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AFKHAMI, MIRIAM MAGDALEN
THE OFFSPRING OF SCHIZOPHRENIC PARENTS:
PSYCHOLOGICAL AND PHYSIOLOGICAL MEASURES
RELATED TO ACTIVITY.

CITY UNIVERSITY OF NEW YORK, PH.D., 1979

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1979

THE OFFSPRING OF SCHIZOPHRENIC PARENTS: PSYCHOLOGICAL
AND PHYSIOLOGICAL MEASURES RELATED TO ACTIVITY

by

MIRIAM M. AFKHAMI

A dissertation submitted to the Graduate Faculty in
Psychology in partial fulfillment of the requirements
for the degree of Doctor of Philosophy, The City
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1979

This manuscript has been read and accepted for the Graduate Faculty in Psychology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

6/28/79
date

Steven J. Ellman
Chairman of Examining Committee

June 28 1979
date

Martin L. Hoffman
Executive Officer

Steven Ellman, Ph.D.

Louis Gerstman, Ph.D.

Gilbert Voyat, Ph.D.

Supervisory Committee

The City University of New York

Abstract

THE OFFSPRING OF SCHIZOPHRENIC PARENTS:
PSYCHOLOGICAL AND PHYSIOLOGICAL MEASURES
RELATED TO ACTIVITY

by

Miriam M. Afkhami

Adviser: Professor Steven J. Ellman

Studies examining the incidence rates of schizophrenia among the foster-home reared and adopted children of schizophrenic parents have substantiated the role of genetic factors in the etiology and transmission of schizophrenia. Studies of the development of these high-risk subjects have pointed to neurological dysfunction, particularly "soft-signs" of disturbance and to irregularities in activity and response. Retrospective research, examining the childhood records of individuals who later manifest schizophrenic symptoms, has also suggested that disturbances in activity and response may constitute a premorbid pattern reflective of a predisposition towards schizophrenia.

The present study involved the use of data from the Collaborative Study on Cerebral Palsy, Mental Retardation and Other Neurological and Sensory Disorders of

Infancy and Childhood, a comprehensive study conducted by the National Institute of Neurological and Communicative Disorders and Stroke (NINCDS). Researchers at the National Institute of Mental Health (NIMH), who are involved in a continuing series of studies using these data, established three groups of Index subjects and three groups of matched controls. Index groups consisted of children born to parents who had been diagnosed as definite schizophrenics; children of parents diagnosed as possible schizophrenics; and children born to parents who had been hospitalized for a non-schizophrenic psychiatric disturbance. Control groups were also formed, one for each of the Index groups, and subjects were matched for age, race, sex and socioeconomic status of the parents.

This study focused upon disturbances in muscle tone, activity and response. Study data described the functioning of these subjects, along these dimensions, from infancy until seven years of age. Summary measures were established in which individual variables were weighed and summed so as to provide more global descriptions of functioning.

An initial mass screening of the data suggested overall Index vs. all Control group differences on seven year measures of activity and response. Muscle

tone measurements and activity and response measures prior to age seven did not result in overall group differences. A comparison of each of the three Index groups to its matched control group, through the use of Mann-Whitney U test comparisons, revealed that only the offspring of definite schizophrenics (DSI) could be differentiated from their controls (DSC) based upon seven year activity and response performance. The DSI subjects manifested a general greater level of disturbances at age seven and a specific tendency towards emotional flatness, withdrawal, perseverative attention span, low activity level and behavioral rigidity.

An examination of the DSI group failed to provide significant seven year activity and response score differences related to sex of the diagnosed parent; congruence between sex of the child and sex of the diagnosed parent; and diagnostic subclassification of the parent.

The results served to provide a group of behavioral characteristics which specifically describe the functioning of the offspring of definite schizophrenic parents. Interpretations were offered in terms of genetic and environmental influences. Recommendations for future research were suggested.

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Finally, I would express my appreciation to my parents, who were always there when needed and who never failed to provide encouragement and support. To my husband, Stephen, without whom those long and difficult

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moments would have been unbearable, I offer my gratitude
and love.

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I. GENETIC FACTORS AND SCHIZOPHRENIA:
A REVIEW OF THE LITERATURE

The symptoms of the disorder which Bleuer labelled as schizophrenia in 1911 have been described in the literature for the past hundreds of years. Originally attributed to the effects of supernatural forces such as demonic possession, current confusion still remains regarding the etiology of this disorder. Today, schizophrenia is a highly prevalent and incapacitating disorder. The general incidence figure for schizophrenia has been estimated at approximately 1% (Buss, 1966). Cross-cultural studies of the lifetime expectancy for schizophrenia have been reviewed by Slater (1968) and include: Switzerland: 1.23%; Germany: .51%; Denmark: .69%; Finland: .91%; and Sweden: .81%. Analyzing such figures, Gottesman and Shields (1972) note a relatively good degree of cross-cultural concordance in general incidence rate. In view of the large number of people who are affected by this disorder it is not surprising that theories of schizophrenia have flooded the literature as researchers have attempted to comprehend the etiology of this disruption in mental functioning.

One avenue of investigation involves the study of genetic factors in schizophrenia. Proponents of gene-

tic theories propose that there is a genetic diathesis or predisposition towards the development of schizophrenia which may be inherited by individuals related to a person who has manifested schizophrenic symptoms.

The following survey will initially provide an examination of the research implicating the role of genetic factors in schizophrenia. This will be followed by a review of studies focusing upon a determination of possible expressions of the schizophrenic genotype. This literature will then be reviewed and examined in relation to the present study, an assessment of neurological and psychological factors related to activity level among the offspring of schizophrenic parents.

Genetic vs. Environmental Variables

Consanguinity Research

Consanguinity studies have aimed to estimate the relative involvement of genetic factors in schizophrenia. Early consanguinity research focused upon the incidence rates of schizophrenia among the relatives of schizophrenic patients. Reviewing this literature, Buss (1966) reports that the rates of occurrence of schizophrenia among the grandparents and grandchildren of schizophrenics is estimated at 4%. Siblings of schizophrenics have a range in incidence rate, vary-

ing from 5 to 14 %. A 16% incidence is reported among the offspring of one schizophrenic parent, while the incidence rate for the offspring of two schizophrenic parents varies from 39 to 68%. Describing these figures, Buss notes that as the degree of genetic closeness between schizophrenic patients and their relatives becomes higher, the expectancy rate for schizophrenia in those relatives also rises.

Discrepancies in incidence rates for schizophrenia among the relatives of schizophrenic patients have been reported. For example, Zerbin-Rudin (1967) lists a 12% incidence figure among the children of one schizophrenic parent in contrast to Buss' reported 16%. Such differences are usually ascribed to differing diagnostic standards and to differing sampling techniques. Thus, Rieder (1972) notes that a high degree of interrater reliability is not always achieved with regard to the diagnosis of schizophrenia. In his paper, Rieder then proceeds to provide a computation of morbidity risk estimates. He explains that morbidity risk involves an estimation of the eventual prevalence of "certain" or chronic schizophrenia among the offspring of schizophrenic parents based upon an incidence rate in a group who have not all reached the age of risk. The age of risk is defined as the per-

iod from 15 to 45 years of age. Utilizing the incidence rates provided in the European consanguinity research, the morbidity risk estimates for schizophrenia among the offspring of one schizophrenic parent was found to vary from 3.5 to 16.9%.

One avenue of consanguinity research specifically attempts to differentiate between genetic and environmental factors by comparing the concordance rates for schizophrenia among monozygotic (MZ) and dyzygotic (DZ) twin pairs. Since MZ twins share identical genotypes, dissimilarities between them are attributed to environmental factors. However, in contrast, it is noted that DZ twins are no more similar genetically than non-twin siblings of the same parent. Gottesman and Shields (1972) explain the rationale of this research strategy by writing that if genetic factors do play a role, the concordance rate among MZ twins should be higher than that found among DZ twins. Moreover, these authors do add that anything lower than 100% concordance among MZ twins would implicate non-genetic environmental factors.

Rosenthal (1971a) provides a review of the major twin studies of schizophrenia. He cites Kallman's (1946) study which found that while only 10 to 14.5%

of DZ twins were concordant for schizophrenia, among MZ twins, the concordance rate peaked at 59 to 86.2%. Gottesman and Shields (1966) report a 9.1% concordance among DZ twins and 41.7% concordance among MZ co-twin pairs. Summarizing his analysis of eleven twin studies, Rosenthal (1971a) notes that the MZ:DZ concordance rate ratio varies, in general, from 3:1 to 6:1 but that the concordance rate for schizophrenia in MZ twin pairs is consistently less than 100%. In summary, he concludes that the findings of the twin studies provide compelling but not conclusive evidence of the role of genetic factors in schizophrenia.

Reviewing the data offered in the consanguinity studies, it appears that genetic factors are, indeed, implicated in the etiology of schizophrenia. Differences in reported incidence rates among the relatives of schizophrenic patients are also evident. Rosenthal (1971a) explains this phenomenon in terms of variations in sampling procedures, diagnostic criteria and, in the case of the twin studies, differences in the method of zygosity determination. However, in spite of these variations the incidence rate for schizophrenia among individuals who are related to schizophrenics is always significantly higher than the general incidence rate of approximately 1% (Buss, 1966). Moreover, and

more compelling, as the genetic relationship becomes closer, the incidence rate also increases.

The Foster-Home and Adoption Studies

Heston (1971) contends that the incidence figures reported in the consanguinity studies do not merely reflect the effect of genetic factors, but instead, represent an intermeshing of genetic and environmental variables. He suggests that a closer degree of genetic relationship also implies a closer social relationship and wonders if genes or a maladaptive social environment is the critical factor in the high degree of concordance among the relatives of schizophrenic individuals. In an attempt to assess the relative strength of genetic variables in isolation from potentially critical characteristics of the environment which is produced by a schizophrenic parent, several studies have been designed using the adopted or foster-home reared children of schizophrenic parents as the experimental group.

Heston (1966) describes a research design aimed at assessing the adult adjustment of foster-home reared offspring of schizophrenic mothers who delivered while confined to an Oregon state psychiatric hospital. The study group contained only those individuals who had been permanently separated from their mothers at birth and

who had never resided with maternal relatives. Approximately one-half were originally reared in foundling homes, although most eventually experienced some type of placement within a family setting. The remainder were reared in foster homes. Control subjects, born to mothers without history of psychiatric illness, had also been separated from their biological mothers during the first month of life. Subjects were matched according to variables such as sex, type of placement and total amount of time spent in child-care institutions.

In this study, information about the subjects was obtained through an examination of school, public agency and credit records. In addition, most subjects received a psychiatric interview and psychological testing. Reviewing the data, Heston (1966) states that the results suggest that a genetic model of schizophrenia is appropriate. Schizophrenia was found only in the experimental group, the offspring of schizophrenic mothers. Five from a total of 47 offspring in the experimental group received a diagnosis of schizophrenia while none of the controls were so classified. Moreover, approximately 50% of the offspring of schizophrenic mothers displayed some sign of disturbance. The majority were diagnosed with disorders other than schizophrenia. These

included mental deficiency (IQ less than 70), sociopathic personality and neurotic personality disorder. In each instance the number of experimental subjects characterized by each disturbance exceeded the number of controls.

Moreover, in a subsequent study, Heston and Denny (1968) report that the remaining half of those subjects born to schizophrenic mothers could be described as rather successful in their adaptations to life. They appeared more creative than controls. However, the authors provide no data regarding the possible factors which could successfully differentiate those members of the experimental group who displayed creative adaptations from those who developed psychiatric disorders.

In order to control for potentially contaminating factors, Heston, Denny and Pauly (1966) compare those subjects who had been assigned to institutional care within foundling homes from birth for a mean period of 24.7 months to a matched group who had spent 0 to 3 months in such institutions and had been usually reared by relatives (paternal relatives in the case of the offspring of schizophrenic mothers). Children of normal and schizophrenic mothers were evenly distributed between the two study groups. The investigators found that the incidence of psychopathology was not

associated with institutional as opposed to familial rearing. Rather, the study pointed to the importance of genetic factors since the offspring of schizophrenic mothers accounted for the majority of the psychiatrically abnormal subjects within the institutional and familial groups.

The work of Heston and his colleagues did function to control for the effects of rearing by a schizophrenic parent and pointed to the role of genetic factors in schizophrenia. Further work in support of a genetic model of schizophrenia is supplied in the work of Rosenthal and his associates. These researchers sought to provide support for the role of genetic factors in schizophrenia by studying individuals who had been separated from their family at an early age through adoption. This continuing study is based in Denmark, in part, because of the presence there of three comprehensive registers, namely: (1) the Adoption Register of the State Department of Justice; (2) the Folkregister, containing the current address and household of every citizen; and (3) the Psychiatric Register of the Institute of Human Genetics which lists admissions to psychiatric units of general hospitals.

In the Adoptees study (Rosenthal, Wender, Kety, Schulsinger, Welner & Østergaard, 1968), researchers

scanned the Copenhagen census records for listings of the biological parents of infants who had been given up for nonfamilial adoption at an early age between the years 1924 and 1947. The names of approximately 10,000 individuals were obtained and then compared to listings in the Psychiatric Register and at Bispebjerg Hospital (a facility that does not report to the Register). Case records were obtained each time it was noted that an individual on the list had experienced a psychiatric illness which required hospitalization. Team investigators made independent diagnostic assessments and a consensus diagnosis was then reached. If there was full consensus that the parent's diagnosis fell within the schizophrenic range, the offspring was labelled an Index case. The Index group was comprised, in part, of the adopted children of parents whose diagnoses fell within the following categories: chronic schizophrenia (N=36); acute schizophrenic reaction (N=7); borderline schizophrenia (N=3); doubtful schizophrenia (N=1); and combinations of the above (N=11). In addition, the children of eleven parents who had been diagnosed as manic-depressive psychosis, possible manic-depressive psychosis and manic-depressive psychosis/schizophrenia?, were included to enlarge the experimental group and also to

provide a second Index subgroup so that the effects of specified classes of parental mental illness might be assessed.

Matched controls were selected from adoptees without record of psychiatric hospitalization in the biological parent. Variables included in the matching process were age, age at adoption and socio-economic class of the adoptive parents. Among the Index subjects there were 31 males and 38 females. Eighty-six controls were selected. All subjects were asked to participate in a 2 day examination which included an extensive psychiatric interview and psychological testing. Refusals were found to be evenly distributed between the Index and Control groups.

The results reveal that of the total pool of subjects, only one had experienced a psychiatric hospitalization. This individual was an Index case. The psychiatric interview served to result in the diagnosis of three subjects as schizophrenic and all three were within the Index group. Seven cases were diagnosed as borderline schizophrenia and six were Index cases.

