with a drop in percentage of responses given from A to B of only 3%.

Comparison of results from the combined schizophrenic group with those from control subjects, shows little difference in percentage of responses given to each sentence category. Differences between each schizophrenic subgroup and the control group are attenuated when combined. To control for individual differences in recognition rates, the frequency of 'yes' responses in each of the four categories were converted to proportions of total responses given by each subject. (For raw frequencies see Appendix D).

A two factor ANOVA (unequal n's) was performed on the data. This analysis showed that there was a significant main effect for test across the four conditions ($F(3, 111) = 34.34$, $p = < .001$). Because the proportions of total responses sum to unity for all subjects, there were no significant differences between the groups ($F, 2,37) = 0$, $p > .10$). There were no significant interactions, condition by group, in this analysis ($F, (6,111) = 0.65$, $p = > .10$). (For summary table see Appendix B).

Multiple comparisons between the reality preserving (A and B) sentences and the non reality preserving (B and C) sentences showed an overall main effect for test ($F(1,37) = 53.92$, $p < .0001$) indicating that all groups showed a drop in proportional responses given across these two categories. Again, for reason given above, there was no significant difference between the groups ($F(2,37) = 0$, $p > .10$, unequal n's) in this analysis and no significant interactions between reality preserving and non-reality preserving sentences by group were found ($F(2,37) = 0.28$, $p > .10$, unequal n's). (For summary table see Appendix B).

Separate one way analyses of variance were carried out for each group on reality preserving sentences only (original A sentences and inference B sentences). There was no significant differences between these two sentence categories for control, combined schizophrenic and non-paranoid groups. There was however a significant difference between responses to these two sentence categories for the paranoid group ($F,(1,111) = 6.69$, $p < .05$) (see Appendix B). This finding indicates a difference in cognitive processing between paranoid and non-paranoid schizophrenics.

Confidence ratings were analysed separately from YES/NO responses. First a proportional analysis of conditional probabilities was carried out on the ratings for all groups. The proportion of items rated at each level of confidence was considered as to whether they were OLD or NEW items. The results of this analysis are shown in Table 5. (For raw frequencies see Appendix E).

TABLE 5

Proportional Analysis of Conditional Probabilities for Confidence Judgements

Group	Item Type	Confidence Judgements					
		---	--	-	+	++	+++
Control	A	.06	.11	.16	.35	.36	.53
	B	.18	.24	.18	.35	.34	.29
	C	.39	.28	.33	.13	.13	.15
	D	.37	.37	.33	.17	.17	.03
Paranoid	A	.09	.12	.24	.25	.40	.50
	B	.30	.24	.20	.25	.20	.25
	C	.26	.30	.24	.37	.33	.14
	D	.35	.33	.32	.13	.07	.11
Non-paranoid	A	.08	.21	.20	.17	.35	.37
	B	.24	.18	.20	.33	.30	.30
	C	.20	.29	.32	.33	.23	.20
	D	.48	.32	.28	.17	.12	.13

Results for the control group show that situation preserving (B) sentences although actually NEW items were generally treated as OLD in terms of the proportions of confidence responses given to them. There is however, one exception. The reversal of expected proportions at the higher confidence levels (++ = .34, +++ = .29) for B items. This indicated that subjects had some reservations about using the highest level of confidence for these items. This general pattern of responses does not hold for either of the schizophrenic groups. Paranoid subjects treated B sentences in a similar way to other NEW items but gave responses comparable to the control group on OLD (A) items; of all the groups non-paranoid subjects showed the lowest level of confidence in their responses to OLD (A) items and little difference between their confidence ratings of responses to B and C (NEW) items.

Confidence judgement frequencies were also cumulated to give the proportion of confidence judgements made at each of five cut-off points (of Murdock, 1974, pp. 27-28). These results are shown in Table 6 (see Page 43). (For raw frequencies see Appendix E).

