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DEVIAN'T DISCRIMINATION LEARNING IN ADOLESCENT PSYCHIATRIC PATIENTS AND THEIR MOTHERS: A MODEL OF ATTENTION DYSFUNCTION IN PSYCHOPATHOLOGY

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

By
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* * * * *

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1981

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Attention dysfunction has long been considered to be a characteristic correlate of schizophrenic pathology. However the status of attention dysfunction as a pathognomonic symptom seems to rest on tradition, Kraepelin's and Bleuler's nosologies, and clinical observation rather than on any single theoretical conceptualization. Clinical psychology and psychiatry are not wholly to blame for the resulting muddle however, since psychology as a whole seems unable to agree on a definition of attention. As it is commonly employed, attention does not seem to be a unitary construct, but to include at least two component constructs; vigilance and selective attention. One result of this conceptual ambiguity is that the available methods for assessing attentional functioning in normal populations are diverse and often unrelated to each other.

The approach to assessment of attention in clinical populations is of course, no more orderly. For example, Kopfstein and Neale (1972) demonstrated very low levels of shared variance among five attentional assessment procedures, highlighting the multidimensional nature of the construct. The resulting "shot-gun" approach to the empirical demonstration of attention dysfunction in schizophrenic subjects has produced a large body of data, but has not yielded any
The aims of this paper are threefold: first, to propose a model of (selective) attention and of attention pathology, secondly to explore ways in which the existing data support such a model, and finally, to present new data demonstrating the relevance of the model to explanations of attention pathology.

**Discrimination Learning**

A rather large body of data exists on the developmental changes, both phylogenetic and ontogenetic, associated with discrimination learning tasks. Although discrimination learning paradigms have only rarely been used to assess attention dysfunction in clinical populations, they do have several unique advantages over more traditional assessment measures. The experimental paradigm has a large theoretical and empirical literature (employing both human and animal populations) associated with it. It is the only attentional assessment procedure which has addressed developmental issues. Finally, the within subjects nature of the discrimination shift paradigm is well suited to the demonstration of a differential deficit since relative as well as absolute speed of shifting is available for analysis.

In its simplest form the discrimination learning problem presents the subject with two different stimuli, one of which is paired with a reinforcer the other of which is not. When the organism consistently responds to the positive stimulus and consistently avoids responding to the negative stimulus it is said to have learned the discrimination. At this point, exact specification of what has been
learned is impossible although a considerable amount of data indicate that subjects are learning to select a stimulus and not simply to make a response (Kendler & Kendler, 1962). The data from subsequent related discrimination problems may be used to illuminate this process of stimulus selection. The subject's speed of learning three different variations, a reversal, intradimensional, and an extradimensional shift, is of interest for this purpose.

Suppose the subject is confronted with a two-choice simultaneous discrimination problem. The subject's task is to choose between two objects which vary on two dimensions. One dimension, for example color, is relevant and one of the values on that dimension is the positive stimulus, while the other value is associated with nonreinforcement. The other dimension on which the stimuli vary, for example form, is also represented by two stimulus values, but they are both randomly associated with reinforcement, and this dimension is irrelevant to solution of the problem. A solution to this original learning problem might be for example that the "red" stimulus is always the correct stimulus. On the succeeding shift problem the subject must select the new "correct" stimulus from the same two pairs of stimuli varying in both color and form. In a reversal shift problem, the originally relevant dimension remains relevant, but the previously unreinforced value on that dimension becomes the correct or reinforced stimulus. Continuing the example from above, in a reversal shift problem the "green" stimulus would become the new correct choice. In an extradimensional shift one of the two values on the previously irrelevant form dimension, would become
the correct stimulus. A further elaboration of this basic design provides a third possible type of shift; the intradimensional shift. In an intradimensional shift the originally relevant dimension, color in this example, remains relevant, but the subject must select between two novel stimulus values, say blue and yellow, on that dimension.

As was mentioned previously, there are ontogenetic and phylogenetic differences in the relative speed of solution of these three shift problems which, it can be argued, reflect the utilization of different problem solving styles by subjects. Animals and low MA human subjects, (e.g., very young children and retardates) demonstrate faster extradimensional than reversal shifting when number of trials to criterion is the index of speed of learning (Kendler, Kendler, & Wells, 1960; Tighe & Tighe, 1967; Sanders, 1971). Human subjects from about a three to five year-old level exhibit the opposite pattern; performing the reversal shift more quickly than the extradimensional shift (Kendler & Kendler, 1962). Beginning at this age level, accompanying the developmental increases in reversal shift facilitation, is a concomitant decrease in the speed of the extradimensional shift. However, with further increases in subject MA the magnitude of the discrepancy between speed of the reversal and extradimensional shifts decreases and the "mature" subject ultimately performs all the shift problems within a very few trials. This maximally efficient learning style has been referred to as an hypothesis-testing or hypothesis generating style (e.g., Trabasso & Bower, 1968).
Studies of developmental changes in problem solving styles employing paradigms other than the discrimination shift learning task generally identify similar style changes. Weir (1964) was able to differentiate between three developmental levels based on group performances which seem to correspond to the discrimination shift findings. The task he used required subjects to select from among three knobs on a panel. Correct responses were reinforced. Two of the knobs never paid off. The third did, but reinforcement was delivered on a VR schedule. Weir reported a U shaped relationship between age and terminal level of correct response, defined as the solution which would yield the greatest reinforcement (though there was no solution which would yield 100% reinforcement). Subjects at each end of the age distribution, the three year olds, five year olds, and the college students, showed similar levels of performance, while subjects in the middle of the age distribution showed significantly lower levels of correct responding after eighty trials. Weir argued that these results support the Kendler's mediation model and that the obtained differences reflect: "...differential growth of the ability to generate hypotheses, employ strategies, and the ability to process information subjects gain from their own responding" (p. 471).

Druker and Hagen (1969) investigated the role of perceptual discrimination in the development of the ability to process information selectively. They found that while central recall scores did increase with age, incidental (irrelevant) recall scores declined with age. From these data they concluded that the older subjects
(subjects ranged in grade level from the fourth through the eighth grades) were better able to employ certain information processing skills in order to focus their concentration on task-relevant information, but only at a cost of reduced attention to "irrelevant" information.

Although the ontogenetic and phylogenetic differences in discrimination shift behavior are highly reliable, several quite different models have been proposed to account for them. The Kendlers (1962, 1970) have suggested that subject's utilization of mediation, verbal or otherwise, produces the reversal shift facilitation. Zeaman (Zeaman & House, 1963, 1974; Fisher & Zeaman, 1973) has proposed that developmental changes in learning and extinction rate parameters, and within subject parameter differences produce the same reversal shift facilitation effect. Sutherland and Mackintosh (1971) have argued that the "firmness" with which a dimensional analyzer is switched in mediates the relative speed of shifting and they have produced reversal shift facilitation in rats by manipulating variables that should strengthen such analyzers. Note that all theories, though they differ in the hypothesized mechanism, e.g., verbal mediation or dimensional analyzer, agree that reversal shift facilitation can only result from differentially greater positive transfer of the covert than the instrumental response.

The model of attention being proposed in this paper shares assumptions with all of these theories. It is a chaining model, which implies that both an overt instrumental and a covert dimensional response are acquired in reaching solution and that these two
responses may have differential acquisition and extinction rates. Conceptually, it is most similar to the Zeaman models, but there is a crucial distinction. For example, the Fisher and Zeaman model (1973) arbitrarily assigns the parameter values to fit the theory to pre-existing data. The model being offered here makes an a priori assumption that breadth of attention is a crucial mediating variable which in turn determines the learning rate parameters. Rather than hypothesizing developmental (and discontinuous) changes in parameter values, the breadth of attention model suggests that it is changes in the amount of information to which the organism is capable of attending and processing simultaneously which correspond to the empirically obtained developmental changes in speed of shifting.

The conception of breadth of attention proposed here incorporates a distinction that has been addressed in earlier theoretical models as a distinction between single vs. multiple looking. The issue is whether, on a given trial, the organism's attention to only a single dimension is strengthened or weakened, or whether s/he simultaneously processes information about more than one dimension. The original proposal by Zeaman and House (1963) was a "one-look" model. A one-look model has the obvious advantage of being conceptually much simpler and it generates the corresponding statistical simulations (stat-children or stat-rats) much more conveniently. Unfortunately, later studies (e.g., Fisher et al., 1969; Campione & Wentworth, 1969) have given strong indication that one-look models are incapable of accounting for a substantial portion of the discrimination shift learning data. These findings led Fisher and Zeaman
(1973) to propose a multiple-look model. (They emphasize that the one-look model may be viewed as a special instance or parameter value of the more general multi-look model.)

The model employed throughout this paper asserts that the discrimination shift learning performance of low MA subjects is best characterized by a one-look model. Assuming that the probability of attending to all available dimensions must sum to one, then in a one-look model the subject either attends to the dimension, in which case \( p = 1.0 \), or does not, in which case \( p = 0 \). No intermediate probability values are possible. When this model is applicable, there should be no reversal shift facilitation since following the first trial of the reversal shift problem, a nonreinforced trial, the subject's probability of continuing to attend to that dimension goes to zero.

Reversal shift facilitation (and impaired extradimensional shift performance) is however mandated by the assumptions of the multi-look model. In this model dimensional probability values must also sum to one. However obviously, the dimension with the strongest probability value will determine the instrumental response. Note that this probability value need not be one, and at least in the early stages of learning, may be considerably less than one. Consider next, the effect of the first non-reinforced trial of the reversal shift. The probability value of the relevant dimension is decremented and the value of all the other attended dimensions incremented, but since this increment is divided between multiple dimensions the net result is that no single dimension gains
ascendancy. Thus, multiple-looking itself, makes the relative strengths in the probability values of the covert dimensions slow to change and results in both reversal shift facilitation and slower extradimensional shift performance. In the present model it is assumed that multiple-looking becomes characteristic of subjects from the three-to-five MA level.

The developmental changes in the speed of the reversal and the extradimensional shifts that have consistently been obtained are clearly compatible with the proposed model of attention. It is however, also true that the extradimensional shifts do not become "limitlessly" more difficult with the increasing mental age of the subject. In fact, ultimately all the shift problems are learned very rapidly. This latter performance pattern corresponds to a third developmental phase of discrimination learning style: the hypothesis testing or generating stage. As it is construed in the present model, this stage presupposes multiple-looking at its most sophisticated and efficient. When criterion learning on all the shift problems occurs within three to four trials it probably is no longer reasonable to theorize about acquisition and extinction rate parameters for the covert and overt responses. Learning is simply occurring too quickly to be adequately characterized by a process of gradual strengthening or weakening of these responses. Rather, in the hypothesis testing phase, the information which the subject gathers as the result of feedback after every trial is not used simply to confirm or disconfirm a specific (dimensional and instrumental response) hypothesis, but is being used as a tool for data gathering. The group of
hypotheses being considered at any one time is dependent upon and limited to the dimensions which are simultaneously perceived and attended to by the subject. In this phase, reinforcement not only directly strengthens or weakens both the covert and overt responses, but also serves to focus the hypotheses being considered (Trabasso & Bower, 1968) and to eliminate irrelevant hypotheses.

Attention Dysfunction

If one accepts the three-phase developmental model of normal discrimination shift learning argued for here, in which attention and more specifically breadth of attention is presumed to be a crucial variable, one might next question the applicability of this model to pathological disturbances in attention. In attempting to account for the diverse clinical symptomatology he observed in dementia praecox, Bleuler (1911) argued that the multiple forms by which the disorder might be expressed all shared a single common symptom, the only symptom which was both fundamental and primary. This basic symptom was the disturbance of association. A variety of theoretical perspectives on the etiology of the disorder agree that disruptions of attention and associative processes are the sine qua non for this disorder. However, attempts to operationally define these theoretical constructs have employed quite diverse techniques and methodologies.