The concept of the schizophrenic spectrum was developed to describe those disorders which appeared to be genetically related to schizophrenia. Schizo-

phrenic spectrum disorders include chronic, acute and borderline schizophrenia, as well as schizoid and inadequate personality. Summarizing the findings of the present study, the authors note that one-third of the Index group received diagnoses within the schizophrenic spectrum as compared to only 15% of the controls. In addition, the more severe diagnoses, including 3 cases of clearcut schizophrenia, were found in the Index group. It is noteworthy that the offspring of chronic schizophrenic parents obtained approximately the same incidence of schizophrenic spectrum disorders as those whose parents had received less severe diagnoses. In addition, the offspring of manic-depressive parents appeared to obtain an incidence rate of schizophrenia which served to raise the question of a possible genetic linkage between these two disorders.

In an attempt to compare the results obtained in the Heston and Rosenthal studies, Wender (1971b) re-analyzed their data, drawing only cases of clearcut diagnosed schizophrenia in offspring. Wender found that the results of both studies, pooled together, indicate that approximately 9% of the children of schizophrenic parents who are raised in foster or adoptive home settings are later diagnosed as schizophrenic, while, in contrast, none of the subjects who

were raised in similar settings, but whose parents were not so diagnosed, manifested clearcut symptoms of schizophrenia.

Thus, genetic factors in the etiology of schizophrenia would appear to be clearly indicated. However, opponents of the genetic model suggest that the effects of rearing by a schizophrenic parent upon the later development of psychopathology requires further attention and that although genetic factors may contribute somewhat, disturbed familial relationships are the primary etiological factor in the transmission of schizophrenia. In an effort to resolve this controversy, Rosenthal, Wender, Kety, Schulsinger, Welner and Rieder (1975) examined a group of 258 subjects who were subdivided into the following categories: (1) index adoptees, who had been separated early in life from a biological parent who had been diagnosed as schizophrenic or manic-depressive; (2) control adoptees, individuals who had been adopted at an early age but whose biological parents had not been classified as psychiatrically disturbed; (3) cross-fostered subjects whose biological parents had not been diagnosed as mentally disturbed, but who had been adopted by a family in which there was a parent who had experienced a schizophrenic or manic-depressive episode;

and (4) a nonadoptees group consisting of subjects who had been diagnosed as schizophrenic or manic-depressive and who had been reared by their biological parents for a minimum of the first fifteen years of life.

The subjects were all of adult age and each received a three to five hour psychiatric interview in which the quality of the parent-child relationships was discussed. At the end of the interview, a diagnostic impression of the subject was also formulated. Three judges independently sorted the information regarding the parent-child relationships into twenty categories and five judges sorted the data involving the degree of pathology in offspring. The twenty categories formed a continuum. The judges, performing each of the two sorts, achieved a good degree of reliability. Analysis of the data provided through the sorting procedure suggests that the two groups of subjects who had a biological parent who was diagnosed as schizophrenic or manic-depressive, the index adoptees and the nonadoptees, received the highest scores with regard to psychopathology in offspring. However, when the variable of rearing by a psychotic parent is examined, it is noted that there are no significant differences in degree of psychopathology in the child differentiating those subjects who had experienced the

familial environment that is produced by a psychotic parent, the nonadoptees and the cross-fostered subjects, and those who had not, the index adoptees and the control adoptees. Furthermore, an analysis of the association between parent-child relationships and the degree of psychopathology in offspring reveals that the rearing environment exerts a more powerful influence upon later psychopathology among individuals who do not have a genetic diathesis. However, among subjects who do have a biological parent diagnosed as schizophrenic or manic-depressive, the correlations between the quality of the familial relationships and subsequent psychopathology are far less compelling. Moreover, the authors indicate that although the index adoptees manifest higher levels of psychopathology than control adoptees, there are no significant differences between these groups with regard to the quality of the parent-child relationships. This is viewed as evidence in support of a genetic model since the elevated level of psychopathology among the index adoptees appears to reflect genetic rather than environmental influences.

In conclusion, the authors note that their finding of both greater psychopathology in offspring as well as poorer parent-child relationships among the

nonadoptees, or subjects who had been raised by their schizophrenic or manic-depressive biological parent, as compared to control adoptees, would not serve to isolate the effects of genetic as opposed to environmental influences. However, with the addition of the other comparison groups, the reported results suggest that genetic factors, indeed appear to be a primary etiological factor. Thus, results from the current study, such as the finding that nonadoptees were characterized by significantly poorer parent-child relationships than index adoptees and, yet, could not be differentiated from index adoptees with regard to the degree of psychopathology in offspring, serve to offer support to a genetic model.

Subclassifications of Schizophrenia and Schizophrenia
As Related to Other Psychiatric Disorders

The results of the foster-home and adoption studies served to substantiate the role of genetic factors in the etiology of schizophrenia. Moreover, these studies also suggested that the offspring of schizophrenic parents are characterized by an elevated incidence of psychiatric disorders other than schizophrenia. Heston (1971) notes that, in addition to schizophrenia, the index subjects exhibited a variety of other psychiatric disorders as adults.

Heston labels this range of disturbances as schizoid manifestations and divides this category into sub-grouping such as antisocial personality or schizoid psychopath; the schizoid with paranoid features; and the schizoid that is unable to meet the challenges of life. The work of Rosenthal, Wender, Kety, Schulsinger, Welner and Østergaard (1968) failed to confirm an increase in identical types of pathology among the offspring of schizophrenic parents. It is noted that schizoid personality was included within the schizophrenic spectrum by Rosenthal and his associates. In addition, manic-depressive psychosis was viewed as potentially bearing a genetic relationship to schizophrenia in that the offspring of individuals so diagnosed appeared to be characterized by an incidence rate of schizophrenia that was higher than that found among the general population.

In order to address themselves to the failure to find an increase in criminality and psychopathy, Rosenthal, et al (1968) suggest that differing environmental influences between the social climate of the United States and Denmark may have played a role. It is contended that the social climate of the United States, in which Heston's study was conducted, could result in an increased probability

of the development of certain types of non-schizophrenic psychopathology in individuals with an assumed diathesis. Moreover, it is also possible that prenatal influences may have contributed to the obtained differences. This is postulated since all of the experimental subjects in Heston's study were born to mothers who were psychotic and hospitalized at the time of delivery while, in contrast, only five of the Index subjects in the Rosenthal studies were born to mothers who had experienced a psychiatric admission prior to the birth of the child.

In an effort to assess the genetic linkages between psychiatric disorders within the schizophrenic spectrum, Kety, Rosenthal, Wender and Schulsinger (1968) utilized a variation of the original adoptees study to examine the presence and types of psychopathology among the biological and adoptive relatives of adoptees who had experienced an admission to a psychiatric facility. A list of such adoptees was obtained and, after the determination of consensus diagnoses, thirty-three cases were selected. These subjects had received diagnoses within the schizophrenic spectrum. Matched controls were selected. For each case in the Index

and Control groups a listing of biological and adoptive parents, siblings and half-sibs was established. Records of psychiatric hospital admissions as well as police and military records were searched for the names of these biological and adoptive relatives. When it was determined that a relative had experienced a psychiatric hospitalization, the case record was obtained and a consensus diagnosis determined.

The results indicate that out of the 150 biological relatives of Index cases, 8.7% received a diagnosis of schizophrenia, uncertain schizophrenia or inadequate personality as compared to only 1.9% among the biological relatives of controls. This difference was determined to be highly significant. Moreover, among the adoptive families, psychiatric illnesses were evenly distributed between the Index and Control groups. Thus, heredity rather than environment appears to be the critical factor.

In addition, subclassifications of the Index group were then considered. It was noted that among the biological relatives of sixteen adoptees diagnosed as chronic schizophrenic, there were seven cases within the schizophrenic spectrum including: 1 chronic schizophrenic; 3 borderline schizophrenics; 2 uncertain borderlines; and 1 inadequate personality. A similar range

was found among the biological relatives of individuals diagnosed a borderline schizophrenia. However, when the biological families of individuals diagnosed as acute schizophrenic reaction were examined not one case within the spectrum was obtained. Thus, the authors suggest that although chronic schizophrenia appears to have a clear genetic base and that borderline schizophrenia can be viewed as genetically related to schizophrenia, acute schizophrenic reaction appears to have little genetic loading.

In a later study, Kety (MH 15602) sought to broaden his information base by conducting actual psychiatric interviews of the biological and adoptive relatives. Independent, blind diagnoses of the relatives were performed. Analyzing the results thus obtained, Kety notes that there was a higher incidence of definite, uncertain and borderline schizophrenia among the biological relatives of adopted schizophrenics as compared to matched controls. However, there was no difference in the incidence of the diagnosis of schizoid or inadequate personality. Summarizing his findings, Kety suggests that it would appear that there is, indeed, a spectrum of disorders genetically related to schizophrenia and while this spectrum includes borderline schizophrenia, the data suggest that it

does not include acute schizophrenia and schizoid and inadequate personality.

High-Risk Research: The Offspring
of Schizophrenic Parents

Methodological Considerations Favoring This Research Design

The contribution of genetic factors to the development of schizophrenia which was suggested in the consanguinity research was clearly substantiated by subsequent studies of the foster-home reared and adopted children of schizophrenic parents. Once genetic influence had been isolated from environmental factors, researchers seeking to comprehend the etiology of schizophrenia began to focus increasing attention upon the study of children born to schizophrenic parents. This avenue of research, utilizing subjects who are at risk for the development of schizophrenia because of genetic loading was first developed by Mednick (1966) and continues to be one of the more popular research strategies employed in studies of schizophrenia.

The advantage of the study of such high-risk groups has been stressed by Mednick and Schulsinger (1970): They note that the three alternate forms of schizophrenia research involve: (1) observations of adult schizophrenics; (2) studies of families that have a schizophrenic member; and (3) examination of childhood

records of adult schizophrenics. They continue to highlight the difficulties encountered in each of these research plans. For example, studies of adult schizophrenics are potentially contaminated by the consequences of being schizophrenic. Examples of such potentially confounding variables would include medication and hospitalization. Moreover, studies of families with a schizophrenic member are criticized because families are altered by the experience of living and dealing with a schizophrenic. Thus, both these research strategies are insufficient in that they do not allow for a clear discrimination between the etiology and consequences of schizophrenia.

The use of childhood records data, describing the functioning of individuals who subsequently develop schizophrenia, addresses itself to this problem since the information on the subjects has been collected prior to the onset of schizophrenic symptomatology. However, childhood records are biased by the differing perceptions of various raters who are usually untrained in methods designed to enhance rater reliability. In addition, the researcher, utilizing childhood records, is limited to the material provided in the records and thus is not free to test potentially relevant hypotheses. Sampling biases may also affect childhood

records studies. For example, potentially confounding variables such as migration may not be adequately controlled for in the experimental design.

In contrast, high-risk research focuses upon the selection of individuals who, because of certain characteristics, are viewed as having an increased probability of developing schizophrenic symptoms. As a prospective research strategy, experimenters are free to choose the variables for study. It is also possible to have direct contact with subjects. Moreover, since the subjects have not yet developed schizophrenia, obtained differences between groups are free from the criticism that they reflect the consequences of schizophrenia. Anthony (1971) notes that there are many varied ways of conceptualizing the idea of enhanced risk, or elevated probability of deviant outcome. He suggests that an individual may be viewed as a member of a high-risk group because of genetic, constitutional, environmental, experiential or developmental factors.

In a review of current research in this area, Keith, Gunderson, Reifman, Buchsbaum and Mosher (1976), report that the two most commonly used methods of selecting high-risk samples involve the consideration of genetic factors or the presence of early symptomatic signs viewed as precursors of schizophrenia. They conclude

that of these two approaches, the genetic model is the most predominant in research planning. There are, indeed, a large number of studies examining the children of schizophrenic parents. The goal of such studies is to delineate differences in the course of development that would characterize the functioning of this high-risk group and that would contrast them from individuals whose parents are not schizophrenic. Thus, it is hoped to gain a clearer understanding of the manifestations of the schizophrenic genotype. In reviewing these studies, it becomes evident that each researcher or research team focuses upon a particular area of interest and examines subjects with regard to their functioning in this area. The studies to be presented will focus upon neurological functioning and behavioral characteristics which are viewed as critical to the individual's understanding of and adaptation to the world around him.

Neurological Findings and Schizophrenia

The question of neurological impairments among the offspring of schizophrenic parents has been the focus of extensive study. This choice of experimental focus gains validity in view of the finding that an increased incidence of neurological abnormalities, particularly "soft-signs" has been noted to characterize the function-

ing of adult schizophrenics (Rochford, Detre, Tucker & Harrow, 1970). Moreover, Pollack, Levenson and Klein (1968) studied the histories of 74 hospitalized schizophrenics and found that 47% contained suggestive or strongly suspicious evidence of minimal brain damage. In addition, Pollin and Stabenau (1968) note that when monozygotic twins are discordant for schizophrenia, the twin that develops schizophrenia was more likely to have experienced a central nervous system illness as a child.

Infant Mortality and Malformation

Infant mortality and malformation may, at times, be an expression of neurological impairment, although other factors certainly may also play a causative role. In an early study, Sobel (1961b) reviewed the records of 218 schizophrenic women who delivered while confined to New York State mental hospitals. Sobel obtained an 8.1% incidence of perinatal death, as compared to 3.6% nationwide according to the United States National Office of Vital Statistics. The rate of malformations among newborns was estimated at 3.2% among the offspring of schizophrenic women, in contrast to .8% among the general population. Sobel concludes that the offspring of schizophrenic women were characterized by an elevated incidence of deviant fetal development. However, the factors responsible for the mortalities and malformations

were not specified.

Another study of infant mortality and malformation among the offspring of schizophrenics, both mothers and fathers, was conducted by Rieder, Rosenthal, Wender and Blumenthal (1975). Data was obtained through the use of the Boston subsample of the Collaborative Study on Cerebral Palsy, Mental Retardation and Other Neurological and Sensory Disorders of Infancy and Childhood. The Collaborative Study was a prospective, longitudinal study conducted by the National Institute of Neurological Diseases and Stroke. In the Rieder, et al study, a list was obtained of all women who participated in the Boston study who had noted that either they or their husbands had experienced a psychiatric hospitalization. Hospital records were then obtained and initial, blind diagnoses made. A consensus diagnosis was then determined for each individual. The subjects were classified into three major groups, namely, schizophrenic, possible schizophrenic and other psychiatric disorders besides schizophrenia. The differentiation between definite and possible schizophrenic parent groups allows for an assessment of the potential effects of degree of diagnostic confidence upon obtained results. Moreover, in providing the last comparison group, it then becomes possible to obtain potential differences

between groups which can be specifically related to genetic loading for schizophrenia and not merely to the effects of any parental psychopathology.