For all groups the pattern A>B>C>D obtained at the YES/NO cut-off point was found at all other cut-off points with one exception (i.e. for non-paranoids C>B at ---/-- levels). This suggests that the conclusions reached on the basis of the YES/NO cut-off point are not solely a function of selection of that cut-off point but hold across all confidence levels. For the control group, responses to B were found to be closer to A than to either C or D at all cut-off points. This was not the case for either of the schizophrenic groups. For paranoid subjects responses to B are closer to C than to A at all cut-off points. The non-paranoid group gave similar responses to A, B and C items indicating a fairly low level of confidence in their responses to both

OLD and NEW items.

The more extended evaluation of results allowed by analysis of confidence ratings in addition to that of 'YES' responses, strongly supports the finding for the control group that situations preserving (B) sentences are more readily confused with OLD items than are other NEW items (C and D sentences). For each of the schizophrenic groups, the analysis of confidence ratings does not suggest such a marked difference between their responses to situation preserving NEW (B) items and other NEW (C and D) items.

TABLE 6

Cumulated Proportions of Confidence Judgements Cut-Off at Five Confidence Levels

Group	Item Type	Confidence Judgements				
		---/--	--/-	-/+	+/++	++/+++
Control	A	.95	.88	.75	.65	.41
	B	.85	.69	.55	.45	.23
	C	.68	.49	.24	.20	.11
	D	.69	.44	.19	.14	.02
Paranoid	A	.90	.80	.65	.60	.45
	B	.68	.48	.35	.30	.23
	C	.73	.48	.33	.25	.13
	D	.63	.35	.15	.13	.10
Non-paranoid	A	.95	.78	.65	.63	.28
	B	.85	.70	.58	.53	.23
	C	.88	.63	.43	.38	.15
	D	.70	.43	.25	.23	.10

DISCUSSION

Results from the first experiment showed that there was a significant difference in abstracting ability between the combined schizophrenic group and the control group on the similarities measure. This measure of abstraction, based on a necessity to form conjunctive classes, confirmed that when schizophrenics abstract they employ lower conceptualising levels than control subjects do. The attribute classes formed by schizophrenics were based on constructs that were less abstract and universal than those used by control subjects. In the present study the type of responses given by schizophrenic subjects indicated that they were more aware of the immediate concrete attributes of stimuli and did not co-ordinate abstract aspects of stimuli into a more general superordinate concept (Goldstein, 1939, 1944; Vygotsky, 1934, 1962). This finding supports a number of previous studies which suggest that schizophrenics have difficulty in abstracting, because they are impaired in their ability to form higher order abstract concepts (Lothrop, 1961; Trunnell, 1964, 1965; Wright, 1975).

Comparison of results from the two clinical groups showed that non-paranoids were more impaired than paranoids on the similarities measure. This was illustrated by the more concrete attributes used by non-paranoids as a basis for their conceptual groupings of test items. Paranoids made less use of concrete attributes in constructing concepts than non-paranoids but their performances still showed little evidence of using superordinate abstract concepts to classify items. However, the scores of the two schizophrenic groups on the similarities measure were much closer to each other than either of them was to those of the control group. This finding supports previous studies using traditional measures of abstraction and confirms that schizophrenics perform at an inferior level to non-psychiatric controls on tasks that re-

quire Posner's (1973) first type of abstraction (Hamlin & Folsom, 1977; Payne, 1962; Schimkunas, Gynther & Smith, 1967).

Results from the second experiment showed that there were no significant differences between the combined schizophrenic group and the control group on the abstraction measure derived from Bransford, Barclay and Franks' (1972) paradigm. As a group, schizophrenics integrated inferential information into their memory representations of a spatial situation, indicating that they used abstracting and intergrating processes in this task. Closer inspection of results from the two clinical groups, however, reveals that each group responded quite differently on the recognition test and that they employed different cognitive strategies. For example, the paranoid group have the lowest recognition ratings to inference sentences of all the groups. From this it could be assumed that paranoid schizophrenics do not automatically abstract schemata of spatial relationships in the same way as control subjects do. Paranoid subjects do not appear to elaborate the stimulus material beyond its deep structure (Chomsky, 1965) but actually seem to have a more accurate recognition memory for the original form of the acquisition sentences than control subjects do (Bransford, Barclay & Franks, 1972).