Studies by Kopfstein and Neale (1972) and Asarnow et al. (1977) have demonstrated very low intercorrelations between tasks used to assess attentional processes. In considering this literature it should be stressed again that although studies may purport to
investigate and describe attention dysfunction in schizophrenic popu-
lations, the meaning of attention must be inferred from the tasks
that the experimenter selects. Reaction time tasks, object sorting
tasks, proverb interpretation tasks, size estimation tasks, continu-
ous performance tasks, dichotic listening tasks, and the Stroop Color
Word Test among other measures have been used to assess attentional
functioning in schizophrenic and high-risk populations. Kopfstein
and Neale (1972) investigated the correlations among a reaction time
task, a size estimation task, a proverbs task, an object-sorting
task, and an (auditory) vigilance task, using both schizophrenic and
nonschizophrenic subjects. They concluded:

   It is clear from the correlational data
   that the tasks employed in the present inves-
   tigation share little common variance.
   Therefore, in contrast to what has become a
   common assumption, these data suggest that
   performance on these tasks cannot be subsumed
   by a general attention construct. (p. 297)

They further suggest that the distinction between attention as
a selective process and attention as maintenance of alertness or
vigilance is probably an important one, too often ignored.

   Clearly, the discrimination shift learning tasks are primarily
   concerned with the first aspect or attention as a selective process.
   In many of the other tasks these two factors seem to be quite con-
   founded. As Garmezy (1980) has noted, this definitional confusion
   has long been recognized as problematic, E.G. Boring planned to
   review the history of the experimental study of attention and,
   according to Garmezy, his outline had cited "ten little overlapping
   histories." Unfortunately, Boring died before completing his
historical analysis.

For these reasons alone it should not be surprising that as diverse as the assessment strategies are, the theories used to account for the frequently obtained "pathological" differences are even more so. Vigotsky (1934), Hanfman and Kasanin (1942), Goldstein (1959), McGaughan and Moran (1956), and Tutco and Spence (1963), among others addressed the issue of the "abstractness" or "concreteness" of schizophrenic's concepts. Others: Gorham (1956), Blaufarb (1962), and Hamlin, Haywood, and Folsom (1965), have attempted to extrapolate from these performance-based measures of concept formation to examine the phenomenon of concept formation in verbal tasks such as proverb interpretation. In general, all these studies found that while it was true that some schizophrenics were more "concrete" than normal subjects, this pattern was most characteristic of the chronic or process schizophrenics. The acute or reactive schizophrenics often differed from the normal subjects in a direction opposite that of the chronic schizophrenics. For example, Tutco and Spence found that process schizophrenics as a group made more "restrictive" errors on their concept sorting task, while the reactive schizophrenics made more "expansive" errors, but did not differ from normals in the number of restrictive errors that they made.

Unfortunately many of the more recent studies which have addressed these same issues were methodological challenges to the earlier reports and offered fairly convincing evidence that many of the earlier results may have been experimental artifacts.
Methodological criticisms have particularly stressed the need to demonstrate a differential deficit in a schizophrenic population as an essential prerequisite to offering an elaborate theoretical rationale for the relationship between the deficit and schizophrenic pathology.

Both Cameron (1938, 1939) and Chapman (1956) essentially argued that these early data, rather than reflecting a loss of the abstract capacity in schizophrenic subjects, reflected the schizophrenic's excessive yielding to normal stimulus-selection biases. They both suggested that the schizophrenic subject is unable to sort on the basis of an abstract dimension only when that dimension is not his/her "preferred" dimension. More recently Chapman (1979) has referred to this tendency as excessive distractibility in schizophrenics.

McGhie and Chapman (1961) also considered the relationship between early schizophrenia and disorders of attention. They employed a rather unique strategy to document and describe this relationship. They asked schizophrenic patients to describe their experiences and included statements by patients in their article.

I can't concentrate. Its diversion of attention that troubles me. I am picking up different conversations. Its like being a transmitter. The sounds are coming through to me, but I feel my mind cannot cope with everything. Its difficult to concentrate on any one sound. Its like trying to do two or three different things at the same time. (p. 51)

Whether the inappropriate responses of schizophrenics are the result of their being stimulus bound or concrete or whether they reflect the schizophrenic's inability to inhibit responses to
distracting stimuli, clearly attention is the major cognitive process that directs the choice of both stimulus and response. The research which focuses directly on elucidation and description of the attentional deficit associated with schizophrenia can generally be placed into one of two major orientations. The first includes those theories which account for the production of inappropriate responses as the result of a constriction of the range or breadth of attention, e.g., Venables (1964), Broen (1966). The second includes those theories which propose a breakdown in the filter mechanism or a failure of the ability to disattend to stimuli, in short a breakdown in selective attention.

Selective attention refers to the process by which information from a source or of a kind is chosen over other information or as Schneider (1976) phrased it: "...the process by which an individual maintains heightened awareness of a limited range of stimuli."

In 1958 Broadbent proposed a model to account for this selective process. Specifically, he proposed the existence of a filter mechanism to screen out irrelevant stimuli, a process necessitated by the limited capacity of what he called the "P system," which is probably equivalent to short term memory. Additionally, he suggested that this filter may be tuned to different information channels (or sensory channels). Broadbent referred to this as the "Filter Theory." Studies by McGhie and his colleagues (McGhie & Chapman, 1961; Lawson, McGhie, & Chapman, 1964) have suggested that the attentional dysfunction in schizophrenia may be characterized as a breakdown in this filtering mechanism. Studies pursuing this line of
research may be broadly grouped under the label of distractability studies.

The earliest studies focused on patients' performance on speed tests involving a motor response (Chapman & McGhie, 1962; McGhie, Chapman, & Lawson, 1965). These studies indicated that the performance of schizophrenics was significantly more impaired in the presence of distractors than was the performance of either normal or other psychiatric patient groups. Other investigators (Shakow, 1950, 1962; Sutton et al., 1961) also demonstrated the detrimental effects of the presence of distractors on motor tasks with schizophrenic subjects.

Oltmanns and Neale (1975) studied the effect of auditory distractors on a digit span task. In the nondistractor condition subjects heard a series of digits and were asked to write them down at the end of the series. In the distractor condition a second voice read irrelevant digits. Importantly, Oltmanns and Neale matched these two tasks on difficulty by varying list length and were therefore able to demonstrate a differential deficit in the schizophrenic's performance; the schizophrenics were more affected by distractors than by list length. In a more recent study Oltmanns, Ohayon, and Neale (1978) investigated the effects of withdrawal from neuroleptics on schizophrenic performance on this task. They found that although drug withdrawal did not affect performance in the non-distractor condition, it significantly impaired performance in the distractor condition.
As the result of their clinical observation of schizophrenic patients, McGhie and Chapman (1970) speculated that this same breakdown in the filtering mechanism accounted for the expressed language difficulties of these patients. "When people talk to me it's like a different kind of language. It's too much to hold all at once. My head is overloaded and I can't understand what they say" (p. 12).

Lawson, McGhie and Chapman (1964) investigated this speculation. The task they used had been developed for linguistic studies of normal subjects and used the fact that redundancy in normal speech reduces information processing demands and enables the subject to organize speech into smaller phrase units. Presumably, if McGhie's hypothesis is correct, schizophrenics are unable to profit from this redundancy and the processing demands overload the system. Miller and Selfride (1950) had found that the ability of normal subjects to recall passages was strongly positively correlated with the degree of contextual constraint present. Lawson et al. used the same design, strengthened by the potential for demonstration of a differential deficit, to demonstrate that under conditions of low contextual constraint, schizophrenic subjects performed as well as normals. However, increased contextual constraint facilitated the performance of the normal subjects, but not the performance of the schizophrenic subjects. In addition, Lawson (1965) noted a high significant positive correlation between poor performance on this task and high distractability on the reaction-time tasks mentioned above. (Lawson however, found a negative correlation between ratings of paranoid symptoms and distractability scores.)
Cameron (1938, 1939) in arguing against Goldstein's theory of loss of the abstract attitude, first referred to the "over-inclusiveness" of schizophrenic thinking. This theory can be viewed as the cognitive adjunct to the studies of motor performance cited above. Payne and his colleagues (Payne, 1966; Payne & Hewlett, 1960) investigated the relationship between overinclusive thinking and tachistoscopic performance. Theorizing that overinclusive individuals have a widened span of attention, they speculated that schizophrenics should be able to identify target stimuli under shorter exposure times than would normals. Payne measured overinclusiveness on a variety of tasks, including such diverse tasks as object-sorting tasks and a proverb word count. (Unfortunately these measures did not intercorrelate highly.) Payne (1966) reported a strong positive correlation (.90) between speed of identification and his measure of overinclusiveness, but concluded that overinclusive thinking is characteristic of only a subgroup of schizophrenic patients; the paranoid individuals.

Weckowitz (1960) reported that schizophrenic patients performed less adequately on a hidden figures test than nonschizophrenic patients, presumably reflecting an inability to disregard irrelevant information. Chapman (1956) reported that on a card sorting test of concept formation, schizophrenics sorted significantly more frequently on the basis of distractors than did normal subjects. Silverman's (1964) finding of inferior performance by schizophrenic subjects on perceptual matching tasks (size constancy) also might be considered to be supportive of the distractability hypothesis since accurate
matching depends on the subject's selective disregard of certain prominent stimuli. Johansen et al. (1963) investigated depth perception in schizophrenic patients and concluded that the chronic patients made significantly more errors than either the acute patients or normal controls, and that acute patients made very few errors. It should be noted that the effects of the distractability factor have been exacerbated or attenuated by manipulations of the number of stimuli which must be attended to, the number of relevant sensory channels, or the perceptual salience of the relevant stimuli.

In contrast to theories which state or imply that the information processing of at least a subgroup of schizophrenic patients may be characterized by an increased breadth of attention and/or an inability to disregard irrelevant stimuli, are the theories of Venables (1964) and Broen (1966).

Venables (1977) distinguished between the attentional processes of the acute schizophrenic, which he believed to be characterized by excessive breadth and distractability, and those of the chronic schizophrenic, which he suggested are characterized by a constriction or narrowing of attention as the result of cortical arousal. Venables cited a large body of data demonstrating that in normal subjects:

...narrowing of attention occurs under conditions which may be loosely classed as arousing, that is under conditions that might be considered to produce alert EEG or to evoke sympathetic discharge. (p. 13)

To gather support for his hypothesis, Venables tested a group of schizophrenic patients for critical flicker thresholds as a measure
of cortical arousal. He then had the group perform a series of five card sorts. The subject's task was to sort cards, each of which had nine capital letters in random locations, into two piles, cards with a "B" and cards with a "Z" present among the letters. The first four trials of this task used identical stimuli, however on the fifth trial the irrelevant letters on the card were changed. Venables plotted the regression line from a subject's performance on the first four trials to produce a point estimate of the expected speed of the fifth sort. To the extent that the fifth sort was slower than this estimate, the subject had demonstrated distractability. Venables found that subjects who demonstrated high cortical arousal showed little distraction on this task, while those with lower cortical responsivity did demonstrate distractability on the fifth sort. Corroborating conclusions were drawn by Lang and Buss (1965), Buss and Lang (1966), and Chapman (1973), all of whom reviewed the physiological data. All three suggested that on a variety of measures of arousal, including cortical arousal, autonomic arousal and neuromuscular arousal, chronic schizophrenics demonstrate heightened arousal.

According to Chapman (1973), Broen developed his response disorganization theory out of his attempt to incorporate all of the "well established, but contradictory" findings on breadth of attention. There were two major areas where discrepancies had been noted. Payne's (1962) finding that acute, but not chronic schizophrenics were overinclusive and Chapman's (1961) conclusion from his research that it was the chronic and not the acute schizophrenics who were
overinclusive, constituted the first area of disagreement. The second contradiction was between Venable's (1966) finding, cited above, that chronic, but not acute schizophrenics demonstrated a narrowed span of attention and Chapman's (1966) report of heightened distractability in a chronic population.