Controls were selected for each subject. For a subject to be chosen as a control neither parent could have reported the experience of a psychiatric disorder. In addition, controls were matched with regard to race, number of fetuses, socioeconomic status, age of mother and number of prior pregnancies.

Reviewing the delivery data on 205 Index offspring and 410 controls (two for each subject in the Index group), a higher incidence of fetal and neonatal deaths was found to characterize the offspring of schizophrenics. Possible schizophrenic group offspring and offspring of individuals hospitalized for non-schizophrenic disorders were not found to have an increased incidence of fetal and neonatal deaths. Moreover, the authors report not only an elevated incidence of death but also of unexplained death among the offspring of schizophrenics. Fetal and neonatal deaths involving severe neurological malformations were also noted among the offspring of schizophrenics.

Neurological Impairment Among the Offspring of Schizophrenic Parents

An ongoing study of early neurological functioning

associated with schizophrenia has been conducted by Fish and her associates. Initially, Fish (1957) examined a random sample of babies attending a Well Baby Clinic and selected a group of subjects who exhibited certain deviant patterns of development which she viewed as indicators of vulnerability to schizophrenia. These criteria include a disturbed regulation of physiological patterns, homeostatic instability and growth patterns characterized by both retardation and precocity. Fish then presents a detailed longitudinal report on the development of one infant, the offspring of a schizophrenic mother, who had been chosen as most vulnerable to schizophrenia when he was one month of age. At five and a half years, this child, Peter, was diagnosed as schizophrenic (Fish, Shapiro, Halpern & Wile, 1965).

Fish's (1959) analysis reveals that Peter's biological development did not approximate the normative standards determined by Gessell and Amatruda (1947) while also differing from patterns indicative of either retarded or advanced development. The deviations noted involved disturbances in postural-locomotor development as well as retarded physical growth and autonomic instability.

In a subsequent study, Fish and Alpert (1962) examined the infants of schizophrenic mothers during

the mothers' confinement at various mental hospitals throughout New York State. The mothers had been hospitalized at least six months up to a maximum of twenty years and most had been free of phenothiazines for one to three months prior to delivery.

Examinations of the infants were scheduled for the first day of life, the fourth day and subsequent observations occurred at 1, 2, 3, 4, 7, 10 and 13 months. Yearly examinations were to follow. At the time of study, nine infants were in foster homes. Three resided with grandmothers. One was institutionalized in a foundling home.

The one and a half hour testing consisted of the Gessell examination, as well as exposure to a graduated series of stimuli, such as voice, touch, a pinprick and postural manipulation. Alterations in states of consciousness, ranging from extreme excitement to deep sleep; the relative amount of time spent in each state; and the ability to maintain an optimal state of responsiveness when confronted with external stimuli, were recorded.

Comparing the data thus obtained with that of Gessell and Amatruda (1947), the authors note that median trends within the study group conformed to clinical descriptions of expectable arousal states

during the first month of life. However, it was noted that three infants did exhibit excessively quiet behavior, with extremes of underactivity, relative absence of crying, minimal response to proprioceptive stimuli and hypotonia. A fourth infant displayed extreme irritability, frequent crying episodes and the inability to maintain a stable state of attentiveness. Three additional infants manifested less severe deviations. Alterations in activity level were suggested in the behavior of one infant who was excessively underactive during the early months of life but later became quite hyperactive. Reviewing these findings, Fish and Alpert suggest that these infants genetically loaded for schizophrenia, contained a subgroup of subjects who displayed evidence of early disturbances in nervous system functioning.

Recalling these early studies, Fish and Hagin (1972) write that in those infants chosen as particularly vulnerable to schizophrenia, disturbances in central nervous system functioning were noted. Even in the first month of life, irregularities in alertness and muscle tonus were observed.

Fish and Hagin then report the results of a study of these subjects in childhood. They relate the early deviations to subsequent visual-motor deficits

in childhood. They also note that their findings suggest that whether poor neurological integration among the infants of schizophrenic mothers results in deficits in childhood and the subsequent development of schizophrenia appears to be dependent upon the severity of the neurological deficit, as well as upon the characteristics of the caretaking environment.

Marcus (1974) reports the preliminary findings of a longitudinal study of neurological functioning in children born to schizophrenic parents in Israel. Subjects were chosen only after the diagnosis of the parent was independently confirmed. Fifty children born to schizophrenic parents and fifty matched controls between the ages of 7 and $14\frac{1}{2}$ years each received a neurological examination aimed at assessing both severe neurological impairment and subtle "soft-signs" indicative of a minimal brain dysfunction syndrome. Scores on individual items were summed in order to provide a total score of overall nonoptimal functioning.

In view of the hypothesis that schizophrenia is transmitted through a single dominant gene, the author reasoned that only 50% of the children of one schizophrenic parent should inherit this gene. He hypothesized that this gene could affect neurological function-

ing and thus, its effect would be manifested by a significantly greater degree of nonoptimal neurological functioning among the children who carried this gene.

To test this, the Index group, or the children of schizophrenic parents and the control group subjects were each ranked according to their overall score and the top half of each group (the high nonoptimal functioning subjects) were compared. The bottom 50% of the Index and control groups were also ranked within each group and compared. Results indicate a significant difference between the offspring of schizophrenics and controls in the first comparison, but not in the second, thus revealing not only a higher incidence of neurological impairment within a subgroup of the offspring of one schizophrenic parent, but also providing support for a single gene theory of schizophrenia.

Neurological Functioning and Behavioral Characteristics

Hanson, Gottesman and Heston (1976) focus upon neurological functioning and behavioral characteristics in an attempt to examine the course of development of a group of offspring of schizophrenic parents. Utilizing data provided in the Minnesota subsample of the Collaborative Study of Cerebral Palsy, Mental Retardation and Other Neurological and Sensory Disorders of Infancy and Childhood, these authors examine a series of developmental

indices descriptive of the functioning of a group of 116 children. The sample was divided in the following way: 33 children born into families in which one parent had experienced at least one psychiatric hospitalization and had received a consensus diagnosis of schizophrenia; 36 children born into families in which one parent had been diagnosed as having experienced a non-schizophrenic disorder which had lead to hospitalization; and a final group of subjects born to parents who did not have a history of psychiatric hospitalization. Subjects were matched with regard to age of mother, social class and number of prior pregnancies.

Examining the data provided in eight years of extensive neurological, as well as psychological, testing, the authors note that the offspring of schizophrenic parents were not characterized by a significantly greater number of those abnormalities that would be picked up through a standard neurological examination. Turning next to a consideration of psychological functioning, they add that cluster analysis of the behavior ratings of all subjects did reveal that the offspring of schizophrenics did tend to be described as more socially withdrawn, inhibited, irritable and occasionally aggressive with a flat affect.

These researchers then chose those indicators which they viewed as signaling increased vulnerability to schizo-

phrenia and compared groups with regard to these measures. The variables were: poor motor skills; large inconsistencies in performance on I.Q. or achievement tests; and "schizoid" behavior as noted on the four and seven year psychological examinations. "Schizoid" behavior was defined as apathy, withdrawal and flattened affect observed in individuals who, at times, can also display considerable irritability and negativism. The results revealed that only the offspring of schizophrenics obtained a "hit" on all three indicators. Indeed, 16.7% of these subjects were found to have poor motor skills, a large within person test score variance and "schizoid" behavior. The results suggested that these three indicators may form a premorbid symptom complex which may successfully differentiate the offspring of schizophrenics from other study groups.

Sameroff and Zax (1978) in a prospective, longitudinal research design, examine constitutional and environmental precursors of schizophrenia. These authors study pregnancy, delivery and the first four years of life of a group of offspring of schizophrenic mothers. The comparison groups consist of children whose mothers had either been diagnosed as neurotic-depressive or as a personality disorder and controls whose mothers were viewed as not mentally ill. Diagnostic statements were based upon an interview and case history. Nota-

tions were also made as to the chronicity of the maternal disturbance where applicable. The group of subjects whose mothers were viewed as not mentally ill were matched to the other groups using variables such as race, age, socioeconomic status and sex of child.

The outcome measures focus upon perceptual-motor, cognitive, affective and social functioning. Assessments are made during pregnancy and delivery as well as at 4, 12, 30 and 48 months.

Data analysis remains incomplete at the present time but the preliminary results, comparing groups up to thirty months of age, are noteworthy in that no significant differences are found to characterize the children of schizophrenics from children whose parents have not been so labelled. The authors stress that the initial, apparent differences between groups appear to be, in actuality, attributable to non-diagnostic factors, such as socioeconomic status and chronicity and severity of psychiatric disturbance rather than type. For example, although the offspring of schizophrenics seem to obtain poorer scores on psychometric tests during the first year of life, further analysis suggests that this lowered intellectual functioning is a function of severity rather than type of psychiatric disturbance. Moreover, when socioeconomic status is

examined, the results indicate that both cognitive and affective development up to thirty months of age, varies in relation to social class in that the children of lower class mothers are characterized by poorer levels of functioning irrespective of the presence of diagnosed maternal psychopathology. Moreover, the offspring of schizophrenics also fail to demonstrate a significantly greater irregularity or variability in development.

Reviewing the pregnancy and delivery data, the authors note that six infants, born to schizophrenic mothers were placed in adoptive or foster homes. From this six, four had been placed in intensive care nurseries and three had been premature or of a low birth weight. This subgroup of the infants of schizophrenics later obtained lowered I.Q. scores. Based on these data, Sameroff and Zax suggest that the children previously examined in the early adoption studies may have been atypical not only because of genetic diathesis but also because of constitutional and environmental factors. In conclusion, the suggestion is offered that early functioning is related to the intensity of maternal disturbance and to social class. Diagnostic classification does not appear to have critical differentiating value. However, the authors do note that studies

focusing upon later development, between the ages of four and seven years of age may be more successful in delineating specific characteristics descriptive of the functioning of the children of schizophrenics as opposed to other study groups. This time period is chosen in that it is during this stage that the child attempts to cope with and adapt to the environment that is produced by a schizophrenic family member. A child who is impaired will not be able to cope in a successful manner. The authors offer a transactional model of schizophrenia in which a child with a nonspecified constitutional vulnerability cannot cope with the environment which produces stress. The nature of the stress is left unspecified and the authors do not state whether they view the constitutional impairment to be the result of genetic factors.

Mednick and Schulsinger (1968), in one of the earlier high-risk studies, attempt to examine the course of development of a group of children born to schizophrenics. Their research design aims at comparing the functioning of 207 children of chronic schizophrenic mothers to that of 104 controls, born to parents who had not experienced psychiatric hospitalizations and were viewed as relatively free from psychopathology. The study was conducted in Denmark. Some subjects

resided with their adoptive families while others had been placed in foster or adoptive homes. Diagnostic statements were based on independent evaluations made by psychiatrists. Only the offspring of process schizophrenics were included in the experimental group.

The testing procedure involves an assessment of psychophysiological, intellectual, psychological, familial and school functioning. Information regarding the delivery and birth of the child was also amassed. The results reported in their initial paper suggest that the offspring of schizophrenics experienced more difficult births. In addition, their autonomic nervous system appears to be subject to quick and intense arousal. Autonomic responses, also tend to be overgeneralized. In addition, Mednick and Schulsinger note subtle disorders in thought processes among the offspring of schizophrenics which were not present among controls. The school data indicate that teachers tend to view the high-risk subjects as, indeed, more likely to become upset.

Reviewing the results, the authors describe the offspring of schizophrenics as individuals who can function at relatively appropriate levels as long as tensions remain at low levels. With the addition of even moderate stress, intense arousal follows. With-

drawal and passivity are reinforced as learned means of coping with heightened arousal. However, this avoidance is viewed as maladaptive in that it results in removal from the tension-producing situation and that, as a result, effective coping mechanisms are not established.

In a second analysis, also reported in this paper, Mednick and Schulsinger examine a small subgroup of the high-risk sample, namely those subjects who have, themselves, manifested psychiatric disturbances. These offspring are found to be notably different from the other subjects in that they have experienced more early loss as their mothers required lengthy psychiatric hospitalizations for more severe schizophrenic disturbances. These subjects were also more likely to display disruptive or aggressive behaviors. Autonomic functioning was more hyperlabile and hypersensitive.

In conclusion, the authors note that the results of the current study point to a series of characteristics differentiating the offspring of schizophrenics from controls and also delineate premorbid patterns related to the later development of schizophrenia. The schizophrenic thought disorder is viewed as a set of conditioned responses which allow an individual who has an impaired ability to deal with stress to escape from

stimuli which function to increase tension by re-directing attention upon a competing thought.

Attention and Arousal Among the Offspring of Schizophrenics

The Mednick and Schulsinger (1968) study served to suggest that impairments in the ability to focus attention and modulate arousal so as to allow effective perception, analysis and response, may characterize the offspring of schizophrenics. The literature is filled with references to attentional deficits among hospitalized schizophrenics, from the work of Kraepelin (1919) to recent works by Holzman, Levy and Proctor (1978) and Neale and Cromwell (1976). Utilizing a genetic high-risk model Asarnow, Steffy, MacCrimmon and Cleghorn (1978) study attentional functioning among foster children whose biological mothers were schizophrenics in comparison to the performance of foster children whose biological parents do not have a history of psychiatric disturbance. A third comparison group, containing children living with biological parents who did not have a history of psychiatric illness, was included to isolate the potential effects of foster home placement upon test performance. The subjects were adolescents between the ages of 12 and 18. Consensus diagnoses were established and groups were matched with regard to variables such as age, sex and school grade. The foster-home

groups were also matched for age at separation from biological family and number of previous placements. The study measures included a dichotic listening task; the Concept Attainment Test; the Span of Apprehension Test; a continuous performance test; the Spokes Test, a modification of the Halstead-Reitan Trails Test; the WAIS digit symbol test; and a measure of reaction time.

The results indicate that the high-risk subjects displayed an overall tendency to perform at poorer levels across all tasks. The measures which most successfully differentiated the offspring of schizophrenics from the other comparison groups were the most difficult version of the Spokes Test and those sections of the Span of Apprehension Test in which the target stimulus was imbedded in a more complex stimulus array. Moreover, on the Concept Attainment Test, a card sorting test in which subjects are required to determine the degree of relevancy and irrelevancy of stimulus dimensions, the high-risk subjects also obtained poorer scores than the controls.

In order to determine if there was a subset of the offspring of schizophrenics who were performing poorly across different tasks, the worst performing subjects on the three most discriminating measures were studied. It was found that seven of the ten offspring of schizophre-

nics received scores in the bottom third of both the complex versions of the Span of Apprehension and Spokes Tests and that five out of the seven also obtained scores in the bottom third on the Concept Attainment Test. The authors note that these results serve to suggest that there is, indeed, a subgroup of the high-risk children who are performing poorly on those measures which are of most value in discriminating the total high-risk group from controls.