Further support for this observation comes from the analysis of confidence judgements. Paranoid schizophrenics used confidence judgements for original sentences in the same manner as control subjects did. In contrast, however, their confidence judgements for the inference sentences were used quite differently from that of controls. The controls treated the inference sentences like original sentences in their confidence ratings but the paranoid schizophrenics treated them more like the changed relation sentence C category (i.e. sentences that were not semantically consistent with the

original description). This finding suggests that paranoid schizophrenics appear to remember only the linguistic form of connected discourse, rather than a more abstract descriptive schema; when the linguistic form was forgotten they found difficulty in distinguishing reality preserving from reality distorting alternatives. The performance of paranoid schizophrenics on inferential tasks has customarily been viewed as rigid and highly controlled (Foulds & Owen, 1963), and in the present study, their confidence rating responses were fairly consistent across all types of new recognition items giving some support to this view.

In contrast to the paranoid group, non-paranoids performed more like the control group in terms of the high recognition responses given to inference sentences. In contrast to the control group, however, non-paranoid subjects also showed considerable confusion between all sentence categories. This finding could be explained by Friths' (1979) contention that non-paranoids become distracted and confused by verbal stimuli because they are aware of normally pre-conscious operations. This could possibly be an explanation for the fact that the confidence judgements of the non-paranoids were not greatly different for either A, B or C recognition sentence categories. On judgemental tasks non-paranoid schizophrenics are generally considered to show good task knowledge but they do not apply this knowledge consistently (Gillis & Bleven, 1978). The results in the present study are consistent with the inefficient, random and uncertain performance that non-paranoid schizophrenics have shown on a number of tasks (Chapman & Chapman, 1973; McGhie, Chapman & Lawson, 1965).

If patients had not been receiving their regular medication, it is likely that larger differences in performance would have been found between the schizophrenic groups and the control group on the two abstraction tasks. The clinical

picture of schizophrenia has probably altered quite significantly with the extensive use of tranquilizing drugs and it is likely that far more regressed cognitive behaviour was seen in schizophrenics before phenonthyazines and other antipsychotic drugs were used as extensively as they are today (Gillis & Bleven, 1978; Gillis & Moss, 1975; Oltmanns, 1978).

For the combined schizophrenic group, performance on both the similarities measure and the relational measure was at an inferior level to that of control subjects. In comparison to the control group, however, the combined schizophrenic group showed a more marked inability to abstract on the similarities measure than they did on the relational measure. This finding suggests that in schizophrenia the capacity to form higher-order abstract concepts is more impaired than is the capacity to abstract ideas and information from natural discourse.

The present results give come support to Knight and Sims-Knight's (1979) finding that chronic schizophrenics have an impaired ability to integrate and organise ideas because their information processing strategies are deficient (Blaufarb, 1962; Chapman & Chapman, 1973). Of the two schizophrenic groups, the paranoids performed best of all in their capacity to abstract information from natural discourse but their performance was still inferior to that of the control group in terms of their ability to derive inferential information from stimulus materials.

There is, however no evidence from the present study that chronic schizophrenics have a total inability to organize relationships between stimuli into memory representations as was suggested by Knight and Sims-Knight on the basis of their 1979 findings. The reason for this difference between the findings from the two studies is not clear. It has, however, been proposed by Bransford et al. (1972) that their 1972

paradigm is a more rigorous measure of abstraction and integration of ideas into memory than is their 1971 paradigm. In the present study, which utilized this more rigorous paradigm, differences between schizophrenic sub-groups and controls did not reach significance. It cannot be concluded, therefore, that chronic schizophrenics are totally impaired in their ability to abstract and integrate ideas and relationships from verbal stimuli into memory representation. Neither can it be inferred that chronic schizophrenics may not be able to intregrate ideas into memory representation unless specifially required to do so (Knight & Sims-Knight, 1979). The present study utilised an incidental learning paradigm based on Bransford et al.'s 1972 experiment, and yet there was some evidence that chronic schizophrenic subjects integrated ideas although to a differential degree. The impaired abstracting ability in chronic schizophrenics is clearly not of the same quality for different sub-groups of the chronic dimensions on this type of measure.