Basically, Broen used a Hull-Spence model to propose that heightened drive in schizophrenic subjects produces a flattening of the response hierarchies which leads to response disorganization. This response disorganization is expressed behaviorally as a loss of "focusing responses" or not being able to attend to one stimulus more than another. Broen proposed that the narrowing of attention observed in chronic patients is the result of their reaction to such an initial process and additionally, that the narrowed range includes only those stimuli which are most salient to all subjects. Consequently, a schizophrenic "deficit" should be observed in studies in which the appropriate stimulus is not the most salient stimulus. Since chronic schizophrenic subjects have restricted their attention to these stimuli, they should appear to be responding to the distractors when the distractors are the most salient stimuli. In a recent reformulation of this theory (Broen & Storms, 1977) Broen substituted the term arousal for drive, to imply a state of diffuse excitation as well as the usual physiological concomitants. The collapse of the schizophrenic's response hierarchies which Broen and Storms implicate in schizophrenic cognitive dysfunction is presumed by them to result from the multiplicative relationship between high arousal and a lowered ceiling habit strength of the dominant
response, making the difference in strength between the dominant and the competing responses smaller than it is in normal subjects. Broen (1977) cited data from a variety of studies that support this hypothesis of the collapse of response hierarchies in schizophrenics (Gottesman & Chapman, 1960; Chapman, 1958, 1961; Chapman & Taylor, 1957; Fey, 1951). In a study which is representative of this group, Gottesman (1964) had schizophrenic and normal subjects complete a pencil and paper word association task. There were three possible responses to each stimulus word: the dominant normal adult associate, the dominant normal child associate, and an irrelevant response. Presumably the strength of both the adult associate and the child associate would be appreciable, while the strength of the irrelevant response should be negligible. If in fact, schizophrenics do experience a flattening of their response hierarchies, they should exhibit an increased number of responses to the child associate, but not to the irrelevant associate. Gottesman obtained just such an effect. The schizophrenic subjects chose the irrelevant word an average of 1.88 times, the adult associate an average of 23.44 times, and the child associate an average of 25.00 times (note the near equivalence of the last two categories). The normal subjects chose the irrelevant, adult, and child associates an average of 1.31, 31.75, and 18.56 times, respectively. Broen and Storms (1977) suggest that schizophrenic patients learn to restrict their attention in response to the collapse of response hierarchies and the resulting disorganization. As clinical evidence in support of this pattern they offer a quotation from one of McGhie's (1970) patients.
My concentration is very poor. I jump from one thing to another. If I am talking to someone they need only to cross their legs or scratch their head and I am distracted and forget what I am saying. I think I could concentrate better with my eyes shut. (p. 250)

Broen and Storms hypothesized that since this habit of restructuring attention would take time to develop, it should be observed in chronic patients, but would not be apparent in acute patients.

In a study done in 1972 Broen and Nakamura obtained additional empirical data in support of the hypothesis of narrowed attention in chronic schizophrenics. They used a signal detection task, in which the task of the subject was to identify during which of two intervals a tone stimulus had been presented. The subject was simultaneously engaged in a tracking task with a pursuit rotor. The two experimental conditions varied the relative importance assigned to these tasks in the experimenter's initial instructions to the subjects. As anticipated, when the importance of identifying the tone was emphasized, chronic nonparanoid schizophrenic patients were able to do so about 77% of the time. However, when the instructions emphasized the tracking task, these patients correctly identified the tone interval only about 60% of the time. Acute patients were correct 75% of the time under both conditions. Thus it appears the ability to attend to more than one channel simultaneously was significantly impaired in the chronic nonparanoid patients. In a 1973 paper Broen cited research by Feeney that demonstrated a significant dual-modality deficit in chronic schizophrenics using a reaction time task. Acute schizophrenics once again did not demonstrate this
pattern.

Somewhat tangentially related to this same issue, Harrow et al. (1973) offered longitudinal data on the object sorting performance of 74 schizophrenic patients. When tested on admission, Harrow reported that these individuals demonstrated conceptual overinclusion. Eleven months later on reassessment, clinical improvement seemed to be associated with a decrease in overinclusion on the object sorting task.

To summarize, it seems clear from a large and diverse body of empirical data that schizophrenics exhibit some type of attentional dysfunction. In acute patients this dysfunction is perhaps best characterized as "distractability" or loss of the ability to focus attention. Chronic patients, however, probably in response to this early confusion and disorganization, generally demonstrate a narrowing of breadth of attention with respect both to sensory channels and number of stimuli that they are able to attend to simultaneously. The three types of tasks which have commonly been used to explore this phenomenon are: word association tasks, reaction time tasks, and object sorting tasks.

At this point the relevance of the discrimination learning literature and methodology to the study of attention dysfunction in schizophrenia should be apparent. Both the loss of the focusing capability and narrowing breadth of attention should theoretically be associated with characteristic patterns of responding on the discrimination shift tasks.
For example, if acute schizophrenics experience loss of their focusing capability (Broen & Storms, 1977), but normal breadth of attention is preserved, one would hypothesize that since this group does not use an efficient hypothesis testing strategy, learning in the preshift as well as on the extradimensional shift would be slower than that observed with normal populations. Relative to the extradimensional shift, the reversal shift would be faster, since attention to the relevant dimension is the dominant response as the result of original learning. The extradimensional shift would be slow since once the dominant attention response has been extinguished, the subject is unable to use systematic testing strategies, and stimulus compounds and components as well as idiosyncratic responses such as positional choice may be at equivalent strength. In other words, at this stage, the perceptual processes of the individual (breadth of attention) remain intact, but the central processing capacity or the individual's ability to superimpose cognitive strategies to organize the available information is impaired. This impairment is chiefly reflected in a reduction of the efficiency with which the subject is able to choose a new response from among alternatives.

On the other hand, Broen and Storms propose that in at least some schizophrenic patients, probably chronic, nonparanoid individuals, a narrowed range of attention can be identified. In terms of the model proposed earlier, this effect would seem to correspond to the developmentally early process of discrimination learning best explained by a one-look model. Since the subject for whom this model is appropriate only attends to a single dimension on each trial, the
probability of the relevant observing response occurring can only be zero or one on any single trial. In this model there is no basis for predicting reversal shift facilitation and the extradimensional shift should be performed more easily than under conditions of the multi-look model.

Although the theoretical model that he uses to account for the performance of schizophrenics is different from the one presented in this paper, Nolan (1968, 1970, 1974) presented data from applications of the discrimination shift methodology to schizophrenic populations. In an early study (1968), he found that while normal adult subjects perform reversal shifts more quickly than extradimensional shifts, schizophrenic subjects did not demonstrate this same reversal shift facilitation (the speed of the reversal and extradimensional shifts were not significantly different in this group of individuals). According to Nolan (1968) this result may reflect a weak dimensional attention response, a learning disability under partial reinforcement conditions, or a perseverative response pattern. Certainly all of these explanations have some validity when considered with respect to schizophrenic's characteristic performance on other tasks.

In capitalizing on the within-subjects design possibilities of the discrimination shift learning tasks, Nolan (1974) identified three deviant types of response patterns in his schizophrenic subjects. The performance of the first group of subjects simply reflected a weak attention response. This response could presumably be strengthened under overtraining conditions. A second group of subjects did demonstrate reversal facilitation, but performed the
extradimensional shift very slowly. This group according to Nolan, has an adequate attention response, but is unable to utilize efficient hypothesis testing strategies (and may correspond to the hypothetical acute individual described above). The final group Nolan identified may or may not demonstrate an adequate attention response, but is best characterized by their inability to respond to old stimuli in a new way. Both reversal shifts and, where the same stimuli are used, the changed extradimensional subproblem should be quite difficult for this group. Nolan cautions however, that attention deficits are not characteristic of all schizophrenics. Sixty-one percent of the subjects in one study, Nolan (1974), were not classified as attention deficient. Nolan's subjects appeared to be primarily chronic, but did include a significant proportion of paranoid individuals.

The application of Broen and Storms' model to discrimination shift learning task performance yields the following theoretical predictions and explanation of schizophrenic performance on these tasks. Through response disorganization, perhaps due to both higher arousal states and lowered ceiling levels for habit strength, the acute schizophrenic patient loses his capacity for focusing, or in attention language, the ability to utilize efficient hypothesis testing strategies. The attentional model which is relevant at this stage is a multi-look model which does not include hypothesis testing. From both theory and existing developmental data, it can be predicted that the individual who has lost his organizing strategies, but is still able to perceive and learn about more than one
dimension simultaneously, will continue to demonstrate reversal shift facilitation. In a multi-look model if one assumes that each dimension is associated with some probability of being observed (attended to) and one assumes that the probability values for all the observing responses must sum to one, then the reason for the positive transfer effect on the reversal shift becomes apparent. In pre-shift learning the observing response to the relevant dimension is strengthened each time outcome expectancies are met and all the irrelevant observing responses are simultaneously decremented by an identical amount. At the start of shift training, outcome expectancies are violated, the relevant observing response is decremented and the irrelevant observing responses are incremented, but the total increment must be divided among these irrelevant dimensions. The net effect is that the observing response is slow to change in a multi-look model. (The fact that the observing response has been learned under conditions of partial reinforcement also contributes to the differential extinction rates of the observing and instrumental responses.) To the extent that overlearning strengthens the dominant attention response, it should facilitate reversal, but at a cost of retarding the extradimensional shift performance. Nolan (1970) reported this effect when schizophrenics were given fifteen overtraining trials after reaching criterion on the preshift problem. It is difficult to see how partial reinforcement accounts of the differential extinction rates of the observing and instrumental response can account for this effect. Mackintosh (1962) obtained this same effect with overtraining of the preshift response in rats.
and hypothesized that it was due to the observing response, or analyzer as he termed it, being more firmly switched in.)

As applied to schizophrenic subjects, the proposed theory would suggest that overtraining would produce reversal facilitation as long as the attention response is not approaching the ceiling level. However, by increasing drive (for example, through aversive conditioning), the collapse of the response hierarchies and response disorganization which Broen and Storms postulate should occur, would consequently reduce reversal facilitation, even under conditions where an overlearning reversal effect would otherwise be expected. (The rationale for this prediction is based on Broen and Storms' assumption of a multiplicative relationship between habit strength and drive or arousal. Therefore increases in either habit strength or drive may increase response strengths to the point where they approach the hypothesized lowered ceiling levels in schizophrenics and produce flattening of the response hierarchy resulting in response disorganization.) Nolan and Anderson (1973) reported data completely consistent with this prediction. Under aversive feedback conditions, neither 15 nor 40 overtraining trials produced any reversal facilitation in a group of schizophrenic subjects, though the aversive feedback itself may have strengthened the attention response somewhat.

One problem in accounting for Nolan's data with this model arises from his finding that, under nonaversive feedback conditions, 40 overtraining trials produced facilitation of the extradimensional as well as the reversal shift (Nolan & Anderson, 1973). Clearly, the subject who demonstrates facilitation on both reversal
and extradimensional shifts must be using a hypothesis testing strategy; this effect cannot be explained within the simple multi-look model. As Nolan (1974) notes however, Eimas (1969) got exactly this effect with 100 overtraining trials in children who did not characteristically employ efficient hypothesis testing strategies. Therefore, although the exact mechanism remains unexplained, it seems reasonable to conclude that extensive overtraining produces a problem-solving style change (from a multi-look to a hypothesis testing model) in both children and schizophrenics.

One way to test the predictions of the proposed model would be to experimentally restrict the breadth (range) of attention in normal subjects and observe their discrimination shift performance. Use of a fading or errorless learning procedure on the pre-shift problem (as opposed to the usual trial and error procedure) should produce such an artificial constriction of attention to a single dimension. Nolan and Harris (1981) presented data consistent with the expectations summarized above. Using a college student population, they compared shift performances under fading and trial and error original learning conditions. Although the fading procedure did not significantly weaken the attention response (intradimensional shift means were not significantly different in the two conditions), it did significantly and selectively retard reversal shift performance. In subproblem analyses of extradimensional shift performance, the number of spontaneous reversers was extremely low in the fading condition, a pattern characteristic of five-year-old children (Fisher & Zeaman, 1973). Hence, these data seem to reflect the effect of reduced
partial reinforcement of the observing response, leading to rapid extinction of this response, as well as to a narrowed range of attention.

It is proposed here that not only do individuals differ in the efficiency or speed at which they are able to process information, but they differ in their preferred "style" of information processing. Data from attention studies indicate a developmental progression through three distinct styles. These have been designated in this paper as the one-look model, the multi-look model, and the hypothesis-testing model. For reasons that may be secondary effects of the primary pathology in schizophrenia, some schizophrenics appear to perform in ways which suggest a regression through these three stages. Clinical accounts as well as the available empirical data support the applicability of these schema to developmental accounts of attention dysfunction in schizophrenia.