The authors conclude that specific attentional deficits may be identified among the offspring of schizophrenics.

Retrospective Studies of Neurological and Behavioral Precursors of Schizophrenia

The studies of neurological functioning among the offspring of schizophrenic parents reviewed in the preceding section suggest that there may be a higher incidence of symptoms associated with faulty neurological integration among this genetically high-risk group. These studies also indicate that although gross neurological dysfunction may not always be found to be associated with a genetic diathesis for schizophrenia, subtle neurological impairments and certain deviant personality characteristics may be found among the offspring of schizophrenic parents. The results provided

in these studies may be compared to the data contained in retrospective research designs. Such retrospective research studies, in describing characteristics of subjects before the manifestations of schizophrenic symptoms, offer a view of the neurological and behavioral patterns which precede schizophrenia.

For example, Ricks and Berry (1970) examine the child guidance clinic records of 100 boys who were later diagnosed as schizophrenic. In accordance with genetic theory predictions, they found an elevated incidence of schizophrenic mothers among the mothers of these subjects. Moreover, these authors report that a large number of boys who later became chronic schizophrenics displayed either of two patterns: one, in which symptoms of hypo-activity and impaired attention span were common; and a second, characterized by hyperactivity, short attention span and over-reaction to frustration. Ricks and Berry state that the patterns of symptoms contained in each of these patterns serve to raise the question of neurological impairment. In addition, they note that social withdrawal was associated with the first pattern, while acting out behaviors were linked with the second. In contrast, although released schizophrenics could also be sub-divided into withdrawn and acting out groups, the symptoms suggestive of neurological impairment were

infrequently found to characterize the individuals in the released schizophrenics group.

In the Ricks and Berry (1970) study, only boys were included and the withdrawn, hypoactive pattern was found more frequently than the acting out, hyperactive symptom complex. In another childhood records study, Watt, Stolorow, Lubensky and McClelland (1970) examine the cumulative school records of 30 boys and girls who later developed schizophrenia and compared the findings thus obtained to the functioning of matched controls. In this study, the school records data were blindly coded and subsequently analyzed drawing on a factor analytic pattern analysis method. Reviewing their data the authors note that certain trends appeared present. For example, preschizophrenic boys, particularly those from the lower social classes, tend to be characterized by a pattern of unsocialized aggression, marked by hostility and irritability. In contrast, preschizophrenic girls appear more excessively socialized in that they had more academic initiative and were more dependable than controls. It was suggested that these girls were excessively inhibited and insecure in that they associate continued parental love with excessively conforming behavior.

Disturbances in Activity Level and Schizophrenia

The retrospective studies of Ricks and Berry (1970) and Watt, et al (1970) provide a view of the neurological and behavioral patterns associated with the later development of schizophrenia. When taken in conjunction with the earlier cited studies of offspring of schizophrenic parents, it appears that faulty neurological integration and a group of behavioral characteristics may reflect the manifestation of a genetic predisposition to schizophrenia.

Disturbances in the modulation of motor activity have been associated with both the premorbid pattern of boys who later develop schizophrenia (Ricks & Berry, 1970) and the offspring of schizophrenics (Fish and Alpert, 1962). Moreover, Ricks and Berry's work suggests that there may be a group of behavioral characteristics which are correlated with activity level. The existence of such an "activity level factor" has been suggested in the literature. Werry (1968); Stewart, Pitts, Craig and Dieruf (1966); and O'Malley and Eisenberg (1973) indicate that heightened activity level is associated with distractibility, impulsivity and increased emotional reactivity.

The specific activity level disturbance which has received the most attention in the literature is hyper-

activity. Studies of parents of hyperactive children reveal an elevated incidence of parental psychopathology (Cantwell, 1974). The type of parental disturbances reported has varied from schizophrenia to affective disorders and sociopathy (Wender, 1971a).

Attempting to isolate the effects of genetic and environmental influences, Morrison and Stewart (1973) performed a systematic psychiatric examination of the biological and adoptive parents of hyperactive children. Their findings reveal an elevated incidence of hyperactivity among the biological parents of hyperactive children, but not among the adoptive parents or matched controls. This would suggest the operation of genetic factors in the etiology and transmission of hyperactivity. Turning next to a consideration of the psychiatric status of the biological parents, they note that three disorders namely, alcoholism, sociopathy and hysteria, were found to be present.

The work of Morrison and Stewart (1973) failed to provide support for an association between schizophrenia and hyperactivity in offspring. This association might have been expected in view of the Ricks and Berry (1970) study which reported the presence of hyperactivity among boys who later were diagnosed as chronic schizophrenics. To explain this discrepancy, it may be suggested

that differing diagnostic criteria for hyperactivity may have been employed in the two studies. Moreover, it may also be that hyperactivity is one symptom that is manifested by individuals who will experience a wide range of outcomes. Thus, there may be a subgroup of hyperactive children in whom the hyperactivity is a manifestation of a premorbid pattern associated with the later development of schizophrenia. A random clinic sample of hyperactive children, such as the one studied by Morrison and Stewart (1973), may contain very few individuals who have a genetic predisposition towards schizophrenia or who will later manifest schizophrenic symptoms. Therefore, the possible relationship between schizophrenia and hyperactivity, if it indeed exists, may not be reflected unless the study group is specifically chosen to include individuals with an elevated probability of developing schizophrenia because of a genetic diathesis.

Addressing himself to the differing varieties of hyperactivity, Wender (1971a) provides an explanation for the range of psychiatric disorders associated with hyperactivity. Wender first defines a minimal brain dysfunction syndrome (MBD) in terms of disturbances in motor activity, primarily hyperactivity; perceptual-cognitive deficits, specifically short attention span

and poor concentration; learning difficulties; poor impulse control; emotional instability; and disturbed interpersonal relationships. He then states that MBD symptoms may result in varying psychiatric diagnoses in adulthood depending upon the prominent symptom in the MBD picture. Thus, the development of sociopathic trends would be associated with the predominance of impulsivity and poor social controls. In contrast, demandingness, concrete thinking and volatility would result in the later diagnosis of hysteria. However, should cognitive abnormalities and poor social functioning appear as the primary symptoms, the later development of schizophrenia would become more probable.

In concluding this section on activity level disturbances and the later development of schizophrenia, it is important to emphasize that both the Ricks and Berry (1970) and Fish and Alpert (1962) papers indicate that hypoactivity as well as hyperactivity are associated with schizophrenia. Indeed, in these studies, hypoactivity was more prevalent than hyperactivity.

The Comparative Effects of Parental Physical
and Mental Illness

The studies describing the development of the off-

pring of schizophrenic parents previously described suggest that this group is characterized by an elevated incidence of disturbances in neurological functioning and that behavioral disturbances, many of which appear related to activity level, also mark the functioning of this genetically high-risk group. The hypothesis has been advanced that the higher rates of disorder found among the offspring of schizophrenic parents may be attributable, at least in part, to the disruptive effects of any parental illness. To determine the validity of this argument, Ekdahl, Rice and Schmidt (1962) studied children who had experienced the hospitalization of a parent for either mental illness or for tuberculosis. This study focused only upon immediate reactions to parental illness and did not include follow-up examinations of the children. In his analysis of this work, Rutter (1966) notes that the hospitalization of a parent tended to pose similar problems for children, regardless of the reason for the hospitalization. Chronic mental or physical parental illness appeared related to the development of psychiatric disturbances in the children. Rutter concludes that there is a need for a more comprehensive study of the effects of parental illness upon children.

Such a study is provided in the work of Anthony (1968). Anthony developed a research strategy designed to compare

the effects of parental illness, either mental or physical, upon the development of offspring. Study groups were formed, consisting of families in which one parent was a diagnosed schizophrenic, and those in which a physically sick parent suffered from a subacute or severe physical illness, usually tuberculosis. Families were intact with members living together except for the period of hospitalization. A control group consisted of families without histories of parental hospitalization for any significant mental or physical illness. Families in all three groups were matched with regard to socioeconomic, educational and racial variables. A total of 480 children were studied. The number of subjects in the 6 to 10 year old group equaled the composite total for ages 1 to 5 and 12 to 17, the other two study age groups. The evaluation procedure involved a field study as well as clinical appraisal and experimental investigation, although the last was restricted to children between the ages of 6 to 10.

Psychiatrists studied the sick parent in terms of observable behavioral characteristics which could be perceived by the child, such as avoidance of contact, attacking behavior, reproach and distrustfulness. The presence of delusions or hallucinations was noted as well as any incongruities in thought, conation and affect. Measures

were obtained assessing the degree to which the sick parent was able to differentiate between the children. A composite estimate of psychiatric pathology in the sick parent was then plotted along a continuum ranging from process to reactive disorders.

A clinical evaluation of all family members followed. Children were evaluated in order to determine their knowledge of the parental illness; their belief in parental delusions and hallucinations, if present; and their involvement and identification with the ill parent. A global rating of the child's clinical status was obtained. This was plotted along a continuum of severity and predictions were made regarding the future development of schizophrenia in offspring.

The results indicate that a higher incidence of clinical disturbances were found among the children of schizophrenics as compared to the children of chronically physically ill parents. Moreover, analyzing parallel morbidity in schizophrenic parents and their offspring, it was noted that higher levels of severity of parental mental illness, as indicated by scores along the process end of the process-reactive scale, were associated with lesser degrees of disturbance in offspring. In addition, the children of schizophrenic parents tended to perceive attacking, threatening behavior as more alarming than

parental avoidance or lack of interest. Anthony (1971) reports that the data would suggest that reactive psychoses in the parent result in an immediate development of disturbance in offspring. In the case of the process psychoses, however, the effect appears to be postponed. The child seems more able to distance itself from the process psychosis parent, so that immediate severe disturbances might not be manifested. However, it is stipulated that the manifestation of pathology among the offspring of process parents would only be delayed, appearing at a later stage of development.

Through an analysis of the data provided, two specified clinical syndromes have been identified among the offspring of schizophrenic parents. The first, a genetically vulnerable prepsychotic syndrome, is characterized by a family diathesis and a predominance of constitutional factors such as low birth weight and puny body strength and body size. A heightened sensitivity to relatively minor stress and certain behavioral attributes such as suspiciousness, excessive day-dreaming and apprehensiveness were also noted. The prepsychotic pattern was found among both the offspring of schizophrenic mothers and fathers and the symptoms were generally not affected by separation from the sick parent.

In contrast, the development of the parapsychotic

syndrome appeared to be contingent upon certain environmental variables. Higher degrees of subsequent pathology were discovered to be associated with instances of symbiotic relationships between mother and child in which the child was directly involved in the parent's symptomatology. Disturbances in the child mirrored those in the parent and the dissolution of the mother-child unit through separation generally resulted in the remission of symptoms in the child.

Moreover, a third clinical group was noted, consisting of children who suffered from transient situational disturbances, neurotic reactions or anti-social behavior. These maladjustments were viewed as reactive to the stresses of parental illness. Such disorders tended to disappear with separation from the sick parent.

Recapitulation

In this chapter studies illustrating the operation of genetic factors in schizophrenia have been presented. In addition an attempt has been directed towards delineating possible manifestations of the schizophrenic genotype among the offspring of schizophrenic parents. Studies utilizing the childhood records of individuals who later develop schizophrenic symptoms have also been reviewed. The data provided in these studies serve to raise the question of neurological disturbances in activity level

and muscle tonus as possible early expressions of a predisposition towards schizophrenia. Moreover, it also appears that a group of certain behavioral characteristics, related to activity level, may also characterize the functioning of individuals at risk for the development of schizophrenia due to a genetic diathesis.

For example, the consanguinity studies pointed to the role of genetic factors in schizophrenia since it was noted that individuals who were related to a schizophrenic were characterized by a higher incidence rate for schizophrenia than the general population. Moreover, the incidence rate among family members of a schizophrenic tended to increase as a function of the degree of genetic closeness. Although these studies suggested that genetic factors were operating in schizophrenia, the criticism was raised that the heightened incidence rate among individuals related to a schizophrenic might reflect the operation of environmental rather than genetic factors.

Developed in response to this problem, the foster-home and adoption studies sought to examine the incidence rate among individuals who had been permanently separated from their schizophrenic parents at an early age. Although the subjects in these studies had been isolated from interaction with their schizophrenic parents, they were characterized by a significantly higher inci-

dence rate for schizophrenia than the general population. Thus, genetic rather than environmental influences were viewed as the critical factor.

These studies served to substantiate the role of genetic factors in schizophrenia. Moreover, it also appeared that the offspring of schizophrenic parents tended to be characterized by the development not only of schizophrenia but also of other psychiatric disorders. The concept of the schizophrenic spectrum was developed in order to include those disorders which were viewed as genetically related to schizophrenia. Further study served to suggest that although chronic and borderline schizophrenia has a clear genetic base, acute schizophrenia and inadequate personality may not.

Once the role of genetic factors in schizophrenia had been substantiated, researchers attempting to comprehend the etiology and transmission of this disorder began to focus increasing attention upon the study of children born to schizophrenic parents. The goal of these studies was to delineate differences in the course of development which would characterize the offspring of schizophrenics, as opposed to matched controls, and thus gain a clearer understanding of the manifestations of the schizophrenic genotype. The results of these studies suggest that neurological dysfunction, particularly subtle "soft-

signs" of disturbance, characterize the functioning of this genetically high-risk group. Disturbances in the modulation of motor activity have been noted among the offspring of schizophrenic parents as well as among children who later develop schizophrenic symptoms in adulthood as revealed through retrospective research. Irregularities in muscle tonus were also found. Moreover, researchers suggested that there appeared to be a group of behavioral characteristics related to activity level which may constitute a premorbid pattern reflective of a predisposition towards schizophrenia. These behavioral characteristics include frustration tolerance, emotional reactivity and impulse control. In addition, the disturbance in motor activity which has received the most attention in the literature is hyperactivity. Although studies of the role of genetic factors in hyperactivity have generally failed to note a clear relationship between hyperactivity and schizophrenia, it has been postulated that hyperactivity may be a symptom which may be caused by a variety of etiological factors. Therefore, a clinic population of hyperactive children would only contain a few individuals whose hyperactivity might reflect a genetic predisposition towards schizophrenia. Moreover, hypoactivity as well as hyperactivity have been hypothesized as suggestive of a vulnerability to schizophrenia.

