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Reversal and Non-Reversal Shifts in Process and Reactive Schizophrenics, Brain Damaged Patients and Normals

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REVERSAL AND NON-REVERSAL SHIFTS IN PROCESS
AND REACTIVE SCHIZOPHRENICS, BRAIN
DAMAGED PATIENTS AND NORMALS

by

Gerald S. O'Keefe

A Dissertation submitted to the Faculty of the
Graduate School of Loyola University
in Partial Fulfillment of the
Requirements for the degree
of Doctor of Philosophy
Process and reactive schizophrenics, brain damaged patients and normal controls were compared on an optional shift task, in which they could either make a reversal or a non-reversal shift. All the subjects were patients in one of two Veterans Administration hospitals. The normal controls had been hospitalized for various medical reasons, other than psychiatric or neurological difficulties.

Previous research has shown that schizophrenics as a group display atypical thought organization, using personal and idiosyncratic constructs. There is also some evidence of more atypical thought organization in process schizophrenia than in reactive schizophrenia. Process schizophrenics have been shown to be under-aroused, relative to normals, whereas reactive schizophrenics have been shown to be over-aroused, relative to normals. Diffusely brain damaged subjects have been shown to have difficulty in learning abstract concepts and difficulty in shifting from one response to another when the requirements of the task are changed. Research on reversal shifts has shown the preference for reversal shifts, relative to non-reversal shifts, is enhanced by ability to mediate and ability to attend to the relevant cues.

It was predicted that each of the three pathological groups would make fewer reversal shifts than the normal group. This prediction was confirmed for the process group. It was also predicted that the reactive schizophrenics would make fewer reversal shifts than the process schizophrenics. This prediction was verified. It was also found that process schizophrenics took more trials than normals to learn the initial concept, and the reactive schizophrenics and brain damaged subjects required more trials than normals to learn the shift concept. It was concluded that the process schizophrenics were so inattentive to the relevant stimuli that they had difficulty in learning the initial concept. Their inattentiveness and failure to mediate eliminated the negative as well as the positive transfer effects in shifting, and they consequently shifted with the same ease as normal subjects, who were affected by both positive and negative transfer. However, since there was no transfer for the process group they made significantly fewer reversal shifts than the normal group. In contrast to the under-arousal and inattentiveness in the process group, the reactive groups' performance can be understood in terms of over-arousal. Because of their heightened state of arousal they learned the initial concept quickly, but were so aroused that they were not flexible enough to shift off it. In a similar fashion the brain damage subjects because of their cognitive rigidity were also unable to shift.
For reactive schizophrenics and brain damaged subjects, there were significantly more reversal shifts when the initially learned concept was color than when it was form. Two interpretations were offered for these results. First, color is often thought of as an affective stimuli, and since previous research has shown reactive schizophrenics and brain damaged subjects to be emotionally aroused, it is possible that they may have been attracted to color, continued to respond to it when it was learned initially and shifted to it when form was learned initially. A second explanation is that with the stimuli used, learning the opposite of the color concept may have been easier than learning the opposite of the form response. Hence the tendency to continue to respond to color when it was learned initially, but to frequently cease responding to form when it was learned initially may be a function of the reactive schizophrenics' and brain damaged subjects' ability to make an easy abstraction but not a more difficult one.
Gerald S. O'Keefe was born in St. Paul, Minnesota, on October 19, 1946. He graduated from St. Paul's Cretin High School in June of 1964, and received a Bachelor of Arts *magna cum laude* in Psychology from the College of St. Thomas, St. Paul, Minnesota in January of 1968.

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In September of 1971, he was married to Carol Rogers of Chicago. Since September of 1971, he has worked as an Intern in Clinical Psychology at the Loyola Child Guidance Center and Day School.
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Chapter I
Introduction and Survey of the Literature

The purpose of the present study is to compare the preference for reversal or non-reversal shifts in four groups, process schizophrenics (schizophrenics with a poor premorbid history), reactive schizophrenics (schizophrenics with a good premorbid history), diffusely brain damaged patients, and normals. A reversal shift is one in which the previously positive stimulus becomes negative and the previously negative stimulus becomes positive. In a non-reversal shift, the previously relevant dimension becomes irrelevant and the previous irrelevant dimension becomes relevant.

Previous research has shown that preschool children and animals prefer non-reversal shifts, whereas, normal adults prefer reversal shifts. The present study hypothesizes that schizophrenics, especially process schizophrenics, display a greater preference for non-reversal shifts than normal controls. This study also hypothesizes that brain damaged patients differ from normals in that they will show a greater preference for non-reversal shifts.

In reviewing the literature studies from four areas will be examined. First, studies relating to cognitive deficit in schizophrenics will be reviewed, than the studies that deal with cognitive deficit in light of the process-reactive distinction will be examined. Thirdly, those studies pertaining to cognitive difficulties with brain injured patients will be presented. And finally, relevant studies on reversal and non-reversal shifts will be reviewed.
Studies Dealing with Cognitive Deficit in Schizophrenia

Since there has been voluminous research in this area, a focused review of articles most relevant has been performed. For the purpose of organization articles are grouped together on the basis of what they consider to be the basic area of deficit in schizophrenia: abstraction, regression, associative interference, overinclusion, or attention.

Abstraction

Goldstein (1946) argued that a disturbance of the abstract attitude was the fundamental thinking disorder in schizophrenia. The term abstract attitude as used by Goldstein includes the following characteristics: (a) to assume a mental set voluntarily, (b) to shift voluntarily from one aspect of the situation to another, (c) to keep in mind simultaneously various aspects, (d) to grasp the essentials of a given whole; to break up a given whole into parts and to isolate them voluntarily, (e) to generalize; to abstract common properties; to plan ahead ideationally; to assume an attitude toward the "mere possible", and to think or perform symbolically, (f) to detach our ego from the outer world.

Goldstein (1959) stated that both brain damaged patients and schizophrenics operate on the basis of the "concrete attitude", which is merely a response to immediate sense impression. He cited as evidence for this theory the relatively poor performance
of schizophrenics on the Goldstein-Scheerer test (Bolles and Goldstein, 1938; Goldstein and Scheerer, 1941). In studies with the Vigotsky blocks, other investigators also concluded that schizophrenics showed impaired ability to form abstract concepts (Hanfmann and Kasanin, 1937, 1942; Kasanin, 1946). Fisher (1950), however, found that schizophrenics and hystericics did not differ on their performance with the Vigotsky blocks.

Buss and Lang (1965) considered the results of these early studies inconclusive. They cited the nonquantitative scoring of the Goldstein-Scheerer test, the time-help score of the Vigotsky test and the lack of adequate control groups as reasons to consider Goldstein’s hypothesis unproven.

Later investigations, with adequate control groups, have shown that schizophrenics are not abnormally concrete (Adinolfi and Barocos, 1970; Chapman, 1961a; Chapman and Taylor, 1957; Fey, 1951; Lothrop, 1960; McGaughran, 1954; McGaughran and Moran, 1956, 1957; Payne and Hewlett, 1960; Rashkis, 1947; White, 1949).

Essentially, these studies show that schizophrenics are capable of giving abstract responses but the abstract responses they give are often personal and idiosyncratic.

In the studies by McGaughran (1954) and McGaughran and Moran (1956, 1957), the distinction between the abstract-concrete dimension of conceptual thought and idiosyncratic-shared dimension of conceptual thought was spelled out clearly. McGaughran and Moran referred to this first dimension as the open-closed dimension and they called the second dimension the public-private
An open concept is an abstract one; a closed concept is a concrete one; a public concept is one that is defined by an attribute which is easily communicated to another person; a private concept is one that is idiosyncratic and personal. McGraughran and Moran found that schizophrenics did not differ from normals on the open-closed dimension, but that schizophrenics used significantly more private concepts than normals. In comparing brain damaged patients to schizophrenics, they found no difference on the public-private dimension, but found that as compared to the schizophrenics, brain damaged patients were more likely to use a closed concept than an open one.

Regression

Another early theory advanced regarding schizophrenic thinking is that it represents a regression to a previous, less mature level. According to this view schizophrenic thinking is "childish" thinking. It should be noted that much of the evidence in support of regression may also be taken as supporting the theory that schizophrenics are fixated at an early developmental stage, that is they have never progressed beyond a certain level. Gardner (1931) was one of the first to propose the regression hypothesis. However, Cameron was the first to put the regression hypothesis to an empirical test. In a series of systematic studies of regression, Cameron (1939a, 1938b, 1939, 1944) compared the verbal responses of children, normal adults, disorganized
schizophrenics and psychotic senile patients on a test which required them to complete sentences. Cameron's results were mostly negative. He concluded that there were only superficial resemblances between the language, logic and conceptualization of children and schizophrenics.

Two recent theories stress the central role of regression in schizophrenia. Kantor and Wilder have argued that the degree of regression is related to the process-reactive distinction, and their work will be discussed in a later section dealing with process-reactive studies. The other theorist, who stresses the importance of regression is Goldman (1962), who has applied Werner's (1940) developmental approach to schizophrenia.

Werner (1940) assumed that development moves from an unorganized, undifferentiated, diffused state to an organized, differentiated, specific state. The key process in development is differentiation. Goldman assumed that in schizophrenia there is a regression to earlier developmental stages—those characterized by a lack of differentiation, generalized responsivity and diffusiveness.

In attempting to parallel the thinking and language of children with the thinking and language of schizophrenics Goldman stated there were three important dimensions on which schizophrenics and children differed from adults. These were the development from idiosyncrasy to concensuality of concepts, from lability to stability of concepts, and from contextualization to autonomy of concepts.
Goldman's first dimension is essentially the same dimension that McGaughran and Moran (1956, 1957) referred to as the public-private dimension. The McGaughran and Moran studies (1956, 1957) and other studies cited above have shown that schizophrenics differ from normal adults in that they use significantly more private (idiosyncratic) concepts. Goldman (1962) cited evidence showing that children also use more idiosyncratic concepts than adults.

Goldman's second dimension, the development from lability to stability of concepts, refers to the tendency to keep a conceptual set (stability) or to switch it rapidly (lability). Goldman cited Reichard, Schneider and Rapaport (1944) as evidence of children's labile use of concepts and cited Goldman (1960) as evidence of schizophrenic's labile use of concepts. Goldman's third dimension, the development from contextualization to autonomy is the dimension that McGaughran and Moran (1956, 1957) referred to as the open-closed dimension. As mentioned above McGaughran and Moran found that schizophrenics and normals did not differ on this dimension, calling into question the notion that schizophrenics think concretely. However, Goldman (1962) argued that schizophrenics' concepts are concrete and tied to the stimulus context and cited evidence from Arieti, (1955); Cameron, (1938); Goldman, (1960); and Kasanin, (1946). However, Buss and Lang (1965) disputed these findings because of the lack of quantification or adequate controls.
As further evidence Goldman noted that schizophrenics tend to define words more concretely than normals (Choderkoff and Mussen, 1952; Feifel, 1949; Flavell, 1956; Harrington and Ehrmann, 1954). However, as noted above in the discussion of abstraction, idiosyncratic and bizarre responses tend to be scored as concrete, and there is evidence that schizophrenics give abstract concepts.

Other studies of regression give equivocal evidence. Ellsworth (1951) found that children and schizophrenics were similar in the way they used different parts of speech. Burstein (1959, 1961) found that children and schizophrenics tended to equate antonyms with synonyms to a greater extent than normals. Chapman, Burstein, Day and Verdone (1961) gave two different thinking tasks to children, schizophrenics and brain damaged patients. On one task the children resembled the schizophrenics, but not the brain damaged patients. On the other task the children resembled the brain damaged patients, but not the schizophrenics. Following up on Chapman, Chapman and Miller's (1964) finding that schizophrenics responded to the strong aspects of word meanings and ignored the weaker, Klarman and Chapman (1969) found that schizophrenics, relative to normal adults, were similar to third and fourth grade children, relative to eighth grade children, in that they responded to the stronger aspects of the meaning of words and ignored the weaker aspects of meaning.

In summarizing the data on regression, it is necessary to conclude that the regression hypothesis is lacking in systematic support. Goldman has produced some evidence for equating
children and schizophrenics on the dimensions of idiosyncrasy-consenuality and stability-lability. Ellsworth (1951), Burstein (1959, 1961); and Klarman and Chapman (1969) have shown some similarities between schizophrenics and children on some language and thinking tasks. However Goldman's (1962) assumption that schizophrenics, like children, think concretely has little support. Other studies on regression, most notably those of Cameron (1938a, 1938b, 1939, 1944) have also yielded negative results. In addition to this, many of the studies that yielded positive results may have been biased in that there were not sufficient response alternatives, so that any subjects that did not give the correct adult answer gave a similar deviate answer. In such a situation children and schizophrenics could make the same error but for entirely different reasons.

Although Cameron's studies of regression caused him to reject the regression hypothesis, they did lead him to a rather complete descriptive understanding of schizophrenic language. Cameron (1944) and Cameron and Margaret (1946) stated that schizophrenic language has the following characteristics: (a) asyndesis, the speech is lacking in essential connectives; (b) metonymy, the language is lacking in precise, definitive terms, many concepts dealt with instead by loose figures of speech or other private idioms; (c) fragmentation, there is an occurrence of a miscellany of discontinuous and abortive responses, or of sudden inaction that is not followed by the original theme; (d) interpenetration, language dealing with events in the external world is continually
interwined with material from the ongoing fantasy of the patient. Cameron viewed interpenetration as an intrusive movement, word, movement or thought that appears in an ongoing sequence of activity but belongs to some other sequence; (e) overinclusion, by overinclusion Cameron referred to the inability to exclude from a thought sequence material that is irrelevant to the major theme of the thought.

Cameron's last three concepts, fragmentation, interpenetration and overinclusion have been thoroughly examined in many studies. Research on associative interference, which relates to fragmentation and interpenetration, and will be reviewed first. Then the data on overinclusion will be reviewed. It is noteworthy that the results of studies in these two areas, and the results of studies on disturbances of attention and set, which are reviewed also here have been explained similarly. Lang and Buss (1965) pointed out that schizophrenics have difficulty focusing on the relevant aspects of the stimulus situation and are distracted by their own idiosyncratic associations as well as outside distractors.