In addition to its theoretical usefulness, there are distinct methodological advantages to exploring performances on discrimination shift learning tasks. The within-subject design makes it possible to identify different types or patterns of attention dysfunction. Most of the traditional techniques employed by clinicians to demonstrate attention dysfunction are subject to the criticism that schizophrenic patients show a general performance deficit. The utility of repeated demonstrations of slow reaction times in schizophrenics, for example, seems questionable. Oltmanns and Neale (1980) argue for the necessity of demonstrating a differential deficit in schizophrenic performance if data are to be meaningful. That is, schizophrenics must
show a greater deficit on task A than they do on task B when the
two tasks have been equated for difficulty if a specific deficit is
to be demonstrated. The predictions which follow from the applica-
tion of discrimination shift learning tasks satisfy this requirement.

Correlates of Discrimination Shift Learning

Assuming that the model of discrimination shift learning being
proposed in this paper is in fact a reasonable representation of both
developmental and pathological changes in attention processes, then
not only should it be possible to make very specific predictions
with respect to a subject's speed of learning the shift problems, it
should be possible to identify other tasks which would also reflect
these changes in attention functioning. The Span of Apprehension
task, which both Neale et al. (1969) and Asarnow et al. (1977) have
employed, is presumed to directly assess the amount of information
to which the individual is capable of simultaneously attending.
Therefore, if as has been suggested earlier in this paper, the
pathological changes in schizophrenia correspond to a developmental
"regression" in attentional style, the Span of Apprehension task
should be sensitive to such regression. For example, the chronic
individual who defensively restricts his range of attention, conse-
quently demonstrating slow reversal shifts on the discrimination
task, should demonstrate greater impairment on tasks which place
increasing demands on him in terms of the number of stimuli to which
he must attend. On the other hand, the acute individual who is unable
to organize and process perceptions efficiently (and therefore demon-
strates reversal shift facilitation but retarded extradimensional
shifting), may consequently not perform as accurately as the normal individual on tasks requiring such organization and processing ability. However, in a task (like the Span of Apprehension task) in which breadth of attention is the crucial variable, he should not show increasing impairment as number of stimuli increases.

The span of apprehension task consists of matrices of letters which are presented tachistoscopically to the subject whose task it is to identify which of two target letters is embedded in the array on each trial. The tachistoscopic presentation eliminates the possibility of eye movement effects and insures that the measurement is of a central cognitive process. By varying the number of distractors presented in addition to the target letter it is possible to obtain a measure of the information processing capabilities of the subject. Once again with this task as with the discrimination learning task the repeated measures nature of the design (each subject is observed over four matrix sizes), makes it possible to demonstrate a differential deficit, varying with matrix size, in the clinical population.

Both the discrimination shift learning task and the span of apprehension task are to some extent artificial laboratory representations of cognitive processes. Since the cognitive changes in the schizophrenic patient are not subtle differences, but are grossly apparent, it seems reasonable to speculate about and investigate how changes in attention functioning might be correlated with (and expressed as) more overt behavior and cognitive variables.

The apocryphal association between creativity and "madness" has a long history which can be traced back to Aristotelean philosophy.
The literature on creativity and the creative process provides anecdotal accounts of psychological pathology in literally hundreds of creative individuals. In 1968 Grant provided clinical descriptions and diagnoses of many "great abnormals" including Kafka, Van Gogh, Poe, Newton, Chopin, Pascal, and many others.

In addition to such anecdotal evidence of a relationship between psychosis and creativity, recently a considerable amount of effort has been directed toward demonstrating such a link empirically. Not surprisingly however, the creativity construct has proven to be almost as amorphous and elusive as the attention construct, when attempts have been made to define and measure it. The empirical literature itself is vast and methodologies employed diverse. There is however, a rather small body of data which has addressed the issue of schizophrenia and creativity as it may relate to attentional functioning, information processing, and the formation of associations.

Andreasan and Powers (1975) compared the performance of three groups: successful writers, manic patients, and schizophrenic patients on the Goldstein-Sheerer Object Sorting Task. They concluded that the writers and manic patients both exhibited more over-inclusion, while the sorts of the schizophrenics were best characterized as underinclusive. It should be noted though, that these appeared to be chronic schizophrenic patients and factors such as length of institutionalization and medication were not controlled for or reported. Al-Issa and Robertson (1964) also used chronic schizophrenic patients in their investigation of divergent thinking, as
measured by Guilford's tests, and reached similar conclusions. They found a strong relationship between low scores on the tests of divergent thinking ability and the presence of thought disorder as reflected in scores on tests of formal thought disorder. Note that both of these findings are quite consistent with the attention model's description of the chronic individual who has defensively restricted his attentional field.

A slightly different but potentially fruitful strategy focuses on the attentional and information processing capabilities of normal, highly creative individuals. Mendelsohn and Griswold (1964) investigated the relationship between creativity and the use of incidental stimuli. They hypothesized that: "One characteristic of highly creative individuals is a greater sensitivity to environmental cues and a greater ability to utilize these cues in problem solving, i.e., highly creative individuals may retain more of their stimulus experience in such form that it can appear in their associative and problem-solving processes" (p. 431). From their study which employed a variant of an anagram task they concluded that their original hypothesis had indeed been supported and more specifically that: "High creatives deploy their attention more widely and thus receive a broader range of information with sufficient strength to influence their subsequent responses" (p. 436). Russell (1976) reported that high scorers on Mednick's Remote Associates Task recalled more irrelevant information after a card sorting task than did low scorers. He also concluded that this widened span of attention was not characterized by increased distractability. Both of
these studies clearly imply a relationship between creativity and the multiple-look model of attention and are consistent with the hypothesis that span or breadth of attention may be a crucial cognitive variable underlying both creativity and schizophrenic pathology.

Two studies have addressed this issue more or less directly by comparing the performances of creatives and schizophrenics on tasks designed to illuminate attentional strategies or associative processes. Mednick's (1962) theory on the associative basis of the creative process clearly is related to an attention construct, though this article does not directly consider the relationship between schizophrenic pathology and creativity as reflected in association strengths. Mednick proposed that creative thought processes are related to "flatness" of associative hierarchies as well as a greater number of available associates to the problem. He offered the example of the novice's creative solution to a difficult problem whose solution had eluded experts. He explained the phenomenon by theorizing that the key to success in this instance was the ability to avoid the obvious. This ability was determined by the flatness of the novice's associative hierarchies. The relationship between Mednick's flat associational hierarchies and Broen's response strength hierarchies is apparent. In an investigation of this factor in chronic schizophrenic patients, Higgins, Mednick and Phillip (1965) reported results supportive of the hypothesis of greater associative disturbance with increasing chronicity in schizophrenia. However, the schizophrenic subjects in the study differed from the normal subjects on all three measures of associative behavior:
over-all associative behavior, "most common" associative behavior, and "least common" associative behavior. This non-selective effect makes any direct comparison with the other studies in this section impossible, and once again illustrates the necessity for demonstration of a differential deficit in the schizophrenic population.

More obviously related to issues being addressed in this paper is a study conducted by Dykes and McGhie (1976). They compared the performance of a group of highly creative adults with the performance of a group of acute, non-paranoid schizophrenic adults on the Lovibond Object Sorting Task, the Chapman card sorting task, and a dichotic shadowing task. Dykes and McGhie concluded that: "The results offer support to the view that both highly creative and schizophrenic individuals habitually sample a wider range of environmental input than do less creative individuals" (p. 50). In the case of the schizophrenic this involuntary widening of attention tends to have a deleterious effect on performance while, in contrast, the highly creative individual is more able to successfully process the greater input without this producing a performance deficit. Reasoning along this same line, they quote Lehman (1966), "If he is capable of coping with this greater than average influx of discrete sensory stimuli he might perform at a better than average level; but when the extraordinary sensitivity of his receptive apparatus is not matched by an equally extraordinary performance of his central processing apparatus then his integration breaks down and he may become psychotic" (p. 52). The direction of the cause and effect relationship implied by Lehman is unsupported. However, it is difficult to imagine statements more
consistent with the assumptions and performance predictions of "phase II" of the attention model being proposed than those offered by these authors.

**Populations at Risk for Schizophrenia**

If attention dysfunction can be assumed to underlie the primary disturbance in associations which Bleuler (1911) described, then it should be possible to demonstrate this dysfunction prior to clinical diagnosis of the disorder. In studies of hospitalized clinical populations, one must always recognize the uncomfortable possibility that the deviant behavior being studied is not central to the disorder, but merely associated with it. The effects of hospitalization itself, the change in activity level, and the change in diet, have all been implicated as extraneous factors which may mediate "deviant" performances.

The study of high-risk populations, although developed out of etiological theories and investigations, has the advantage of avoiding all of these issues. Numerous studies of children at risk for schizophrenia have explored the possibility of attention dysfunction prior to the exhibition of clinical symptomatology.

Reliability and validity problems aside, most studies on high-risk populations employ multiple measures of attention and generally, on at least some of the measures, report an attentional deficit in 10 to 15% of the high-risk children, prior to the presence of any clinical symptomatology. These percentages closely correspond to expected rates of expression of the disorder over the course of a lifetime and suggest the possibility that attention dysfunction might
be a useful vulnerability marker.

'Since the studies in this area are of relatively recent origin, the data they report are cross-sectional, not longitudinal for the most part, but nonetheless interesting. However as Garmezy (1978) has argued, high-risk research would be greatly enhanced by the existence of normative developmental data.

...we limp noticeably in our efforts to assess children at risk...because we lack basic normative developmental data on numerous tasks that are relevant to our assessment strategies. (p. 469)

Normative developmental data are clearly lacking for most of the techniques traditionally used to assess attention. However, an extensive empirical literature exists on the developmental aspects of discrimination shift learning, an advantage that further illustrates the appropriateness of using discrimination shift learning measures of attentional functioning.

In their study of children of psychotic mothers Grunebaum et al. (1974) explored cognitive and attentional development. Their findings are based on comparisons between 68 children of 50 psychotic mothers and 68 children of control mothers. The children ranged in age from one to six. Thirty-six of the psychotic mothers had a diagnosis of a schizophrenic spectrum disorder: 14 were diagnosed as having an affective disorder. The cognitive measure was one of field dependence vs. field independence. A continuous performance task was used to assess attention. This task was scored for both errors of omission and errors of commission. Grunebaum et al. also investigated the performance of the mothers on these tasks. Although the psychotic
mothers performed poorly on both tasks, only the schizophrenic mothers did significantly less well than the control mothers on both tasks. Grunebaum et al. concluded, with respect to the children, that the high-risk children demonstrated a significant developmental lag in the one, three, and five year old groups on both measures. In general, the children of the schizophrenic mothers appeared to be the most impaired, followed by the children of the affective patients. Grunebaum et al. found no differences between the six year old groups on either task and concluded that the obtained developmental lags are primarily apparent and identifiable before age six. (It is also quite possible that the CPT task was too easy for the six year olds and that the no difference finding reflected a ceiling effect at that level.) Herman et al. (1977) investigated behavioral and electrographic measures of attention in children at risk for schizophrenia. Subjects in this study were six of the same children from the Grunebaum et al. (1974) study and six newly selected controls--the children of normal mothers. At the time of this study the children were between 7 and 10 years old. A continuous performance task (CPT) was again used as the attention measure. Correct responses, errors of omission and commission were recorded. On the basis of CPT performance, the high risk children could not be differentiated from the controls. The high-risk group also showed a significant improvement over their earlier performance in the Grunebaum et al. study, even though task difficulty had been increased. Herman et al. took this data to be supportive of Grunebaum et al.'s original hypothesis of developmental lag.
Oltmanns et al. (1978) investigated the object-sorting performance of high-risk children. After children sorted cards with pictures of objects, each child was asked to explain why the objects in each pile went together. They scored responses as belonging to one of four types: a superordinate response, in which groupings are on the basis of one or more attributes shared by all members of the group, a complex response, based on realistic relationships, yet describing no single attribute as applying to all group members, a thematic response which included sorts of objects that were related by some functional interaction, and a vague response that included those sorts in which the method was unclear to the experimenter. Subjects in this study included 156 children of a schizophrenic parent, 102 children of a depressed parent, and 139 children of normal parents. Both the children of schizophrenics and those of depressives made fewer superordinate sorts than the controls. However, after Oltmanns et al. partialled out the effects of IQ, they found that the children of schizophrenics performed significantly more complex sorts than did either the children of depressed parents or the control children. This finding is quite consistent with the data reported earlier in this paper on the performance of adult schizophrenics on tasks of this type (Tutco & Spence, 1962) and with data from a study by Daut and Chapman (1974) which described an association between complex sorts and adult schizophrenic performance.