Moreover, a review of the literature also suggests that studies of high-risk groups may be characterized by varying findings depending upon the particular sample chosen for examination. For example, significant differences were found between the premorbid personality patterns manifested by boys as opposed to girls who later developed schizophrenic symptoms. Boys revealed more unsocialized aggression, while girls were more overinhibited. Moreover, since some critics contend that certain non-genetic biological factors might be transmitted by actively schizophrenic mothers to their offspring, an examination of the course of development of offspring of schizophrenic mothers as opposed to fathers could potentially reflect differences attributable to such a non-genetic biological influence. Furthermore, since the incidence figure for offspring of one schizophrenic parent is approximately 12% (Zerbin-Rudin, 1967) while the figure for offspring of two schizophrenic parents rises to an estimated 36 to 46% (Rosenthal, 1971a), as the level of genetic loading increases one might expect that the amount of disturbances in a high-risk group also to increase.

In conclusion, it is noted that critics of high-risk research contend that even a higher incidence of abnormalities among the offspring of schizophrenic parents

might not reflect a schizophrenic genotype. Rather, the hypothesis has been advanced that such higher rates of disorder may be attributable, at least, in part, to the disruptive effects of any parental illness. Anthony (1968; 1971) does report a higher incidence of disturbances among the offspring of schizophrenics as opposed to the offspring of chronically physically ill parents. With regard to the potentially differential effects of various types of psychiatric disturbance and the effect upon the child, the need for additional studies of the comparative effects of schizophrenia in the parent as opposed to non-schizophrenic parental disorders, such as Rieder, et al (1975) performed, becomes highlighted.

II. QUESTIONS INVESTIGATED IN THE PRESENT RESEARCH

The purpose of the present study is to examine neurological and psychological variables associated with activity and response among the offspring of schizophrenic parents. The literature suggests that individuals related to a schizophrenic are characterized by a greater probability of developing schizophrenic symptoms than the general population even when potentially critical environmental influences are controlled for in the experimental design. Thus, a genetic diathesis towards schizophrenia has been postulated. Researchers attempting to comprehend the manifestations of this schizophrenic genotype have noted that disturbances in the quality and level of motor activity as well as abnormalities in muscle tone have been noted among the offspring of schizophrenics. Retrospective studies of individuals who later develop schizophrenia have also pointed to the importance of disturbances in activity and response to environmental stimuli as a possible premorbid symptom complex reflective of vulnerability to schizophrenia.

The present study attempts to address itself to these findings and the questions which have been generated by past research. Its major goal is to determine if irregularities in muscle tone and disturbances in the quality and level of activity and in environmental

response are, indeed, related to the schizophrenic genotype. Thus, the functioning of these subjects will be compared to that of matched controls whose parents have not experienced a psychiatric hospitalization.

In order to examine the possible effects of the degree of diagnostic confidence upon performance of offspring, there will also be a group of offspring born to parents who have been diagnosed as possible schizophrenics and the functioning of these children will also be compared to that of matched controls.

Moreover, in order to determine whether any obtained disturbances in offspring are specific to children whose parents have been diagnosed as schizophrenic, a third comparison group will consist of offspring whose parents have been diagnosed as exhibiting symptoms of a non-schizophrenic psychiatric disturbance and the performance of these subjects will also be compared to that of matched controls.

In addition, a secondary objective of the current study is to examine, within the offspring of schizophrenics, the specific effects of sex of child; sex of parent; congruence between sex of child and sex of parent; and diagnostic sub-type of schizophrenia in the diagnosed parent, upon performance on the study measures.

In relation to these objectives, the study attempts to answer the following questions:

I. Are disturbances in muscle tone, activity and response associated with the schizophrenic genotype?

A. Thus, will the offspring of schizophrenics be characterized by a significantly greater number of such disturbances when compared to matched controls?

B. Are all the study measures equally effective in differentiating the offspring of schizophrenics from matched controls or are some measures more effective than others?

C. Do the offspring of schizophrenics tend to function at significantly better or poorer levels on the study measures at any one specified point in time?

D. If significant differences emerge between the offspring of schizophrenics and matched controls, is this attributable to the effects of any parental psychopathology or specific to the offspring of schizophrenics? Thus, will the offspring of schizophrenics exhibit a greater level of disturbances on the study measures when compared to matched controls, while the offspring of parents diagnosed as having a non-schizophrenic psychiatric disorder would not be differentiated from their set of matched controls?

E. Is the degree of confidence in the diagnosis

of schizophrenia related to performance on the study measures? Do the offspring of parents diagnosed as definite schizophrenics function at poorer levels when compared to matched controls than the offspring of parents diagnosed as possible schizophrenics do when they are compared to their matched controls?

II. Focusing only upon the offspring of parents diagnosed as definite schizophrenics, do significant sub-divisions of this group emerge based upon performance on the study measures?

A. Are there significant differences between male and female offspring with regard to their scores on the measures chosen for examination?

B. Does the sex of the diagnosed parent affect scores among the offspring in the definite schizophrenic group?

C. Is there any relation between sex of the diagnosed parent and sex of the child that affects performance on the study measures? In terms of identification, does congruence between the sex of the child and the sex of the diagnosed parent result in significantly poorer functioning than noncongruence?

D. The literature suggests that acute schizophrenia may not be genetically related to other types of schizophrenia. Since the current study assumes that the

performance of subjects in the definite schizophrenic group will, at least in part, reflect a genetic diathesis, will the offspring of parents diagnosed as acute schizophrenics obtain significantly better scores than the offspring whose parents have been diagnosed as chronic, chronic schizoaffective or borderline schizophrenia?

E. A disturbance which is chronic may be viewed as more severe and potentially more harmful in its effects upon the developmental process than a psychiatric disturbance which is not labelled as chronic. Will the offspring of parents diagnosed as chronic and chronic schizoaffective schizophrenia obtain more pathological scores on the study measures than the offspring of parents who are diagnosed as borderline or acute schizophrenia?

III. METHODS AND PROCEDURES

The Perinatal Research Branch of the National Institute of Neurological and Communicative Disorders and Stroke (NINCDS) developed the Collaborative Study on Cerebral Palsy, Mental Retardation and Other Neurological and Sensory Disorders of Infancy and Childhood in order to obtain a composite picture of the course of development of approximately 60,000 infants. Women attending prenatal clinics at various hospital centers across the nation were interviewed and extensive medical, genetic and socio-economic histories obtained. These women received frequent examinations and the data describing their pregnancies and subsequent deliveries were collected. After delivery, regular pediatric, neurological and psychological examinations of the child were scheduled up to the seventh year of life.

The Perinatal Research Branch of NINCDS has allowed the Laboratory of Psychology, National Institute of Mental Health (NIMH), to utilize the data collected at the Hospital for Women and the Children's Hospital Medical Center in Boston. NIMH is currently involved in a series of studies, examining the development of offspring born to schizophrenic parents, using the Boston NINCDS data.

The present study involves the use of a segment of

the Boston subsample data and is conducted with the approval of NIMH and NINCDS.

Subjects

The subjects in the present study represent a segment of the Boston subsample of the Collaborative Study. The NINCDS study did not involve any specific hypotheses regarding schizophrenia. The study data did include a history, provided by the mother upon her first visit to the clinic in which she was asked about the psychiatric history of her husband and herself. Researchers at NIMH pooled together a listing of all cases in which an expectant mother had indicated that either she, or the child's father, had experienced a psychiatric hospitalization. Records were then obtained from each of the hospitals specified. Independent and then consensus diagnoses were determined by NIMH researchers. The complete details of the diagnostic procedure was noted by Rieder, Rosenthal, Wender and Blumenthal (1975).

After the establishment of consensus diagnoses, three sub-groups of Index subjects were formed. In each of these Index groups, a mother, father, or both parents had experienced a psychiatric hospitalization prior to the child's birth and had been given a

consensus diagnosis by NIMH researchers.

Index Groups

Definite schizophrenic index: This group contains offspring born to mothers, fathers, or to two parents who received a diagnosis of definite schizophrenia. This group number 86 offspring whose parents were given any of the following consensus diagnoses: chronic schizophrenia; acute schizophrenia, chronic schizoaffective schizophrenia; borderline schizophrenia; schizoaffective schizophrenia: single episode; schizoaffective schizophrenia: recurrent episodes; possible chronic schizophrenia with definite schizophrenic episode(s); and borderline schizophrenia with definite schizophrenic episode(s). For further descriptions of the definite schizophrenic index group, see Appendix A.

Possible schizophrenic index: This group contains offspring born to mothers, fathers or two parents who are diagnosed as possible schizophrenic. This group includes 59 offspring whose parents received consensus diagnoses identical to those listed for the previous group, except that they are preceded by the word "possible" to convey some degree of uncertainty with regard to the diagnosis. In addition, this group also contains subjects whose parents received diagnoses of

schizophrenic spectrum personality (schizoid, paranoid, inadequate and psuedopsychopathic) and possible schizophrenic spectrum personalities.

Other diagnoses index: This group consists of 55 offspring whose mothers, fathers or both parents experienced a psychiatric hospitalization but who are not viewed as schizophrenic or possible schizophrenic. Diagnoses which resulted in this classification include: character disorder; neurosis; manic-depressive illness; depressive character disorders; depressive neurosis; and alcohol addiction with psychosis.

Control Groups:

All controls were chosen from the Boston subsample of the NINCDS project. The control groups were selected by matching each of the individuals in the three Index groups to a control subject with the following variables employed in the matching process: age of offspring; sex of offspring; race; and socio-economic status of the parent. Excluded from the control groups were individuals whose parents had reported a history of psychiatric illness.

Definite schizophrenic control: This group contains 86 subjects each of whom was matched to a subject in the definite schizophrenic index group.

Possible schizophrenic control: This group contains

59 subjects, each of whom was matched to a subject in the possible schizophrenic index group.

Other diagnoses control: This group contains 55 offspring each matched to a subject in the other diagnoses index group.

Additional Data

Additional data describing the subjects has also been obtained. These involve the sex of the offspring and, when appropriate, the sex of the diagnosed parent; the number of parents diagnosed; the presence of organic involvement; and the presence of any history of alcoholism in the diagnosed parent.

Modification

Subsequently, two subjects, one definite schizophrenic index group subject and its matched control, were dropped from the study. These subjects had been omitted from subsequent NIMH lists and it was noted that all data on these subjects that was relevant to the current study, had been coded as missing. This resulted in a decrease in the number of subjects in both the Definite Schizophrenic Index and Definite Schizophrenic Control groups to 85 each.

Procedure

Given the combined Index and Control groups, 398, in toto, the following measures have been collected for

all subjects utilizing the Boston subsample of the NINCDS project. For actual scoring measures and rating scales, see Appendix B.

Muscle Tone Measures

These measures were taken from the following examinations: the Neonatal Neurological Examination; the Four Month Pediatric Examination; the One Year Neurological Examination; and the Seven Year Neurological Examination. Muscle tone was scored on a five-point scale, ranging from hypotonic to hypertonic. In general, the parts of the body tested were the upper extremity, lower extremity, neck and trunk.

Disturbances in Activity and Response

Body movement: Tremulous body movements, if present, scored as slight, moderate or marked. This measure was taken from the Neonatal Neurological Examination.

Activity level: As taken from the Bayley Examination at eight months, this measure involved scores on a five-point scale which ranged from hypoactive to hyperactive. On the Four and Seven Year Psychological Examinations, activity level was scored on a five-point scale ranging from extreme inactivity to extreme overactivity.

Behavioral descriptions focusing upon response to environmental stimuli: The following measures taken from the listed examinations have all been scored on a five-point scale. From the Bayley Examination, the study measures are: speed of response to objects; intensity of response to objects; duration of response to objects; and intensity of social response. From the Four Year Psychological Examination, the study measures are: emotional reactivity; irritability; attention span; and nature of activity. The measures taken from the Seven Year Psychological Examination are: emotional reactivity; attention span; frustration tolerance; and nature of activity.

Summary Measures

In order to provide for generalized descriptions of functioning and to allow for comparisons at different age levels, summary measures were created. In the formation of these summary measures, the subjects' scores on sub-groups of the previously listed individual variables were weighed according to deviancy from normal values.

Muscle tone summary measures: The muscle tone data involved scores on a five-point scale in which the mid-point, or a score of "3" represents normal functioning. The values of "1" and "2" indicate definite hypotonicity

and questionable hypotonicity, respectfully. The value of "4" represents questionable hypertonicity and "5" indicates definite hypertonicity. Measures at each age level involve assessments of the tone of various parts of the body. Given this information, it is possible to calculate the summary measure of Max_1 in the following manner. One begins with the muscle tone measures as taken from the Neonatal Neurological Examination and one point is assigned for each score of questionable hypertonicity and two points for each score of definite hypertonicity involving any part of the body that was included in the muscle tone testing. Similarly, the summary measure of Min_1 represents the sum of scores derived by adding one point for each indication of questionable hypotonicity and two points for each notation of definite hypotonicity on the Neonatal Neurological Examination. Thus, if a total of five parts of the body are tested for muscle tone on the Neonatal Neurological, the maximum weighted score for Max_1 or Min_1 is ten. This procedure was followed in the creation of all of the muscle tone summary measures. These are the resulting muscle tone summary measures:

Max_1 = weighted score for hypertonia as scored on the Neonatal Neurological Examination

Min_1 = weighted score for hypotonia as scored
on the Neonatal Neurological Examination

Max_2 = weighted score for hypertonia as noted
on the Four Month Pediatric Examination

Min_2 = weighted score for hypotonia as noted on
the Four Month Pediatric Examination

Max_3 = weighted score for hypertonia as noted on
the One Year Neurological Examination

Min_3 = weighted score for hypotonia as noted on
the One Year Neurological Examination

Max_4 = weighted score for hypertonia as noted on
the Seven Year Neurological Examination

Min_4 = weighted score for hypotonia as noted on
the Seven Year Neurological Examination

In addition, the following measures of total muscle
tone functioning at each age level, regardless of the
direction of deviancy from normal values, were created:

$Muscle_1$ = Max_1 and Min_1

$Muscle_2$ = Max_2 and Min_2

$Muscle_3$ = Max_3 and Min_3

$Muscle_4$ = Max_4 and Min_4

The final muscle tone summary measure created was
 $Musctot$ which represents the sum of scores on $Muscle_1$,
 $Muscle_2$, $Muscle_3$ and $Muscle_4$. $Musctot$ indicates a
subject's total muscle tone abnormalities, weighted and

scored across all four age levels for which muscle tone measures were available.

Activity and response summary measures: A second set of summary measures were computed, focusing upon activity and response measures, or the total group of study variables, excluding muscle tone. In the computation of these summary measures, the same type of weighing procedure used in the formation of the muscle tone summary measures was employed. Thus, weighing according to deviancy from the mid-point of the scale, or normal values was utilized. Data, here, usually represented scores on a five-point scale. Therefore, for example, the summary measure of Maxact_2 reflects the sum of scores obtained by a particular subject on the study variables taken from the Bayley Examination which were on the +3 end of the scales. In the weighing procedure, one point is given for each score of "4" and two points for each score of "5". Similarly, Minact_2 represents the weighted sum of scores from the -3 end of the scale across all the variables studied on the Bayley Examination. Weighing here was again based upon deviancy from normal values with one point scored for each score of "2" and two points for each score of "1". In those cases where an alternative score of "6",

indicating a high degree of variability in performance was given, one point was added to both Minact_2 and Maxact_2 .