**Associative Interference**

Research has shown that schizophrenics' associations are uncommon and that intrusive associations worsen the performance of schizophrenics more than of normals. A number of studies have supported the first assertion. Moran (1953) found that on a word association task schizophrenics as compared to normals gave
associations that were significantly less related to the stimulus words. Johnson, Weiss and Zelhart (1964) reached a similar conclusion in another study in which the word association of schizophrenics were compared to normals. Sommer, DeWar and Osmond (1960) gave the Kent-Rosanoff word association list to schizophrenics and normals. Again it was found that schizophrenics gave significantly more uncommon associations. In a follow-up to this study Sommer, Witney, and Osmond (1962) found that it was easier to condition common association with alcoholics than with schizophrenics.

There is also empirical validation to the assumption that intrusive associations worsen the performance of schizophrenics more than of normals. Chapman (1958) found that on a verbal concept formation task, schizophrenics displayed more associative interference than normals. Donahoe, Curtin and Lipton (1961), however, found that when nonsense syllables were used there was no difference between schizophrenics and normals on the amount of associative interference. Downing, Ebert and Shubrooks (1963) discovered that schizophrenics were more distracted by associatively linked words than by contiguity or rhyme clang distractors. From these three studies Lang and Buss (1965) concluded that schizophrenics suffer especially from the intrusions of meaningful, irrelevant associations but not all types of irrelevant associations.

Cole (1968) found that with a non-verbal concept formation task increasing the number of distractors did not make the task more difficult for schizophrenic subjects. However, Langer, Stein
and Rozenburg (1969) did find that schizophrenics displayed greater interference on the Color-Phonetic Symbol test. It seems likely that these findings are explained by Buss and Lang's (1965) conclusion that more interference is evidenced when meaningful irrelevant associations are used. The task used by Langer; Stein and Rozenburg involved more meaningful associations than did Cole's task.

Lang and Luoto (1962) had subjects learn two lists of paired associates. On the second list, half the response terms were associates of the response terms used in the first list. The response terms of the other half were also associates, but they were not assigned to the correct stimulus term, thereby creating an interference list. Schizophrenics showed significantly poorer performance than normals on the early trials of the interference list. In addition schizophrenics persisted in giving the response term pairs of pairs already learned.

Spence and Lair (1964) failed to find differences between the paired associate learning of schizophrenics and normals. However Buss and Lang (1965) pointed out that Spence and Lair's normals differed from their schizophrenics in that they made primarily errors of omission, while their schizophrenic subjects erred by giving overt, inappropriate responses.

Lester (1960) found that schizophrenics and epileptics showed more interference than the normals in the selection of associates, the interference occurring because of the intrusion of extraneous stimuli.
Lang and Buss (1965), in concluding that the hypothesis of associative interference had been verified, related the data on uncommon associations and external distractors to one common defect. They quoted Shakow (1962) who pointed out that schizophrenics are distracted by irrelevant aspects of the stimulus surroundings both inner (their own associations) and outer, which prevent their focusing on the "to be responded to" stimulus.

Overinclusion

A number of studies have also shown Cameron's notion of overinclusion to be at least partially accurate.

Epstein (1953) used a verbal task called the Inclusion Test to test the hypothesis that schizophrenics are overinclusive. Subjects were required to underline all words which designated things or concepts required for the complete thing described by the key word. Normals made as many errors of overinclusion (including irrelevant aspects) as errors of underinclusion (excluding relevant aspects). Schizophrenics did not differ from normals in the number of errors of underinclusion, but made significantly more errors of overinclusion. Moran (1953), Craig (1967), Kreitler, and Kreitler (1967) have obtained similar results on verbal tasks.

Chapman (1956) and Chapman and Taylor (1957) presented pictures of different objects and had subjects sort them under specific headings. They found that schizophrenics were more
overinclusive than normals.

In spite of considerable data showing schizophrenics are overinclusive, Chapman (1961) questioned whether or not the tendency to be overinclusive was central. He hypothesized that schizophrenics were both overinclusive and underinclusive and that the issue was not a tendency to overinclusion or underinclusion, but rather "a tendency to use concepts of a specific preferred breadth regardless of appropriateness". In a test of his hypothesis Chapman (1961) used two tasks, one tending to elicit errors of overinclusion and the other tending to elicit errors of underinclusion. He found that schizophrenics made both kinds of errors.

These findings parallel those of Zaslow (1950) who had schizophrenics sort a series of figures ranging along a continuum from triangularity to circularity. Zaslow's patients produced two kinds of performance, very narrow or very broad, or in other words they were either underinclusive or overinclusive.

Hence, it can be concluded that although schizophrenics tend to be overinclusive this tendency is really a manifestation of a broader deficit, namely, an inability to respond with the appropriate amount of conceptual breadth that is required.

Attention

Payne (1964) has reformulated the concept of overinclusion in terms of a breakdown of a hypothetical "filter mechanism", which prevents schizophrenics from attending to the relevant
McGhie and Chapman (1961) have made a similar proposal attributing schizophrenic deficit to a disturbance of "selective attention" and an inability to select the relevant aspects of the stimulus situation.

Payne (1962) and Payne and Friedlander (1962) argued that if there was a breakdown in the hypothetical "filter mechanism" schizophrenics should include more details on an object sorting task. This hypothesis was confirmed in two studies (Payne, 1962; Payne and Friedlander, 1962). In an earlier study along the same vein, Payne and Hewlett (1960) demonstrated that schizophrenics gave longer, more complex response to proverbs than normals.

All of the above cited studies by Payne and his associates were with acute patients. When chronic long term schizophrenics were tested on the proverbs test they did not differ from normals on overinclusion scores (Payne, Friedlander, Laverty and Haden, 1963).

McGhie and Chapman (1961) presented clinical data to support their hypothesis that schizophrenic deficit is due to disturbance of "selective attention", the disturbance being greatest when the patient must inhibit information in one sensory channel and attend to another. In an experimental study McGhie and Chapman (1962) found that when a sporadic high pitched voice noise was introduced schizophrenics displayed a greater increase in errors on a visual tracking task then either normals or non-schizophrenic psychiatric patients. Chapman and McGhie (1962) found the same effects for visual distractors. Schizophrenics, as compared to
normals and non-schizophrenic psychiatric patients, showed greater disturbance in attempting to attend only to auditory stimuli while being simultaneously presented with competing visual cues.

Weckowicz (1960) found that schizophrenics and brain damaged patients performed worse than non-schizophrenic psychiatric patients on a hidden figures test which required subjects to select relevant and disregard irrelevant information.

In a study with chronic schizophrenics Draguns (1963) used a task that required subjects to interpret pictures that became progressively clearer with successive presentations. In addition to making more recognition errors, chronic schizophrenics were less able than normals to inhibit responses to the earlier ambiguous pictures.

There appears to be ample evidence to support the assertion that acute schizophrenics have difficulty attending to the relevant aspects of a stimulus situation. However, evidence on chronic patients is equivocal, and it is possible that the relevant dimension is the process-reactive one. Studies dealing with differential attention and arousal states in process and reactive schizophrenics will be dealt with in the next section.

Some Conclusions

The following conclusions are suggested by the research on cognitive deficit in schizophrenia: (1) Schizophrenics as a group are not abnormally concrete, nor are they abnormally overinclusive.
rather the concepts they use on tests of abstraction are personal and idiosyncratic. (2) Schizophrenic thinking is not explained by the concept of regression. Differences between thought in children and schizophrenics are at least as great as similarities. Further, on tasks where the performances of schizophrenics and children were found to be similar the possibility that they performed similarly but for different reasons exists. (3) Schizophrenics' associations are uncommon. (4) Acute schizophrenics experience difficulty attending to many tasks and their performance is adversely affected by distractors.

Process-Reactive Studies

The process-reactive distinction, in its general form, states that within the category of schizophrenia two subgroups may be distinguished. One of these is process schizophrenia; the other reactive schizophrenia. The process schizophrenic may be characterized as having an early and insidious onset, with a relative absence of precipitating stress. Typically his premorbid personality was inadequate, with a marked tendency to avoid interpersonal contacts. He presents a clinical picture of flat affect and a relative absence of confusion. His prognosis is poor. In contrast, the reactive schizophrenic, has experienced a relatively rapid and stormy onset of psychosis, usually attributed to an identifiable and realistic stress situation. His premorbid personality was not schizoid, and he had a history of adequate
interpersonal relationships. His clinical picture typically includes many affective components and severe confusion. His prognosis is good.

Garmezy (1968) pointed out that Kraeplin, Bleuler, Meyer, and Sullivan all grappled with the issue of prognostic efficacy and suggested factors that influence the course of the disorder. These factors gradually framed the dimensions that now characterize the process reactive distinction. Wittmann (1941) developed the original version of the Elgin Prognostic Scale, which was the first instrument designed to differentiate between process and reactive schizophrenics. The original version of the Elgin Scale was comprised of 30 subscales (25 measured premorbid adjustment and five the presenting symptoms), that were subsequently trimmed to 20. Each subscale carried "armchair" weights that reflected the prognostic significance of the items based upon clinical judgement.

Since the appearance of the Elgin Scale, Becker (1956) has created a revision that provides for more precisely described intermediate points within each subscale thus strengthening the likelihood of more reliable ratings by clinical judges. Subsequently, Steffy and Becker (1961a, 1961b) created an abbreviated version of the Elgin Scale on the basis of factor analytic research.

The other and now most popularly used process-reactive rating scale is the Phillips Scale of Premorbid Adjustment (Phillips, 1953). Initially the scale consisted of three subsections: premorbid history, possible precipitating stress, and signs of
disorder. Since Phillips found a marked tendency for premorbid history scores to correlate highly with signs of the disorder \( r = .91 \) and to a lesser extent with possible precipitating factors \( r = .72 \), other investigators began to use the premorbid history subsection as the sole criteria for making the process-reactive distinction (Garmezy, 1968). This revised Phillips Scale, which was used in the present study consists of five sub-scales: (a) recent sexual adjustment, (b) social aspects of sexual life during adolescence and immediately beyond, (c) social aspects of recent sexual life, (d) history of personal relationships, (e) and recent adjustment in personal relations.

Garmezy (1968) pointed out that Phillips Scale has a number of advantages over the Elgin Scale. First, it avoids such elusive concepts as constitutional bias, low energy tone, asthenic build, and toxicity of exhaustion. Second, it demands only minimal case history data. Third, the reliability of the scale had been vigorously established. Fourth, its construct validity has been elaborated though a series of interdependent and independent studies.

A number of self report inventories for making the process-reactive distinction have been developed (Ullman and Giovannoni, 1964; Johnson and Ries, 1966; DeWolfe, 1968). DeWolfe (1968) utilized information gathered on the self-report General Information Questionaire (GIQ) to obtain Phillip's Scale scores. He found that this method yielded interjudge reliabilities and concurrent validity scores equivalent to interjudge reliabilities and concurrent validity scores achieved when Phillips Scale scores
were obtained from selected complete case histories. The GIQ was used in the present study to establish Phillip Scale scores.

Since the development of the Elgin Scale, and even more so with the development of the Phillips Scale, there has been much research comparing process and reactive schizophrenics in a wide variety of areas. General review articles of process-reactive research have been written by Herron (1962) and by Higgins (1964, 1969). A number of writers have appraised the efficacy of the process-reactive distinction in such areas as psychophysiological functioning (Lang and Buss, 1965; Venables, 1966), information processing (Cromwell, 1968; Pearl, 1962; Silverman, 1967; Vaillant and Funkenstein, 1966), motivation and emotion (Buss and Lang, 1965), avoidance behavior and hypersensitivity to noxious stimulation, physical and social, (Garmezy, 1965, 1968; Silverman, 1963), perceptual and cognitive processes (Kantor and Herron, 1965; Rodnick, 1967; Silverman, 1964), developmental theory (Phillips, 1966; Rodnick, 1968) familial factors (Baxter, 1966; Fontana, 1966; Lidz, Fleck, and Cornelison, 1965; Mednick and Schulsinger, 1965; and Mishler and Waxler, 1966), socio-environmental orientation (Higgins, 1968a), and therapeutic intervention with patient (Betz, 1963; Coyle and Coyle, 1965; Field and Miller, 1967). Conceptual and methodological issues surrounding the process-reactive concept have been discussed by Garmezy (1968), Higgins and Peterson (1966), and Raskin (1963).

The present review will limit itself primarily to studies dealing with cognitive function in process and reactive schizo-
phrenia. The same format as was used in reviewing cognitive deficit in schizophrenia will be used here. First studies dealing with abstraction will be reviewed, and then studies dealing with regression, associative interference, overinclusion and arousal and attention will be reviewed.

In light of the review of studies dealing with schizophrenic deficit, it is recognized that this breakdown is somewhat artificial, in that many of the studies in the different sections are tapping the schizophrenics' tendency to respond in a unique, idiosyncratic manner, different from the normal culturally expected manner of responding. However, the breakdown does provide some utility in that different tasks were used by authors seeking to tap different functions. Hence in the abstraction section, studies using various concept formation tasks and verbal tasks such as proverbs are reviewed. Most of the authors who have explained their results in terms of regression used projective techniques. In the associative interference section, studies dealing with word association tasks and some other verbal tasks will be reviewed. In the overinclusion section, a number of studies using standard overinclusion tasks are reviewed. And finally, in the attention and arousal section, a number of studies using both behavioral and physiological measures will be reviewed.
Some studies have shown process schizophrenics to do poorer than reactives on non-verbal sorting tasks that require abstract thinking. Reactives' performance in these studies typically more resembled the performance of normals. Parsons and Klein (1970), DeLuca (1968) and Donoghue (1964) found process schizophrenics inferior to reactives on a non-verbal sorting task. Brodsky (1968) and Berman (1963) obtained similar results with tasks requiring subjects to sort cards depicting interpersonal situations. However, in studies with similar tasks, Day (1960), Roth (1960) and Sturm (1964) obtained negative results. Sturm attempted to replicate McGaughran and Moran's (1956, 1967) studies on open-closed and the public-private dimensions of conceptual thinking. He gave the Wide Range Vocabulary Test, the Goldstein-Scheerer Object Sorting Test and the Revised Inclusion Test to process and reactive schizophrenics, brain damaged subjects and normal controls. He found no difference between any of these three groups on either concept formation dimension.