Erlenmeyer-Kimling and Cornblatt (1978) reported results of attentional assessment in their sample of children of schizophrenic parents. The sample they used was somewhat larger than that of many
of the other high-risk studies. These children were between seven and twelve years old; 44 had schizophrenic mothers, 23 had schizophrenic fathers, and 100 controls had parents who had no history of psychiatric treatment. Erlenmeyer-Kimling and Cornblatt included two measures of attention: a continuous performance task and an auditory attention task, as a part of a larger battery of tasks they administered to these children. The continuous performance task they used was administered under both distractor (auditory) and nondistractor conditions. They recorded errors of omission, errors of commission, and reaction time. The auditory attention span task was a digit span task, varying in two rates of presentation of information, length of sequence, and distractor vs. nondistractor conditions. In general their hypotheses were confirmed. The high-risk group performed less adequately overall on the CPT and was impaired to a greater degree by the presence of distractors, although this difference was not significant. Problems with task difficulty made clear interpretation of subject's responses on the attention span task impossible. However, as has been indicated earlier, one would anticipate only 10-15% of the high-risk group to ultimately manifest the clinical symptoms of the disorder. If in fact, attention dysfunction is a vulnerability marker, then comparison of group means is a very inefficient and misleading analytical strategy. Identifying individual subjects who perform poorly on all the tasks and then identifying their group membership seems a more reasonable strategy to pursue. Erlenmeyer-Kimling and Cornblatt (1978) did pursue this strategy. When they compared the number of subjects who scored in the worst 5% of the
standardized distribution, considering both numbers of performance indices and group membership, a deviant subgroup of 19.1% of the high-risk subjects clearly emerged. However, the distribution of the high-risk subjects with respect to level of performance over all the indices was not a bimodal distribution as the authors seem to imply, but could best be described as having significant negative skew.

The final study to be cited in this section is, in many ways, the most relevant to the purposes of this paper, and the strongest from a methodological standpoint as well. Asarnow et al. (1977) administered a battery of eight tasks associated with attention to three groups of children. These individuals were all fifteen to eighteen years old. The first group was a group of children in foster homes whose biological mothers were diagnosed schizophrenic. This was the high risk group. The second was a group of foster children without the genetic risk and the third was a group of children living with their biological parents, neither of whom had ever received a psychiatric diagnosis. All eight of the tasks Asarnow included had, in earlier research, been shown to be associated with a performance deficit in adult schizophrenics. Asarnow reported a general tendency for the high-risk children to demonstrate inferior performance on all the tasks in comparison with the other two groups. However, while the foster group did perform more adequately than the high-risk group, they also performed less adequately than the control group. Once again, since epidemiological data suggests that only 10-15% of the high-risk group will ultimately manifest clinical symptomatology, Asarnow investigated the possibility that a subgroup of the high-risk
subjects were demonstrating grossly inferior performance—a fact that could not be observed from comparisons of group means. By identifying subjects who scored in the bottom third on the most discriminating tasks, Asarnow was able to identify such a subgroup. This group performed significantly less adequately on the complex version of span of apprehension and the Spokes test, and on the simple version of the concept attainment task. In addition, Asarnow found a nonsignificant tendency for this high-risk subgroup to perform less adequately under distractor conditions. A similar nonsignificant tendency toward slow reaction times was also observed in this group. Asarnow et al. speculated that this demonstration of attention dysfunction in children at risk for schizophrenia, prior to the exhibition of any clinical symptomatology, suggests that attention dysfunction is: "...part of the schizophrenic diathesis, not merely a reflection of a general psychiatric disorder" (p. 274).

As Spring and Zubin (1978) noted, two characteristics of a performance anomaly are necessary for it to be theoretically useful as a marker of schizophrenic vulnerability:

(a) the characteristic is not present in non-schizophrenic psychiatric patients or healthy controls, but does appear in both the non-affected sibling and the schizophrenic proband.

(b) the anomaly persists in the 'recovered' schizophrenic.

If performance differences are found in both these groups, they cannot be reflective only of disorganized pathological states and might well be associated with some underlying vulnerability.
In addressing this issue, Asarnow (1978) reported results of a study using his span of apprehension task with three additional groups of subjects: schizophrenic patients in clinical remission living in the community, hospitalized schizophrenic patients, and normal adult controls. This task requires the subject to identify the presence of a tachistoscopically presented target stimulus. When this data was analyzed in combination with the data reported earlier in the high-risk study, Asarnow found no significant differences among the patterns of error rates for the group of most impaired children, the acute adult schizophrenics, and the clinically remitted schizophrenics. However, this cluster of subjects was significantly different from the other cluster (normal adult controls and less impaired children) in performance on the complex arrays, though not on the simple stimulus arrays. Asarnow interpreted these findings as reflective of a schizophrenic process which is independent of clinical state.

Diagnosis and the Schizophrenic Spectrum

The amount of recent research in the general area of schizophrenia is, without question impressive. Yet, its sheer volume cannot mask the conclusion that after years of effort: "we do not know what schizophrenia is, and often, we cannot agree on which individuals will become schizophrenic" (Haier, 1980). In addition, when this literature is viewed from a historical perspective it becomes apparent that every attempt to clarify the diagnostic criteria only: "has led further into a morass" (Cancro, 1979). Kraepelin's reification of the term schizophrenia from a syndrome into a discrete
disorder may have initiated this process. As a disorder schizophrenia is perhaps unique in that it has no single etiology, no truly pathognomonic symptoms, and no recognized prognosis or generally effective treatment.

Numerous nosological schemes have been proposed for differential psychiatric diagnosis including among others, the DSM III criteria, the RDC criteria, and the New Haven Criteria. All stress their high interrater correlations as evidence of their worth in terms of successive approximations to the "true disorder." However, with this increasing interrater reliability comes decreasing cross-system agreement (Haier, 1980). Many of these diagnostic systems, notably the DSM III, included only reliable items as diagnostic criteria and this procedure obviously may have produced a set of rather arbitrary, nonempirically validated criteria. There is no independent standard or measure against which the validity of these systems may be evaluated. In addition, the "Chinese Menu" features of these schema have led to the observation that schizophrenic patients are generally more different from each other than they are alike.

None of the above is intended to imply that the category of schizophrenia is meaningless and those volumes of research worthless. It is rather to point out that the commonly employed diagnostic systems share an implicit (and perhaps unwarranted) assumption that "...the schizophrenic syndrome is a genuine disease entity that exists in the real world, and the task of the diagnostician is to identify those signs that will lead to the discovery of this external truth" (Cancro, 1979). Given this assumption, diagnostic distinctions
must rest on clinical symptomatology and as such, heterogeneity among
patient groups is to be abhorred. (Given these assumptions it also
is surprising that relatively few studies have used statistical
clustering approaches to define homogeneous patient groups.)

Another possible approach to classification stresses the
utility--etiological, prognostic, or therapeutic--of a category rather
than its reality. Unlike the other approach cited above, rather
than attempting to reduce diagnostic "noise" by narrowing diagnostic
criteria, some researchers have focused on the generally obtained
variability for systematic study. Most notably, some biologically
oriented researchers have begun employing biological variables as the
independent rather than the dependent variables in their research
(Buchsbaum & Haier, 1978). The procedure may yield clusters of
patients which do not correspond to the traditional diagnostic cate-
gories and in fact may cut across them. However, the validity (and
utility) of a diagnosis arrived at through this procedure has the
advantage of an independent criterion against which clinical judgment
could be assessed.

A psychologically oriented researcher could obviously employ a
similar strategy yielding similar benefits. This strategy has not
been pursued, although Payne outlined it quite eloquently twenty
years ago. "Countless studies attempt to find objective correlates
of these (diagnostic) labels. Thus instead of investigating, for
example, the nature and causes of 'slowness in problem solving,' a
psychological variable which can be accurately defined and measured
and clearly related to other psychological variables, psychologists
have administered batteries of tests to individuals whom psychiatrists have labeled 'schizophrenics.' They have never inquired closely into the meaning of the term 'schizophrenia' nor have they apparently been concerned to discover whether or not schizophrenia can be defined and detected accurately enough to make it a fundamental variable to which everything else must be related" (Payne, in Eysenck, 1961, p. 196).

Perhaps psychology should do what it does best and focus on identifying meaningful psychological variables and their correlates, and ultimately we may thereby identify factors which may themselves define the syndromes. That is, we may be asking the "wrong" question when we seek to "build a better" diagnostic system on a priori grounds.

Obviously, in an exploration of psychological schizophrenic "vulnerability indicators," the current diagnostic systems, even given their deficiencies, are logical starting points for identification of research subjects. However, a broad rather than a narrow construal of the category is desirable in this case. Kety et al. (1968) in their Danish adoption study presented convincing evidence of the utility of the concept of a "schizophrenic spectrum" disorder. They found significantly higher incidences of not only chronic, acute, and latent schizophrenia among the biological relatives of schizophrenic patients, but also concluded that significantly more diagnoses of schizoid personality, inadequate personality, and "uncertain schizophrenia" ("Schizophrenia was the most likely diagnosis, but was necessarily questionable because the symptoms were too
mild, too few, or too atypical"), were appropriate to individuals in this group. They stated that despite their lack of diagnostic specificity:

...a consistent increase in the prevalence of the diagnosis of uncertain schizophrenia in individuals genetically related to schizophrenic probands, as compared to those not so related. This diagnosis... discriminated consistently the adoptive, and biological relatives at a high level of significance (p values of .003, .01, and .009 for each rater independently)...This appears to justify a more exhaustive search for those characteristics which permit that diagnosis. (p. 32)

Such a search has been underway since 1970 and seems to be focusing on identifying information processing difficulties in schizophrenic patients. Heston (1970) argued at that time that the schizophrenic spectrum disorders are simply different phenotypic expressions of the same core deficit. Most recently, Saccuzzo and Schubert (1981) have presented results supportive of a "slow information processing hypothesis" which is characteristic of not only the schizophrenic adolescent but also of individuals receiving any schizophrenic spectrum diagnosis.

Given the absence of a logical rationale for adhering to the traditional diagnostic systems, as well as the mounting empirical evidence supportive of a schizophrenic spectrum concept, it seems reasonable to select research subjects with these considerations in mind. Ultimately, the obtained empirical data will support or refute the validity of the construct.
Research Implications

Characteristics of the attentional processes in the schizophrenic subjects mentioned earlier may be viewed as being derived from some central cognitive process. However, it is not yet possible to decide whether the cognitive disruption is a precursor to the more florid clinical symptomatology or whether it is merely coincidental with, or in response to, more obvious symptoms. Almost without exception, studies of attention in schizophrenia have focused on diagnosed and institutionalized populations. Not only do designs of that type preclude the possibility of determining antecedents, they also obviously permit the extraneous variables such as institutionalization itself, and the concomitant changes in diet and exercise, to further obscure what seems likely to be a subtle relationship. (In addition, studies of institutionalized populations would be likely to be primarily composed of "chronic" patients and the chronic-acute dimension is obviously one significant to the theoretical proposals implicit in the present study.)

Mednick and McNiel (1968) proposed the high-risk strategy in part to avoid these methodological difficulties. (This strategy, since it uses a longitudinal design, also readily addresses issues of antecedents of symptomatology and the progressive nature of the disorder.) Indeed, this strategy was readily embraced as offering significant new theoretical and research possibilities. Unfortunately, the high-risk design too has its share of liabilities.