The only exception to this scoring system involved the measures of duration of response as taken from the Bayley Examination and duration of attention span as noted on the Four and Seven Year Psychological Examinations. As can be observed from the actual scales for these variables as presented in Appendix C, the high and low values of this scale do not appear logically consistent with those of the other behavioral descriptions. To remedy this, the labels for this scale were reversed. The corresponding numerical values were also reversed. Through this procedure, a score of "1" which previously indicated brief attention span was transformed into a score of "5" but since the labels were also reversed, this score of "5" continues to indicate brief attention span.

The following activity and response summary measures were created:

Maxact_2 = weighted score reflective of the sum of scores on the +3 end of the scale on the Eight Month Bayley.

Minact_2 = weighted score representing the sum of scores on the -3 end of the scale on the Eight Month

Bayley.

Maxact₃ = weighted score representing the sum of scores on the +3 end of the scales on the variables examined on the Four Year Psychological Examination.

Minact₃ = weighted score representing the sum of scores on the -3 end of the scales on the variables examined on the Four Year Psychological Examination.

Maxact₄ = weighted score reflecting the sum of scores on the +3 end of the scales on the measures studied on the Seven Year Psychological Examination.

Minact₄ = weighted sum of scores on the -3 end of the scales across all variables taken from the Seven Year Psychological Examination.

In addition, the following summary measures of total activity and response deviancy from normal values at each age level, regardless of the direction of the deviancy, were created:

Active₂ = Maxact₂ and Minact₂

Active₃ = Maxact₃ and Minact₃

Active₄ = Maxact₄ and Minact₄

The final activity and response summary measure of Activtot was created by summing the scores for Active₂, Active₃ and Active₄. To this was added the subjects' scores on tremulousness as taken from the Neonatal Neurological Examination.

Total functioning summary measure: The summary measure of Supertot was created. Supertot is the value obtained by summing Musctot and Activtot. Therefore, Supertot is a weighted measure which represents a subject's total score for abnormalities as noted across all study measures.

IV. RESULTS

The initial phase of data analysis involved a comparison of all Index to all Control subjects on each of the previously defined summary measures. This resulted in a series of 23 t tests. All subjects with data across all measures coded as missing or at normal values were excluded from this analysis. Indeed, all statistical comparisons were restricted to subjects who revealed some deviancy from normal values on at least one study variable. Since the summary measure of Supertot represents the total weighted score for all deviations from normal values as noted across all the study measures, data analysis was limited to subjects who received a Supertot score of one or greater. This served to reduce the total Index group to 175; the total Control group to 190; and the entire pool of subjects to 365. The comparisons of all Index subjects to all Controls on each of the summary measures served as an initial mass screening procedure.

Significant differences between Index and Control groups were achieved when the following measures were studied: Maxact₄; Minact₄; and Active₄. In these comparisons, the Index subjects were characterized by a greater level of disturbances across these measures than controls.

Table 1 presents these results.

Table 1
Comparison of Index and Control Subjects
on Seven Year Activity Measures

Variable	<u>N</u> of Cases	Mean	SD	t Value
Maxact ₄				
Index	175	.4971	1.134	2.16*
Controls	190	.2789	.743	
Minact ₄				
Index	175	.8514	1.165	2.36*
Controls	190	.5947	.878	
Active ₄				
Index	175	1.3486	1.633	3.13**
Controls	190	.8737	1.215	

*p < .05, two-tailed.

**p < .01, two-tailed.

This comparison suggested that the Index group, as a whole could be differentiated from the total group of Controls based upon their performance at seven years as noted on the activity and response measures. Children whose parents had experienced a psychiatric hospitalization, regardless of diagnosis of the parent, were characterized by a greater number of abnormalities in activity and response at seven years. These distur-

bances, based upon the current set of t tests, would appear to be noted both on the -3 and +3 ends of the scales for these variables.

Tables 2 to 4 provide the frequency distribution of scores obtained by Index and Control subjects on the summary measures of Maxact_4 ; Minact_4 ; and Active_4 . In these tables, the three subgroups of Index subjects: Definite Schizophrenic Index (DSI); Possible Schizophrenic Index (PSI); and Other Diagnoses Index (ODI), as well as the three subgroups of Control subjects: Definite Schizophrenic Control (DSC); Possible Schizophrenic Control (PSC); and Other Diagnoses Control (ODC) are listed separately and the frequency distribution of scores obtained by subjects within each of the six groups are presented.

Table 2 contains the frequency distribution of scores on Maxact_4 . Tables 3 and 4 present the frequency distribution of Minact_4 and Active_4 scores, respectively.

The pattern of scores obtained by subjects in all groups on all three seven year activity and response measures reveals a high concentration of individuals receiving a score of zero, the value indicating either normal functioning or missing data. The total pattern of scores appears decidedly non-normal, more nearly representing exponential decay functions.

Table 2

Frequency Distribution of Scores Obtained
by Index and Control Ss by Group on Maxact₄

Score	DSI	PSI	ODI	DSC	PSC	ODC	Total
0	56	41	37	66	49	41	290
1	6	6	7	9	4	9	41
2	6	2	3	4	3	2	20
3	2	0	1	0	1	0	4
4	3	0	2	1	0	0	6
5	1	0	0	0	0	0	1
6	0	0	2	0	0	1	3
Total	74	49	52	80	57	53	365

Table 3

Frequency Distribution of Scores Obtained
by Index and Control Ss by Group on Minact₄

Score	DSI	PSI	ODI	DSC	PSC	ODC	Total
0	35	32	26	50	37	28	208
1	26	8	11	18	12	17	92
2	5	4	7	8	6	6	36
3	5	3	5	2	2	2	19
4	3	2	2	2	0	0	9
5	0	0	1	0	0	0	1
Total	74	49	52	80	57	53	365

Table 4

Frequency Distribution of Scores Obtained
By Index and Control Ss by Group on Active₄

Score	DSI	PSI	ODI	DSC	PSC	ODC	Total
0	29	31	21	46	31	25	183
1	17	3	9	15	13	13	70
2	9	7	5	10	9	9	49
3	11	6	7	4	4	4	36
4	5	2	5	3	0	1	16
5	2	0	3	2	0	0	7
6	1	0	1	0	0	0	2
7	0	0	0	0	0	1	1
8	0	0	1	0	0	0	1
Total	74	49	52	80	57	53	365

In view of the distribution of scores obtained by subjects on Maxact₄; Minact₄; and Active₄, it was necessary to make any further hypothesis tests by means of nonparametric tests which only take cognizance of ordinal scale differences. Moreover, the contrasts assessed by t tests and illustrated in Table 1 were re-assessed through the use of Mann-Whitney U tests. The results of this analysis are illustrated in Table 5.

It is observed that the difference between the total Index and total Control groups remains highly significant when the summary measure of Active₄ is considered. The Maxact₄ difference is no longer significant. The Minact₄ difference between groups does not achieve significance based upon two-tailed probability levels. However, since the direction of the difference between groups had been predicted prior to statistical analysis, i.e., that Index subjects would be characterized by more deviant scores than Controls, it is possible to determine one-tailed probability levels. Using a one-tailed test, differences between Index and Control subjects reach significant levels.

In reviewing these results, it must be recalled that Active₄ is comprised of the sum of Maxact₄ and Minact₄. When differences between groups are assessed

with regard to scores on the measure of $Active_4$, the results are far more compelling than when each of the two contributors to $Active_4$, namely, $Maxact_4$ and $Minact_4$, are examined individually.

Table 5

Comparison of Index Subjects and Control Subjects on Seven Year Activity Measures Utilizing the Mann-Whitney U Test

Variable	<u>N</u> of Cases	Mean Rank	<u>U</u>	z Value
$Maxact_4$				
Index	175	189.17	15544.5	1.522
Controls	190	177.31		
$Minact_4$				
Index	175	192.29	15000.0	1.807*
Controls	190	174.45		
$Active_4$				
Index	175	196.32	14293.5	2.49**
Controls	190	170.73		

* $p. < .05$, one-tailed.

** $p. < .01$, one-tailed.

The next step in data analysis involved a comparison of each of the three Index groups to its matched Control group with regard to obtained scores on the two summary measures of Minact₄ and Active₄. Maxact₄ was dropped from further analysis since the total Index to total Control group comparisons using the Mann-Whitney U test failed to result in significant differences between groups when scores on this measure were considered.

Thus, the Definite Schizophrenic Index group (DSI) was compared to the Definite Schizophrenic Controls (DSC); the Possible Schizophrenic Index group (PSI) was compared to the Possible Schizophrenic Controls (PSC); and the Other Diagnoses Index group (ODI) compared to the Other Diagnoses Controls (ODC), with regard to scores on Minact₄ and Active₄.

The results of these analyses indicated that no significant differences between PSI and PSC or ODI and ODC groups emerged. Thus, the offspring of parents who had been diagnosed as possibly schizophrenic could not be differentiated from matched controls whose parents had not experienced a psychiatric hospitalization. Similarly, the children of parents who had experienced a psychiatric hospitalization for a non-schizophrenic disorder could not be differentiated from children whose parents had not experienced a psychiatric

disturbance based upon their Minact₄ and Active₄ scores.

In contrast, comparisons of DSI to DSC subjects reveal significant differences. These results are illustrated in Table 6. The results of this phase of data analysis served to suggest that the overall original finding of differences between the total Index and total Control subjects with regard to Minact₄ and Active₄ scores was primarily attributable to the more deviant scores obtained by the offspring of parents who had been diagnosed as definitely schizophrenic.

Table 6

Comparison of Definite Schizophrenic Ss
to Matched Controls on Minact₄ and Active₄

Variable	<u>N</u> of Cases	Mean Rank	<u>U</u>	z Value
Minact ₄				
Index	74	83.32	2529.0	1.734*
Controls	80	72.11		
Active ₄				
Index	74	86.07	2326.0	2.454**
Controls	80	69.57		

*p. < .05, one-tailed.

**p. < .01, one-tailed.

Data analysis, to this point, had resulted in two findings which served to determine the focus of subsequent study. Significant differences between Index and Control subjects only emerge at seven years and involve activity and response measures and not muscle tone. Moreover, it also became evident that what had initially appeared to be an overall finding of greater deviancy from normal scores among all Index subjects, could, in reality, be attributed primarily to the Definite Schizophrenic Index group. With this information in hand, subsequent analysis was restricted to the Definite Schizophrenic Index group and its matched set of controls and focused only upon seven year activity and response measures.

Initially the Definite Schizophrenic Index group (DSI) was compared to its matched controls (DSC) with regard to scores on each of the five individual variables which constitute the summary measure of Active₄. Each of these variables is taken from the Seven Year Psychological Examination. The five variables are: emotional reactivity; attention span; activity level; nature of activity; and frustration tolerance. In this comparison, just as in the creation of the summary measures, scores were weighted with regard to deviancy from normal values. In these computations, directionality of the disturbance was not

considered. Therefore, since each variable was measured on a five-point scale, with the mid-point or a score of "3" representing normal functioning, a subject who received a score of "2" or "4" was given one point, while a subject who received a score of "1" or "5" was given two points. The assessment of possible differences between DSI and DSC groups with regard to performance on each variable which constituted the seven year activity and response measures was conducted in order to determine if the highly significant difference between these groups on Active₄ was due to the effect of one or two variables, or alternately, if it was the result of a more equal differentiating effect emanating from each variable which constitutes Active₄.

It became evident that each of the variables at seven years is not equally powerful in discriminating between DSI and DSC subjects. Rather, activity level appears to be the most effective differentiator between groups, with emotional reactivity and nature of activity also providing significant differences between DSI and DSC groups in the predicted direction.

Table 7 illustrates these results.

Comparisons of DSI and DSC subjects with regard to attention span and frustration tolerance failed to reach significant levels.

Table 7

Comparison of DSI and DSC Subjects
on Seven Year Measures of Reactivity
and Level and Nature of Activity

Variable	<u>N</u> of Cases	Mean Rank	<u>U</u>	z Value
Reactivity				
DS Index	74	82.78	2569.5	1.906*
DS Controls	80	72.62		
Activity Level				
DS Index	74	85.99	2331.5	3.01**
DS Controls	80	69.64		
Nature of Activity				
DS Index	74	82.20	2612.0	2.002*
DS Control	80	73.15		

*p. <.05, one-tailed.

**p. <.01, one tailed.

The next phase of data analysis involved a closer examination of the Definite Schizophrenic Index group in order to ascertain if significant differences between sub-sections of this group would emerge. The first set of variables studied were sex of the diagnosed parent; sex of child; and congruence between sex of diagnosed parent and sex of child. A series of three sets of eight Mann-Whitney U tests were performed comparing scores on the summary measures of Maxact₄; Minact₄; and Active₄, and the five individual seven year variables which constitute these summary measures, namely, emotional reactivity; attention span; activity level; nature of activity; and frustration tolerance. The first series of comparisons examined scores obtained by offspring born to father (N = 32) as opposed to mothers (N = 53), diagnosed as definite schizophrenics. In four cases, both a mother and a father were given diagnoses which resulted in classification in the Definite Schizophrenic group. In all instances, the mother had received the more serious diagnosis and thus, the offspring, in these comparisons was included in the "sick" mother group. Statistical tests revealed that the variable of sex of the diagnosed parent failed to be associated with significant differences on seven year activity and response measures.

Sex of child was then studied. A comparison of boys whose parents had been diagnosed as definite schizophrenics as opposed to girls resulted in the finding that significantly poorer scores were obtained by boys when the variable of Maxact₄ was considered. These results are illustrated in Table 8.

Table 8
Comparison of Boys vs. Girls in
the DSI group on Maxact₄

Variable	<u>N</u> of Cases	Mean Rank	<u>U</u>	z Value
Maxact ₄				
Boys	47	46.90	709.5	2.272*
Girls	38	38.17		

*p. < .05, two-tailed.

Significance was not achieved on any of the other summary measure comparisons or on the individual variable comparisons when sex of child was examined.

The next series of comparisons examined the performance of offspring who were of the same sex as the diagnosed parent to those who were of the opposite sex. Thus, male offspring who were of the same sex as the diagnosed

parent, i.e., whose fathers were diagnosed as definite schizophrenics, and female offspring whose mothers received this diagnosis constituted one group who were compared through a series of eight Mann-Whitney U tests to all other subjects in the Definite Schizophrenic Index group. This examination of the variable of congruence in gender failed to provide significant differences between groups.