Studies with verbal tasks also have yielded equivocal results. Johnson (1966) and Murray (1970) found process schizophrenics to do more poorly than reactives on the Benjamin Proverbs Test. Meichenbaum (1968) obtained similar results with the Kaufman Proverbs Test, and True (1966) has shown that process schizophrenics did not learn abstract responses on a verbal task,
whereas, normals and reactives did. Gregg (1965) using proverbs, the Goldstein-Scheerer Object Sorting Test and the WAIS similarities subtest found the conceptual responses of process schizophrenics were concrete, but socially meaningful, whereas the conceptual responses of reactives were abstract, but autistic.

On the other hand Judson and Katahn (1964) and Cancro (1969) found no process-reactive difference on the Benjamin Proverb Test. Little (1966) found that schizophrenics ability to abstract was affected by the social context, but found no process-reactive differences. Lewinsohn (1967) found process schizophrenics displayed superior abstraction ability than acute reactives on the Gorham proverbs and the abstraction subtest of the Shipley Hartford Test.

To summarize, it seems necessary to conclude that reactive schizophrenics have not been shown to display superior performance to process patients on non-verbal and verbal abstraction tasks. On both types of tasks, almost as many negative as positive results have been reported, and there is at least one study that shows process subjects superior to acute reactives on a proverbs test (Lewinsohn 1967).

Regression

Becker (1965) using the Rorschach and the Benjamin Proverbs Test found process patients to display more immature and regressive thinking, a conclusion that received additional support from
Becker's (1959) subsequent factor analysis of the 1956 data. Steffy and Becker (1961a, 1961b) predicted and found that process schizophrenics gave "more diffuse, undifferentiated, immature responses" on the Holtzman Inkblot Test than did reactive schizophrenics. Steffy and Becker have interpreted their results in terms of the Wernerian concept of levels of personality organization, stating that process schizophrenics are more undifferentiated and therefore more regressed in their thinking. These results and others in support of greater regression in process schizophrenics as opposed to reactive schizophrenics may be interpreted as supporting earlier or greater fixation in the process group.

Kantor and Winder (1959) and Kantor and Herron (1966) have proposed a theory which incorporates the process-reactive and the regression concepts. Following Sullivan, they proposed that there are sequential steps of growth which most members of our culture encounter; and that each step contains a central problem which must be at least partially coped with successfully before a new organization of experience can occur adequately on the developmental continuum. To deal successfully with the central problem in any given growth step is what Sullivan called an integration. If all the core problems are dealt with adequately, then regression becomes a very unlikely possibility. Kantor and his associates stated that incomplete integrations are antecedents of regressions, and that failures to progress developmentally are reflected in schizophrenia. The amount of regression, and the
amount and duration of a psychosis is determined by the stage at which an unsuccessful integration first occurred. Unsuccessful integrations at the early stages lead to severe regression and process schizophrenia, whereas a failure to achieve an adequate integration at the last stage, the syntactic, might lead to a slight regression and reactive schizophrenia.

In an early study Kantor, Wallner and Winder (1953) predicted and found that, of 203 schizophrenics, those rated reactive were most often judged nonpsychotic from the Rorschach, while those rated process typically produced psychotic Rorschach protocols. In a later study, Kantor and Herron (1966) found that life history pathology, a measure of the stage at which an unsuccessful integration occurred, predicted the degree of pathology as measured by the Rorschach, the personality-age-level as measured by the Rorschach, the degree of pathology as assessed by psychiatric symptomatology, and the duration of the schizophrenic episode. The earlier the unsuccessful integration, the greater is the severity and the length of the psychosis.

Fine and Zimet's work closely resembles that of Becker and of Kantor and his associates. Fine and Zimet (1959) used the Rorschach to evaluate perceptual immaturity in process and reactive schizophrenia, and concluded that process subjects' responses were less mature than those of reactive subjects. However, Fine and Zimet also interpreted their data in cognitive as well as perceptual terms stating, "the perceptions scored as immature and mature might also be regarded respectively as
expressing primary and secondary levels of thinking" (p.85). Zimet and Fine (1959) speculated further that process schizophrenia has its roots in the oral psychosexual stage, and reactive schizophrenia has its roots in later stages. In a further study using a modified form of Holt's method for assessing primary and secondary thought processes from the Rorschach, Zimet and Fine (1962) concluded that process schizophrenics function on a considerably more "primitive" level than the reactive patients. These results received only partial confirmation in a study by Zukowsky (1961).

Byrant (1961) found process schizophrenics inferior to reactives on the Witkin Rod and Frame Test and the Embedded Figures Test, their results were interpreted as indicating a "field-independent, analytical" perceptual mode for reactive schizophrenics as compared with a "field dependent" orientation for process schizophrenics. Bryant related these results to Wernerian levels of personality organization, stating that process subjects showed greater regression than reactive subjects.

Although, most of the studies reviewed in this section found process-reactive differences on various projective instruments, these results cannot be taken as direct evidence in support of more severe regression in process schizophrenia. They do demonstrate greater perceptual or cognitive disturbance in the process group, but they do not necessarily demonstrate more regression. It is possible to view the data which the above authors offered in support of regression as merely supporting greater
disturbance in the process group. The theory of Kantor and his associates is lacking in definitive supporting findings. They have, however, offered some support for their hypothesis concerning the relationship between the stage of unsuccessful integration and the characteristic level of psychopathological functioning. However, as suggested by Buss and Buss (1969) a longitudinal study is necessary to provide the crucial evidence.

**Associative Interference**

Dokecki, Polidora and Cromwell (1965) found that reactivess' performance was equal to that of normals on stability and commonality of response on the Kent-Rosanoff word association list. Process schizophrenics were inferior to both reactivess and normals on stability and commonality of response. Foley (1967) also found that reactivess' associations were closer to those commonly given by normals than were responses given by process patients. DeWolfe and McDonald (1970) found process-reactive differences in cognitive structure and type of deficit as measured by a word association test. On the Gottesque Forced Choice Word Association Test, Steir (1968) found process schizophrenics, as compared to reactivess, to prefer child to adult responses.

However, studies by Deckner (1968), Dokecki (1968), Rodnick (1965), Schweid (1966) and Ries and Johnson (1967) found no process-reactive differences on word association tasks. Ries and Johnson however, did obtain a process-reactive commonality
difference in a subsample of patients hospitalized over five years. This finding could not be reproduced by either Deckner (1968) or Dokecki (1968).

Katahn, Harris and Swanson (1967) found that except for a process deficiency in learning socially relevant material, there were no process-reactive differences on a verbal learning task that required subjects to learn a list of 60 words.

Mednick (1958, 1959) proposed that the schizophrenic condition is fundamentally the result of cumulative acquisition of improbable or remote associative responses. In a test of this theory Higgins, Mednick and Thompson (1966) found as predicted process subjects were superior to reactives in their ability to retain learned remote associations. Higgins (1968b) predicted from this theory chronicity as opposed to premorbid adjustment should more strongly affect commonality of word association responses. This prediction was confirmed. However, Dokecki, Cromwell and Polidoro (1968) in a similar study found pre-morbid adjustment to be the more important variable.

In other studies of language and associative processes Husni-Palacious, Palacious, and Gibeau (1967) using the Sound Test, an auditory projective test, found process schizophrenics, as compared to reactives, gave fewer units of thought and had more trouble integrating the stimulus situation into a meaningful responses. Reactives displayed higher cognitive organization, were more coherent, and drew more on personal feelings, ideas and associations in responding. Cancro (1968) found process schizo-
phrenics to display more severe thought disorder in their verbalization.

Deckner and Blanton (1969) using Taylor's Clozure Procedure found that process schizophrenics are less able to utilize the information available in the structure, redundancy and context of language commonly used by others. However, Eliseo (1963a) with a task similar to Deckner and Blanton and two other studies which sought to test similar abilities by Pearl (1963) using Shannon's guessing game technique and by Livingston and Blum (1968) using a modified version of William's word strings obtained negative results.

Schwartz, Hunt and Walker (1963) found that experienced clinical judges were unable to differentiate the verbalizations of process and reactive schizophrenics to WAIS Comprehension, Vocabulary and Similarities subtest. In a follow-up study with process and reactive response to Wechsler-Bellevue Similarities, Hunt, Schwartz, and Walker (1965) achieved some limited success, but the authors concluded that although the differences found were significant they were not meaningful. In still another study, Schwartz (1968) again failed to demonstrate process-reactive differences using process and reactive verbalizations on the Comprehension, Vocabulary, and Similarities subtests of the WAIS. He did find, however, that retardates, but not organics, were judged more often as process than reactive. Reactives were called normal more often than organic or retardate.
Lefeurt, Steffy, Buckspan, and Rottenburg (1968) also failed to find process-reactive differences on the Webb Similarities Test. And Rice (1968) did not find thought disorganization to be any more pronounced in the essays of process than of reactive schizophrenics.

Summarizing the research in this section, a number of statements can be made. There is some evidence supporting the hypothesis that process schizophrenics display less common associations on structured word association tests. Mednick's (1958, 1959) results are consistent with these findings in that they show process patients, relative to reactives, have a preference for remote associations. These results however, do not give definitive support to Mednick's theory that the schizophrenic condition is the result of a cumulative acquisition of remote associative responses. On tasks other than structured word association tests, process-reactive differences were less often obtained. Especially notable in this regard were the negative results obtained by Schwartz, Hunt and Walker (1963), Hunt, Schwartz and Walker (1965) and Schwartz (1968). So although the associations of process schizophrenics on word association tests are more remote than those of reactives, these two groups' verbalizations are less easily differentiated when the verbalizations are given in a more spontaneous manner.
Overinclusion

Tutko and Spence (1962) employed the Rapaport version of the Goldstein-Scheerer sorting test, to measure inclusion with process and reactive schizophrenics, brain damaged patients and normals. They found, as predicted, that their process schizophrenics, like their brain damaged group, predominately made errors of a concrete or underinclusive nature, while their reactives predominately made errors of a hyperabstract or overinclusive type. The normals, while showing some tendency to be overinclusive exhibited less of an imbalance in error preference.

Sacks (1967) did a factor analysis of various tests of schizophrenic deficit expecting to find a concreteness and overinclusion factor. Instead he obtained a general conceptual deficit factor, a conceptual autism factor, an overinclusion versus underinclusion factor and an associational disturbance factor. There were no process-reactive differences on any of the five factors.

Strum (1965) measured overinclusion and concreteness in process and reactive schizophrenics and brain damaged patients. He found process and brain damaged patients to be more concrete than reactives, but found no difference for the three groups on overinclusion. Eliseo (1963b) found no process-reactive differences on the Epstein Inclusion Test.
Results on the studies reviewed here are equivocal. Tutko and Spence's (1962) positive results have not been replicated and like the studies on abstraction it is necessary to conclude that process-reactive differences are unproven.

Arousal and Attention

A number of studies suggest that reactive schizophrenics are characterized by higher resting levels of automatic activity than process schizophrenics, and that they are autonomically more responsive than their process counterparts.

DeVault (1955) studied the physiological responsiveness of process and reactive schizophrenics and normals. Pictures representing areas of conflict, a loud bell and a verbal warning preceding the bell were among the stimuli. He found reactives to have autonomic responsiveness exceeding the process group and equal to the normal group. Higgins and Mednick (1963) suggested that DeVault might have obtained a reactive-normal difference with reactives displaying greater responsiveness than normals with a less chronic reactive group (DeVault's reactive group had been hospitalized a mean 8.7 years). Utilizing the positive relationship between arousal level and psychomotor reminiscence with a less chronic reactive sample, Higgins and Mednick (1963) predicted and found that reactive schizophrenics displayed greater reminiscence effects in a repetitive inverse alphabet printing
DeWolfe (1962) found that when process, reactive and normal groups were given words and asked to construct sentences only reactives exhibited a marked increase in reaction time when the words were affectively laden.

Crider, Grinspoon and Maher (1965) obtained higher skin potential and faster simple reaction time from their reactive group. Crider, Maher and Grinspoon (1965) further observed that the reaction time of their process group decreased and approached that of the reactives as intensity and rate of auditory stimulation increased, further suggesting that the resting level of arousal is lower for process subjects inasmuch as their performance is enhanced by increased sensory input.

Reisman (1960), Mason (1962) and Donoghue (1964) all found reactives' performance on conceptual tasks to be more impaired by distractors than the performance of process subjects (Mason, 1962 and Donoghue, 1964) or the performance of process and normal subjects (Reisman, 1960). These findings were interpreted as indicating higher arousal levels in reactives. In addition, studies on classical conditioning (Struve, 1966), associative interference (Altshuber, 1966; and Higgins, Mednick and Thompson, 1966), generalization (Higgins, Mednick, Phillip and Thompson, 1966) and critical flicker frequency (McDonough, 1960) suggest that reactives function at a higher level of arousal than their process counterparts.
Reactives have been found to display greater autonomic responses as measured by various physiological indices to neutral sound and light stimuli (Stephens, Brown, Forster and Klein, 1967), a visual discrimination task (Ward and Carlson, 1966) and verbal censure (Barry, 1968). Altshuler (1966) also found that reactives scored higher on the Taylor Manifest Anxiety Scale.

Two studies, one by Zlotowski and Bakan (1963) and by Zlotowski (1959) showed that on repetitive tasks, reactives were more likely to introduce variations, whereas process patients continued to respond in a stereotyped manner—a finding consonant with studies showing reactives to be more highly aroused than process subjects.

There have been some negative results, but they are not as impressive as the positive findings. Unlike other investigators, Klein, Cicchetti and Spohn (1967) did not find differential process-reactive reaction times, and Schweid (1966) failed to find differential process-reactive reaction times, and also failed to show a decrease in process reaction time with increased auditory input.

Vollenweider (1963) was unable to replicate McDonough's (1960) finding of a higher critical flicker frequency threshold for reactive schizophrenics. Reynolds (1963) failed to find process-reactive differences with a number of physiological measures when he measured resting levels of autonomic activity or when he measured autonomic responsiveness to exercise, a cold pressor test, and a mental arithmetic task failure followed by...
verbal censure.