Pragmatic issues such as the possibility of identifying offspring of schizophrenic parents and then following these offspring
for twenty or more years obviously restrict the amount and variety of data that can be or will be gathered. There are theoretical problems as well. Only about ten per cent of diagnosed adult schizophrenics have any family history of schizophrenia, so the selection procedure itself raises doubts about the applicability of the results to all schizophrenics, and particularly to the vast majority with no family history of schizophrenia. Another apparently insoluble problem concerns the specification of the "at risk" period. How long must these individuals be followed before it can confidently be asserted that they are not going to exhibit any clinical symptomatology? Additional problems with the strategy concern the possibly iatrogenic effects of being followed, if the design is longitudinal, or the effect of both conscious and "accidental" distortion implicit in a retrospective design. To summarize, while the high-risk design may be uniquely well suited to address etiological issues, its original intention, both practical and theoretical concerns raise questions about its usefulness in exploring descriptive issues in particular, and its frequent invocation as a research panacea.

Variation on the original high-risk design might eliminate several of these implicit difficulties. Robert Asarnow (1978) has for example, explored the possibility of identifying indicators of vulnerability in the offspring of schizophrenic parents and in remitted schizophrenic patients (as well as acute and chronic schizophrenic patients), in the absence of clinical symptomatology. Asarnow and his colleagues have demonstrated that a percentage of the schizophrenic's offspring show the same differential deficit on
a complex span of apprehension task as do remitted and in-patient schizophrenics. This suggests that he indeed, may have identified a core deficit, uncorrelated with clinical symptomatology. While this approach eliminates the waiting-period problem, the practical issues of identifying and gaining the cooperation of a high-risk population remain.

The research strategies of both Mednick and Asarnow share as an implicit assumption, the heritability of schizophrenia. There is at present an extremely large and diverse body of data making such an assumption almost mandatory, although the precise genetic mechanisms cannot be confidently asserted. Proceeding from this reasonable assumption, a third methodological strategy suggests itself. If, as Asarnow has speculated, attention dysfunction is part of the schizophrenic diathesis, then performance anomalies might also be observed in a sample of the parents of schizophrenics just as Mednick, Asarnow and others have observed such anomalies in the offspring of schizophrenics. Clearly, the practical advantages of pursuing this alternative strategy are enormous. Additionally, since most schizophrenic patients have parents, one avoids the generalizability problems. (These are even more striking when the low fertility rates of schizophrenics are recognized. All in all the data suggest that the offspring of a schizophrenic parent who himself becomes schizophrenic is, in many ways, quite unrepresentative of the average schizophrenic patient.)

McConaghy (1959) investigated the object-sorting performances of parents of adult schizophrenics and concluded that they showed
greater impairment of conceptual thinking than did members of a randomly selected control group. McConaghy felt that this deficit was therefore, genetically transmitted. Schopler and Loften (1969) found a similar concept formation deficit in the parents of childhood schizophrenics. (They caution however, that instructional set may in part, determine the presence of this deficit.) There is therefore at least some meager evidence suggesting that the examination of the parents of schizophrenic patients may indeed prove to be a fruitful, if underutilized, strategy in identification and description of the core symptomatology which distinguishes the schizophrenic disorders.

The study reported here employed an inpatient adolescent psychiatric population as the clinical population, but did not focus on diagnostic classifications. Instead, the a priori hypotheses and data analyses were guided by a search for correlations among psychological variables. To summarize: the general methodological approach was to select four subject groups: in-patient adolescents, their mothers, control adolescents, and their mothers, and to investigate the extent to which the performances of the patients and their mothers were similar and the extent to which these two groups performed in a manner which distinguished them from the two control groups.

On the basis of the three-phase attention model described earlier in this paper, it is possible to make very specific predictions both as to how the groups will perform on the tasks and how their performances on different tasks may be related. The major hypothesis of the study was that the patient group would, on the
discrimination shift task, perform in a manner which reflects the loss of efficient hypothesis testing strategies, but maintenance of breadth of attention. Specifically, the patient group should not differ significantly from the control groups on the speed of either the reversal or the intradimensional shift, but should exhibit significantly slower extradimensional shift performance. (The mothers of these individuals should also exhibit this pattern if the anomaly is part of the diathesis and not simply a correlate of severity of symptomatology.) This performance difference should be apparent not only in comparisons with both of the control groups in this study, but also in comparisons with other published normative data (Nolan, 1968, 1970, 1974). If breadth of attention is maintained in these patients then, as was argued earlier, although accuracy may be lower at all levels of matrix size in comparison with normal performance, the clinical subjects should not be as impaired as control subjects by increasing numbers of distractors on the span of apprehension task. Finally, it may be argued that the number of responses given on the alternate uses task (a reflection of the capacity to imagine an object simultaneously as serving different functions), should be positively correlated with rapid extradimensional shift performance and with little impairment under large matrix sizes on the span of apprehension task, since a similar ability to attend to more than a single dimension, or stimulus, or function is suggested in all three tasks.
CHAPTER 2
METHODOLOGY

Subjects

The clinical subjects were thirteen patients at the Central Ohio Adolescent Center who agreed to participate after initial screening had determined that they were appropriate for the purposes of this study. Seven female subjects and six male subjects comprised this group. The admission diagnosis per se (listed in Appendix A) was not used to make this determination for reasons discussed earlier in this paper. Rather, the more appropriate general behavioral criteria described below, principally exclusionary criteria, were used. Subjects who had been admitted to the institution as a result of primary organic pathology were excluded, as were deaf or blind patients, and those individuals whose difficulties, in the judgment of the psychology and social work staff were produced by extreme and transient situational stressors. All other patients who agreed to participate comprised the patient sample. A general description of these individuals would be: a moderately to severely disturbed individual who is unable to function adequately outside an institutional setting and who exhibits cognitive, social and behavioral difficulties.

Mothers of the patients who had agreed to participate were contacted and informed of the nature of the study. (It was at that
time emphasized to these mothers that the study was attempting to identify strengths or capacities in their children, in light of Schopler and Loftin's (1969) research cited earlier, regarding the importance of instructional set.) Their personal cooperation as well as their permission for their child's participation was solicited at this contact. Ten of these thirteen mothers ultimately agreed to participate.

The control subjects were twelve high school students enrolled in an introductory level psychology course. Six female and six male students comprised this group. Their mothers were contacted by telephone and informed of the nature of the study. Their personal participation as well as their permission for their child's participation was solicited at this contact. Ten of these mothers agreed to participate in the study.

The mean age of the clinical subjects was 16.53 years, with the range from 15 to 18 years. The mean age of the control subjects was 16.92 years, with the range from 16 to 18 years.

Apparatus

The discrimination learning materials were eight colored plastic objects approximately 3.8 cm in diameter, including: a red cross, a red square, a blue cross, a blue square, a yellow circle, a yellow triangle, a green circle, and a green triangle. The stimulus presentation apparatus was a modified version of a Wisconsin General Test Apparatus. The discriminanda were presented to subjects on a tray slid through a slot in the bottom of the upright partition. Subjects placed their stimulus choice through a hole in the center
of the partition.

The apparatus used in the span of apprehension task was a Lafayette Instruments Electro-Tac. The stimulus arrays were constructed by randomly assigning letters to one of sixteen imaginary one inch square locations within a 4 x 4 inch matrix on a white index card. Each array contained one of the two target letters; a "T" or an "F". Four different sized arrays were constructed in this fashion. The first level of complexity presented subjects with only the target letter, no distractors were present. The other three levels included in addition to the target letter either two, four, or eight distractor letters randomly assigned to locations within the matrix. Each level of array size consisted of ten "T" cards and ten "F" cards. This design is similar to that described by Neale et al. (1969) and Asarnow and MacCrimmon (1978). These stimulus displays were typed on white index cards which were then inserted into the rear of the apparatus.

Procedure

After the experimenter introduced herself and answered any questions that the subjects might have, subjects were administered the span of apprehension task. The Electo-Tac apparatus was explained and demonstrated for the subjects. Subjects were told that either a "T" or an "F" would appear, sometimes along with other letters and that their task was to report which of these two letters had been present on each trial. Subjects received one practice trial at each matrix size. Each matrix size was presented in a block of ten trials. A total of twenty trials for each matrix size was
administered, producing eighty total trials. When no response was forthcoming subjects were encouraged by the experimenter to guess. Subjects were assigned to one of two counterbalanced orders of presentation of the blocks of trials. The stimulus exposure time was 100 msec. Subjects' responses were recorded by hand following their verbal response. This procedure produced four scores; one for each matrix size, for each subject. The entire procedure required approximately fifteen minutes to complete.

Subjects were next randomly assigned to either a color relevant or a form relevant two-choice discrimination learning problem. Order of presentation and position of the stimuli was predetermined to insure that no single stimulus appeared on more than three successive trials and that the "correct" stimulus did not appear in the same position on more than three consecutive trials. Subjects received the following verbal instructions from the experimenter.

"This is the apparatus we will be using. When I slide this tray out to you, it will contain two objects. You are to pick the object that you think is correct and put it here in the slot. If your choice was correct I will say "correct," if your choice was wrong I will say "wrong." The first time you will just have to guess, but after that you will be able to figure it out. The same one will be correct every time. Remember try to pick the correct one each time."

Subjects were presented with a series of two-choice discrimination problems in which the two stimuli presented on each trial differed simultaneously in color and shape. Subjects were trained
to a criterion of ten successive correct responses on each of the four discrimination tasks. After learning this original problem to criterion, the reversal shift problem was presented immediately. Shift training began without warning. The intradimensional shift problem, marked by the introduction of new stimuli, followed criterion performance on the reversal shift. The extradimensional shift was presented following the intradimensional shift and was begun without warning. Thus, the discrimination learning procedure also produced four scores for each subject.

The final task was the alternate uses task in which the subject is asked to generate uses for a verbally specified object. The administration procedure for this task was described by Wallach and Kogan (1965). The following instructions were read to the subject:

"Now, in this task I'm going to name an object - any kind of an object like a light bulb or the floor - and it will be your job to tell me lots of different ways that the object could be used. Any object can be used lots of different ways. For example, think about string. What are some of the ways you can think of that you might use string?...Yes, and you might use it to tie your shoe, you might use it to wrap a package, or you could use it to fly a kite. Think of all the different ways you could use the object that I name."

The eight alternate uses objects which were used in this study were: a newspaper, a knife, an automobile tire - either the tube or the outer part, a cork, a shoe, a button, a key, and a chair. The subject's responses to each item were recorded by the experimenter.
CHAPTER 3

RESULTS

Discrimination Shift Task

Each subject received four scores on this task corresponding to the number of trials taken to reach criterion, excluding the ten criterion trials, for each of the discrimination problems: original learning, reversal shift, intradimensional shift and extradimensional shift. A 2 (patient vs. control) x 2 (parent vs. child) x 4 (type of learning problem) analysis of variance with repeated measures on the learning factor was carried out on those data. (No effects for original learning dimension, form vs. color, were significant and these data were pooled.) Since significant heterogeneity of variance (original learning F max (4,12) = 65.33, p < .01) between cells was present, the analysis of variance was also carried out on a log transformation (log (x + 1)) of the raw score data. In addition to reducing the heterogeneity of variance, this transformation also facilitated the comparison of the data with other published data and was intuitively meaningful in that the difference between two and eight trials to criterion is not equivalent theoretically to the difference between 42 and 48 trials. The two ANOVAs produced very similar results with respect to the inferential statistics.
The ANOVA performed on the transformed discrimination and shift data yielded significant main effects for type of shift, $F(3,123) = 34.7, p < .001$, and for patient vs. control group membership, $F(1,41) = 16.72 (p < .001)$. However, the significant interaction between these two factors ($p < .001$) suggested that these main effects be interpreted with caution.

Newman Keuls tests indicated that the interaction effect was produced by performance on the extradimensional shift problem, which was performed significantly more slowly by the patient groups (adolescents and mothers), than by the control groups ($p < .01$). (See Table 1.) The two patient groups did not differ significantly, nor did the two control groups. There were no significant differences among any groups obtained on the speed of either the reversal or the intradimensional shift problem. However, the patient-adolescent group did learn the original problem significantly ($p < .05$) more slowly than any of the other three groups. For all the groups the intradimensional shift was significantly ($p < .05$) faster than the reversal shift which was significantly ($p < .05$) faster than the extradimensional shift.