Both the type and severity of thought disorder are important in understanding schizophrenia. The difference in cognitive performance found in the present study between paranoid and non-paranoid subjects supports this belief. Paranoids may be protected from further cognitive disintegration because of their greater conceptual organization and the more integrated core of their psychopathology (Cromwell, 1972; Frith, 1979; Nitsun, 1976) but the present study suggests that the difference between the two groups is more than one of severity.

Information processing paradigms have merit in accounting for the different performance of the paranoid and tne non-paranoid schizophrenics on the two abstraction tasks. In the similarities experiment which examined the ability to form higher order abstract concepts, subjects were required to form conjunctive classes. Although the paranoid schizophrenics

performed slightly better than the non-paranoids on this task, both clinical groups were impaired in their ability to form abstract conjunctive classes. Although the paranoid schizophrenics performed slightly better than the non-paranoids on this task, both clinical groups were impaired in their ability to form abstract conjunctive classes. Trunnell (1964) proposed that the reason schizophrenics were impaired on this task was they were unable to hold multiple hypotheses in memory sufficiently long enough to form a conjunctive concept. In the present studies both clinical groups seemed to be similarly affected by this deficit.

In comparison to the general deficit common to both schizophrenic subgroups on the similarities measure, results from the second experiment suggest that paranoid schizophrenics process connected discourse differently from non-paranoid schizophrenics. In terms of a depth of processing account of memory proposed by Craik and Lockhart (1972), the type of memory schema that a subject constructs depends on the type of analysis that subjects perform on the to be remembered material. They proposed that in memory tasks material is processed to various depths of analysis using an array of perceptual, cognitive and abstraction processes.

In subsequent revisions of the theory, the notion of depth has been replaced by the concept of minimal encoding which is subsequently elaborated to higher levels of abstraction in memory (Craik, 1975; Craik & Tulving, 1975). This notion implies that there are many different ways that information may be abstracted from stimulus situations and that the type of memory representation constructed from identical stimuli will have different features and characteristics depending on the specific aspects of the stimuli that are originally encoded. Oltmanns (1978) considers that those levels of abstraction occurring relatively early in the elaboration are executed almost automatically without con-

scious effort but those that occur later must be performed with conscious effort. Frith (1979) proposed that in schizophrenia cognitive operations frequently become impaired because ordinarily preconscious processes become conscious and disrupt the normal information flow.

From the results of the present study it seems that paranoid subjects tend to encode the specific linguistic form of sentence information in memory and do not elaborate it further. This was illustrated by the high recognition responses given by the paranoids to the original form of the acquisition sentences. They do not, however, appear to employ cognitive operations to derive inferences across sentence boundaries with any certainty. On the other hand, non-paranoid schizophrenic subjects tend to encode the specific linguistic form of sentences poorly in memory. Although they seem capable of encoding inferential information, they confuse inferences with specifically stated information much more than normal subjects do. In addition, the similar proportions of recognition responses given by non-paranoids to inference and original sentences suggests that this pattern of responses could be a result of confusion at the preconscious level between what is perceived and what is inferred; it does not necessarily indicate an enhanced ability to form wholistic memory representations of a situation or event.

It has been shown that schizophrenics' preconscious operations are relatively intact in some areas of cognitive processing. For example, schizophrenics are reported to spontaneously encode contextual information (Koh & Peterson, 1978). A number of researchers into schizophrenia, typically employing word lists, report that schizophrenic subjects have a deficient executive control system in tasks that require elaboration of stimulus material to a sufficient cognitive depth to support recall (Koh, 1978; Koh, Kayton &

Peterson, 1976). These points also have relevance for the findings of the second experiment in this research which utilized a recognition paradigm. The concept of a generally deficient executive control system is, however, not specific enough to clarify the findings of the present study which indicates quite different types of impairment in different sub-groups of chronic schizophrenics. For example, results from the present study show that chronic paranoid schizophrenics abstract information from connected discourse differently from non-paranoid schizophrenics. Neither group performed in an equivalent manner to the control group. Paranoid schizophrenics did not show much further elaboration from the original encoding and generally treated information in a rigid manner. This finding is in keeping with their clinical description. The case for the non-paranoid schizophrenics is not so clear and indicates a need for continued research to establish whether the impairment found in this experiment is at a preconscious level of encoding or whether it occurs at later stages of elaboration.