Gromwell (1961) found no differences in the EEGs of process and reactive schizophrenics. Bergson (1967) found reactives to have a lower arousal level as indexed by skin conductance. Friedman (1966), Rice (1968) and Ward and Carlson (1966) failed to find a process-reactive difference in resting skin resistance. Friedman (1966) also failed to find differences when he showed his subjects pictures of nurturant and rejecting patents and peers, and Rice (1968) found likewise when he presented an auditory stimulus.

Conclusions

Summarizing this last section and relating it to the findings from the other sections a number of interrelated conclusions are suggested. It appears that process schizophrenics are under-aroused, while reactives are over-aroused. Hence, whereas reactives are very much distracted by outside stimuli, process patients are somewhat oblivious to them. This suggests that on many of cognitive tasks given to schizophrenics, process and reactive patients, may do poorly as compared to normals but for different reasons. Reactives do poorly because of their inability to filter out irrelevant outside stimuli, whereas, process patients do poorly because they have withdrawn and are to a great degree oblivious to outside stimuli.
Goldstein (1939) argued that in brain damaged patients certain cortical areas, through lesions, are isolated from the background of the rest of central nervous system. As a result of this isolation Goldstein (1939) stated that brain damaged patients show defective abstracting ability, and in addition when their reduced capacity for abstraction prevents them from performing a task, they become rigid. Their reaction to a problem which they cannot solve is to do something which they are able to do. Such rigid performance continues even though it is inadequate and they cannot shift even if asked to.

Whereas, Goldstein's notion of the loss of the abstract attitude has been disproven in regard to schizophrenic disorders, his assertion that brain damaged patients have suffered a loss of the abstract attitude and as a result often display rigid behavior and an inability to shift responses has received considerable experimental support.

Rylander (1939) gave three tests of abstract thinking ability to 32 patients who had undergone partial frontal lobe excisions for the removal of brain tumors and to 32 controls matched for age, occupation and socioeconomic status. The two groups differed significantly on all measures. Halstead (1940) compared a group of patients with organic brain damage to a
control group on an object sorting task. He found that patients with frontal lobe extirpation showed the greatest departure from the performance of the normal group. The patients with disorder in the more posterior regions of the cortex also differed from the normals, but the difference was not as great.

A number of extensively studied cases of both frontal and diffuse brain pathology have been reported in which patients manifested fairly general signs of impairment in abstract behavior as measured by such procedures as the Weigl color-form sorting, object sorting tests, the Shipley Hartford Conceptual Quotient, Koh's Block, etc. (Ackerly and Benton, 1950; Benton and Howell, 1941; Halstead, 1945; Hanfmann, Rickers-Ovsiankiva, Goldstein, 1944; Nichols and Hunt, 1940; Zangwill, 1945a). Other studies have shown the value of such tests of abstraction as the Kohs Block, Weigl color-form and Shipley Hartford in differentiating patients with known heterogeneous types of brain damage from normal controls (Goldstoen, 1942; Goldstein, 1943; Greenblatt, Levine and Atwell, 1945; Hoedemaker and Murray, 1952; Zangwill, 1945b).

Several studies (Armitage, 1946; Bauer and Becka, 1954; Brown, 1955; McFie and Piercy, 1952a, 1952b; Meyers, 1947) failed to find differences between brain damaged patients and normal controls on various abstraction tasks. However, these studies all used subjects with localized lesions, whereas, the above cited studies with positive results used subjects either
with diffuse damage or with frontal lobe damage.

Goldstein (1939) and Werner (1948) found that brain damaged children gave more animistic responses than normal children. They interpreted these findings as a function of a greater rigidity and concreteness which prevented the brain damaged children from detaching themselves from objects and events. They are thus unable to differentiate between their own feelings and those of the surrounding world. Cotton (1941) found evidence that supported these findings and offered evidence to support the hypothesis that these tendencies are a result of impairment due to brain injury, instead of merely representing a particular kind of intellectual limitation. Studies by Tooth (1947), Lidz, Gay and Tietze (1942), Sheerer (1949), Grassi (1953), Battersby, Kreiger, Pollak and Bender, (1953) produced results that further supported Goldstein's notion of an inability to shift in brain damaged patients.

A number of studies have compared conceptual behavior of brain damaged and schizophrenic subjects. In the studies by McGaughran and Moran (1956, 1957) and Leventhal, McGaughran and Moran (1959) mentioned in the above section on schizophrenia, it was found that schizophrenics differed from normals on the public private dimension, in that they gave more personal idiosyncratic responses. Brain damaged subjects on the other hand differed from normals in that they gave more concrete responses. Penk (1967) replicated these results.
Chapman (1960) using multiple choice paper and pencil test items found schizophrenics, compared to normals, made more literal than figurative misinterpretations, whereas brain damage subjects differed nonsignificantly from normals in the opposite direction. Bernstein (1960) compared schizophrenic, brain damaged and normal groups with respect to the nature of their thought processes as judged from their performance on a conceptual categorization problem. He found normals tended to use functional and morphological categories, the brain damaged subjects used inappropriate and associative categories, and the schizophrenics used bizarre and rejected categories.

Several studies have shown the conceptual performance of brain damaged patients to resemble that of process schizophrenics, while differing from that of reactive schizophrenics. Tutko and Spence (1962) found process schizophrenics and brain damaged subjects to make errors of a concrete and underinclusive nature on a sorting task, whereas reactives made errors of hyperabstract or overinclusive nature. Parsons and Klein (1970) found that on a non-verbal concept identification task process and brain damaged subjects exhibited poorer performance than reactives or controls. Strum (1965) compared process, reactive, brain damaged and normal subjects on an inclusion and an abstraction task. The groups did not differ on their performance on the inclusion task, but the process and brain damaged subjects were more concrete than the reactives and normals on the abstraction task.
However, Sturm (1964) found no significant difference between process, reactive, brain damaged and control subjects on either McGaughran and Moran's open-closed or public-private dimension. In addition many studies reviewed in the previous section did not obtain the process-reactive difference in abstraction or inclusion that the studies cited above did.

In summarizing, it is concluded that patients suffering from brain damage of a diffuse nature suffer from an impairment in their ability to learn abstract concepts. It is further concluded that such patients have difficulty in shifting from one response to another and tend to respond in a previously correct way. Finally, although, there is some evidence of a similarity between brain injured patients and process schizophrenics, this relationship has not been conclusively demonstrated.

Studies Dealing with Reversal and Non-Reversal Shifts

Wolff (1967a) extensively reviewed the literature on reversal and non-reversal shifts. Slamecka (1968) has assessed the adequacy of various shifts paradigms. Paul (1965) and Sperling (1954a, 1965b) have reviewed related animal studies, and Sugimura (1962), Mackintosh (1965) and Shepp and Tirrisi (1967) have reviewed some highly selective animal studies.

A number of different paradigms have been used in studying reversal and non-reversal shifts. Wolff (1967a) listed six
paradigms, two for reversal shifts, called intradimensional shifts (ID) by Wolff, and four for non-reversal shifts, called extradimensional shifts (ED) by Wolff. Two types of shifts are, of course, distinguished by whether the same dimension remains relevant throughout the task (reversal shift) or one dimension is relevant during the original learning and another dimension is relevant during the shift learning (non-reversal shift). The six paradigms listed by Wolff (1967a) are:

**IDr** - Specific cue response associations are merely rearranged in the manner of a A-Br transfer paradigm commonly employed in studies of paired associates.

**IDn** - Similar to IDr except that new cues are introduced within the relevant dimension to replace the old and these new cues are associated with the old responses.

**EDc** - Responses originally associated with the cues of one dimension become associated during the shift learning with cues from another dimension.

**EDc'** - Similar to EDc except in EDc the originally relevant dimension varies on each trial, whereas, in EDc' it is held constant on each trial.

**EDs** - Differs from EDc and EDc' in that the cues of the originally relevant dimension (and possibly all other cues as well) are replaced by novel ones during shift learning.

**EDn** - Differs from the other three ED paradigms in that in EDn, the formerly relevant dimension now exhibits a single cue, and the newly relevant dimension is a dimension which did not vary. In EDc, EDc' and EDs the opposite is the case.

A seventh paradigm, the one used in the present study, was not listed by Wolff (1967a). This paradigm, called the optional-reversal technique, was first introduced by Kendler, Kendler and Learnard (1962). This paradigm allows subjects to chose between
making a IDr or EDc shift during the shift learning, and then employs another series of trials after criteria has been reached on the shift learning to determine whether the subject has made an IDr or an EDc.

Wolff divided his review into six sections, parital re-inforcement during non-reversal shifts, number of response choices, age and type of shift interaction, intelligence, degree of original training, and verbal, perceptual and attentional factors. Two of these areas, age and type of shift interaction and verbal, perceptual, and attentional factors are relevant to the current study and they will be reviewed here.

Kendler and Kendler (1962) have argued that there are two possible models in which to view concept shift learning: a single-stage S-R model and a two stage (S-r-s-R) model in which the connection of S and R is assumed to be mediated by implicit responses. Kendler and Kendler (1962) state that the mediating responses are assumed to obey the same laws as overt responses and are normally conceived of as either verbal labels for stimulus dimensions or verbal labels for cues within a dimension, which either act as a cue for the subsequent response or function to direct a dimension-specific orienting reaction. Kendler, Glucksberg and Koston (1961) have pointed out that S and R are at times mediated by perceptual responses, such as overt head and eye orientations, as well as by verbal mediators.

The single stage model predicts that if fortuitous partial reinforcement of the formerly positive cue is eliminated, non-
reversal shifts should be easier to learn than reversal shifts. However, the two stage model predicts that reversal shifts should be easier to learn than non-reversal shifts either because there are a greater number of S-r and s-R connections involved in non-reversal shifts or mediating responses are better able to resist extinction than are overt responses (Kendler and Kendler, 1962).

From the developmental standpoint Kendler and Kendler (1962) argued that the two stage model fits the behavior of adults, whereas the single stage model fits the behavior of children under five and infrahuman organisms. Kindergarten children are seen as being in a transitional period in which for half of the children a single stage model applies and for the other half a two stage model applies. Kendler and Kendler (1962) argued that this change from operating on the basis of the single stage model, as opposed to the two stage model, is due to the acquisition of verbal mediators.

Hence as pointed out by Wolff (1967a) there are several hypotheses relating to the type of shift and age in the Kendlers' account of concept shift learning. The first hypothesis is that normal adults learn reversal shifts with greater ease than they learn non-reversal shifts. This hypothesis has been confirmed. Buss (1953) first found college subjects learned a reversal shift easier than a non-reversal shift. This finding has been confirmed in studies by Kendler and D'Amato (1955), Buss (1956), Kendler and Mayzner (1956), Harrow and Friedman (1958), Yelen
(1963), Johnson, Fishkin and Bourne (1966), and Ohnmacht (1966).

The second hypothesis generated is that rats and young children learn non-reversal shifts more easily than reversal shifts. Kelleher (1956) has shown that rats learn non-reversal shifts more easily than reversal shifts. The picture with young children has been a subject of some controversy. Kendler and Kendler (1959) compared kindergarteners on ID_r and ED_n shifts. They found no significant differences on these two types of shifts. However, when they divided subjects according to speed of learning the original concept, they found that fast learners learned the reversal shift more easily and slow initial learners learned the non-reversal shift more easily.

Kendler, Kendler and Wells (1960) compared ID_r and ED_n in nursery schoolers and found that non-reversal shifts were easier for the nursery schoolers to learn. Marsh (1964) replicated these results.

Kendler, Kendler and Learnard (1962) using the optional reversal technique, tested children of 3, 4, 5, 6, 7, and 10 years of age. As predicted the proportion of subjects choosing the non-reversal shifts rose from 37.5% at age 3 to 62.5% at age 10. From these three studies the Kendlers have concluded that their hypothesis that children under five learn a non-reversal shift more easily than a reversal shift has been confirmed.

Wolff (1967a) has disputed this claim. He questioned the conclusion reached by Kendler, Kendler and Wells (1960) and by
Marsh (1964), pointing out that these studies compared subjects on EDn and IDr shifts, and that this same result has been obtained with college Ss (Isaacs and Duncan, 1962) and six year olds (Viney, 1964) while a similar result (no difference between IDn and EDn) has been reported for 10 years olds.

Wolff (1967a) argued further that in other studies Cobb (1965) found that 3 and 4 year olds learned IDr and EDc equally easily, Trabasso, Deutsch and Gelman (1966) found IDn to be as easily learned as EDn with pattern stimuli and more easily learned than EDn with object stimuli, and Dickerson (1966) found that 4 and 5 year olds performed both IDr and IDn more easily than EDs.

Kendler and Kendler (1969) have rebutted Wolff's (1967a) contention that a developmental change does not exist in concept shift behavior. As confirmatory evidence of Kendler, Kendler and Learntard's (1962) finding, they noted that this result has been replicated (Kendler and Kendler, 1968) with a greater variety of stimuli (color-form, size-color and size-form) in an age range from 5 to 18 years. In addition, Kendler and Kendler (1969), stated that a systematic developmental increase has been shown in the relative speed in executing a reversal shift as compared to a half reversal shift between ages 4 and 18 years in a discrimination task requiring the subject to sort two sets of conceptually related pictures (Kendler, Kendler and Markham, 1969). The third age-related hypothesis generated from Kendler and Kendler review of concept shift behavior is that kindergarteners are in a transitional stage of mediational development in
which some of the children (fast learners) are likely to mediate in concept shift tasks, while others (slow learners) are not.

In concluding that this finding had been confirmed, Kendler, Kendler and Learnard (1962) cited their findings and the findings of the earlier Kendler and Kendler (1959) study. Wolff (1967a) has disputed the Kendler's conclusion. Wolff (1967a) in criticizing the conclusion reached in the earlier Kendler and Kendler (1959) study noted Suchman and Trabasso (1966) showed that children have definite preferences for stimulus dimensions, and Wolff (1966) showed that these dimensional preferences determine the learning speed in the original learning portion of the concept shift task. Hence children whose preferred dimension happens to be relevant in the original learning learn the initial concept quickly, while children whose preferred dimension happens to be irrelevant learn the initial concept slowly. Since the relevant dimension remains the same in reversal shifts, but changes in non-reversal shifts, it is possible that Kendler and Kendler's (1959) results could be due to the fact that in reversal shifts, dimensional preferences have the same effect on learning the original concept as learning the shift concept, while in non-reversal shifts they have the opposite effect.