The last questions remaining to be answered revolved around the variable of parental diagnosis. In order to determine if the type of schizophrenia in the diagnosed parent would result in differing patterns of scores, two sets of comparisons were performed. In the first, all subjects in the Definite Schizophrenic Index group were divided into two categories depending upon the chronicity of parental disturbance. Offspring born to chronic schizophrenics and chronic schizoaffective schizophrenics were compared to offspring whose parents had received diagnoses of borderline or acute schizophrenia. The manner in which the various categories of definite schizophrenia in the parent were collapsed into these four categories is presented in Appendix B and is based upon NIMH procedure.

The "chronic" group contained 43 offspring, while

42 were included in the "non-chronic" group. These two groups were compared through the use of eight Mann-Whintey U tests spanning the three summary measures and the five individual variables descriptive of seven year activity and response. Data analysis failed to determine significant differences between these two groups.

Finally, the total Definite Schizophrenic Index group was divided in the following manner. Offspring born to parents diagnosed as chronic, borderline and chronic schizoaffective schizophrenia were compared to offspring whose parents were diagnosed as acute. Here, again, the three summary measures and five individual seven year activity and response variables were employed in the comparison, resulting in a series of eight Mann-Whitney U tests. The number of subjects in the first group was more than triple that in the second (65 vs. 20). None of the comparisons resulted in significant differences between these two groups based upon performance on seven year activity and response measures.

V. DISCUSSION

An Interpretation of the Results Presented

The major goal of this study was to determine if disturbances in muscle tone as well as activity and response, specific to the offspring of schizophrenic parents, could be identified. The study focused upon these aspects of development up to the seventh year of life. The findings which did emerge initially pointed to total Index vs. Control group differences on activity and response measures at seven years of age. However, comparisons of each of the three subdivisions of the total Index group to their matched groups of Controls (DSI vs. DSC; PSI vs. PSC; and ODI vs. ODC) revealed that the overall Index vs. Control group difference at seven years was attributable to the more deviant scores obtained by the offspring of parents who had been diagnosed as definite schizophrenics. Thus, the offspring of definite schizophrenic parents showed a significantly higher level of irregularities in seven year activity and response measures, compared to matched controls, while offspring whose parents had received diagnoses of possible schizophrenia or non-schizophrenic psychiatric disturbance could not be differentiated from their matched controls on these measures.

Were it not for the inclusion of the possible schizophrenic and other diagnoses comparison groups, it would have been possible to argue that the seven year activity and response disturbances were related to the effects of any parental psychiatric disturbance. By the addition of these comparison groups, it is then possible to state that the pattern of increased deviancy from normal functioning at seven years is specific to that group of children whose parents received a diagnosis of definite schizophrenia.

Therefore, a major objective of this study was realized in that a subgroup of selected study measures proved effective in differentiating the offspring of definite schizophrenic parents, as opposed to offspring of possible schizophrenic or other diagnoses parents, from matched controls whose parents had not experienced a psychiatric hospitalization. It is noteworthy that activity and response measures, not muscle tone, are implicated. The failure of the offspring of definite schizophrenics to be characterized by an enhanced level of muscle tone abnormalities is not overly surprising. Krusen, Kottke and Ellwood (1971) report that hypotonia in infants and children is often associated with disorders such as cerebral palsy; muscular dystrophy; and benign con-

genital hypotonia. The Mayo Clinic's handbook on neurology (1971) suggests that hypotonia in infancy may reflect the influence of medication or hypoglycemia. Premature infants may also appear hypotonic. After the neonatal period, hypotonia may indicate the presence of anterior horn cell disorders; myopathies; or neuropathy. Disturbances in muscle tone, especially after the early stages of infancy, can be reflective of a significant underlying disturbance.

Fish and Alpert (1962) did report that three infants born to schizophrenic mothers did manifest hypotonia. However, other researchers have often failed to find a significantly elevated incidence of single-symptom neurological abnormalities among this genetically high-risk group. Utilizing the Minnesota NINCDS Collaborative Study data, Hanson, Gottesman and Heston (1976) report that the offspring of schizophrenic parents were not characterized by a significantly greater number of abnormalities that would be noted on a standard neurological examination. Marcus (1974), studying the offspring of schizophrenics in Israel, did observe that this group could be differentiated from controls based upon a summary score of nonoptimal neurological functioning when the worst

scoring or high non-optimal half of the subjects in the Index and Control groups were compared. In this regard, it is valuable to note that an overall summary measure of neurological dysfunction was utilized rather than a single variable such as muscle tone. Moreover, significance was reached only on the Index vs. Control group comparisons which were limited to the most dysfunctional half of the subjects in each group.

In the current study, muscle tone measurements were included since the quality of the child's muscle tone would affect him in the process of understanding and adapting to the world around him. However, it was also assumed that of all the study measures, muscle tone disturbances would constitute the most severe type of dysfunction and thus, might not lead to significant differences between groups of subjects who were not preselected because of neurological abnormalities. It is worthwhile to note that not one of the subjects in the six comparison groups obtained a score reflective of any degree of hypertonia at seven years of age.

In contrast, disturbances in activity and response have frequently been associated with schizophrenia. Both prospective studies focusing upon the offspring of schizophrenic parents and retrospective research,

involving the examination of childhood records of individuals who later manifest schizophrenic symptoms, have noted irregularities in activity and response. In the current study, it was found that the offspring of schizophrenic parents received more abnormal scores on the summary measures of Minact₄ and Active₄ when their performance was compared to matched controls. Moreover, when each of the five individual variables which constitute these summary measures was examined, it was noted that activity level was the most powerful discriminator of DSI from DSC subjects, with emotional reactivity and nature of activity resulting in significant but statistically less powerful differences ($p < .01$ vs. $p < .05$). In these individual variable comparisons, the quantity and not the type of disturbance was the focus of study.

The results suggest that, overall, the offspring of schizophrenics, based upon their performance at seven years, appear more deviant than controls, when a summary measure of total disturbances across the variables of emotional reactivity; frustration tolerance; attention span; activity level; and nature of activity, is considered. Moreover, if the type of disturbance is examined, with regard to directionality, these subjects tend to obtain scores clustering

around the low end of the scale across these five variables. In effect, this group, overall appears to tend towards flatness, withdrawal, perseverative attention span, low activity level and behavioral rigidity to a significantly greater degree than controls. In contrast, the offspring of schizophrenics do not receive scores that, in general, would reflect a greater degree of instability, acting out, brief attention span, overactivity and impulsivity when compared to controls.

These results may be compared to prior research. Ricks and Berry (1970), in a retrospective study, examined the childhood records of boys who later became chronic schizophrenics and observed that two patterns emerged which appeared to be premorbid symptom complexes associated with the later development of schizophrenia. The first, and more predominant, was characterized by hypoactivity and impaired attention span, while the second, involved hyperactivity, short attention span and low frustration tolerance. In the present study, the offspring of schizophrenics in the DSI group are characterized by an elevated incidence of disturbances as measured by a summary measure that weighs and totals disturbances, or deviancies from normal values across the variables of emotional reactivity,

frustration tolerance, attention span, activity level and nature of activity. Thus, both the current study, examining individuals born to schizophrenic parents, and that of Ricks and Berry (1970), studying retrospectively, the records of individuals who later became chronic schizophrenics, provide findings suggestive of disturbances in activity and response. Moreover, another similarity emerges as the results of the present study indicate that Minact₄ successfully differentiates DSI from DSC groups and two of the measures included in the summary measure of Minact₄ are precisely those reported by Ricks and Berry to constitute the more predominant symptom complex associated with the later development of chronic schizophrenia, namely hypoactivity and impaired attention span.

In addition, Hanson, Gottesman and Heston (1976) indicate that one of the measures in a cluster of variables which successfully differentiated the offspring of schizophrenics from controls was the presence of "schizoid" behavior. The authors defined this as apathy, withdrawal and flattened affect in children who, at other times, could act in an irritable and negativistic manner. Mednick and Schulsinger (1968) report disturbances in autonomic functioning resulting in withdrawal and passivity as learned means of coping

with heightened arousal among the offspring of schizophrenics. In the present study, the summary measure of Minact₄ includes variables which involve emotional flatness and withdrawal. Minact₄ did successfully differentiate the offspring of definite schizophrenics from controls.

The secondary objective of this study was to ascertain if sub-divisions of the offspring of definite schizophrenics group tended to be characterized by differing patterns of performance on the study variables. The variables chosen for examination were: sex of parent; sex of child; congruence between sex of parent and sex of child; and diagnostic sub-classification of the parent.

This phase of data analysis only focused upon the three summary measures and the five individual variables descriptive of activity and response at seven years. This approach was selected since it was only at seven years that significant differences between groups had emerged.

The offspring of definite schizophrenics were divided into two groups based upon the sex of the diagnosed parent. The number of diagnosed fathers was smaller than that of diagnosed mothers (32 vs. 53). In four cases, both parents received a

diagnosis of definite schizophrenia. Since the total number of these dual matings was too small to allow for individual comparisons and since the mother, in each instance, received the more serious diagnosis, the classification in this, and other analyses in which the sex of the diagnosed parent was considered, was based upon the mother.

A review of the literature reveals that some researchers (Fish & Alpert, 1962; Sameroff and Zax, 1978) have restricted their study samples to the offspring of schizophrenic mothers. This technique does enhance accuracy in the determination of the child's true parent, since maternity is far more easily established than paternity. However, questions have been posed regarding the contribution of non-genetic prenatal influences, particularly when the mother is actively psychotic during pregnancy. Moreover, the interpersonal environment that is produced by a schizophrenic father may be different from that created when the mother is schizophrenic.

In the current study, the offspring of schizophrenic fathers could not be differentiated from the offspring of schizophrenic mothers based upon their activity and response functioning at seven years. This failure to obtain significant differences based

upon the sex of the diagnosed parent is noteworthy. If a schizophrenic mother produces a different pattern of influences and experiences for the child as compared to a schizophrenic father, this difference did not result in variations in performance on seven year activity and response measures.

This result would be consistent with reports that the incidence of schizophrenia among the offspring of male schizophrenics is equal to that found among the offspring of female schizophrenics (Gottesman & Shields; 1978). Differences in age of onset of schizophrenia have been associated with the sex of the diagnosed parent (Gottesman & Shields, 1978). Kringlen (1978) has found that in matings between two psychotic individuals when only one is schizophrenic, the rate of schizophrenia in offspring will be higher if the mother is the schizophrenic parent. However, among families in which only one parent is schizophrenic, which to a great extent characterizes our definite schizophrenic group, sex of the diagnosed parent has not been associated with variations in prevalence of schizophrenia in offspring.

The comparable performance of the offspring of male and female schizophrenic parents in the DSI group would serve to suggest that the capacities

assessed by these study measures may be associated to a greater degree with genetic factors rather than with environmental influences.

Turning next to a consideration of the differential performance of boys vs. girls within the DSI group, it was found that male offspring received scores reflective of a significantly greater number of disturbances on the seven year activity and response measure of Maxact₄. Therefore, boys were more frequently described as tending towards instability, acting out, hyperactivity, brief attention span and impulsivity. This finding is consonant with descriptions of boys, in general, and is not restricted to that group of boys who have a familial relationship with a schizophrenic. Cantwell (1972) writes that the symptoms commonly associated with heightened activity level, similar to the individual variables which in the present study are reflected in the summary measure of Maxact₄ occur more frequently among boys than girls.

The next phase involved an examination of the possible effects of congruence between the sex of the child and that of the diagnosed parent upon seven year activity and response scores. In terms of models for identification, it would have been possible to assume that schizophrenia in the same sex parent might

exert a more deleterious effect upon the developmental process than noncongruence in gender.

This results failed to support this, and again, as in the case of comparable findings among the offspring of schizophrenic mothers and fathers, serve to suggest that genetic, rather than environmental factors may be primary. For, although we can assert that it is a vastly different experience for a female child, for example, to progress through the stages of ego development when her mother rather than her father is schizophrenic, congruence vs. noncongruence in gender failed to result in differing patterns of scores on the seven year activity and response measures.

The current study also revealed that sub-divisions of the DSI group based upon type of schizophrenia in the diagnosed parent failed to result in significant differences on seven year activity and response measures. Chronic vs. non-chronic comparisons, as well as examinations of the performance of offspring born to acute schizophrenics as opposed to those born to chronic, chronic schizoaffective and borderline schizophrenics, failed to provide significant differences between groups. These comparisons appear to suggest that it is the diagnosis of definite schizophrenia in the parent and not a specific type of

schizophrenia that results in the seven year activity and response findings. These results would seem inconsistent with logical assumptions about the developmental process. It would appear sensible that children born to parents diagnosed as experiencing a chronic disturbance should manifest more disturbances. Moreover, based upon the literature, the finding has emerged that family members of a person diagnosed as acute schizophrenia do not appear to have the same high-risk status of individuals related to persons who received other types of schizophrenic diagnoses (Kety, Rosenthal, Wender & Schulsinger, 1968).

To explain these apparent discrepancies, two factors should be considered. First, the diagnosis of the parent was based upon psychiatric records established prior to the birth of the child. No further data on the parent's psychiatric status have been considered in the current study. It is quite possible that a portion of those parents diagnosed as acute schizophrenics experienced subsequent relapses, and thus, would be more correctly diagnosed as chronic.

Moreover, another approach towards understanding this apparent inconsistency involves a consideration of the work of Anthony (1971). In an examination of

children born to process and reactive schizophrenics, Anthony found that reactive schizophrenia in the parent was associated with a more elevated level of disturbances in offspring. Reviewing his findings, Anthony concludes that the child appears more able to distance itself from the more severely disturbed parent and thus, immediate disturbances are not noted. However, he contends that this only results in a delay in symptom formation and that dysfunction would be seen at a later stage of development.

In view of this suggestion, it would be helpful if future studies could focus upon the later stages of development for it would be at this time that diagnostic sub-classification of the parent within the schizophrenic range may prove effective in resulting in significant differences in functioning among offspring.

Attempt At Integration

What are the major findings which emerge from this study? The results have indicated that the offspring of parents diagnosed as definite schizophrenics (DSI) are characterized by a higher level of disturbances in activity and response at seven years than matched controls. In terms of type of disturbance, the DSI group, as a whole, tends towards flatness, withdrawal, perseverative attention span, low activity and behavioral

rigidity more than the controls. An examination of the DSI group in terms of sex of the diagnosed parent; congruence between sex of child and sex of the diagnosed parent; and diagnostic sub-classification of the diagnosed parent, failed to provide any significant differences.

Inclusion of the other Index groups allows one to relate the seven year activity and response findings specifically to children whose parents are viewed as definite schizophrenics. Whatever doubts entered the diagnosticians' minds when they added the word "possible" to the diagnosis of schizophrenia appear quite relevant in determining how these children will function at seven years of age.