The ability to abstract is a critical cognitive process because people are constantly required to preconsciously and consciously abstract higher order constructs from the environment in order to make sense of reality (Frith, 1978; Lunzer, 1979; Nelson, 1974; Schwartz & Gilmore, 1980; White, 1974). The parameters of the impairment in this ability have not been clearly established by previous research on schizophrenia, in particular there has been little clarification of the differential deficit in different sub-groups of schizoprenics. The utilization of multiple measure to study the abstracting ability of schizophrenics is obviously more useful in delineating the characteristics of the cognitive dysfunction in this area than is the use of traditional single measure paradigms. It is also clear from the finding of the present study that treating schizphrenia as a homogenous group can lead to misleading interpretations. The results of the present study

indicate some possible directions for future research that could ultimately offer insights into the development of differential and more effective therapeutic strategies.

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APPENDIX A

MATERIALS

Contents — Page

Similarity Test (Trunnell, 1964)

Subjects are asked whether three, two or no objects can be grouped together on the basis of what they have in common.

Items

1	Book, teacher, newspaper
2	Wool, cotton, leather
3	Rose, potato, tree
4	Orange, apple, grape
5	Rain, snow, heat
6	Fly, tree, man
7	Air, water, sky
8	Table, chair, bookcase
9	Car, bicycle, train
10	Poem, painting, concerto
11	Petrol, steam, electricity
12	Telephone, radio, television

Scoring Criteria for Similarities Test (Trunnell, 1964)

Rank Value	Number of Items	Reasons Given
6	Groups 3 together	Classified according to a universal concept which encompasses all attributes of the object. Eg: book, teacher, newspaper = education, knowledge; orange, apple, grape = fruit; car, bicycle, train = transportation.
3	Groups 2 together	Classified universally, but with evidence that subject focusses on partial attributes or on functional utility. Eg: book, teacher, newspaper = sources of knowledge; table, chair, bookcase = pieces of furniture; car, bicycle, train = means of transportation.
2		Classified universally, but classification based upon some limited physical aspect of object. This would include classifications made on the basis of contigency of location, or made on the basis of a mutual relationship. Eg: book, teacher, newspaper = teacher uses books and newspapers; rose, potato, tree = "rose grows on a tree and a potato grows nearby"; car, bicycle, train = "they all travel distances".
1	Groups none together	No reason given, or "don't know" or an insensible or bizarre answer. Included here are personalized stories. Eg: book, teacher, newspaper = "Don't know", or "teacher looks in a book that comes in a newspaper"; fly, tree, man = "man flies in an airplane."

INSTRUCTIONS

Similarities

"I am going to ask you to listen to some sets of words. After you have heard them I am going to ask you some questions. There are no right or wrong answers, to these questions."

Practice - "I will begin by showing you some lists of words written on cards. Here is an example. Consider the following list of words: show, belt and coat. Do all of these words have something in common, or only two, or do none of the words have anything in common?"

"Just for practice, what do the words shoe, belt, and coat have in common?" (If at this point, the response appears unclear, suggest that some people say clothes, or items of apparel.)

"We will begin if you are quite clear about what you have to do?"

Question - "What do the following words have in common?" (Experimenter reads items from Similarity Test (Trunnell, 1964)).

RELATIONAL ABSTRACTION MATERIAL

Paradigm

Acquisition Description

1. A is related to B.
2. B is related to C in such a way that it can be inferred that A is related to C.
3. Descriptive filler.

Recognition

A. B - (Original relation) - C (Old)
B. A - (Original relation) - C (Valid inference)
C. B - (Opposite relation) - C (Invalid relation)
D. A - (Opposite relation) - C (Invalid inference)

A.	Original sentence	Old	Reality preserving
B.	Valid inference	New	" "
C.	Invalid relation	New	Reality non-preserving
D.	Invalid inference	New	" "

Story Sets

1. Description
   Relation: behind; in front.

   1. There is a rug under a table.
   2. The table is behind the lamp.
   3. The lamp glows brightly.

   Recognition sentences

   A. The table is behind the lamp.
   B. The rug is behind the lamp.
   C. The table is in front of the lamp.
   D. The rug is in front of the lamp.