Heal, Bransky and Mankinen (1966) and Smiley and Weir (1966) have given some empirical evidence that support Wolff's (1967a) argument. As further evidence, Wolff (1967a) cited Eimas' (1966) finding that kindergarteners as whole perform IDn significantly
more easily than ED_s and Suzuki's (1965) finding that ID_r is learned more easily than ED_c by subjects of this age. Wolff (1967a) also noted that in the Kendler, Kendler and Learnard (1962) study, although the number of subjects choosing reversal shifts rose from 37.5% at age 3 to 62.5% at age 10, the proportion of subjects choosing a reversal shift remained constant between the ages of 4 and 6.

Kendler and Kendler (1969) acknowledged that Wolff's analysis of their 1959 study may be accurate. However, they maintain that the Kendler, Kendler and Learnard (1962) study with the optional shift technique does show that there are developmental changes in concept shift behavior. They cited their 1968 study as further proof of this fact.

Summarizing, it appears that although there have been some negative results, there does seem to be enough evidence for the hypothesis that there is a developmental change from greater ease in make non-reversal shifts to greater ease in making reversal shifts. Evidence that kindergarteners are in the transitional stage is weak, but in spite of this fact, there is evidence that a change does occur even though the age at which this happens has not been specified.

As mentioned above, Kendler and Kendler have emphasized the value of language in guiding shift behavior. Other investigators have stressed the attentional nature of the shifting process (Zeaman and House, 1963) or the importance of perceptual factors
Tighe and Tighe (1966) have explained the developmental change in the ease in learning reversal shifts relative to non-reversal shifts in terms of differentiation theory. They argued that if a subject has reached a level of perceptual development characterized by the analysis of stimuli into stimulus dimensions, he should learn a reversal shift more easily than a non-reversal shift.

Positive evidence for this hypothesis is provided by Tighe (1965) and by Jeffrey (1965). Tighe and Tighe (1966) pointed out that if their hypothesis is correct, then any condition that makes it easier to isolate the distinguishing dimension should increase the ease of a reversal shift relative to a non-reversal shift. In a test of this interpretation, Tighe (1965) administered reversal and non-reversal shifts to first-grade children following a preliminary session devoted to either a control activity or perceptual pre-training designed to familiarize the subject with the distinguishing dimensions of the stimulus. It was found that the pretraining facilitated learning of the non-reversal shift but had no effect on the learning of the reversal shift.

Jeffrey (1965) found that by changing the constant irrelevant dimension (form) from Series 1 to Series 2 and 3 of an optional shift task it was possible to increase the percentage of 4-year olds choosing a reversal shift from 37.5% (form not changed) to 76% (form changed). Consonant with Tighes' hypothesis, Jeffrey
interpreted his results to mean that half of the 4 year old subjects were initially responding to stimulus compounds, and that the change in the irrelevant constant dimension increased the number of such subjects making reversal shifts by reducing their tendency to respond to the test pair discriminandum which was positive in the original learning. Wolff (1967a), however, has questioned this interpretation.

Wolff (1967a) also cited three pieces of evidence dissonant with this hypothesis. First, Wolff (1967a) argued that Tighe's perceptual-differentiation hypothesis should predict a strong retaining effect in the original learning, as well as in the shift learning this prediction was not borne out by the data. Secondly, Wolff (1967a) cited a series of studies that suggest that all subjects, regardless of age, tend to dimensionalize the stimuli at the start of the shift learning, a fact directly contrary to the Tighe's hypothesis. Thirdly, Wolff (1967a) cited three studies (House and Zeaman, 1963; Colby and Robertson, 1942; Kendler, Kendler and Learnard 1962) as proof that the evidence of stimulus compounding is positively correlated with developmental level, and not negatively correlated as Tighe and Tighe propose. House and Zeaman (1963) found that retarded subjects of higher mental ages tend to respond more to stimulus compounds that do those of lower mental ages, and Kendler, Kendler and Learnard (1962) reported that the percentage of subjects using verbal compounds to describe the positive stimulus (e.g. "the big black
one") increases with age. Colby and Robertson (1942) reported that the number of children making stimulus compound type matches in a matching to sample type of task (i.e. identity matches as opposed to matches agreeing on one dimension only) increases between ages 3,5 and 9.

Zeaman and House (1963) have emphasized the attentional nature of the shift process. According to Zeaman and House (1963) a subject's behavior on a given trial in a typical two choice concept learning task may be conceived of as a chain of two responses: (1) a preliminary response of attending to a stimulus situation (termed a dimensional observing response), and (2) an eventual instrumental response to one or two cues contained in the attended to dimension. Wolff (1967a) noted that the strongest evidence for the existence of dimensional observing response is provided by several studies (Heal, Bransky and Mankinen, 1966; Smiley and Weir, 1966; Wolff, 1966) that demonstrate the existence of relatively stable dimensional preferences in children.

Further support comes from studies by McConnell (1964) and House and Zeaman (1962). McConnell (1964) gave nursery school and kindergarten subjects a size reversal problem in which stimuli were arranged in such a way as to perceptually emphasize one or the other of two 100% confounded stimulus dimensions, size or brightness, or give no differential perceptual emphasis to either dimension (control). For subjects of both age groups arrangements emphasizing size tended to facilitate shift and
arrangements emphasizing brightness retarded it. These results were explained on the assumption that the perceptual arrangement emphasizing size enhanced the probability that subjects would attend to size and the arrangement emphasizing brightness did the same for the subjects in which it was emphasized.

House and Zeaman (1962) found that learning curves for both IDn and IDr were negatively accelerated while the learning curve for EDs was ogival, indicating that a greater period of trial and error learning precedes solution in EDs than in either IDr or IDn. The authors point out that these curves are what would be expected if the observing response serves primarily to reveal relevant cues and, hence they support an observing response analysis.

As mentioned above Kendler and Kendler (1962) have suggested that subjects' responses on concept shift tasks are mediated by implicit responses that are normally conceived of as verbal labels for stimulus dimensions or verbal labels for cues within a dimension, which either act directly as the cue for the resulting response or function to direct a dimension specific orienting reaction.

Wolff (1967a) divided studies dealing with Kendler's hypothesis into five groups: (1) studies comparing the performance of deaf and hearing subjects on reversal and non-reversal shifts, (2) studies investigating the effects of verbal associative strength, (3) studies manipulating overt verbalization,
(4) studies using verbal learning tasks, and (5) an additional study by Wolff (1967b) that does not fit readily into any of the other four categories.

Wolff (1967a) stated that on the assumption that hearing facilitates the normal development of verbal mediation, it follows from Kendler and Kendler's hypothesis concerning verbal mediation, the reversal shift superiority relative to non-reversal shifts should be greater in hearing than in deaf children. None of the three studies (Rosenstein, 1960; Youniss, 1964; Russell, 1964) done with deaf and hearing found this predicted difference.

Lachman, Meehan and Bradly (1965) hypothesized that positive transfer between cues whose labels have high verbal associative strength should be greater than that between cues that have low verbal associative strength; that is, some stimulus situations where the verbal labels for the within dimension cues are high associates should facilitate reversal shift as compared to stimulus situations in which the verbal labels for within dimension cues are low verbal associates. This prediction was verified in a study in which subjects were shifted from black to white or white to black (high order associate) or red to white or white to red (low order associate). However, Wolff (1967a) questioned this conclusion, citing other studies by Lachman and Sanders (1963) and Lachman (1966) as evidence that Lachman's results from all three studies support a observing response model and not a verbal mediation model.
Nine studies have investigated the effect on shifting of manipulating overt verbalization either during the learning task. Three studies, (Kendler and Kendler, 1961; Silverman, 1966; Woerner, 1963), all using similar designs obtained results supporting the verbal mediation hypothesis. Preschool and second-grade children were made to name two original learning discriminanda with labels for cues of one dimension only. Subjects were then shifted to an opposite cue either from the dimension whose cues were label (relevant-label shift) or from one whose cues were not labeled (irrelevant label shift). It was found that relevant verbalization facilitated shift and irrelevant verbalization retarded shift.

Three studies failed to find a labeling effect on shift. Kendler, Kendler and Wells (1960) had nursery school subjects vocalize their choices during a ten trial overtraining period immediately prior to IDr and EDn shifts. The verbalization had no significant effect. Lachman and Sanders (1963) found that with college subjects verbalizing overtly or covertly had little effect on the shift. Cobb (1965) pretrained nursery school subjects to use labels, which were either relevant or irrelevant to an original discrimination and subsequent reversal or non-reversal shifts, and found no effect due to pretraining in either original or shift learning.

Two studies found that overt verbalization sometimes retards shift. O'Connor and Hermelin (1959) required one group of
retarded subjects to label the chosen cue following every response in the original learning, while a second group learned without vocalization. Subsequent performance differences between the two groups on ED favored the non-vocalizing group. Blank (1966) found that nursery schoolers instructed as to the correct response in original learning and made to verbalize the cues of the relevant dimension at the beginning of this period performed reversal shifts more slowly than those uninstructed and not verbalizing during the original learning.

In analyzing these results Wolff (1967a) pointed that in the two studies where verbalization appeared to retard reversal, the low IQ of the subjects may account for the results obtained. He also pointed out that as far as overt verbalization goes, it may have two effects: to increase attention to the relevant dimension and to retard extinction of the originally relevant response. Hence, Wolff (1967a) argued that verbalization interferes with reversal when the number of new possibly correct responses is small (as it was in both the O'Connor and Hermelin, 1959; and Blank, 1966, studies), but facilitates reversal when the number of new possibly correct response is large (as it was in the studies showing facilitation). This interpretation is supported in a study by House (1964).

Evidence supporting the verbal mediation hypothesis is supplied by Kendler, Kendler and Sanders (1967) who had college subjects sort words falling naturally into two conceptual
categories into two groups, and then required them to reverse the original sorting pattern. It was found that if the original sorting followed the natural conceptual categorization, reversal sorting was easier than when the original sorting did not follow these categories. Bogartz (1965) found that if a subject learns one of two responses to half of the stimulus items in a list of CVCs and the second response to the remaining half, it is easier for him to learn to reverse his responses to all the stimuli than to learn to reverse his responses half of the stimuli and keep the same responses to the other half. In a third somewhat similar study, Yelen (1963) had college subjects sort cards showing a single English sentence under four stimulus cards which also showed single English sentences. All sentences were divided on two verbal dimensions: type of name (male or female) and type of verb (hostile or nurturant); and subjects had to sort according to one or the other dimension during the original learning and shift learning. Following an original learning period in which either type of verb or type of name was the correct response, subjects were given a reversal or a non-reversal shift. The reversal shift was learned easier than the non-reversal shift.

And finally in a study somewhat different than any of the other reviewed, Wolff (1967b) identified first grade mediators (subjects choosing a reversal shift in an optional shift task) and non-mediators (subjects choosing non-reversal shifts). Wolff (1967b) reasoned that if the verbal mediation hypothesis were
correct then mediators would be more likely to use verbal mediators in solving concept learning problems. He found that although verbalization affected performance on the concept formation task, there was no significant difference between the performance of mediators and non-mediators and no interaction between the mediation category variable and verbalization.

In summarizing the studies on perceptual, attentional and verbal factors in concept shift learning, it seems that for the reasons cited by Wolff (1967a) and listed above, Tighe and Tighe's perceptual hypothesis appears to be incorrect. Concerning the attentional and verbal mediation hypothesis, it should be realized that these two explanations are not mutually exclusive. Both hypothesize a preliminary response, although they differ on the nature of this response: House and Zeaman (1966) hypothesize that the response is a dimensional observing response and Kendler hypothesizes the existence of an implicit verbal mediation response. It is noteworthy that House and Zeaman (1962) took their results that showed that learning curves for both ID_n and ID_r were negatively accelerated while the learning curves for ED_s was ogival (indicating that a greater period of trial and error learning precedes solution in ED_s, than in either ED_r or ID_n) as supporting an observing response analysis. However as Wolff (1967a) pointed out trial and error, according to the Kendlers' notion, should be largely centered in finding an appropriate mediator, and once this is found, attaching the overt response
should be quickly accomplished. However, since the appropriate mediating response is already present in ID_{r} and ID_{n} conditions, the mediator should become quickly attached, therefore producing a negatively accelerated curve. Hence, both hypotheses account in a similar fashion for the difference in ease of learning a reversal, as opposed to a non-reversal shift.

Where the two theories do differ is whether the implicit response is a verbal one or merely a dimension specific orienting reaction (although Kendler, 1964, has admitted this second possibility may be operating at times). Evidence on verbal mediation is equivocal. Some of the negative results, e.g. those with deaf and hearing subjects and those studies dealing with verbal associates of hypothesized verbal mediators, may be discounted by being based on faulty assumptions not relating directly to the issue of verbal mediation. There are some positive findings (Kendler, Kendler and Sanders, 1967; Bogartz, 1965; Yelen, 1963) that give support to the notion of verbal mediation. It appears, however, that as mentioned above having subjects verbalize overtly can under different conditions help or hinder reversal learning performance.

In conclusion, it appears that subjects make an implicit response that facilitates reversal learning, relative to non-reversal learning. There is evidence that this response may be a dimensional orientating response and evidence that it may be an implicit verbal label. It is likely that both attentional
and verbal factors are operating in reversal shift learning.

There have been three studies that deal with reversal and non-reversal shifts in schizophrenic and/or brain damage populations. Nolan (1968) used two schizophrenic groups, a concrete group and an abstract group. Subjects were defined as abstract or concrete in terms of their performance on the Weigl-Goldstein-Scheerer Color Form Sorting Test. Results showed there was no difference on the original learning, that the concrete subjects were slower on both non-reversal and reversal shifts, that there was no difference for fast and slow original learners on shift learning and that abstract subjects verbalized the correct dimension more often. Nolan explained his results in terms of an attentional model, stating that since concrete subjects had difficulty with both kinds of shifts, both the cue attended to and their choice of response extinguished slowly for them.

Nolan (1970) found that with schizophrenic subjects over-training on the original learning task facilitated performance on a reversal shift, relative to a non-reversal shift. Similar results have been reported with children, but with normal adults, over-training does not have this effect. Nolan stated the results reflect slow or incomplete learning of attentional responses in schizophrenics.