Span of Apprehension Task

Table 2 displays the mean percentage of correct responses for each group at each of four matrix size conditions. Each subject received four scores for the task which corresponded to the number of correct responses (out of 20) in each size condition. (The effects for order of block size presentation were not significant and these data were pooled.)
Table 1

(a) Mean Log Trials-to-Criterion and (Standard Deviations); (b) Raw Score Equivalents: Mean Trials-to-Criterion and (Standard Deviations)

<table>
<thead>
<tr>
<th></th>
<th>Control Mother</th>
<th>Control Child</th>
<th>Patient Mother</th>
<th>Patient Child</th>
</tr>
</thead>
<tbody>
<tr>
<td>OL</td>
<td>.4678</td>
<td>.3891</td>
<td>.5612</td>
<td>.8024</td>
</tr>
<tr>
<td></td>
<td>(.2493)</td>
<td>(.2778)</td>
<td>(.4331)</td>
<td>(.4553)</td>
</tr>
<tr>
<td>R</td>
<td>.4333</td>
<td>.3806</td>
<td>.3786</td>
<td>.4878</td>
</tr>
<tr>
<td></td>
<td>(.2391)</td>
<td>(.2258)</td>
<td>(.2390)</td>
<td>(.4350)</td>
</tr>
<tr>
<td>ID</td>
<td>.1857</td>
<td>.1903</td>
<td>.2911</td>
<td>.1998</td>
</tr>
<tr>
<td></td>
<td>(.2061)</td>
<td>(.1750)</td>
<td>(.5197)</td>
<td>(.3904)</td>
</tr>
<tr>
<td>ED</td>
<td>.6829</td>
<td>.5993</td>
<td>1.1502</td>
<td>1.2326</td>
</tr>
<tr>
<td></td>
<td>(.1861)</td>
<td>(.1854)</td>
<td>(.4478)</td>
<td>(.4172)</td>
</tr>
</tbody>
</table>

(b) Raw score equivalents: Mean trials-to-criterion and (standard deviations)

<table>
<thead>
<tr>
<th></th>
<th>OL</th>
<th></th>
<th>R</th>
<th></th>
<th>ID</th>
<th></th>
<th>ED</th>
<th></th>
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</thead>
<tbody>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OL</td>
<td>1.94</td>
<td>1.45</td>
<td>2.64</td>
<td>5.34</td>
<td>(.78 )</td>
<td>(.90 )</td>
<td>(1.71)</td>
<td>(1.85 )</td>
</tr>
<tr>
<td>R</td>
<td>1.71</td>
<td>1.40</td>
<td>1.39</td>
<td>2.07</td>
<td>(.73 )</td>
<td>(.68 )</td>
<td>(0.73)</td>
<td>(1.72 )</td>
</tr>
<tr>
<td>ID</td>
<td>.53</td>
<td>.55</td>
<td>.95</td>
<td>.58</td>
<td>(.61 )</td>
<td>(.50)</td>
<td>(2.31)</td>
<td>(1.46 )</td>
</tr>
<tr>
<td>ED</td>
<td>3.25</td>
<td>2.97</td>
<td>13.13</td>
<td>16.08</td>
<td>(.53 )</td>
<td>(.53)</td>
<td>(1.80)</td>
<td>(1.61 )</td>
</tr>
</tbody>
</table>
Table 2
Cell Means Span of Apprehension and Standard Deviations (Raw Scores, Out of 20)

<table>
<thead>
<tr>
<th>Number of Letters in Array</th>
<th>Control Mother</th>
<th>Control Child</th>
<th>Patient Mother</th>
<th>Patient Child</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18.20 (2.35)</td>
<td>18.75 (1.42)</td>
<td>15.30 (2.79)</td>
<td>12.80 (2.27)</td>
</tr>
<tr>
<td>3</td>
<td>17.50 (2.37)</td>
<td>17.08 (2.57)</td>
<td>14.50 (2.67)</td>
<td>13.60 (2.40)</td>
</tr>
<tr>
<td>5</td>
<td>14.80 (2.30)</td>
<td>16.00 (1.47)</td>
<td>14.30 (3.02)</td>
<td>11.50 (2.40)</td>
</tr>
<tr>
<td>9</td>
<td>13.00 (2.54)</td>
<td>13.58 (1.56)</td>
<td>12.80 (2.93)</td>
<td>9.90 (2.14)</td>
</tr>
</tbody>
</table>

A 2 (patient vs. control) x 2 (mother vs. child) x 4 (matrix size) analysis of variance with repeated measures on the matrix size factor was conducted. The ANOVA yielded significant main effects for the patient vs. control group factor, $F(1,41) = 34.75$ ($p < .001$) and for the matrix size factor, $F(3,123) = 39.86$ ($p < .001$). However, two significant interaction effects were also obtained: patient vs. control by parent vs. child, $F(1,41) = 7.10$ ($p < .05$) and matrix size by patient vs. control, $F(3,123) = 3.67$ ($p < .05$). These interaction effects suggest that the main effects should be interpreted with caution.

Newman Keuls tests indicated that the control groups did not differ from each other at any level of matrix size. The performance of the patient-child group differed significantly ($p < .05$) from the
other three groups at all levels of matrix size with the exception of the three-letter matrix. The patient-parent group fell midway between the performance of the control groups and the performance of the patient-child group. The performance of the patient-parent group was significantly inferior to the combined control group's performance at one and three letters, but not at five and nine letters. Their performance was superior to that of the patient-child group except at the three letter level where there were no significant differences among any of the groups.

A linear regression analysis was carried out on the combined control vs. patient group data. The slope of the regression line for the control group data was -.621, while for the patient group data it was -.299. Significance testing indicated that these slopes were significantly different (p < .001). As the number of nonrelevant letters in the array increased, the control groups showed a more rapid decrease in detection accuracy than did the patient groups, though the control groups' absolute level of performance was significantly higher at all array size levels.

Correlational Analysis

It appears from the ANOVA conducted on the span of apprehension and the discrimination shift data that performance on these tasks distinguished between the patient and control groups. However, it is possible that different individuals within each group were producing the effects on the two tasks. Correlational analyses were conducted to investigate this possibility as well as to examine the hypothesized relationship between the speed of the extradimensional
shift and the subject's performance on the alternate uses task.

When the correlation matrix for the four levels of the span of apprehension task, the four discrimination shifts, and the number of responses on the alternate uses task was generated, fairly substantial negative correlations existed between the Span of Apprehension scores and the speed of the extradimensional shift (see Table 3). These correlations indicate that the individuals who were slow extradimensional shifters also did poorly at all levels of the span of apprehension task. The size of these correlations ranged between -.65, at the single letter level, to -.33, where eight distractors were present, with intermediate array sizes taking on intermediate values. Span of apprehension performance was essentially uncorrelated with either the reversal, the intradimensional shift, or the speed of learning the original problem.

The total number of responses on the alternate uses task correlated -.65 with the speed of the extradimensional shift and positively, though more modestly, with the span of apprehension task data.

A principal components factor analysis, summarized in Table 4, was carried out on the complete correlation matrix. This analysis yielded one factor which accounted for 40% of the total variance. This factor was defined by the four levels of the span of apprehension task, the extradimensional shift, and the number of responses on the alternate uses task.
Table 3
Correlation Matrix of All Experimental Variables

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Patient vs. Control</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) Parent vs. Child</td>
<td>0.020</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3) O L</td>
<td>0.323</td>
<td>0.130</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4) R</td>
<td>0.132</td>
<td>0.127</td>
<td>-0.063</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5) ID</td>
<td>0.178</td>
<td>-0.107</td>
<td>0.675</td>
<td>-0.085</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6) ED</td>
<td>0.578</td>
<td>0.052</td>
<td>0.281</td>
<td>0.329</td>
<td>0.032</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7) 1 Letter A</td>
<td>-0.705</td>
<td>-0.163</td>
<td>-0.394</td>
<td>-0.147</td>
<td>0.024</td>
<td>-0.576</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8) 3 Letters B</td>
<td>-0.561</td>
<td>-0.123</td>
<td>-0.164</td>
<td>0.015</td>
<td>0.165</td>
<td>-0.418</td>
<td>0.766</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9) 5 Letters C</td>
<td>-0.482</td>
<td>-0.154</td>
<td>-0.201</td>
<td>-0.149</td>
<td>0.139</td>
<td>-0.408</td>
<td>0.720</td>
<td>0.512</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10) 9 Letters D</td>
<td>-0.403</td>
<td>-0.228</td>
<td>-0.238</td>
<td>0.168</td>
<td>0.045</td>
<td>-0.249</td>
<td>0.549</td>
<td>0.442</td>
<td>0.449</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>11) Alternate Uses</td>
<td>-0.628</td>
<td>0.024</td>
<td>-0.360</td>
<td>-0.218</td>
<td>-0.179</td>
<td>-0.605</td>
<td>0.586</td>
<td>0.307</td>
<td>0.518</td>
<td>0.260</td>
<td>1.000</td>
</tr>
</tbody>
</table>

(All correlations greater than .30 are significant beyond the .05 level for this sample size.)
### Table 4

Factor Loadings from a Principal Components Analysis

<table>
<thead>
<tr>
<th>Factor Loadings*</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
<th>Factor 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Letter Matrix</td>
<td>.92</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3 Letter Matrix</td>
<td>.81</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Patient = 1 vs. Non-patient = 2</td>
<td>-.78</td>
<td>.26</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5 Letter Matrix</td>
<td>.77</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9 Letter Matrix</td>
<td>.65</td>
<td>0</td>
<td>.38</td>
<td>-.31</td>
</tr>
<tr>
<td># of Alternate Uses Responses</td>
<td>.65</td>
<td>-.32</td>
<td>-.39</td>
<td>0</td>
</tr>
<tr>
<td>ED Shift (Trials)</td>
<td>-.64</td>
<td>0</td>
<td>.49</td>
<td>0</td>
</tr>
<tr>
<td>ID Shift</td>
<td>0</td>
<td>.93</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Original Learning</td>
<td>-.27</td>
<td>.87</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Reversal</td>
<td>0</td>
<td>0</td>
<td>.90</td>
<td>0</td>
</tr>
<tr>
<td>Parent = 1 vs. Child = 2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>.95</td>
</tr>
<tr>
<td>Cumulative Proportion of Total Variance</td>
<td>.40</td>
<td>.55</td>
<td>.67</td>
<td>.77</td>
</tr>
</tbody>
</table>

*Loadings less than .25 have been replaced with zeros.*
The results of the present study are consistent with the proposed theoretical model of attention processes and discrimination learning. As was anticipated, the discrimination shift performances of both control groups were quite similar to those generally obtained in studies of normal populations, both with respect to the relative speed of the shifts and to the obtained mean trials to criterion for each of the individual shift problems. This consistency indicates that the procedures employed in this study were comparable to those in other studies of discrimination shift learning, and that the control groups are appropriate standards for comparison.

The major hypothesis of the study was that at least some individuals in a clinical population experience a reduction in their capacity to focus attention and use efficient hypothesis testing strategies in problem solving, while maintaining a "multi.look" attentional style. It was argued that the resulting attentional style, which could lead to adjustment difficulties like those experienced by hospitalized mental patients, should also produce significant and selective retardation in the speed of the extradimensional shift. Precisely such selective retardation was obtained in the patient group tested. Furthermore, since each subject was assessed on three
shift problems with no evidence of impairment on the other two, this retardation does not reflect a general performance deficit in the clinical population, but one which is specific to the requirements of the extradimensional shift problem.

Not only was the predicted extradimensional shift deficit obtained, but the absolute speed of the extradimensional shift obtained for the clinical population in this study is consistent with the speed of the extradimensional shift Nolan reported in earlier investigations of discrimination shift learning in schizophrenic populations (e.g., Nolan, 1974, Table 2). This study may therefore be seen as a theoretical and methodological extension of that research. The fact that a similar performance deficit was demonstrated in the mothers of the patients raises the possibility that deviant discrimination shift learning may prove to be a useful marker of vulnerability for (nonspecific) psychological impairment and that this deficit is independent of clinical state.