.....

2. Description

Relation: north; south

1. A car is parked inside a garage.
2. The garage is to the north of the house.
3. The house is painted white.

Recognition sentences

A. The garage is to the north of the house.
B. The car is to the north of the house.
C. The garage is to the south of the house.
D. The car is to the south of the house.

3. Description

Relation: right; left

1. A chair is on top of the box.
2. The box is to the right of the tree.
3. The box is made of wood.

Recognition sentences

A. The box is to the right of the tree.
B. The chair is to the right of the tree.
C. The box is to the left of the tree.
D. The chair is to the left of the tree.

4. Description

Relation: below; above

1. There is a tray with a cup on it.
2. The cup is below a shelf.
3. The shelf is covered with dust.

Recognition sentences

A. The cup is below a shelf.
B. The tray is below a shelf.
C. The cup is above a shelf.
D. The tray is above a shelf.

INSTRUCTIONS

Relational Abstraction

Acquisition - "I will now read to you some short descriptions. Each description is composed of three sentences and each describes a scene. Here is an example." (Experimenter reads description).

"A man stands on a jetty.
The jetty is to the right of a ship.
The ship is very large."

"Can you tell me something about what you have heard?" (When subject is clear then:) "I will now read to you some more descriptions, one at a time, and after you have heard them all I would like you to answer some questions. Do you have any questions?" (Experimenter reads out the full set of acquisition setences).

Recognition - "I will now show you some sentences on cards." (Experimenter shows subject a sample card.) "For example, on this card is written 'The jetty is to the right of the ship.' After you have seen each sentence, I would like you to look at this card." (Experimenter shows subject recognition decision card.) "If you have heard the sentence before, I would like you to point to YES. If you have not heard the sentence before, I would like you to point to NO. After you have made your decision, I would like you to decide how confident you are about your answer, by pointing to this card." (Experimenter shows subject confidence rating card.)

"Do you remember the description that I read out to you before?" (Experimenter repeats description.)

"A man stands on a jetty.
The jetty is to the right of a ship.
The ship is very large."

.....

Relational Abstraction (Cont.)

"Now if I showed you this sentence (Experimenter shows subject the sample card) and asked you if you had heard it before, where on this card (Recognition decision card) would you point? How confident about your decision would you be (Experimenter shows subject the confidence rating card)? Do you have any questions about what you have to do?"

"We will now begin the actual sentences. Have you heard this sentence before (Experimenter shows subject sentence card and then the recognition decision card)? How confident are you about your decision (Experimenter shows subject confidence rating card)?"

APPENDIX B

ANOVA Summary Tables for Similarities

(Experiment 1)

One-way ANOVA (unequal n's): paranoid, non-paranoid and control

Source of variation	df	SS	MS	F
Between groups	2	2223.06	1111.53	11.82
Within groups	37	3477.75	93.99	

One-way ANOVA: combined schizophrenic and control

Source of variation	df	SS	MS	F
Between groups	1	28593.87	28593.87	8.22
Within groups	37	3477.75	93.99	

One-way ANOVA: paranoid and non-paranoid

Source of variation	df	SS	MS	F
Between groups	1	162.24	162.24	1.72
Within groups	37	3477.75	93.99	

One-way ANOVA (unequal n's): non-paranoid and control

Source of variation	df	SS	MS	F
Between groups	1	2086.93	2086.93	22.20
Within groups	37	3477.75	93.99	

One-way ANOVA (unequal n's): Paranoid and control

Source of variation	df	SS	MS	F
Between groups	1	1085.41	1085.41	11.54
Within groups	37	3477.75	93.99	

PERCENTAGE OF VARIANCE: Eta

F = overall F ratio

g = number of groups

N = total number of subjects

$$\eta^2 = \frac{F(g-1)}{F(g-1)+(N-g)}$$

(Meyers & Grossen, 1978)

Non-paranoid $\eta^2 = .36$

Paranoid $\eta^2 = .19$

ANOVA Summary Tables for Relational Abstraction

(Experiment 2)