Fein (1969) compared schizophrenics, brain damaged, and control subjects on reversal and non-reversal shifts. He found that brain damage subjects, but not schizophrenics, were slower
than normals in learning a reversal shift. Both pathological groups were slower than normals in learning a non-reversal shift.

Summary and Conclusions

Research on abstraction, regression, associative interference, overinclusion and attention in schizophrenia and process and reactive schizophrenia were reviewed. In light of the research on conceptual shifts that indicates that age, attention and ability to mediate are important variables in the learning of reversal shifts, relative to non-reversal shifts, schizophrenic deficit or process-reactive difference in abstraction, regression, associative interference, overinclusion or attention could produce a schizophrenic-normal or process-reactive difference in ability to learn reversal shifts, relative to non-reversal shifts or a difference in preference for reversal shifts, relative to non-reversal shifts. A deficit in ability to abstract or a tendency to be overinclusive would impede mediation. Associative interference would also impede mediation. Since preference for reversal shifts increases with age, regression would decrease preference for reversal shifts. And finally since attention has been shown to be a relevant variable in reversal shift learning a deficit in this area would lead to a decrease in preference for reversal shift learning.
The research on cognitive deficit in schizophrenia reviewed indicates that there is not definitive support for the hypotheses that schizophrenic thought is concrete, overinclusive or childish. There is support for the hypothesis that schizophrenics show atypical thought organization and that their associations are uncommon. Research on process and reactive schizophrenia gives some support for the hypothesis that process schizophrenics display more atypical thought organization than reactives. Also the literature in this area supports the hypothesis that process schizophrenics are under-aroused while reactives are over-aroused. Hence whereas, reactives are very much distracted by outside stimuli, process schizophrenics are obilivous to them. As a result reactives do poorly on cognitive tasks because of their inability to filter out irrelevant outside stimuli, whereas process schizophrenics do poorly because they do not attend to relevant outside stimuli.

Hence it is predicted that process schizophrenics because of their atypical thought organization, which will impede mediation and because of their inability to attend to the relevant aspects of the stimulus situation, will make fewer reversal shifts than normals. It is predicted that reactive schizophrenics because of their atypical thought organization and their distractability will make fewer reversal shifts than normals. It is predicted that because of their more disturbed and more atypical thought organization, process schizophrenics will make fewer reversal
shifts than reactive schizophrenics. Results of studies with diffusely brain damaged patients support the hypothesis that they suffer from an impairment of the ability to learn abstract concepts. It is hypothesized that because of this deficit, which will impede mediation, brain damage patients will make fewer reversal shifts than normals.

In addition to testing these hypotheses, a number of other comparisons will be made. The four diagnostic groups will be compared on speed of original learning and speed of shift learning. The correlations for age, intelligence and education and speed of original and speed of shift learning will be calculated. And finally the relationship between diagnostic category and verbalization will be explored.

A number of comparisons between reversers, non-reversers and inconsistent responders (those that choose neither a reversal or non-reversal shift in the optional shift situation) will be made. They will be compared on speed of original and speed of shift learning. The contingency coefficients for age, intelligence and education and speed of original learning and speed of shift learning will be calculated. And finally the relationship between type of shift learned and verbalization will be explored.
Subjects. Four groups of 34 male subjects each were used. The groups were process schizophrenics, reactive schizophrenics, diffusely brain damaged patients and a control group of patients hospitalized for reasons other than neurological or psychiatric difficulties. The members of the two schizophrenic groups were all patients at Downey Veteran's Administration Hospital and all had received an official diagnosis of one of the types of schizophrenia. Reactive and process schizophrenics were defined by the Phillips Scale (1953). Information for Phillips Scale ratings was gathered by the General Information Questionnaire (DeWolfe, 1968). Reactive schizophrenics were defined as schizophrenic patients who had a Phillips Scale score of twelve or less. Process schizophrenics were defined as schizophrenic patients with a Phillips Scale score of eighteen or more. Of the 34 brain damaged Ss, 20 were patients at Downey Veteran's Administration Hospital and the remaining 14 were patients at Hines Veteran's Administration Hospital. All of the patients in this group were suffering from a brain injury of a diffuse nature. All the patients for the control group were patients at Hines Veteran's Administration Hospital. The groups were matched for age, intelligence and education. Intelligence was measured by the WAIS Information subtest.
Apparatus and Materials. Thirty-two 3"x5" cards were used. Each card had an ellipse or a circle and a square or a rectangle on it. The former are called continuous sided, the latter four-sided. One of the figures on each card was red and the other was blue. Half of the figures of each color-shape combination had a number of lines running through it. There was a card for each color-shape-plain or lined combination.

Procedure. The Ss were read the following instructions:

"I am going to show you a series of cards. Each card has two colored figures on it. One of the two is a 'VEC' and the other is not. You don't know what a 'VEC' is now, so you will have to guess. I'll tell you whether you are right or wrong and in that way, you will find out what a 'VEC' is."

Three series of trials were presented with no noticeable break in the procedure between them: Series I provided training in an initial discrimination, Series II training in a second discrimination, and Series III composed the test trials.

Figure 1 shows an example of one of the arrangements of stimuli and reinforcements used. For Series I, the cards were divided into two groups. In our example, the groups are blue four-sided vs. red continuous sided and red four-sided vs. blue continuous sided. Cards are presented alternatively from Group One and Group Two. A positive stimulus is any blue figure. The first concept learned (shape or color) was counterbalanced for
Figure 1. Illustration of one arrangement of stimuli and reinforcement used in the experiment.
all groups. The Ss were randomly assigned within groups to first concepts. After a criterion of 10 consecutive correct responses had been reached, Series II was presented. If a S failed to reach this criterion after 128 trials, testing was ceased and he was not used. Six process schizophrenics, seven reactive schizophrenics, nine brain damaged subjects and seven control subjects failed to reach criteria and hence were not used.

For Series II only half of the cards were used. In the example only blue four-sided vs. red continuous sided are used. A positive stimulus becomes any red continuous sided figure. The S can learn by responding to shape, color or both. The third series is designed to ascertain the basis on which Ss learned Series II. Again Ss were excluded if they did not reach criteria after 128 trials. One process schizophrenic was excluded on this basis.

After Series II was learned to criterion (10 consecutive correct responses), Series III was given. In Series III the group two cards were reinserted, but no feedback was given for them. Group one cards were reinforced in the same manner as in Series II. The S was told that he would get feedback only on every other card. There were 32 trials on Series III; sixteen of these, the group two trials, were the test trials. On the basis of the test trials each S was classified as belonging to one of the three following categories:
Reverser. A S continues to respond to the same general concept, shape or color, that had guided his behavior in Series I and chooses 12 or more times the specific shape or specific color that had been incorrect in Series I and correct in Series II.

Non-Reverser. A S ceases to respond to the general concept, shape or color, that had guided his behavior in Series I. Instead he responds on the basis of the general concept that was not relevant in Series I and chooses 12 or more times the specific shape or specific color that was irrelevant in Series I and correct in Series II.

Inconsistent. A S does not choose the specific shape or color that was incorrect in Series I and correct in Series II twelve or more times nor does he respond on the basis of the general concept that was irrelevant in Series I and chooses 12 or more times the specific shape or specific color that was irrelevant in Series I and correct in Series II.

After Series III, the S was shown one of the cards, and asked "Which is a 'VEC'?". If no relevant response was given he was asked, "What does it look like?" and then, if necessary "How do you know?". Ss' answers to the questions were classified as:

Correct. The S mentions the dimension that guided his behavior in Series II and Series III, e.g. A S that had been responding to color states, "It's the red one".

Incorrect. A S describes the dimension that was inconsistent with his overt choice, e.g. A S that had been responding to color states. "It's the square one".

Irrelevant. The S gives no response or refers to some aspect of the stimulus other than the shape or the color, e.g. A S states, "It's the one with lines going through it".
Means and standard deviations were computed for age WAIS Information raw scores and education for the 136 Ss in the four diagnostic groups and for the 30 Ss who were excluded for failing to meet criteria on either Series I or Series II. These scores are given in Table 1. The means for these two groups for these three variables were compared by t tests. It was predicted that Ss who were excluded would have lower Information scores. It was found that two groups did not differ in age (t=.23, df=164, NS), Information raw scores (t=.67, df=164, NS), or education. (t=.50, df=164, NS).

Means and standard deviations for the four diagnostic groups were calculated for the following variables: age, Information raw scores, education, Phillips Scale scores, trials to criteria on Series I, and trials to criteria on Series II. These scores and medians for trials to criteria for Series I and Series II are given in Table 2. Since the groups were matched for age, Information raw scores and education, t tests done comparing the brain damaged and control groups who differed most from each other on the three variables were not significant (age, t=.22, df=66, NS; Information, t=.26, df=66, NS; education, t=.36, df=66, NS).

Figure 2 shows the number of trials to successive criteria on Series I for the Ss of the four diagnostic groups. Figure 3 shows the number of trials to successive criteria on Series II
Table 1

Means and Standard Deviations for Age, Information Raw Scores and Education for all 136 Ss and for 30 Excluded Ss who Failed to Meet Criteria on Either Series I or Series II

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Excluded</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>Mean</td>
<td>43.9</td>
</tr>
<tr>
<td></td>
<td>S.D.</td>
<td>11.6</td>
</tr>
<tr>
<td><strong>Information</strong></td>
<td>Mean</td>
<td>15.5</td>
</tr>
<tr>
<td></td>
<td>S.D.</td>
<td>4.7</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td>Mean</td>
<td>11.3</td>
</tr>
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<td></td>
<td>S.D.</td>
<td>2.6</td>
</tr>
</tbody>
</table>
Table 2


<table>
<thead>
<tr>
<th>Process Reactive Brain Control Damaged</th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>44.0</td>
<td>43.2</td>
<td>45.6</td>
<td>42.6</td>
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<tr>
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<td>7.7</td>
<td>11.7</td>
<td>10.8</td>
<td>15.3</td>
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<tr>
<td>Information</td>
<td>15.4</td>
<td>15.9</td>
<td>14.9</td>
<td>15.9</td>
</tr>
<tr>
<td>S.D.</td>
<td>6.0</td>
<td>4.5</td>
<td>4.7</td>
<td>3.7</td>
</tr>
<tr>
<td>Education</td>
<td>11.5</td>
<td>11.4</td>
<td>10.6</td>
<td>11.6</td>
</tr>
<tr>
<td>S.D.</td>
<td>2.6</td>
<td>2.4</td>
<td>2.8</td>
<td>2.7</td>
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<tr>
<td>Phillips</td>
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<td>9.6</td>
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<td>-</td>
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<tr>
<td>S.D.</td>
<td>2.9</td>
<td>2.5</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Series I</td>
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<td>29.6</td>
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<tr>
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<td>20.0</td>
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</tr>
<tr>
<td>Series II</td>
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<td>25.3</td>
<td>32.4</td>
<td>16.7</td>
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<tr>
<td>Mdn.</td>
<td>18.5</td>
<td>26.5</td>
<td>21.0</td>
<td>15.5</td>
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</table>
Figure 2. Number of Trials to Successive Criteria for Series I for the Ss of the Four Diagnostic Groups
Figure 3. Number of Trials to Successive Criteria for Series II for the Ss of the Four Diagnostic Groups
for the Ss of the four diagnostic groups. In both graphs the average number of trials to successive criteria of consecutive correct responses are shown as a function of that criterion.

Because the distributions of trials to criteria on Series I and Series II were highly skewed, Kruskal-Wallis one way analyses of variance by ranks with the correction for ties were used to compare the four diagnostic groups on trials to the criteria of ten consecutive correct responses on Series I and Series II. There was a significant difference among the four groups on both Series I (H = 13.12, df = 3, p < .01) and Series II (H = 13.56, df = 3, p < .01). To determine which of the four diagnostic groups differed from each other on trials to the criteria of ten consecutive correct responses on Series I and Series II, each two group combination of the four diagnostic groups was compared for trials to criteria on Series I and Series II by means of Mann-Whitney U tests. The z values for each two group combination for Series I are given in Table 3. The only two groups that differed significantly from each other were the process group and the control group (z = 2.45, p < .02). The z values for each two group combination for Series II given in Table 4. Both the reactive and the brain damaged group differed significantly from the control group (reactive-control, z = 2.17, p < .05; brain damaged-control, z = 1.99, p < .05).

Pearson product moment correlation coefficients for all 136 Ss together and for the four diagnostic groups separately were
### Table 3

Z Values for Mann Whitney U Tests for Ranks of Trials to Criteria for Series I for All Combinations of Two of the Four Diagnostic Groups

<table>
<thead>
<tr>
<th>Process</th>
<th>Reactive</th>
<th>Brain Damaged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reactive</td>
<td>1.15</td>
<td></td>
</tr>
<tr>
<td>Brain Damaged</td>
<td>1.25</td>
<td>.12</td>
</tr>
<tr>
<td>Control</td>
<td>2.45**</td>
<td>1.48</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.60</td>
</tr>
</tbody>
</table>

**p < .02**
Table 4

Z Values for Mann Whitney U Tests for Ranks of Trials to Criteria for Series II for All Combinations of Two of the Four Diagnostic Groups

<table>
<thead>
<tr>
<th></th>
<th>Process</th>
<th>Reactive</th>
<th>Brain Damaged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reactive</td>
<td>1.26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brain Damaged</td>
<td>.79</td>
<td>.09</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>1.82</td>
<td>2.17*</td>
<td>1.99*</td>
</tr>
</tbody>
</table>

*P < .05
computed for trials to criteria on Series I and age, Information raw scores and education. The correlation coefficients are given in Table 5. The only significant correlations were between trials to criteria on Series I and age for the brain damaged group ($r=.498, p<.01$) and for the same two measures for the control group ($r=.344, p<.05$).

Pearson products moment correlation coefficients for the 136 Ss together and for the four diagnostic groups separately were computed for trials to criteria on Series II and age, Information raw scores, and education. The correlation coefficients, none of which are significant, are given in Table 6.