The question left unanswered up to now involves the age at which these disturbances, or differences between groups, emerged. Why, then, is it that seven year activity and response measures and not earlier assessments at eight months or four years prove effective in differentiating between groups? In attempting to answer this question, it is important to note that a critical change for the child occurs at approximately age seven. The child is enrolled in school. In a school environment, increased demands are made of the child. He is required to learn and to show evidence of his new knowledge through his performance. There

are new demands regarding the child's capacity to exercise appropriate controls over his or her behavior. Impulses must be regulated and immediate gratification must give way to delay. Social pressures also mount at this time. The child suddenly faces a social setting in which he must prove his adequacy to peers. The child must be able to separate from his family. In essence, to make a satisfactory adjustment to school, the child must be able to regulate his behavior; interact well with peers; learn new material; and separate from his family.

Each of these requirements demands a relatively intact ego which can summon effective defenses; establish appropriate levels of stimulation; and allow for ease in social situations. Of course, such demands are also made of the pre-school child but not with such intensity or with similar consequences of failure. The family is generally more tolerant of a child's failure to reach expected standards of behavior. Moreover, whereas previously the child may have faced social, academic or other demands, each in isolation, school presents him with a situation in which all of these demands are made simultaneously.

In the present study, disturbances in activity and response were noted to characterize the functioning of children in the DSI group at seven years of age.

Although some exceptions may be present, most children generally begin school around their seventh year. The interpretation of the obtained findings offered here is that these children were impaired in their ability to cope with the increased demands of school and, therefore, began to manifest signs of disturbance.

The nature of this hypothesized impairment should next be considered. If the offspring of the definite schizophrenic parents had been removed from their biological parents at birth and raised in foster or adoptive homes, it would have been possible to attribute the study findings to genetic factors. However, genetic and environmental influences remain intertwined in the present study. Thus, proponents of environmental theories of schizophrenia may contend that the seven year activity and response disturbances are due to the familial environment that is produced by a schizophrenic parent, rather than any genetic factor, such as an inherited impairment in ego functioning.

Because of the inclusion of the two comparison groups, it is possible to attribute the seven year activity and response disturbances specifically to the offspring of definite schizophrenic parents. However, the environment that is produced by a parent who has clearly manifested schizophrenic symptoms may be quite

different than that produced when a parent has experienced any other type of psychiatric disturbance.

Anthony (1970), adopting a Piagetian model of development, suggests that the child between the ages of four to six or seven is governed by a magical, ego-centric and animistic mode of thought which, in many ways, is similar to the manner of thought manifested by actively psychotic individuals. Therefore, the child's thought, at least in part, parallels that of the disturbed parent. Sameroff and Zax (1978) also referring to Piagetian theory, state that it is not until the end of the preoperational period that the child will possess the cognitive capacities that would enable him to become aware of the logical inconsistencies present in the social environment that is produced by a schizophrenic parent.

Anthony (1970) notes that it is at this point in development that the child may either continue his involvement in the parent's illogical ideational system and thus, fail to progress or alternately, he may reject the parent's illogical system. A third possibility involves the child's development of a bi-phasic view of reality in which he accepts the parent's illogical system within the family network but adapts to external reality outside the home.

It would be possible to interpret these two theorists' works as focusing upon the child's growing capacity to assimilate and to accommodate to the "craziness" of his environment. The logical assumption, here, is that if the environment were not maladaptive, the child would function appropriately. Anthony (1970) stresses the child's symbiotic relationship with the disturbed mother as the critical factor. However, in the current study, there were no significant differences between the offspring of schizophrenic mothers as opposed to fathers based upon their performance at seven years. Moreover, the quality of the child's familial environment is unknown. We do know that the children in the definite schizophrenic group did have parents who had experienced a psychiatric hospitalization prior to their births. Yet, since the original Collaborative study was not intended to examine the effects of parental psychiatric disturbances upon the development of the child, detailed descriptions of the quality of the parent-child interaction were not provided. It is, however, critical to note that the parents of children in the definite schizophrenic group did manage to bring their children to the hospitals that were participating in the study for examination. This might serve to suggest that these parents were displaying some degree of interest in

and concern for their children.

In another work, Anthony (1971) suggests that there may be two syndromes present among the offspring of schizophrenics. In the first, the relationship with the mother is symbiotic and this is viewed as the critical etiological factor, but in the second, a family diathesis and a heightened sensitivity to relatively minor stress were the most salient characteristics. The second, or prepsychotic syndrome was viewed as primarily affected by the influence of genetic factors. Separation from the parent did not affect symptoms in the child and the syndrome was found to be equally prevalent among the offspring of schizophrenic mothers and fathers.

Based upon the findings of the present study, it can be postulated that genetic factors probably played a more predominant role than environmental factors. The seven year activity and response scores were unaffected by variables such as the sex of the diagnosed parent and congruence between the sex of the child and sex of the diagnosed parent, factors which reflect familial and environmental influences. Although the design of the current study does not allow for a clear distinction between genetic and environmental influences, the findings are viewed as more consistent with a diathesis-stress model, in which a genetically determined deficit

does not allow the child to progress to a stage of ego development in which he develops age-appropriate regulators of affects and impulses. His ability to cope with stress is poor and when the child is confronted with the heightened demands of school, disturbances are manifested. The type of disturbance would suggest a tendency towards disengagement from the stressful situation as a coping mechanism.

Moreover, in terms of cognitive changes, it is possible to refer to the transition from preoperational to concrete operational thought which also begins at approximately the same time in development that disturbances specific to the offspring of definite schizophrenics can be delineated. It would be at this time that the child would normally develop the capacity to appreciate both his perspective and needs as well as those of the other and thus, move from a more egocentric orientation. Thought begins to progress from an animistic and syncretic mode to a more objective and logical system. This age period is marked by many cognitive, social and affective transformations and each of these affects the others. Thus, in view of the transitions and critical cognitive changes which occur at this age, it is not surprising that the study findings reveal that disturbances are manifested among the offspring of

definite schizophrenics.

The eventual outcome of these children is unknown. The disturbances present at age seven are not incapacitating and it is likely that most of these children will never manifest schizophrenic symptoms. The relationship between performance at seven years and eventual outcome will remain uncertain. What does emerge is a set of descriptions which appear to characterize the offspring of schizophrenics and which may reflect the manifestations of a schizophrenic genotype. Had these children been followed into adulthood, it would have been possible to relate functioning at seven years, along the dimensions examined in the current study to adult psychiatric status. That remains to future researchers.

Recommendations For Future Research

The primary recommendation is for the design of studies that would allow for an assessment of the possible relationships between childhood functioning and later development. Moreover, by following high-risk subjects into adulthood, it would be possible to relate early signs of disturbance to the later development of schizophrenic symptoms and thus, determine which early indicators have predictive value in choosing subjects who will eventually actually manifest schizophrenic symptoms.

It would also be quite helpful if future studies could include detailed descriptions of the familial

environment. This would enable researchers to specify which types of stress are most critical in precipitating signs of disturbance in individuals with an assumed diathesis.

As noted earlier, as each researcher chooses the variables which he or she views as critical, other important aspects of the developmental process will be ignored. Thus, a recommendation is made for more comprehensive studies which will provide a multifaceted view of the course of development of these genetically high-risk subjects.

APPENDIX A

Characteristics of the Definite Schizophrenic Index Group

<u>Diagnoses</u>	<u>Number of Subjects</u>
Chronic schizophrenia	20*
Acute schizophrenia	8
Borderline schizophrenia	13
Schizoaffective schizophrenia:	
single episode	3
Schizoaffective schizophrenia:	
recurrent episodes	9**
Schizoaffective schizophrenia:	
chronic	23***
Possibly chronic schizophrenia with	
definite schizophrenic episode(s)	5
Borderline schizophrenia with definite	
schizophrenic episode(s)	<u>4</u>
Total number of subjects in the	
Definite Schizophrenic Index Group	85

* Two subjects whose mothers had been diagnosed as chronic schizophrenics, also had fathers who received the same diagnosis. One subject whose mother was diagnosed as a chronic schizophrenic, had a father who was diagnosed as a schizophrenic spectrum personality.

** One subject had a mother who was diagnosed as a recurrent schizoaffective and a father who was diagnosed as borderline schizophrenia.

*** One subject with a chronic schizoaffective schizophrenic mother had a father who received a diagnosis of borderline schizophrenia with definite schizophrenic episode(s).

In each of these cases, the mother had received the more chronic diagnosis, and thus, the child is classified into a diagnostic sub-group based upon the mother's diagnosis.

Subclassifications of the Definite Schizophrenic Group

For purposes of analysis, the eight sub-sections of the Definite Schizophrenic group previously described were collapsed into four classifications based upon NIMH procedures:

<u>New Category</u>	<u>Prior Classification</u>	<u>Number</u>
Chronic schizophrenia	Chronic schizophrenia	20
Chronic schizoaffective schizophrenia	Chronic schizoaffective schizophrenia	23
Borderline schizophrenia	Borderline schizophrenia; Possibly chronic schizophrenia with definite schizophrenic episode(s); Borderline schizophrenia with definite schizophrenic episode(s)	22
Acute schizophrenia	Acute schizophrenia; Schizoaffective: single episode; schizoaffective: recurrent episodes	20

Descriptive Characteristics of Subjects and Diagnosed

Parents Related to Sex

Number of children of diagnosed fathers	=	32
Number of children of diagnosed mothers	=	53
Number of male subjects	=	47
Number of female subjects	=	38
Number of male subjects whose fathers are diagnosed as schizophrenic	=	16
Number of male subjects whose mothers are diagnosed as schizophrenic	=	31
Number of female subjects whose mothers are diagnosed as schizophrenic	=	22
Number of female subjects whose fathers are diagnosed as schizophrenic	=	16

In cases where both a mother and a father have been diagnosed as schizophrenic, the sex of the parent with the most serious diagnosis is used in computations.

APPENDIX B

NINCDS Examination Child Rating Scales for Study Variables

Neonatal Neurological Examination

Motor Activity - tremulous or jittery

- 0 = normal
- 1 = slight
- 2 = marked

Muscle Tone

- 1 = hypotonic
- 2 = questionable hypotonicity
- 3 = normal
- 4 = questionable hypertonicity
- 5 = hypertonic

Parts of the body tested: upper extremity; lower extremity; neck flexor; neck extensor; and trunk

Exception: In one of the early NINCDS data collection forms only one measure of neck muscle tone, labelled "tone-neck" was indicated.

Examining physicians were allowed to, where relevant, give one score for each part of the body tested, indicating similar functioning on the two sides of the body, or alternately, to assign separate scores which would then indicate assymetry in muscle tone on the two sides of the subject's body.

Four Month Pediatric Examination

Muscle Tone

- 1 = hypotonic
- 2 = questionable hypotonicity
- 3 = normal
- 4 = questionable hypertonicity
- 5 = hypertonic

As noted for the Neonatal Neurological Examination, scoring could reflect asymmetry or equal functioning on the two sides of the body.

Parts of the body tested: upper extremity; lower extremity; neck flexor; neck extensor; and trunk.

Eight Month Psychological Examination

Speed of response

- 1 = very slow, does not approach object, or takes a very long time
- 2 = approaches objects but only after they have been in front of him for some time
- 3 = approaches objects after looking at them briefly
- 4 = quickly approaches objects after looking at them briefly
- 5 = very fast, anticipates E's moves.
- 6 = varies greatly

Intensity of response to objects

- 1 = does not look at or handle objects
- 2 = when given objects, holds them, does not play with or manipulate
- 3 = some manipulation of objects
- 4 = plays with objects actively
- 5 = exerts considerable force in manipulating objects
- 6 = varies greatly

Duration of response

- 1 = attends to objects only very briefly
- 2 = spend short time with objects
- 3 = spends moderate time with objects
- 4 = spends fairly long time with objects
- 5 = spend very long time with objects
- 6 = varies greatly

Intensity of social response

- 1 = does not respond to initiation of social contact.
- 2 = responds only to direct approach, no interest in persons
- 3 = as interested in social contact as in object manipulation
- 4 = behavior strongly affected by persons, more interested in persons than objects
- 5 = very strong, over-reacts to persons
- 6 = varies greatly

Activity level

- 1 = hypoactive, stays quietly in one place, shows no self-initiated movement
- 2 = little activity, seldom moves
- 3 = responds appropriately in situations calling for activity
- 4 = much activity, in action a good deal of the time
- 5 = hyperactive, constantly in motion, cannot be quieted

One Year Neurological Examination

Muscle tone

- 1 = hypotonic
- 2 = questionable hypotonicity
- 3 = normal
- 4 = questionable hypertonicity
- 5 = hypertonic

Parts of the body tested: upper extremity; lower extremity; neck flexor; neck extensor; and trunk.

Similar to neonatal and four month examinations.

Four Year Psychological Examination

Emotional reactivity

- 1 = extremely flat
- 2 = somewhat flat
- 3 = normal
- 4 = mood more variable than average
- 5 = extreme instability

Degree of irritability

- 1 = extremely phlegmatic
- 2 = rarely annoyed
- 3 = normally reactive
- 4 = frequently irritable
- 5 = extremely irritable

Duration of attention span

- 1 = very brief
- 2 = short time
- 3 = adequate
- 4 = more than average
- 5 = highly perseverative

Activity, level of

- 1 = extreme inactivity
- 2 = little activity
- 3 = normal amount of activity
- 4 = unusual amount of activity
- 5 = extremely impulsive

Activity, nature of

- 1 = extreme rigidity
- 2 = some rigidity
- 3 = flexible behavior
- 4 = behavior frequently impulsive
- 5 = extremely impulsive

Seven Year Neurological Examination

Muscle tone

- 1 = hypotonic
- 2 = questionable hypotonicity
- 3 = normal
- 4 = questionable hypertonicity
- 5 = hypertonic

Seven Year Psychological Examination

Emotional reactivity

- 1 = extremely flat
- 2 = somewhat flat
- 3 = normal
- 4 = mood more variable than average
- 5 = extreme instability

Level of frustration tolerance

- 1 = withdraws completely
- 2 = occasionally withdraws
- 3 = attempts to cope with situations
- 4 = becomes quite upset
- 5 = extreme acting out behavior

Duration of attention span

- 1 = very brief
- 2 = short
- 3 = adequate
- 4 = more than average
- 5 = highly perseverative

Level of activity

- 1 = extreme inactivity
- 2 = little activity
- 3 = normal amount of activity
- 4 = unusual amount of activity
- 5 = extreme overactivity

Nature of activity

- 1 = extreme rigidity
- 2 = some rigidity
- 3 = flexible behavior
- 4 = behavior frequently impulsive
- 5 = extreme impulsivity

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