One-way ANOVA (unequal n's): group/condition

Source of variation	df	SS	MS	F
Between subjects				
Group	2	0	0	0
Group*S's error	37			
Within subjects				
Condition	3	2.05	0.68	34.34
Cond*Group	6	0.07	0.01	0.65
Cond*Groups*S's error	111	2.22	0.02	

One-way ANOVA (unequal n's): AB/CD (Reality preserving by reality non-preserving)

Source of variation	df	SS	MS	F
Between subjects				
Group	2	0	0	0
Group*S's error	37			
Within subjects				
AB/CD	1	1.80	1.80	53.92
AB/CD*Group	2	0.01	0.00	0.28
AB/CD*Group*S's error	37	1.25	0.03	

Note: The F = 0 for group arose because the proportions of total responses sum to unity for all subjects (See Results text).

SEPARATE ONE-WAY ANOVA: A/B for each group

Group	
Controls	F(1,111) = 2.96
Combined schizophrenics	F(1,111) = 3.10
Non-paranoid	F(1,111) = 0.88
Paranoid	F(1,111) = 6.69

APPENDIX C

Frequency of Recognition Responses in Each Sentence Category

Group	Recognition Sentence Type A	B	C	D
Control	59	44	20	18
Combined Schizophrenic	51	40	26	15
Paranoid	26	17	12	5
Non-paranoid	25	23	14	10

APPENDIX D

Recognition Frequencies in Each Sentence Category for Individual Subjects

		Recognition Sentence Type			
Group	Subject	A	B	C	D
Paranoid	1	4	3	1	0
	2	4	3	0	0
	3	4	0	2	0
	4	2	1	1	2
	5	2	2	1	0
	6	2	1	1	0
	7	2	1	1	1
	8	3	3	1	0
	9	1	2	1	1
	10	2	1	3	1
Non-paranoid	1	2	3	4	3
	2	2	3	1	1
	3	3	3	1	0
	4	2	2	1	0
	5	2	1	1	2
	6	4	3	0	0
	7	3	2	2	1
	8	2	2	2	2
	9	3	3	2	1
	10	2	1	0	0

.....

Recognition Frequencies in Each Sentence Category for Individual Subjects (Cont.)

		Recognition Sentence Type			
Group	Subject	A	B	C	D
Control	1	3	2	2	3
	2	4	2	2	0
	3	3	2	2	2
	4	3	3	1	1
	5	3	2	1	0
	6	4	2	0	1
	7	4	2	1	0
	8	3	2	3	2
	9	3	4	0	0
	10	3	3	1	1
	11	2	1	1	1
	12	4	3	0	1
	13	3	2	1	2
	14	3	3	1	1
	15	3	2	0	0
	16	2	1	0	1
	17	1	3	0	0
	18	4	2	0	0
	19	1	1	1	0
	20	3	2	3	2

APPENDIX E

Frequencies of Confidence Judgements at Six Confidence Levels for Each Recognition Item Type for Group

Group	Item Type	Confidence Judgements ---	--	-	+	++	+++	
Paranoid	A	4	4	6	2	6	18	
	B	3	8	5	2	3	9	
	C	11	10	6	3	5	5	
	D	15	11	8	1	1	4	
Totals:		43	33	25	8	15	36	160
Non-paranoid	A	2	7	5	1	14	11	
	B	6	6	5	2	12	9	
	C	5	10	8	2	9	6	
	D	12	11	7	1	5	4	
Totals:		25	34	25	6	40	30	160
Control	A	4	6	10	8	19	33	
	B	12	13	11	8	18	18	
	C	26	15	20	3	7	9	
	D	25	20	20	4	9	2	
Totals:		67	54	61	23	53	62	320

Cumulated Frequencies of Confidence Judgements Cut Off at Five Confidence Levels for Each Group

Group	Item Type	Confidence Judgements				
		---/--	--/-	-/+	+/++	++/+++
Paranoid	A	36	32	26	24	18
	B	27	19	14	12	9
	C	29	19	13	10	5
	D	25	14	6	5	4
Non-paranoid	A	38	31	26	25	11
	B	34	28	23	21	9
	C	35	25	17	15	6
	D	28	17	10	9	4
Control	A	76	70	60	52	33
	B	68	55	44	36	18
	C	54	39	19	16	9
	D	55	35	15	11	2