Contingency coefficients for all 136 Ss together and for the four diagnostic groups separately were computed for response category (reverser, non-reverser, and inconsistent) and age, Information raw scores and education. They are given in Table 7. The only significant C values were for response category and Information raw scores for the total group ($X^2=22.85, df=12, \chi^2=3.79, p<.05$) and for the same two measures for the control group ($X^2=24.09, df=12, \chi^2=6.64, p<.02$). In both cases reversers had higher scores on Information than did non-reverser and inconsistent responders. Contingency tables for the 15 contingency coefficients in Table 7 are given in Appendix A.

For the Ss of three response categories, reverser, non-reverser and inconsistent, means and standard deviations were calculated for the following variables: age, Information raw scores and education.
Table 5
Pearson Product Moment Correlations for Trials to Criteria for Series I and Age, Information Raw Scores, and Education for All Diagnostic Groups Combined and for the Four Groups Diagnostic Separately

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Process</th>
<th>Reactive</th>
<th>Brain Damaged</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>.119</td>
<td>-.022</td>
<td>-.316</td>
<td>.498**</td>
<td>.344*</td>
</tr>
<tr>
<td>Information</td>
<td>-.145</td>
<td>-.233</td>
<td>-.322</td>
<td>.062</td>
<td>-.018</td>
</tr>
<tr>
<td>Education</td>
<td>-.153</td>
<td>-.149</td>
<td>-.031</td>
<td>-.162</td>
<td>-.210</td>
</tr>
</tbody>
</table>

* p<.05
** p<.01
Table 6
Pearson Product Moment Correlations for Trials to Criteria for Series II and Age, Information Raw Scores, and Education for All Diagnostic Groups Combined and for the Four Diagnostic Groups Separately

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Process</th>
<th>Reactive</th>
<th>Brain Damaged</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>.096</td>
<td>-.162</td>
<td>-.064</td>
<td>.224</td>
<td>.261</td>
</tr>
<tr>
<td>Information</td>
<td>-.073</td>
<td>-.221</td>
<td>-.177</td>
<td>.086</td>
<td>.083</td>
</tr>
<tr>
<td>Education</td>
<td>-.160</td>
<td>-.311</td>
<td>-.101</td>
<td>-.033</td>
<td>-.210</td>
</tr>
</tbody>
</table>
Table 7
Contingency Coefficients for Response Category (Reverser, Non-Reverser and Inconsistent) and Age, Information Raw Scores, and Education for All Diagnostic Groups Combined and for the Four Diagnostic Groups Separately

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Process</th>
<th>Reactive</th>
<th>Brain Damaged</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>.229</td>
<td>.442</td>
<td>.398</td>
<td>.350</td>
<td>.467</td>
</tr>
<tr>
<td>Information</td>
<td>.379*</td>
<td>.361</td>
<td>.592</td>
<td>.611</td>
<td>.644**</td>
</tr>
<tr>
<td>Education</td>
<td>.272</td>
<td>.360</td>
<td>.369</td>
<td>.391</td>
<td>.430</td>
</tr>
</tbody>
</table>

* *p < .05
** *p < .02
scores, education, trials to criteria on Series I and trails to criteria on Series II. These scores and medians for trials to criteria for Series I and Series II are given in Table 8. For age, Information raw scores, and education the two groups that differed most were compared by t tests. None of the differences were significant (age, reverser-non-reverser, t= .21, df=118, NS; Information, reverser-inconsistent, t= .22, df=94, NS; education, non-reverser-inconsistent, t= .24, df=54, NS).

Figure 4 shows the number of trials to successive criteria on Series I for the Ss of the three response categories. Figure 5 shows the number of trials to successive criteria on Series II for the Ss of the three response categories. In both graphs the average number of trials to successive criteria of consecutive correct responses are shown as a function of that criterion.

The number of trials to the criteria of ten consecutive correct response on Series I and Series II for the three groups were compared by Kruskal-Wallis one way analysis of variance by ranks with the correction for ties. There was a significant difference among the three groups on both Series I (Hc=25.98, df=2, p<.001) and Series II (Hc=22.07, df=2, p<.001).

To determine which of the three response groups differed from each other, each two group combination was compared for trials to criteria on Series I and Series II by means of Mann-Whitney U tests. For Series I the reverser and inconsistent groups differed significantly from each other (z=2.97, p<.01),
Table 8
Means and Standard Deviations for Age, Information Raw Scores and Education, and Means, Standard Deviations and Medians for Trials to Criteria on Series I, and Trials to Criteria on Series II for Reversers, Non-Reversers and Inconsistent Responders

<table>
<thead>
<tr>
<th></th>
<th>Reversers</th>
<th>Non-Reversers</th>
<th>Inconsistent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Mean 42.9</td>
<td>45.5</td>
<td>44.5</td>
</tr>
<tr>
<td></td>
<td>S.D. 12.6</td>
<td>10.9</td>
<td>7.3</td>
</tr>
<tr>
<td>Information</td>
<td>Mean 15.8</td>
<td>15.3</td>
<td>14.8</td>
</tr>
<tr>
<td></td>
<td>S.D. 4.7</td>
<td>5.2</td>
<td>4.0</td>
</tr>
<tr>
<td>Education</td>
<td>Mean 11.4</td>
<td>10.8</td>
<td>11.5</td>
</tr>
<tr>
<td></td>
<td>S.D. 2.5</td>
<td>2.8</td>
<td>2.9</td>
</tr>
<tr>
<td>Series I</td>
<td>Mean 25.0</td>
<td>36.8</td>
<td>43.3</td>
</tr>
<tr>
<td></td>
<td>S.D. 24.1</td>
<td>33.7</td>
<td>31.2</td>
</tr>
<tr>
<td></td>
<td>Mdn. 14.5</td>
<td>24.0</td>
<td>26.5</td>
</tr>
<tr>
<td>Series II</td>
<td>Mean 23.1</td>
<td>38.0</td>
<td>46.9</td>
</tr>
<tr>
<td></td>
<td>S.D. 19.1</td>
<td>28.4</td>
<td>31.7</td>
</tr>
<tr>
<td></td>
<td>Mdn. 17.0</td>
<td>28.5</td>
<td>30.5</td>
</tr>
</tbody>
</table>
Figure 4. Number of Trials to Successive Criteria for Series I for the Ss of the Three Response Categories.
Figure 5. Number of Trials to Successive Criteria for Series II for the Ss of the Three Response Categories
but the reverser and non-reverser groups (z=1.80, NS) and the non-reverser and inconsistent (z=1.18, NS) groups did not. For Series II the reverser and non-reverser groups (z=3.05, p<.01) and the reverser and inconsistent groups (z=2.96, p<.01) differed significantly from each other but the non-reverser and inconsistent group did not (z=.57, NS).

Table 9 shows the number of reverser, non-reverser and inconsistent responders for the four diagnostic groups. It had been predicted that the distribution of reversers, non-reversers and inconsistent responders would differ for the four diagnostic groups. This hypothesis was tested by chi square analysis, but was not confirmed (X²=6.80, df=6, NS). The distribution of reversers, non-reversers and inconsistent responders for two group combination of the four diagnostic groups was compared by chi square analysis. It was predicted that the control group would contain more reversers and fewer non-reversers and inconsistent responders than each of the other three groups. It was further predicted that the reactive group would have more reversers and few non-reversers and inconsistent responders than the process group. Each comparison was done first keeping the non-reversal and inconsistent categories separate (3x2 analysis) and then with the non-reverser and inconsistent categories combined (2x2 analysis). These values are given in Table 10. None of the 3x2 analyses are significant. However the 2x2 process-reactive (X²=3.82, df=1, p<.05, one tailed test) and process-control
Table 9

Number of Reversers Non-Reversers and Inconsistent Responders in the Four Diagnostic Groups

<table>
<thead>
<tr>
<th></th>
<th>Process</th>
<th>Reactive</th>
<th>Brain Damaged</th>
<th>Control</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reversers</td>
<td>15</td>
<td>23</td>
<td>20</td>
<td>22</td>
<td>80</td>
</tr>
<tr>
<td>Non-Reversers</td>
<td>12</td>
<td>7</td>
<td>11</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>Inconsistent</td>
<td>7</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
<td>34</td>
<td>34</td>
<td>34</td>
<td>136</td>
</tr>
</tbody>
</table>

\[ x^2 = 6.80 \]
\[ df = 6 \]
Table 10

X² for Each Two Group Combination of the Four Diagnostic Groups and Response Category (Reverser, Non-Reverser and Inconsistent) with Non-Reverser and Inconsistent Separate (3x2) and Combined (2x2)

<table>
<thead>
<tr>
<th>Group</th>
<th>Process</th>
<th>Reactive</th>
<th>Brain Damaged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reactive</td>
<td>3x2</td>
<td>3.82</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2x2</td>
<td>3.82*</td>
<td></td>
</tr>
<tr>
<td>Brain Damaged</td>
<td>3x2</td>
<td>2.36</td>
<td>1.24</td>
</tr>
<tr>
<td></td>
<td>2x2</td>
<td>1.47</td>
<td>.57</td>
</tr>
<tr>
<td>Control</td>
<td>3x2</td>
<td>4.28</td>
<td>1.22</td>
</tr>
<tr>
<td></td>
<td>2x2</td>
<td>2.90*</td>
<td>.66</td>
</tr>
</tbody>
</table>

*p<.05, one tailed test
(\(x^2=2.90, \, df=1, \, p<.05\), one tailed test) comparisons are significant.

Half of the Ss in each diagnostic group learned a color concept (color group) in Series I, and the other half learned a form concept (form group) in Series I. Table 11 shows the means and standard deviations for trials to criteria for Series I and Series II for the color and form groups of the four diagnostic groups and for all groups combined. The trials to criteria for both Series I and Series II for the form and color groups for each of the diagnostic groups and for all groups combined were compared by Mann-Whitney U tests. Form was learned in significantly fewer trials for all subjects combined (\(z=2.05, \, p<.05\)). However, there were no significant differences for any of the diagnostic groups taken separately (process, \(z=1.17, \, NS\); reactive \(z=.59, \, NS\); brain damaged \(z=.21, \, NS\); control, \(z=1.14, \, NS\)). For Series II there were no significant differences (all, \(z=.90, \, NS\); process, \(z=.07, \, NS\); reactive, \(z=1.16, \, NS\); brain damaged \(z=.38, \, NS\); control, \(z=.16, \, NS\)).

Table 12 shows the distribution of reversers, non-reversers and inconsistent responders for the Ss of the four diagnostic groups who learned a color concept in Series I. A chi square analysis of this distribution was not significant. (\(x^2=10.22, \, df=6, \, NS\)). The distribution of reversers, non-reversers and inconsistent responders for each two group combination of the color groups of the four diagnostic groups was compared by chi
Table 11
Means and Standard Deviations for Trials to Criteria on Series I and Trials to Criteria on Series II for the Color and Form Groups of the Four Diagnostic Groups Separately and All Groups Combined

<table>
<thead>
<tr>
<th></th>
<th>Series I</th>
<th></th>
<th></th>
<th>Series II</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Form</td>
<td>Color</td>
<td>Form</td>
<td>Color</td>
<td></td>
</tr>
<tr>
<td>Process</td>
<td>Mean</td>
<td>34.29</td>
<td>47.70</td>
<td>22.71</td>
<td>29.71</td>
</tr>
<tr>
<td></td>
<td>S.D.</td>
<td>32.51</td>
<td>40.70</td>
<td>10.76</td>
<td>28.69</td>
</tr>
<tr>
<td>Reactive</td>
<td>Mean</td>
<td>29.12</td>
<td>24.00</td>
<td>39.41</td>
<td>30.06</td>
</tr>
<tr>
<td></td>
<td>S.D.</td>
<td>24.54</td>
<td>14.06</td>
<td>26.44</td>
<td>24.05</td>
</tr>
<tr>
<td>Brain Damaged</td>
<td>Mean</td>
<td>28.18</td>
<td>31.12</td>
<td>41.65</td>
<td>35.00</td>
</tr>
<tr>
<td></td>
<td>S.D.</td>
<td>25.44</td>
<td>27.91</td>
<td>32.86</td>
<td>32.54</td>
</tr>
<tr>
<td>Control</td>
<td>Mean</td>
<td>22.76</td>
<td>27.59</td>
<td>19.64</td>
<td>24.29</td>
</tr>
<tr>
<td></td>
<td>S.D.</td>
<td>30.36</td>
<td>25.82</td>
<td>9.88</td>
<td>21.66</td>
</tr>
<tr>
<td>All</td>
<td>Mean</td>
<td>28.59</td>
<td>32.60</td>
<td>30.85</td>
<td>29.76</td>
</tr>
<tr>
<td></td>
<td>S.D.</td>
<td>28.07</td>
<td>29.52</td>
<td>23.93</td>
<td>26.72</td>
</tr>
</tbody>
</table>
Table 12
Number of Reversers, Non-Reversers and Inconsistent Responders for the Color Groups of the Four Diagnostic Groups

<table>
<thead>
<tr>
<th></th>
<th>Process</th>
<th>Reactive</th>
<th>Brain Damaged</th>
<th>Control</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reversers</td>
<td>7</td>
<td>14</td>
<td>13</td>
<td>11</td>
<td>45</td>
</tr>
<tr>
<td>Non-Reversers</td>
<td>6</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Inconsistent</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>17</td>
<td>17</td>
<td>17</td>
<td>68</td>
</tr>
</tbody>
</table>

$X^2 = 10.22$

$df = 6$
square analysis. Each comparison was done first keeping the non-reverser and inconsistent categories separate (3x2 analysis) and then with the non-reverser and inconsistent categories combined (2x2 analysis). These chi square values are given in Table 13. There were process-reactive differences with more reactivies being reversers in both the 3x2 analysis ($X^2=8.47$, df=2, $p<.02$) and the 2x2 analysis ($X^2=6.10$, df=1, $p<.02$). There were also significantly more brain damaged reversers than process reversers in the 2x2 analysis ($X^2=4.37$, df=1, $p<.05$).

Table 14 shows the distribution of reversers, non-reversers and inconsistent responders for the $S$s of the four diagnostic groups who learned a form concept in Series I. A chi square analysis of this distribution was not significant ($X^2=5.66$, df=2, NS). The distribution of reversers, non-reversers and inconsistent responders of each two group combination of the form groups of the four diagnostic groups was compared by chi square analysis. Each comparison was done first keeping the non-reverser and inconsistent categories separate (3x2 analysis) and then with the non-reverser and inconsistent categories combined (2x2 analysis). These chi square values are given in Table 15. None were significant.