In a recent study (1981) Nolan presented data from a longitudinal investigation of remitted as well as chronic schizophrenic patients. From this study he concluded that schizophrenic patients' discrimination shift performances "reflected their current level of functioning rather than a permanent disability" and that the obtained attentional deficiencies show mean abatement over time. The data on which these conclusions were based are included in Table 5. Comparison of the data from Nolan's remitted subjects with the data obtained in the present study from both patients and mothers of patients highlights the similarity of these results. In Nolan's (remitted) group
### Table 5
Mean Log Trials to Criterion (Nolan, 1981)

<table>
<thead>
<tr>
<th>Shift</th>
<th>1974 Test</th>
<th></th>
<th></th>
<th>Current Test</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R</td>
<td>ID</td>
<td>ED</td>
<td>R</td>
<td>ID</td>
<td>ED</td>
</tr>
<tr>
<td><strong>Subgroups (a)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;Custodial&quot; (Boarding home only)</td>
<td>.87</td>
<td>.52</td>
<td>1.51</td>
<td>.87</td>
<td>.72</td>
<td>1.29</td>
</tr>
<tr>
<td>&quot;Autonomous&quot;</td>
<td>.80</td>
<td>.44</td>
<td>1.51</td>
<td>.88</td>
<td>.85</td>
<td>1.42</td>
</tr>
<tr>
<td></td>
<td>.88</td>
<td>.62</td>
<td>1.39</td>
<td>.42</td>
<td>.08</td>
<td>1.06</td>
</tr>
</tbody>
</table>

**Comparison Groups (b)**

<table>
<thead>
<tr>
<th>Study</th>
<th>Schizophrenics</th>
<th></th>
<th></th>
<th>Normals</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R</td>
<td>ID</td>
<td>ED</td>
<td>R</td>
<td>ID</td>
<td>ED</td>
</tr>
<tr>
<td>Nolan, Stoneking &amp; Hatch (1978)</td>
<td></td>
<td></td>
<td></td>
<td>.39</td>
<td>.31</td>
<td>.75</td>
</tr>
<tr>
<td>Nolan (1974)</td>
<td>.91</td>
<td>.52</td>
<td>1.30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smith &amp; Nolan (1973)</td>
<td></td>
<td></td>
<td></td>
<td>.35</td>
<td>.31</td>
<td>.70</td>
</tr>
<tr>
<td>Nolan (1970)</td>
<td>.90</td>
<td></td>
<td></td>
<td>.36</td>
<td></td>
<td>.74</td>
</tr>
<tr>
<td>Nolan (1968)</td>
<td>.91</td>
<td></td>
<td></td>
<td>.36</td>
<td></td>
<td>.74</td>
</tr>
</tbody>
</table>

*Partial change design reduced negative transfer.*
the speed of the intradimensional and reversal shifts at retest had indeed approached normal means. However, this effect was not characteristic of the speed of the extradimensional shift which probably continued to differ significantly from the normal extradimensional shift means.

Nolan employed different data analysis techniques and consequently did not view his similar extradimensional shift results as being especially meaningful in this population. His strategy was to use a college student mean $+ 2$ standard deviations and to interpret only values falling outside this range as indicative of pathology. (It should be noted that using these criteria, the significant findings for the discrimination task in the present study would not be judged pathological.) In light of the close similarity between the obtained descriptive statistics for the extradimensional shift for these two studies, the quite different inferential conclusions seem surprising, especially given the magnitude of the significance levels obtained in the present study.

It can be argued that the appropriateness of Nolan's approach to analysis of the discrimination shift data, acceptance of two standard deviations beyond the mean as the criterion for significance, rests on the confidence with which he is able to make two separate assertions: first, that the sample variances within the groups are comparable, and secondly, that the speed of extradimensional shifting is a characteristic which is normally distributed in the population. Both assumptions seem questionable. While it is true that violations of these assumptions would also have impact on
an analysis of variance, the F distribution is relatively more robust for deviations from the normal distribution and violations of the homogeneity of variance assumptions. In short, the use of a repeated measures ANOVA strategy such as that employed here, seems both more direct and informative than use of Nolan's criterion for pathological performance. The magnitude of the obtained performance differences makes them worthy of attention.

Based on the preceding analysis, it is argued here that the fact that similar deviant patterns of discrimination shift learning were observed in the patients, their mothers, and Nolan's (1981) remitted schizophrenics suggests that deviant discrimination shift learning is not simply reflective of general psychological disorganization, but is also sensitive to core processes and/or structures which are relatively independent of clinical state.

The results of the span of apprehension measure are somewhat more difficult to interpret. The performance of both control groups, mothers and offspring did not differ significantly. The performance of the patient group differed from the control groups at almost every level of matrix size. The mothers of the patients performed at a level between these two extremes. The model of attention which was proposed in this paper, however suggests that the most appropriate and informative analysis would be an examination of the slopes of the regression lines across matrix sizes, rather than absolute level of performance. The prediction was made that, due to loss of, or impairment in the focusing capacity, but maintenance of breadth of attention (clinically variously described as "being bombarded by
stimuli" or as a breakdown in the filter mechanism) the performance of the patient groups would be less affected by an increased matrix size (or increased numbers of distractors), even though their overall performance might be inferior to that of the control groups. If so, the slopes of the regression lines across matrix sizes, should be relatively flat. Just this result was obtained. However, although the predicted results were obtained, this data did not replicate the earlier studies using this procedure. Neale et al. (1969), Neale (1971), Asarnow (1977) and Asarnow and MacCrimmon (1978) all reported that although normal control and patients did not differ from each other on the small matrices (one or three letters), the patient groups showed a more rapid decrease in detection accuracy under the larger matrix size conditions (five, nine, or ten letters). Though not reported in any of these studies, a regression analysis of this data would yield steeper slopes in the clinical than in the control groups, a finding opposite that which was both predicted and obtained in the present study. One possible path toward a reconciliation of these diverse results might lie in the assertion of the proposed attention model that some patients (chronics), after losing their focusing capacity, subsequently defensively restrict their breadth of attention. If this were the population being sampled, then a marked decrease in detection accuracy over increasing matrix sizes would of course be expected. There is reason to believe that Neale employed such a population and therefore his results are not necessarily problematic for, or incompatible with, the assumptions of the model proposed here. Asarnow however, specified that he was
using acute and remitted samples and the results of his studies do therefore pose an apparent challenge to the predictions of the model being proposed.

Although attempts were made to replicate the procedures of Neale and Asarnow as closely as possible, there were several procedural differences which might account for the difference in obtained results. Apparently the span of apprehension task in the present study was more difficult across all matrix sizes. The performance of the control groups initially resembled that which had been obtained in the earlier studies, but as matrix size increased, accuracy of performance dropped off more rapidly than in the earlier studies. The overall performance of both patient groups was inferior to that obtained in earlier investigations, also. It is therefore possible that the flat slopes of the current patient group's regression lines indicate a ceiling effect, produced by a task which simply exceeded their capabilities. Further research is needed to clarify these issues.

In many ways, the magnitude of the correlations between the "laboratory" measures, the speed of the extradimensional shift and span of apprehension, and the more naturalistic, if fairly crude measure, the number of responses on the Alternate Uses Task, was the most surprising result of the study. The patient groups differed significantly from the control groups in supplying fewer responses to the alternate uses items. Although itself impressive, the quantitative analysis of the alternate uses task data misses much of the character, and obscures the qualitative differences, which
distinguished the responses of the patient groups.

As one might expect from an extrapolation from the attention model, some individuals, having learned to attend to a single dimension, find it exceedingly difficult to shift their attention to a new dimension on a discrimination shift task. It is these same individuals who exhibited similar "rigidity" in spontaneous production of functional associations to common objects. When the clinical subjects produced multiple responses to an item, and almost all did, they seemed unable to think of that item in a new or different way. For example, in response to the following: "Tell me all the different ways you can think of to use a newspaper," a typical control group subject listed the following: "Read it, wrap garbage in it, wrap presents, use it for insulation, make a hat, use it for paper mache, hit the dog with it." A typical patient group subject responded: "Read it, cut coupons out, cut recipes out." While it is true therefore, that the results of the present study did not support the predicted correlation between divergent thinking ability or creativity and psychological pathology, they are quite consistent with the proposed model of attention functioning. The alternate uses data strongly suggest that the discrimination shift differences from which attentional style changes are inferred may also reflect a subject's characteristic way of conceptualizing objects and events which may in turn produce the more florid clinical symptomatology associated with schizophrenia. This extrapolation would bring the proposed model into very close agreement with Bleuler's view of disruption of the associative process as being the "core" symptom from
which all other symptoms derive.

Demonstration of close correspondence between the performance of the patient group and their mothers on three quite different assessment procedures strengthens the confidence with which the centrality of attention dysfunction to schizophrenia may be asserted. Asarnow and MacCrimmon (1978) termed the cross-sectional study of the developmental stages of schizophrenic pathology (the premorbid, the acute, and the remitted stages) the convergence strategy. They reasoned that to the extent that all three of these groups exhibited a similar pattern of deviant functioning relative to control groups, that the effect could not be due to: the consequences of institutionalization, the stigmatizing effects of diagnoses, a generalized state of confusion associated with the acute onset of severe psychiatric symptoms, playing the "sick" role, or the effects of medication. The inclusion of the nondiagnosed mothers of patients in the present study may be viewed as a further methodological contribution to the convergence strategy, and one which, as was suggested earlier, encompasses all of the advantages while sidestepping many of the pitfalls of other research designs.

Thoughtful consideration of the existing data on epidemiology and genetic transmission of "schizophrenic-like" disorders leads one to the conclusion that the transmitted diathesis need not necessarily be expressed as a functional deficit, but may instead be expressed as a particular competency or skill. It is for example possible that as Lehman (1966) suggested, the individual who develops alternative coping strategies to deal with multiple incoming stimuli, may
be among the most creative members of society. It is not theoreti-
cally inconsistent with the propositions of the attention model that
some individuals might be able to use a wide span of attention to
their advantage. The mothers of the patients in the present study,
though demonstrating performance differences similar to those of
their offspring, were nonetheless continuing to function adequately
outside an institutional setting. Presumably they have developed such
alternative coping strategies. The identification of the competen-
cies associated with such strategies is just beginning to receive
empirical attention. Grunebaum et al. (1980) offered data which indi-
cated the existence of such competencies such as exceptional creati-
vity in a subgroup of the high-risk offspring of schizophrenic
parents. It is possible to conceive of permutations in the design
of the discrimination shift task which might illuminate these mechan-
isms if the theoretical assumptions of the model are valid.

The study reported in this paper addressed theoretical, empiri-
cal and methodological issues. Several of the methodological strate-
gies employed, including the selection of the mothers of patients as
subjects and the rejection of psychiatric diagnostic categories,
represent breaks with a rather lengthy tradition, though one of
demonstrated questionable utility. It is, for example, difficult to
argue convincingly that the massive amount of empirical research on
schizophrenia since the turn of the century has contributed much to
our understanding or treatment of the disorder. Similarly our
"advanced" diagnostic systems seem to have neither prognostic nor
treatment implications associated with the distinct disorders they
describe. Had the present study produced negative results, these methodological departures from tradition could have been raised as potentially damaging points of criticism. However, in large part the primary hypotheses were confirmed. The historical methodological obsession with the reliability of diagnostic classification and categorization, adopted by psychology from medicine and psychiatry, with virtually no attention to the validity of these hypothetical constructs, seems to reflect only the inertial nature of research in psychopathology.

The empirical data which were obtained are for the most part consistent with data obtained from earlier studies of both normal and clinical populations, adding weight to the logical arguments in support of the appropriateness of the methodological approach which was used. The empirical data were also essentially consistent with the a priori hypotheses derived from the propositions and assumptions of the proposed theoretical model of attention functioning. Of course, alternative explanations for the findings presented here are easily arrived at. The persuasive power of this theoretical formulation lies in the fact that it preceeded the empirical data, yet can account for data associated with a variety of other methodological approaches. Further, the significant results were limited to those which had been predicted and those predictions were confirmed in a "convergence" of the data obtained from the three quite diverse assessment procedures.
APPENDIX A

The diagnoses (final) of the patient subjects were as follows:

Adjustment Disorder
Avoidant Disorder
Borderline Personality
Dysthymic Disorder
Attention Deficit Disorder
Conduct Disorder
Schizoaffective Disorder
Schizophrenia, disorganized type
Schizophrenia, paranoid type - 2 subjects
Schizophrenia, undifferentiated type - 2 subjects
Atypical Psychosis
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