A chi square analysis comparing the distribution of reversers, non-reversers and inconsistent responders for the form group to the distribution of reversers, non-reversers and inconsistent responders for the color group was significant ($X^2=9.90$, df=2,
Table 13

$X^2$ for Each Two Group Combination of the Color Groups of the Four Diagnostic Groups and Response Category (Reverser, Non-Reverser, and Inconsistent) with Non-Reverser and Inconsistent Separate (3x2) and Combined (2x2)

<table>
<thead>
<tr>
<th></th>
<th>Process</th>
<th>Reactive</th>
<th>Brain Damaged</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reactive</strong></td>
<td>3x2</td>
<td>8.47**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2x2</td>
<td>6.10**</td>
<td></td>
</tr>
<tr>
<td><strong>Brain Damaged</strong></td>
<td>3x2</td>
<td>4.67</td>
<td>2.24</td>
</tr>
<tr>
<td></td>
<td>2x2</td>
<td>4.37*</td>
<td>.18</td>
</tr>
<tr>
<td><strong>Control</strong></td>
<td>3x2</td>
<td>1.96</td>
<td>4.56</td>
</tr>
<tr>
<td></td>
<td>2x2</td>
<td>1.89</td>
<td>1.36</td>
</tr>
</tbody>
</table>

* $p < .05$
** $p < .02$
Table 14
Number of Reversers, Non-Reversers and Inconsistent Responders for the Form Groups of the Four Diagnostic Categories

<table>
<thead>
<tr>
<th></th>
<th>Process</th>
<th>Reactive</th>
<th>Brain Damaged</th>
<th>Control</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reversers</td>
<td>8</td>
<td>9</td>
<td>7</td>
<td>11</td>
<td>35</td>
</tr>
<tr>
<td>Non-Reversers</td>
<td>6</td>
<td>7</td>
<td>9</td>
<td>6</td>
<td>28</td>
</tr>
<tr>
<td>Inconsistent</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>17</td>
<td>17</td>
<td>17</td>
<td>68</td>
</tr>
</tbody>
</table>

\[ x^2 = 5.66 \]
\( df = 6 \)
Table 15

$X^2$ for Each Two Group Combination of the Form Groups of the Four Diagnostic Groups and Response Category (Reverser, Non-Reverser, and Inconsistent) with Non-Reverser and Inconsistent Separate (3x2) and Combined (2x2)

<table>
<thead>
<tr>
<th></th>
<th>Process</th>
<th>Reactive</th>
<th>Brain Damaged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reactive</td>
<td>3x2</td>
<td>1.14</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2x2</td>
<td>.12</td>
<td></td>
</tr>
<tr>
<td>Brain Damaged</td>
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<td>1.67</td>
<td>.50</td>
</tr>
<tr>
<td></td>
<td>2x2</td>
<td>.12</td>
<td>.47</td>
</tr>
<tr>
<td>Control</td>
<td>3x2</td>
<td>3.47</td>
<td>1.28</td>
</tr>
<tr>
<td></td>
<td>2x2</td>
<td>1.07</td>
<td>.49</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.49</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>1.89</td>
</tr>
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</table>
The distribution of reversers, non-reversers and inconsistent responders for the form and color groups of each diagnostic groups were also compared by chi square analyses. There was a significant difference for the reactive ($X^2=9.09, df=2, p<.02$) and brain damaged groups ($X^2=6.58, df=2, p<.05$), but not for the process ($X^2=.21, df=2, \text{NS}$) or control group ($X^2=2.40, df=2, \text{NS}$).

Table 16 shows the distribution of correct, incorrect and irrelevant verbalization for reversers, non-reversers and inconsistent responders. Verbalization given by inconsistent responders that were not irrelevant could not be classified as correct or incorrect. These nine Ss are shown between correct and incorrect in Table 15. In doing a chi square analysis the correct and incorrect categories were combined, yielding the total of 109 shown in Table 15. By combining categories, the nine inconsistent responders, who did not give irrelevant verbalization could be considered together. The chi square analysis of this distribution was significant ($X^2=6.85, df=2, p<.05$).

Table 17 shows the distribution of correct, incorrect, and irrelevant verbalization for the four diagnostic groups. The nine inconsistent responders whose verbalizations could not be classified have been excluded. A chi square analysis of this distribution was not significant ($X^2=4.68, df=6, \text{NS}$).
Table 16
Number of Subjects Giving Correct or Incorrect and Irrelevant Verbalizations for the Three Response Categories, Reversers, Non-Reversers and Inconsistent

<table>
<thead>
<tr>
<th>Category</th>
<th>Reversers</th>
<th>Non-Reversers</th>
<th>Inconsistent</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
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<td>30</td>
<td>9</td>
<td>109</td>
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<td>Incorrect</td>
<td>5</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrelevant</td>
<td>12</td>
<td>8</td>
<td>7</td>
<td>27</td>
</tr>
<tr>
<td>Total</td>
<td>80</td>
<td>40</td>
<td>16</td>
<td>136</td>
</tr>
</tbody>
</table>

\[ x^2 = 6.85 \]
\[ df = 2 \]
Table 17

Number of Subjects Giving Correct, Incorrect and Irrelevant Verbalizations for the Four Diagnostic Groups

<table>
<thead>
<tr>
<th></th>
<th>Process</th>
<th>Reactive</th>
<th>Brain Damaged</th>
<th>Control</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
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<td>24</td>
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<td>94</td>
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<td>3</td>
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</tr>
<tr>
<td>Irrelevant</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>2</td>
<td>26</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>29</strong></td>
<td><strong>33</strong></td>
<td><strong>33</strong></td>
<td><strong>32</strong></td>
<td><strong>127</strong></td>
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</tbody>
</table>

\[ x^2 = 4.68 \]
\[ df = 6 \]
Chapter IV
Discussion

There is some support for the principal hypotheses that the pathological groups would make fewer reversal shifts than the normal group, and that process schizophrenics would make fewer reversal shifts than the reactive schizophrenics. There were process-normal and process-reactive differences in the number of reversal shifts made with the process group making significantly fewer than both the normal and reactive groups. For subjects who initially learned a color concept, there were process-reactive and process-brain damaged differences in the number of reversal shifts made, again with process subjects making fewer reversal shifts. In addition, all three pathological groups differed from the control group on some of the other measures. Process schizophrenics took significantly more trials than normals to learn the initial concept. However, they did differ significantly from normals in the number of trials needed to learn the shift concept. The reactive schizophrenics and brain damaged subjects, on the other hand, did not differ from normals on the number of trials needed to learn the initial concept, but took significantly more trials to learn the shift concept. In addition, both the reactive and brain damaged groups, but not the process or control group, made significantly more reversal shifts when the initial concept was color, than when it was form. So when the groups were split on the basis of which concept was learned initially, color or form, in
the color group, the reactives, brain damaged and normal groups
made approximately the same number of reversal shifts, whereas
the process group made fewer reversal shifts than the brain dam-
aged group and significantly fewer reversal shifts than the re-
active and control groups. In the form group, on the other hand,
process, reactive and brain damaged subjects made approximately
the same number of reversal shifts while the control subjects made
slightly, but not significantly more reversal shifts, than the three
pathological groups.

It would appear that because of the process schizophrenics' un-
der-arousal inability to attend, they took significantly longer
to learn the initial concept and made significantly fewer reversal
shifts than the normal group. Whereas, it appears that the control
group made use of mediated cues thus enabling them to learn the
initial concept quickly and make reversal shifts, it appears that
the process group did not make use of any cues, mediated (e.g.
color) or cues as to the correct response (e.g. red). For the
process group there appears to be no transfer at all from Series I
to Series II. They do not respond as normal adults and make use
of mediated cues learned in Series I to assist them in Series II
nor do they respond as young children and animals in the single unit
manner described by Kendler and Kendler (1962) and make predomi-
nately non-reversal shifts. This latter type of subjects according
to the Kendler's do not make a mediated response, (e.g. color)
but instead respond only to the correct stimulus element (e.g.
Instead the process schizophrenic group responded to Series II as if it were a completely new task, and half respond to color and half to form irregardless of which concept was learned initially.

This interpretation also accounts for the process schizophrenics' poorer performance than normals on the initial learning, and the fact that they do as well as normals on shift learning. Assuming that the use of mediated cues facilitates learning in Series I, it would be expected that the process group show a deficit in Series I learning. Assuming further that making use of mediated cues not only increases attention to the relevant dimension, but also retards extinction to the originally correct response, it is possible that subjects who exhibit no transfer from Series I would learn Series II at approximately the same speed as subjects who mediate as result encounter both positive and negative transfer.

Where the process groups' performance, which was characterized by inattentiveness to the relevant stimuli can be understood in terms of under-arousal, the reactive and brain damaged groups difficulty in shifting can be understood in terms of over-arousal and perseveration. The reactivies learn the initial concept with little difficulty but because they are so aroused they cannot cease responding in that manner after the shift. The brain damaged subjects because of their cognitive rigidity are also unable to shift from the previously correct response. Hence where
normals have the attentiveness and flexibility to learn the initial response and to shift when the situation calls for it, the process subjects are so inattentive that they are so slow in learning the initial concept, and chose a new concept irrespective of the initial one, the reactive and brain damaged subjects are attentive enough to learn the initial concept, but get so fixed on it that they cannot learn a new concept.

Whereas reactive schizophrenics and brain damaged groups resembled normals in the number of subjects who made reversal shifts and differed from process schizophrenics in this regard when the initial concept learned was color, these groups' performance in this area more closely resembled that of the process group when the initial concept was form. Reactives made significantly more reversal shifts when the initial concept was color. The same was true for the brain damaged group, whereas there was no difference in this regard for the normal or process group.

Two explanations are offered concerning these findings. First, it is possible that the reactive and brain damaged subjects were attracted by color, which can be thought of as an affective stimulus. If this were the case than it would be expected that reactive and brain damage subjects would continue to respond to color when it was learned initially and would shift from form to color given the opportunity. This explanation is consistent with the theory that relative to normals process schizophrenics are emotionally flat and that reactive schizophrenics along with brain
damaged patients are emotionally aroused.

Second, it is possible that these results are due to the reactive and brain damaged subjects' ability to make an easy abstraction but not a more difficult one. In learning a correct form response in the present study, it was necessary to learn that the correct cue was one of two shapes (e.g. a square or a rectangle) as opposed to one of two other shapes (e.g. a circle or an ellipse). In learning a correct color response, it was necessary to learn that the correct cue was either red or blue. Hence for these subjects, learning red may have made it easier to learn its opposite, blue. However, with the form concept, the opposite was not suggested as easily. Hence, when color was learned, it was possible to learn its opposite. When form was initially learned, these subjects did not learn, an opposite in the shift learning rather learned a new concept, which half the time was color and the other half of the time was form. This pattern was not exhibited by the process group since they did not respond in Series II in a manner at all based on learning in Series I. The normal group on the other hand was able to make the more difficult abstraction needed to make a reversal shift when the initial concept was form.

In order to determine which of these hypotheses is correct it would be necessary to conduct a study in which color were the more difficult abstraction. The first hypothesis would predict the same color-form differences that were found in the present
study, whereas the second hypothesis would predict that these results be reversed.

The other significant results on the correlations and contingency coefficients are of little importance. The fact that only 4 of 45 were significant makes interpretation of the significant ones a questionable procedure. However, the significant positive relationship between age and initial learning for the brain damaged group probably reflects greater impairment in older brain damaged subjects. The significant relationship between type of shift and information scores is slight, and the fact that the t test comparing the reversers and inconsistent responders was significant indicates only a weak relationship between intelligence and type of shift, with reversers showing slightly greater intelligence.
Chapter V
Summary

Process and reactive schizophrenics, brain damaged patients, and normal controls were compared on an optional shift task, in which they could either make a reversal or a non-reversal shift. It was hypothesized that the three pathological groups would differ from normals in that they would make fewer reversal shifts. This prediction was verified for the process group. It was further predicted that process schizophrenics would make fewer reversal shifts than the reactive schizophrenics. This prediction was also confirmed. It was also found that process schizophrenics took more trials than normals to learn the initial concept, and reactive and brain damaged subjects required more trials than normals to learn the shift concept. These results were discussed in terms of under-arousal and inability to make use of relevant cues in the process group, over-arousal in the reactive group, and perseveration in the brain damaged group. Differences between type of shift chosen and type of initial concept learned, color or form, for the reactive and brain damaged groups were discussed in terms of response to affective stimuli and in terms of differing levels of abstraction required in learning the opposite of a shape concept and learning the opposite of a color concept.
Appendix A
### Contingency Table for Response Category and Age for All Groups Combined

<table>
<thead>
<tr>
<th>Age</th>
<th>17-29</th>
<th>30-39</th>
<th>40-45</th>
<th>46-49</th>
<th>50-59</th>
<th>60-79</th>
<th>Total</th>
</tr>
</thead>
<tbody>
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<td>19</td>
<td>12</td>
<td>18</td>
<td>7</td>
<td>80</td>
</tr>
<tr>
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<td>11</td>
<td>8</td>
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<td>3</td>
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Contingency Table for Response Category and Information Raw Scores for All Groups Combined

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Contingency Table for Response Category and Education for All Groups Combined

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Contingency Table for Response Category and Age for Process Group

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### Contingency Table for Response Category and Information Raw Scores for Process Group

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Contingency Table for Response Category and Education for Process Group

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Contingency Table for Response Category and Age for Reactive Group

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## Contingency Table for Response Category and Information Raw Scores for Reactive Group

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<td>1</td>
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</tr>
<tr>
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Contingency Table for Response Category and Information Raw Scores for Brain Damaged Group

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<td>20</td>
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### Contingency Table for Response Category and Education for Brain Damaged Group

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## Contingency Table for Response Category and Information Raw Scores for Control Group

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The Dissertation submitted by Gerald S. O'Keefe has been read and approved by members of the Department of Psychology.

The final copies have been examined by the director of the Dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the Dissertation is now given final approval with reference to content and form.

The Dissertation is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

Date: 1/14/72

Signature of Advisor: William A. Hunt